A Dynamic Analysis of Tourism Determinants in Sicily

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to
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ABSTRACT

Sicily's tourism potential is said to be significant.

Yet, the real economic dimensions of tourism in Sicily, and specifically the determinants of tourism in Sicily, are neglected in the economic research literature. Indeed, as a matter of facts, in the general lack of a scientific approach in studying tourism demand in Italy, none of the studies already carried out have focused on Sicilian tourism.

This lack of appropriate empirical research, therefore, undoubtedly contributes to the limited policy guidance of the Sicilian tourism sector resulting that most of the interventions, even at a public level, come from the past experience and/or some "rules of thumb" that gave good results in the past.

This study attempts to fill this gap by providing a first understanding of the determinants of international, national, and local tourism in Sicily.

The determinants of tourism in Sicily are studied taking into account both the structural and promotional aspects (Mafia is still a synonymous of Sicily) that might affect the demand for Sicily as a holiday resort.

In the general framework of a system dynamics model, several gravity functions are used to generate the tourism demand from specifically selected foreign countries. The national and local tourism is considered as well.

The relations formalized in the economic model are able to generate the tourism demand from within a dynamic environment where the demand of tourism goods and services pushes the local operators for new economic activities and infrastructures that will influence the attractiveness of Sicily over time and, therefore, the number of tourism arrivals in the future.

Forecasts about the future development of tourism in Sicily are not the purpose of the presented model, nor quantitative information about the effects of possible policies are directly provided.

Yet, for the particular nature of the economic analysis dealing with the determinants of tourism in a resort area, some conclusions have been drawn.

The findings of this research can be very useful for local authorities involved in the development of tourism in Sicily.

Chapter 1. Sicily and its Tourism Supply

This chapter aims at introducing the object of investigation.

It starts with a short discussion about Sicily, its history, geography, natural endowment and cultural heritage. The strengths and weaknesses of tourism in Sicily are also described along with a quick analysis of the "September 11th"effect. Finally, some comments and remarks about the future development of tourism and the most recent reputation of Sicily conclude.

1.1 History

The magnificence of Sicily starts with the Greek domination. The area was highly regarded as part of Magna Graecia, and Cicero describes Syracuse as the greatest and most beautiful city of all Ancient Greece.

Greek Syracuse controlled most of the eastern area of Sicily while a few Carthaginian colonies were located in the far west of the island. When the two cultures began to clash, the Greek Punic Wars, the longest wars of antiquity, erupted. Greece began to make peace with the Roman Republic in 262 BC and the Romans sought to annex Sicily as its empire's first province . In 535 AD, as the Roman Empire fell, Emperor Justinian I made Sicily a Byzantine province and, for the second time in Sicilian history, the Greek language became a familiar sound across the island.

In 965 AD, the Byzantine Sicily was conquered by Arabs who initiated a land reforms increasing productivity and encouraging the growth of smallholdings. The Arabs further improved the local irrigation systems. A description of Palermo was given by Ibn Hawqal, an Arab merchant who visited Sicily in 950 AD. A walled suburb called the Al-Kasr (the palace) is the centre of Palermo still today, with the great Friday mosque on the site of the Roman cathedral.

The defeat of Arabs in Palermo led to Sicily coming completely under the Norman control in 1091 AD.

Under the Normans, Roger II of Sicily was ultimately able to raise the status of the island to a kingdom in 1130 AD, along with the other holdings of the Duchy of Apulia and Calabria and the Maltese Islands. During this period the Kingdom of Sicily was prosperous and politically powerful, becoming one of the wealthiest states in all of Europe.

Later, after the Napoleonic Wars, Sicily and Naples formally merged as the Two Sicilies under the Bourbons who ruled the kingdom from Naples until the revolutionary movements occurred in 1820 and 1848. The 1848 revolution was successful and resulted in a period of independence for

Sicily. It is right in this period that the Mafia, a loose confederation of organized crime networks, grew in influence and the Fascist regime began suppressing them in the 1920s with some success. Sicily is today an autonomous region of Italy.

1.2 Geography

Located in the South of the country, just off the toe of the Italian peninsula, Sicily, with its total area of 25.711 square kilometers and a land area of 25.409 square kilometers[1], is the most extended region in Italy and the widest island in the Mediterranean.

Thanks to its position at the heart of this renowned sea, it has always represented a bridge between the European continent and Africa, from which it is separated by the Strait of Sicily, a 140 km stretch of sea.

The regional land is 61% hill, 25% mountain and 14 % plain. The north is mainly mountainous, the central-south area is mainly hilly, the south-east is typical of the highlands (the Ibleo plateau, for instance), whereas the north-east section of the island is characterized by the mountain chain of the highest active volcano in Europe, Mount Etna, which rises 3.350 meters over the sea.

Plains are mainly located near the 1.483,9 kilometers of coastline.

With these morphological characteristics the Region features a stunning variety of constantly alternating landscapes, providing a distinctive uniqueness to each part of the island.

Sicily is also known as the “island of the sun” for its particularly mild climate. In fact, its winters are generally mild, with temperatures rarely dropping below 7-8°C, while the summers are long, hot and dry.

Sicily is inhabited by 5.016.861 people, 1.242.300 just in Palermo (the capital), with a density of 197,7 people per square kilometer[2].

Agriculture is the chief economic activity but has long been hampered by absentee ownership, primitive methods of cultivation, and inadequate irrigation.

The main agricultural products are wheat, barley, corn, olives, citrus fruit, oranges, lemons, almonds, wine grapes, and cotton; cattle, mules, donkeys, and sheep are raised.

In the last decades the wine industry has had a strong improvement and Sicilian wines, first of all Nero d'Avola, have become famous in many important countries, such U.K., U.S.A., Canada, Germany, Russia and many others.

There are also important tuna and sardine fisheries. Sicily's manufactures include processed food, chemicals (in the area of Catania), refined petroleum, fertilizers, textiles, ships, leather

[1] Both values are from EUROSTAT (See Table 1 in the Appendix 1).
[2] Values refer to year 2007 (See Tables 2 and 3 in the Appendix 1).

goods and forest products. There are petroleum fields in the southeast, and natural gas and sulfur are also produced but they are mainly managed by foreign companies.
The tertiary sector in Sicily lacks strong intervention projects with road and railway system being the main issues to face as soon as possible.

1.3 Cultural resources

Sicily still today shows traces of the many cultures that ruled over the centuries: the Greeks, Romans, Arabs, Normans, French and Spanish each made their mark, leaving important testimony of their presence through artistic and architectural works of the highest level.
As a matter of fact, Sicily is among the Italian regions with the biggest endowment of archaeological resources. With its 70 museums/antiquaria[3] and 65 parks/archaeological sites[4], Sicily ranks just after the region of Lazio that counts 162 resources in total (74 museums/antiquaria and 88 parks/archaeological sites). Bizarre though it may sound, tourists can enjoy some of the most beautiful Greek temples and amphitheatres right there in Sicily instead of looking for them in Greece.
UNESCO has recognized 5 historical-cultural sites of Sicily as part of the World Natural and Cultural Heritage Registry: the archeological area of Agrigento, the Roman Villa of Casale (Piazza Armerina), the baroque cities of Val di Noto and Palazzolo Acreide, the Aeolian Islands, Syracuse (Siracusa) and the cliff top Necropolis of Pantalica.
In addiction, the great quantity of castles, "Dimore d'Epoca (Period Homes), villas, aristocratic residences, monumental noble buildings, churches, ancient convents, cloisters, monasteries, theatres and art galleries makes of Sicily a peerless melting pot of history and art able to satisfy the taste of the most sophisticated cultural palate[5].
But culture in Sicily also consists of a series of rituals, events and shows that take place in every part of the Island throughout the entire year. The Christmas and Easter celebrations (in Agira, Custonaci and Trapani the former, in Alto Belice Corleonese still celebrated in ancient Greek the latter), the Carnival (in Sciacca or Acireale), the patronal feasts (Saint Rosalia in Palermo, the Vara in Messina, Saint Agatha in Catania), the flower feast in Noto (Siracusa), the Staircase Illumination in Caltagirone (Catania), the Almond Blossom Festival in the Valley of the Temples

[3] Antiquaria is the plural form of the Latin word antiquarium.
[4] A complete and updated list of antiquaria, archaeological sites and museums in Sicily can be downloaded from the web page of the Assessorato Beni Culturali, Ambientali e P.I. – Dipartimento Beni Culturali, Ambientali ed E. P. www.regione.sicilia.it/beniculturali (in Italian).
[5] For the composition of the cultural supply in Sicily see Table 4 in the Appendix 1. Cultural resources are reported in Table 5 in Appendix 1.

in Agrigento and the medieval race of the Normans in Piazza Armerina (Enna) are just a few examples.

The summer season of classical productions of Aeschylus, Sophocles and Euripides performed in the characteristic settings of Greek theatres (Siracusa and Segesta, to name the most famous), and the cinema and contemporary art festivals held on a yearly basis in the magnificent backdrop of the ancient Taormina Theatre complete the cultural supply of Sicily that allows the tourist also to experience a trip in the history in the range of several kilometers.

1.4 Natural endowments

If Sicily's cultural endowment has no fear of comparison with the other Italian regions and main tourism competitors, the supply of a nature-based holidays in Sicily has to face the foreign and national competition instead.

At a national level, the regions of Sardinia and Calabria deal on the holiday market with the same, or even higher, quality of beaches whereas Trentino, Val d'Aosta, Lombardia, Tuscany and Calabria have a heritage of mountains and "green" resources definitely higher than the Sicilian one.

Sicily nowadays offers a wide array of natural parks, nature reserves, river parks and other protected natural areas[6] for a total of 271.004,51 ha of protected land and 78.569,00 ha of protected sea.

The forest area has not shown substantial variations increasing from 221.044 ha in 1998 to 223.993 ha in 2005[7].

Etna volcano, as angry and unreliable it may look with its constant bubbling and roaring activity, is always something to marvel at for its natural wonder.

An example of a unique and uncontaminated landscape is the archipelago of the Aeolian Islands (from Aeolus, the God of the winds of Greek mythology) composed of seven islands that form a pattern resembling the letter "y" along the north-eastern coast of Sicily. These islands have been called the "seven pearls of the Mediterranean", due to their extraordinary charm, their volcanic origin (Stromboli is an active volcano), the white mountains of pumice (Lipari) the hot, sulfurous mud baths (Vulcano), the characteristics capers and Malvasia wine (Salina), the utmost relaxation, unspoiled nature and splendid landscapes (mainly Alicudi and Filicudi) and last, but not least, the night life (Panarea).

[6] See Table 6 in Appendix 1 for the complete list natural resources.
[7] Source: *ISTAT*.

The pristine and splendid Sicilian sea with its 99,27% of bathing area (the Italian average being 92,00%), the very good locations for diving and the exploration of the remains of ancient crafts, the richly colourful underwater vegetation and a flourishing fauna protected by UNESCO complete the naturalistic panorama of Sicily.

1.5 Tourism infrastructures in Sicily

The accommodation structures in Sicily in 2007, hotels and complementary structures, account for 2,83% of the national total (3,44% hotels and 2,61% complementary structures[8]).

Overall, more than 3.500 accommodation structures operate in Sicily (3.702 in 2007) of varying types (hotels, motels, holiday villages, vacation rentals, rooms for rent, holiday homes, hostels, alpine refuges, B&Bs, agritourism facilities, rural tourism facilities, hotel resorts, campgrounds), providing over 140.000 beds (142.000 in 2007) and a capacity of over 38.000 (38.111 in 2007) people in campsites[9].

About 191 four and five-star hotels, equal to about 20% of the total accommodation structures on the island, allow Sicily to boast a highly qualified market of lodging. The most common type of structure, however, continues to be the three-star hotel (over 50%)[10].

Among the extra-hotel structures, agritourism and B&Bs (bed and breakfast) are the types of accommodation showing the greatest recent growth.

Moreover, in the last years, a series of renovation projects able to combine the demand of new form of tourism with the necessity to preserve unique architectural features have made sleeping in castles, country homes, "bagli" (stone manors), villas, aristocratic residences, ancient convents, farms and farmhouses very common in Sicily.

1.6 The most of tourism opportunities in Sicily

The unique features of Sicily make possible different forms of tourism.

In a survey carried out by DOXA, Mercury and Touring Club Italiana[11] aimed at identifying the main factors of tourism attractiveness and relative regional performance in Italy, Sicily ranked as follows[12]:

[8] The value of 2007 is the latest available in the official statistics. The complete time series of hotels in Sicily is shown in Table 8 in Appendix 1.
[9] Source: *Eurostat.*
[10] SVIMEZ figures – The tourism industry in Southern Italy – 2006 edition.
[11] XV Rapporto sul turismo italiano (fifteenth report on Italian tourism), Mercury (2006).
[12] The survey was carried out through interviews of a sample of 1,000 Italians, 5,000 foreigners (from France, Germany, Great Britain, the USA and Japan), and 70 Italian and foreign tour operators.

- second for its sea and the beauty of its coasts;
- third for its cuisine and wines;
- first in terms of the welcoming nature, culture and charm of its inhabitants;
- third for its local lifestyle;
- fourth for the affordability of a vacation[13].

Although Sicily is firstly seen as the main Italian region for art and culture, in the real context of the holiday market, however, the seaside tourism is actually prevailing.
Indeed, in terms of the real demand for tourism in Sicily, the trinomial sun, sand and sea, still keeps the bigger slide closely followed by the historical and artistic tourism and, for a bit less, by the nature-based tourism (thermal spas and mountains). The cuisine and wine related tourism is in a growing phase, experiencing a positive trend because of the increasing diffusion of "Wine Tours" and agriturisms, allowing visitors to eat typical dishes prepared with very genuine ingredients.

1.7 The competitors

Sardinia (32%), for the sea and beaches, and Greece (21%) for the combination art and sea represent the main competitors for Sicily. Spain (16%), Calabria (13%), Tunisia (9%), Egypt (5%) and Turkey (4%) follow for the seaside tourism as well.
Other tourism areas, like the French and the Dalmatian ones, do not exert a real competition against Sicily because of the characteristic of their supply more traditional and less integrated with the art and archaeology.
In spite of its wonderful natural resources Sicily has to leave the supremacy of nature and mountains to Trentino, Val d'Aosta, Lombardia, Tuscany and Calabria.

1.8 Trends and the "11 September" effect for tourism in Sicily

In 2007 the total number of guests recorded in accommodation facilities in Sicily was equal to 4.588.011 (+0,42%) arrivals and 14.424.129 (-1,15%) days of occupancy, with an average stay of 3,14 (3,19) nights per person[14].
In terms of nationality, France, Germany, United States of America, Spain and United Kingdom represent the "big five" countries generating tourism in Sicily. The Scandinavian countries

[13] Sicily is considered Italy's fourth cheapest vacation destination. However, this result must be also interpreted with respect to the quality of its hotels, infrastructures and tourist information offices.
[14] Figures in brackets indicate percentage of variation and values with respect to 2006 data.

confirm the positive trend of the last three years (+0,09% in 2005, +0,25% in 2006 and +0,31% in 2007 for Norway) while Estonia, Latvia and Lithuania are among the Eastern Europe countries with the highest growth in arrivals in 2007 (1,56%, 0,76% and 1,99% respectively)[15].

Starting from 1999, Sicilian tourism flows show a different behavior whether we consider the total arrivals or the length of stay (nights spent by tourists). Indeed, as shown in figure 1.1, the flow of total arrivals in Sicily has never experienced a downturn, not even after the terrorist attack of the Twin Towers in New York in 2001.

For sure, after September 11th a modification in people's travel decisions has been recorded by tour operators. A remarkable number of tourists chose to spend their holidays in the country of origin or in destinations reachable by car or ship in order to avoid the use of the airplane perceived as unsafe. The change in the travelling behavior therefore interested the "long haul" trips mainly with more evidence for the economies of the United States of America, Canada and Japan.

In this context, total arrivals in Sicily seemed not to be affected at all by the worldwide tourism crises of the years 2001-2002.

In fact, if on one hand the World tourism receipts in 2001 and 2002 were to some extent influenced by the terrorist attack, on the other hand there were also some economic factor determining the reduction in the international arrivals.

Indeed, the drop in arrivals from countries like Germany and United States could be reasonably ascribed to the stagnation of their local economies.

Same remarks for Japan whose economic weakness had already produced a negative trend in the outgoing tourism before 2001.

This conclusion is confirmed, at a regional level, by the analysis of Sicilian trends. Indeed, as shown in figure 1.1, the total number of days of occupancy, expression of a consumption power of the incoming tourists, shows a downturn trend already before 2001 while the number of total arrivals, meaning the number of people on trip, was still increasing.

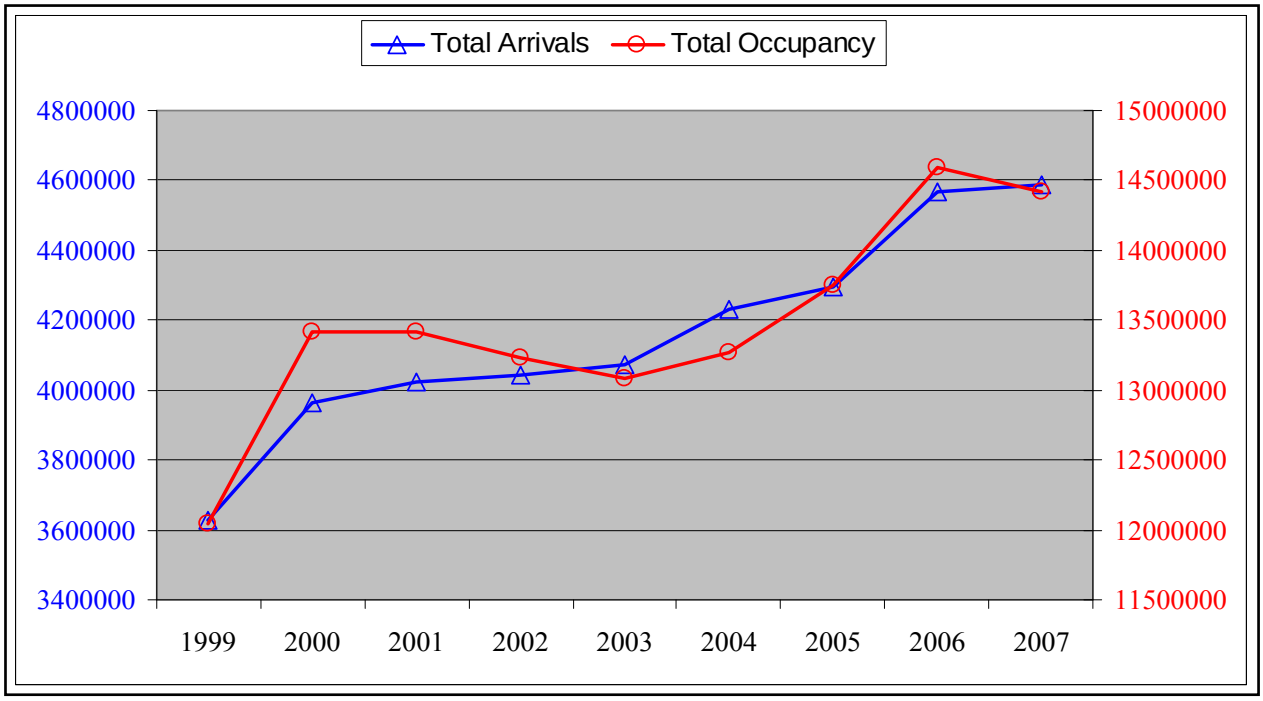
Figures 1.2 and 1.3 show in greater detail the tourism trends, both in terms of arrivals and day of occupancy, from France, Germany, Norway, Spain, United Kingdom, U.S.A. and Japan from 1999 onwards.

A sharp drop was observed in 2001 arrivals and days of occupancy for Germany and U.S.A.

[15] In the present study it has not been possible to consider none of the last three countries mentioned because data regarding the independent countries emerged in Easter Europe from U.S.S.R. dissolution are collected in a disaggregated way by the Assessorato del Turismo, delle Comunicazioni e dei Trasporti della Regione Sicilia (Transport, Communications and Tourism Board of the Sicilian Region) since 2005.

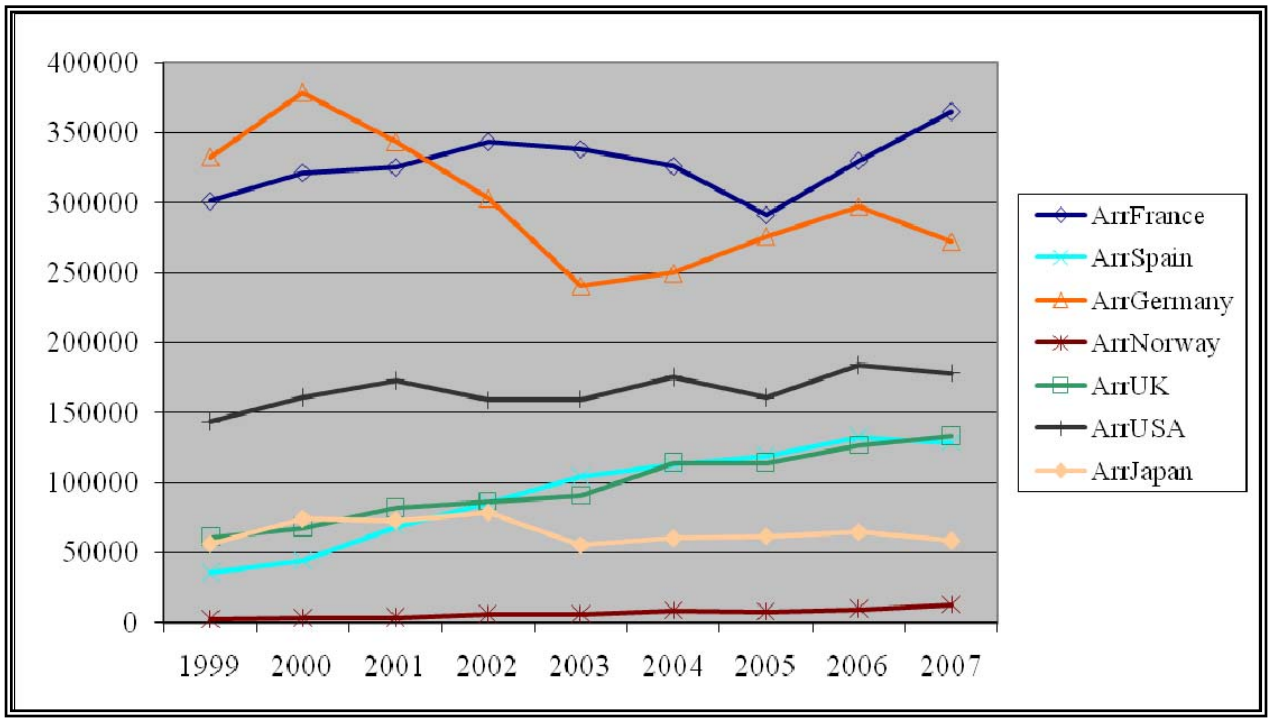
However, while United States better reacted to the causes of the tourism downturn, Germany experienced a much longer crisis.

Figure 1.1: Total arrivals and days of occupancy in Sicily since 1999.



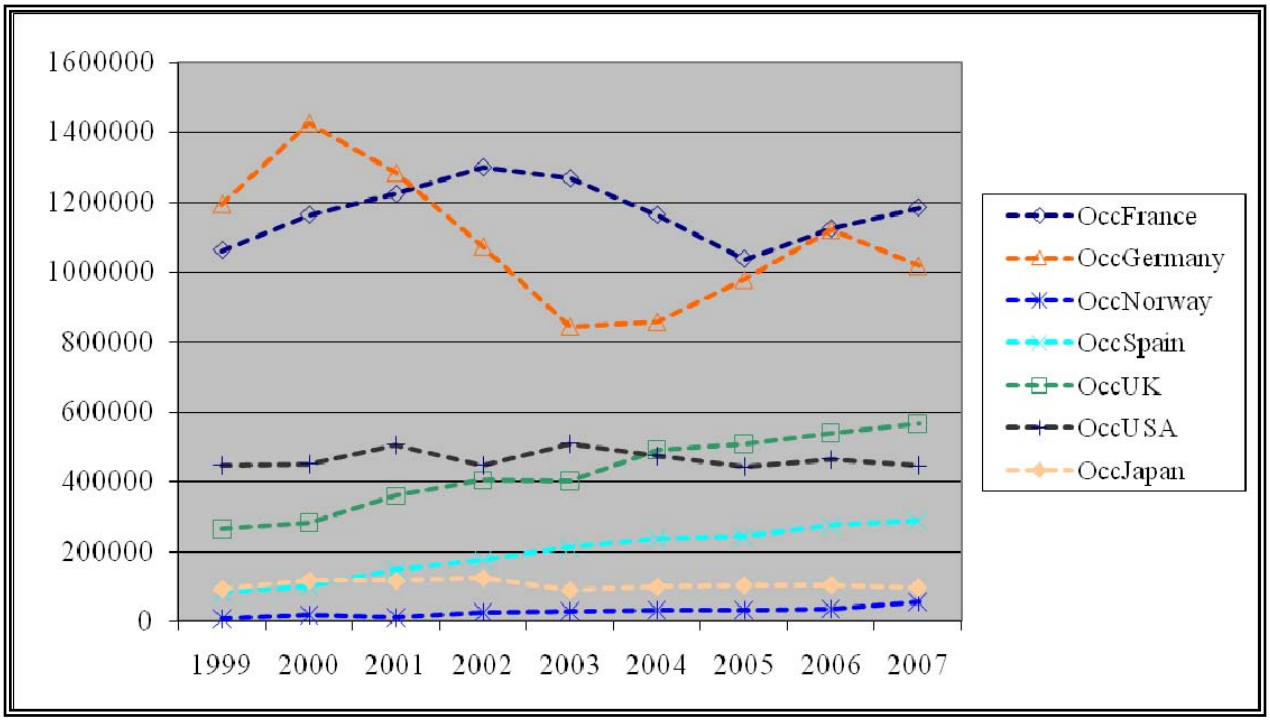
Source: Regione Siciliana, Assessorato del Turismo, delle Comunicazioni e dei Trasporti, Dipartimento Turismo, Sport e Spettacolo.

Figure 1.2: Arrivals from France, Germany, Spain, Norway; United Kingdom, USA and Japan



Source: Regione Siciliana, Assessorato del Turismo, delle Comunicazioni e dei Trasporti, Dipartimento Turismo, Sport e Spettacolo

Figure 1.3: Days of occupancy for France, Germany, Spain, Norway; United Kingdome, USA and Japan



Source: Regione Siciliana, Assessorato del Turismo, delle Comunicazioni e dei Trasporti, Dipartimento Turismo, Sport e Spettacolo[16]

1.9 Tourism market position of Sicily and more recent developments

Sicily is the tenth Italian region (Italy is made of twenty regions) in terms of tourism presence, and the second in the Southern Italy.

Before Sicily, Veneto, Trentino Alto Adige, Tuscany, Emilia Romagna, Lombardia, Lazio, Campania, Liguria and Marche play the role of the lion in the national and international tourism market.

Even worse, using a territorial ratio (resident population/tourism presences), Sicily is the fifth from the last in comparison with the other Italian regions.

The tourism density per square meter (arrivals/Km^2) in Sicily is below the national average (178 versus the national average of 247) and push Sicily in thirteenth position.

As negative and discouraging this data can appear at first glance, they have to be interpreted as the possibility for Sicily to welcome larger tourism flows if properly endowed with the necessary infrastructures and exploited in its peculiarities.

[16] See Table 7 in Appendix 1 for the figures

In this sense, over the last few years, in addition to the more traditional form of tourism that gravitates around Sicily, newer tourism products have been developed on the base of local customs, traditions, culture and sport, encouraging more and more tourists to return in Sicily in less crowded periods of the year.

More specifically, three of these new segments are showing strong growth in Sicily:

- the "green" (environmental) tourism and sports-based tourism;
- the ethno-anthropological tourism and food & wine-based tourism;
- the marine tourism involving fishing, nautical charters and underwater archaeology.

1.10 The reputation of Sicily

There are those who are frightened by Sicily's reputation for crime, and those who think it is fascinating or, indeed, glamorous. Neither view bears much relation to the reality of modern Sicily.

The three Francis Ford Coppola *Godfather* movies (the last in 1990), the popular television series entitled *La Piovra* (the Octopus) broadcast in Italy and abroad between 1984 and 2001, the more than 1,000 deaths in Sicily in the early 1980s' internecine war between rival Mafia families, the assassinations of anti-Mafia judges Giovanni Falcone and Paolo Borsellino in 1992, the electoral victory of Salvatore Cuffaro (on trial for complicity with the Mafia) over Rita Borsellino (the sister of Paolo Borsellino) for the presidency of the Sicilian region in 2006, and decades of headlines and court cases, attest to the presence in Sicily of organized crime. Shrouded by secrecy, protected by blood-oaths, murders and bribery, the Mafia (or *Cosa Nostra*) has long exerted its hold over Sicily, particularly over Palermo and the western half of the island.

The last couple of decades, however, have seen an unprecedented openness, as Italy attempts to come to terms with its legacies of criminality and bloodshed. In a series of mass trials (including those of former Italian Prime Minister Giulio Andreotti), the act of facing up to these legacies began. After extensive police operations, most of the heads of Mafia families in Sicily have been arrested, and several others are being hunted down. People in Sicily have begun to denounce the blackmail, extortion and threats they have been subjected to, abandoning the practice of *omertà* (silence) that for years allowed the Mafia to enrich and entrench itself.

Yet, no one could ever say that the Mafia is going to disappear. Defeating the Mafia is a slow process, with major obstacles to overcome. Surely, the growing effectiveness and timeliness of the latest law enforcement actions have put a severe strain on the Mafia's ability to regroup and reorganize, resulting in a decreased level of danger posed by *Cosa Nostra*, and a decrease in the perception of that danger at local, national, and international levels.

Chapter 2. The Methodological Approach and the Case Study

A search into the economic literature dealing with tourism leads us to two distinct strands: the international trade literature, which is a natural starting point since tourism is essentially a form of international trade, and the empirical tourism literature that attempts to forecast future tourism flows between one or several pairs of countries or to estimate the determinants of tourism demand.

In the latter context, methods focused on non-causal, mainly time-series modelling and on causal, mainly econometric techniques, represent the two alternative approaches.

Non-causal time-series models identify stochastic components (such as autoregressive and moving average components) in each time series. They are useful tools for tourism demand forecast but they can not be used for policy purposes, since they are not based on the theory explaining the tourist's decision-making process.

On the contrary, causal models identify and measure both economic and non-economic variables and are based on the economic theory. Therefore, causal models are preferred to time-series models as they allow the researcher to assess tourists reactions to changes in the determining factors.

In the broad category of causal models, Witt and Witt (1995) also include gravity models, representing a particular class of multiple regression models.

In this study, the evolution of the attractiveness of Sicily throughout 9 years, from 1999 to 2007, will be evaluated using gravity models.

More precisely, three gravity models are formalized to define the international, national and local demand for tourism in Sicily.

Time series for the period 1999 to 2007 (largely obtained from Eurostat, Istat and the Region of Sicily) are used to determine the importance of the typical concerns for tourism arrivals in Sicily, taking into account the origin of tourists.

The variables of interest, their meaning and the relative source are discussed in detail.

2.1 The gravity model

Gravity models take their name from the Newton's law of universal gravitation first formulated in Newton's work Philosophiae Naturalis Principia Mathematica[17] (Mathematical Principles of Natural Philosophy). As part of classical mechanics, it is an empirical physical law describing

[17] I. Newton, 1687.

the gravitational attraction between bodies with mass. It states that every point mass attracts every other point mass by a force pointing along the line intersecting both points. The force is proportional to the product of the two masses and inversely proportional to the square of the distance between the point masses:

$$F = G\frac{M_1 M_2}{r^2} \qquad (2.1)$$

where:

- F is the magnitude of the gravitational force between the two point masses;
- G is the gravitational constant (G = 6.673 * 10^{-11} N m2/kg2, where N stays for newtons[18]);
- M_1 is the mass of the first point mass;
- M_2 is the mass of the second point mass;
- r is the distance between the two point masses.

Newton's law of universal gravitation is about the universality of gravity. Indeed, gravitational interactions exist between all objects so that as one sits in a classroom, she/he is gravitationally attracted to her/his classmates, to the desk she/he is working at, and even to her/his book. Of course, most gravitational forces are too minimal to be noticed and they only become recognizable as masses of objects become large enough.

Today, Newton's law of universal gravitation is a widely accepted theory. It guides the efforts of scientists not only in physics but, duly rearranged, in fields like biology, medicine, transport engineering, social sciences and economics as well. Indeed, due to the simplicity of its mathematical form and the intuitive character of its basis[19], gravity models have experienced a great success in innumerable empirical applications including migration, commuting, hospital patients, and international trade (see Cheng & Wall, 2004). It has been used to analyse the impact of GATT/WTO membership, RTAs (regional trade agreements), currency unions, migration flows, FDI (foreign direct investment) between countries, and so on.

In the wake of such an empirical success, several authors have also provided an economic theoretical foundation of the gravity model (Bergstrand (1985); Deardorff (1998); Földvári (2006)).

In particular, three are the theoretical explanations:

[18] 1 N is the force of Earth's gravity on an object with a mass of about 102 g (such as a small apple).

[19] For some limitations of gravity models see Hasan (2001).

- The statistical interpretation, according to which gravity models translate the most likely distribution of the spatial interaction compatible with the origin and destination restrictions;
- The macroeconomic approach, which shows that the gravity model is the result of the maximization of the demand surplus, subject to the origin and destination restrictions;
- The microeconomic approach, according to which the model of spatial interaction derives from the application of the theory of random utility to the choice of the localization.

2.1.1 A gravity formulation for human interactions

A simple formulation of a gravity model for human spatial interaction used for predicting trades between two cities *i* and *j* is:

$$T_{ij} = \alpha \frac{(P_i P_j)^{\beta}}{d_{ij}^{\gamma}} \qquad (2.2)$$

where T_{ij} is the trading volume between *i* and *j* ($T_{ij} = T_{ji}$ and $i \neq j$); P_i and P_j are the trading factors of country *i* and *j* respectively; $d_{ij} = d_{ji}$ denotes the distance between node *i* and node *j*; α, β and γ are constants (parameters of the model) with β controlling the influence of the attraction factors and γ controlling the influence of the deterrence factor. It is plain to see that with α = G, β = 1 and γ = 2, (2.2) would exactly replicate the Newton's gravitational law (2.1).

The gravity model of international trade was developed independently by Tinbergen (1962) and Poyhonen (1963). In its basic form, the size (masse) of two countries is assumed to be measured by their national incomes whereas the distance between their economic centers works as a deterrence factor (see McCallum, 1995 and Boisso & Ferrantino, 1997). In more sophisticated formulations, the attraction and deterrence is expressed not only by a single variable but by a combination of various factors. Linnemann (1966), for instance, includes population as an additional measure of country size.

The bidirectional gravity model (2.2) can be easily extended to a unidirectional one by allowing the variables to have different parameters values (a vector of βs in the formula) for the origin and destination countries while using the same variables for both. In this case T_{ij} measures the spatial interactions from *i* to *j* only and the equation's terms in the right-hand side represents the attributes of the origin and the destination country separately.

2.1.2 The gravity approach in tourism related studies

Gravity models have been the earliest causal models developed for tourism demand forecasting.
In fact, with tourism being a form of international trade, the factors explaining tourism flows towards a region can be naturally investigated in the context of a gravity model.
Moreover, from an empirical point of view, gravity models turned out to be more appropriate than statistical approaches in the particular context of tourism analysis.
Since 1962, variables used in the analysis of tourism demand have grown both in number and importance (see Lim (1997) for a complete list of variables). As dependent variable, tourist arrivals and/or departures is the most popular (used in 51% of studies), followed by tourist expenditure and/or receipts (49% of studies).
On the right-hand side of the equation, independent variables are focused on the different characteristics of the origin (push factors) and destination (pull factors) country and may be either fixed or varying.
These variables can be relevant to the origin–destination relationship (distance, a common language and/or a common border), destination specific (reputation, cost of living, weather conditions, etc) and origin specific (life stile, population average income, culture, etc) and normally represent geo-economic and service-related factors. Their number usually ranges from 1 to 9.
Geo-economic factors describe the economic activities and geographical characteristics of the tourism areas involved. An important geographical factor affecting inter-area tourism demand is the distance between cities. Increasing distance leads, indeed, to lower social interactions and increases the competitiveness of closer resort areas offering the same holiday type. Moreover, increasing distance discourages tourism towards longer destination because of the longer travel time (the flight time as well).
Service-related factors are the characteristics of the local tourism system and, unlike the geo-economic factors, they are under the control of the local political authorities. The main service-related factors focus on the quality and price of local tourism services.
Finally, resort's reputation is also a relevant factor for the resort's image.

2.2 The system dynamics approach

The use of System Dynamics in tourism analyses is relatively new.
Sedehi (1983), during the first international conference of the System Dynamics society, presented a basic approach to the problem of evaluating a tourist enterprise. Loutfi and Moscardini (2000) focused their analysis on the economic impact of tourism revenue on the

Egyptian economy using classical tourism multipliers. They concluded about the opportunity to carry out tourism analyses mixing traditional econometric methods with System Dynamics models. In 2001, Jambekar and Brokaw proposed a system dynamic structure for snowmobile tourism in the Keweenaw Peninsula in Michigan. The paper presented a preliminary conceptual framework to build a simulation model in support to system-based inquiry for snowmobile tourism.

Xu and Jigang (2000) were actually the first in presenting a complete system dynamics model to understand the effect of several external policies to obtain more international tourists in Guilin. However, the proposed model lacked in the dynamic analysis of most of the tourism determinants. Georgantas (2003) presented a system dynamics simulation model where the aim was Cyprus' hotel chain evaluation within the island's tourism customer-supplier value chain.

Patterson, Gulden, Cousins and Kraev (2004) and Chen (2004) provided a system dynamics based framework to conceptualize the impact of different tourism development strategies in Dominica the former and in a natural-resource based tourism region the latter. None of the two approaches, however, explicitly defines a tourism demand function able to generate the observed tourism flows.

2.3 The case study

This paragraph is meant to formalize a gravity model to explain tourists' volume in Sicily.

Seven sectors create a structural network where the determinants of tourism flows result from the sectors' specific features. In this way the presented study, unlike those described in the previous section, is able to measure the part of tourism demand generated by increasing supply (e.g. resorts development).

The independent variables in the analysis are the baseline gravity variables and other specific determinants of tourism flows in Sicily. This leads to a rich data set which improves estimation accuracy and flexibility and is believed to yield more convincing results.

Real data, including historical Sicilian tourism flows from France, Germany, Norway, Spain and United Kingdom, have been used to calibrate the model.

Countries in the sample, selected in function of the different lifestyles, are modelled as tourism generating regions. In this way, the analysis allows the author a comparative assessment of the sensitivity of tourism flows to different determinants on a continent-wise origin basis. Following Crouch (1995), indeed, it is assumed that factors determining the choice of German tourists to visit Sicily are different from those influencing French ones.

Since this study focuses on leisure tourism, and since leisure tourism is essentially a luxury good, high income countries are considered in the present study. Moreover, tourists coming from the considered countries represent the biggest share of tourism in Sicily.

A graph variable named "Rest of the World" keeps track of the tourism arrivals from the others foreign countries. A national and local tourism demand function has been formalized as well.

The period under study develops through nine years, since 1999 to 2007. Actually, the choice of the time horizon for the dynamic analyses has been motivated by the scant reliability of time series for the previous years. Data for the year 2007, instead, are the most recent in the official statistics.

2.3.1 International demand functions for tourism in Sicily

The basic approach is to treat tourism flows as a demand system for differentiated products. Each country of origin in a certain year is treated as a specific demand market whereas the destination country is in the same year viewed as the different supplied products.

Thus, Sicily can be described as a set of characteristics, which may either be fixed (e.g. distance) or varying across years (e.g. the natural heritage, the reputation, etc).

The international tourism demand is therefore a function of both tourist's country of origin (since cultural difference affect travel behavior) and her/his destination country.

Moreover, demand-elasticity for international tourism varies by country-of-origin and country-of-destination.

In the present study, the functional form for international tourism arrivals in Sicily is specified as follows:

$$A_{iSt} = f(\overline{A_{iS}}, \overline{GDP_i}, POP_{it}, HOTEL_{St}, RESTAURANT_{St}, CULT_{St,} NATUR_{St}, URBENV_{St}, ROAD_{St}, REPU_{St}, DIST_{iS}, DIRECTFLIGHT_{iSt}, LOWCOST_{iSt}, DIRECTLOWCOST_{iSt}) \quad (2.3)$$

where:

- $\overline{A_{iS}}$ is the exponentially smoothed number of tourist arrivals in Sicily from country i[20]. Time series provided by the Tourism Bureau of Sicilian Region have been used to calibrate the international tourism demand function. However, in the simulation runs this

[20] The concept of exponential smoothing is reported in Appendix 2.

variable arises from within the model (meaning this variable is endogenous). The variable $\overline{A_{iS}}$, corresponding to the lagged dependent variable commonly used in regression models, has been introduced to take the possibility of trends and endogeneity in tourism into consideration;

- $\overline{GDP_i}$ stays for the exponentially smoothed value of the gross domestic product of the origin country. In order to smooth also the differences in price levels and exchange rates among countries of origin, GDPs expressed in Purchasing Power Standard units (PPS or PPP) have been considered rather than nominal GDPs. This variable represents the level of economic activity and is used as a proxy of standard of living in the origin country, the rationale being that all citizens would benefit from their country's economic production. In this sense GDP is considered an indicator of the dimension of the market representing the tourism demand from a particular country. EUROSTAT[21] figures have been used[22];
- POP_{it} stays for population of country *i* at time *t*. Origin country's population is based on data from EUROSTAT[23];
- $HOTEL_{St}$ stays for the number hotels in Sicily at time *t.* EUROSTAT figures have been used[24];
- $RESTAURANT_{St}$ represents the number of restaurants in Sicily at time t. Figures provided by the statistical office of the Chamber of Commerce, Industry, Craft Trade and Agriculture (CCIAA) of Palermo have been used[25];
- $CULT_{St}$ represents the cultural resources available in Sicily at time *t.* Figures available on the web page of the Department of Arts and Education of the Region of Sicily have been used[26];
- $NATUR_{St}$ represents the natural resources available in Sicily at time *t.* Figures provided by the Department of the Environment and Territory of the Region of Sicily upon author's request have been used[27];
- $URBENV_{St}$ measures the quality conditions of the urban environment in Sicily at time *t*. The values of this variable over time result from a personal elaboration of data mainly

[21] Eurostat is the statistical arm of the European Commission, with a seat in Luxembourg, producing data for the European Union and promoting harmonisation of statistical methods across the Member States of the European Union.
[22] See Table 17 in Appendix 1.
[23] See Table 2 in Appendix 1.
[24] See Table 8 in Appendix 1.
[25] See Table 10 in Appendix 1.
[26] See Table 5 in Appendix 1.
[27] See Table 6 in Appendix 1.

concerning the production of urban solid wastes and the number of cars in Sicily. Data provided by the Italian Automobile Club and the Institute for the Environmental Research and Conservation have been used[28].

- $ROAD_{St}$ is the length of paved roads at time *t* divided by the size of Sicily. Road is included in the equation as it proxies for the availability and quality of internal land transportation and is aimed at capturing not only the role of transport within the tourism destination (to connect attractions, hotels, shopping centers) but also the provision of safe, comfortable, competitively priced and fast transport services. This measure has been used by a number of authors, particularly in the assessment of the economic importance of the overall transport infrastructure for tourism. EUROSTAT figures have been used[29].
- $REPU_{St}$ represents the reputation of Sicily at time *t*;
- $DIST_{iS}$ [30] is the distance in kilometers between the location of country *i* (fixed at its capital) and the city of Palermo. Because of the importance of transport/travel costs in the overall tourism package, the geographical distance is introduced in the model as a proxy for transportation costs. Indeed, roughly speaking, the more is the geographical distance to the final destination of a trip, the more the cost of transportation will. However, a weakness of using distance as a proxy for travel costs is that it does not measure changes in travel costs over time. For this reason the three other variables $DIRECTFLIGHT_{iSt}$, $LOWCOST_{iSt}$, and $DIRECTLOWCOST_{iSt}$ have been introduced in the model. Distances have been calculated in the webpage http://www.geobytes.com/citydistancetool.htm
- $DIRECTFLIGHT_{iSt}$ is the number of direct flights from any airport in the origin country to any airport in Sicily[31];
- $LOWCOST_{iSt}$ is the number of low cost flights from any airport in the origin country to the international airport of Milan and Rome[32];
- $DIRECTLOWCOST_{iSt}$ is the number of low cost direct flights from any airport in the origin country to any airport in Sicily[33].

[28] Tables 11 and 12 in the Appendix 1.
[29] See Table 13 in Appendix 1.
[30] The variable *GEOGRAPHICAL DISTANCE FROM (name of the foreign country)* in the model.
[31] 5 airports in total: Falcone-Borsellino in Palermo, Fontanarossa in Catania, Vincenzo Florio in Trapani Birgi, Pantelleria e Lampedusa.
[32] Milan and Rome are the two main airport where low cost companies normally depart (arrive) to (from) Sicily.
[33] The best way to introduce direct flights, low cost flights and direct low cost flights in an economic model as the one proposed, is to consider the number of seats available per flight company operating on the destination country. For the present study, unfortunately, it has been impossible to have this kind of data even from the International Civil Aviation Organization (ICAO). Instead of the number of seats, therefore, the number of flight companies has been used.

Variables $HOTEL_{St}$, $RESTAURANT_{St}$, $CULT_{St}$, $NATUR_{St}$, $URBENV_{St}$, $ROAD_{St}$, and $REPU_{St}$, are included in the economic model as important determinants of the attractiveness of a tourism destination. In fact, besides natural, social and historical factors, several authors also stress the importance of recreational and shopping facilities, food and shelter to define a competitive tourism supply. Moreover, generally speaking, inhabitants of high income countries are used to modern transport infrastructure and essentially they prefer to maintain the same comforts while travelling (Cohen (1979); Mo, Howard and Havitz (1993)).

Table 2.1 summarizes the variables used to reproduce the international tourism flows in Sicily.

Table 2.1 – Variables of the international tourism demand in Sicily

Variable	Measure	Description	Supporting reference	Data source	Factor
$\overline{A_{iS}}$	Smoothed number of tourist arrivals (ppl/yr)	Lagged variable of tourist arrivals in Sicily from country *i*	Witt and Witt (1995) and Lim (1997)	Tourism Bureau of Sicilian Region	Endogenous variable
$\overline{GDP_i}$	Smoothed value of the Gross domestic products of country *i* (PPS)	Lagged level of economic activity of country *i*	Witt and Witt (1995), Lim (1997), Eilat and Einav (2004), Naudee and Saayman (2005)	EUROSTAT	Exogenous variable
POP_{it}	Population (ppl)	Population of country *i* at time *t*	Witt and Witt (1995), Lim (1997)	EUROSTAT	Exogenous variable
$HOTEL_{St}$	Hotel	Number of hotels in Sicily at time *t*	Witt and Witt (1995), Lim (1997)	Tourism Bureau of Sicilian Region	Endogenous variable
$RESTAURANT_{St}$	Restaurant	Number of restaurant in Sicily at time *t*	Witt and Witt (1995), Lim (1997)	CCIAA of Palermo	Endogenous variable
$CULT_{St}$	Percentage of variation	Cultural resources in Sicily at time *t*		Department of Arts and Education of the Region of Sicily	Endogenous variable

Variable	Measure	Description	Supporting reference	Data source	Factor
$NATUR_{St}$	Percentage of variation	Natural resources in Sicily at time *t*		Department of the Environment and Territory of the Region of Sicily	Endogenous variable
$URBENV_{St}$	Percentage of variation	Urban environment conditions in Sicily at time *t*		ACI, ISPRA	Endogenous variable
$ROAD_{st}$	Kilometers of roads (km)	Motorways networks at regional level at time *t*	Canning and Bennathan (2000) Prideaux (2000).	EUROSTAT	Endogenous variable
$REPU_{St}$	Percentage of variation	Reputation of Sicily at time *t*		Personal elaboration of ISTAT data	Endogenous variable
$DIST_{iS}$	Geographical distance (km)	Distance in kilometers between the capital of the country an *i* and the capital of Sicily (Palermo)	Witt and Witt (1995), Lim (1997), Crouch(1995).	Geobytes web page	Exogenous variable
$DIRFLIGHT_{iS}$	flight	Number of direct flights from any airport of country *i* to any airport in Sicily	Khadaroo and Seetanah (2008)	ICAO	Exogenous variable
$LOWCOST_{iS}$	flight	Number of low cost flights from any airport of country *i* to the international airport of Milan and Rome	Khadaroo and Seetanah (2008)	ICAO	Exogenous variable
$DIRECTLOWCOST_{iS}$	flight	Number of direct low cost flights from any airport of country *i* to any airport in Sicily	Khadaroo and Seetanah (2008)	ICAO	Exogenous variable

The corresponding econometric model for (2.3) is written as follows:

$$a_{iSt} = \beta_0 + \beta_1 \overline{a_{iS}} + \beta_2 \overline{gdp_i} + \beta_3 pop_{it} + \beta_4 hotel_{St} + \beta_5 restaurant_{St} +$$
$$+ \beta_6 cult_{St} + \beta_7 natur_{St} + \beta_8 urbenv_{St} + \beta_9 road_{St} + \beta_{10} repu + \quad (2.4)$$
$$+ \beta_{11} dist_{iS} + \beta_{12} directflight_{iSt} + \beta_{13} low\cos t_{iSt} + \beta_{14} directlow\cos t_{iSt} + \varepsilon_{iSt}$$

where:

- β_0 *is* an unknown constant and βs 1 to 14 unknown response coefficients;
- ε_{iSt} is an individual error term, which is distributed i.i.d;
- *ì = 1, ..., N; t = 0, ..., T-1; and j = 1, ..., N+1*, where the additional "country" is the *rest of the world*;
- $N = 5$ (France, Germany, Norway, Spain, and United Kingdom)
- $T = 9$ (since 1999 to 2007)

The specification is log linear and the small letters denote that variables are in natural logarithm. Figure 2.1 shows the stock and flow structure with which the international demand function described is implemented in System Dynamics using Powersim software.

2.3.2 National demand function for tourism in Sicily

In the present study, the tourists' flow in Sicily from the other Italian regions is also analysed.

The functional form for the REST-OF-ITALY tourism demand is quite the same as that described for the international demand. Just a variable less, $LOWCOST_{iSt}$, makes the difference with the international function.

Actually, the analysis of tourism determinants becomes less effective in the case of national tourism because the macroeconomic variables used in such an analysis partially lose their explanatory power when dealing with smaller and closer economies (the Italian regions in this case). Nevertheless, national tourism is also considered in the model to take the effect it produces over the attractiveness, reputation and crowding of Sicily into consideration.

The national demand function for tourism in Sicily is written as:

$$A_{iSt} = f(\overline{A_{IS}}, \overline{GDP_I}, POP_{It}, HOTEL_{St}, RESTAURANT_{St}, CULT_{St,} NATUR_{St},$$
$$URBENV_{St}, ROAD_{St}, REPU_{St}, DIST_{IS}, \quad (2.5)$$
$$DIRECTFLIGHT_{ISt}, DIRECTLOWCOST_{ISt})$$

Variables keep the meaning shown in the previous paragraph with the only difference that the subscript I stays for Italian regions, Sicily excluded.

$DIST_{IS}$ is calculated in kilometers between Rome and Palermo.

Since the log linear specification of (2.5) is very similar to (2.4) it is not explicitly reported here.

Figure 2.2 shows the system dynamics model implementing the national tourism demand function.

2.3.3 Local demand function for tourism in Sicily

Finally, since local tourists compete with national and international tourists in the use of territorial resources (bed places in the hotels, seats in restaurants, km of sandy beaches, and so on), a small demand function for regional tourism is also considered in the economic model.

In the present study, the Sicilian demand for tourism in Sicily assumes, the following functional specification:

$$A_{iSt} = f(\overline{A_{SS}}, \overline{GDP_S}, POP_{St}, HOTEL_{St}, RESTAURANT_{St}, CULT_{St,} NATUR_{St}, URBENV_{St}, ROAD_{St}) \quad (2.6)$$

In (2.6), lagged variables, population, tourism infrastructures (hotels, restaurants and roads), cultural and natural resources keep their important role in determining the local tourism demand The resort's quality still plays a role in the local tourism whereas, reasonably, reputation and distance (along with all the other variables related to it) disappear.

The double *S* in the subscript of the variables means that the origin and destination area coincide.

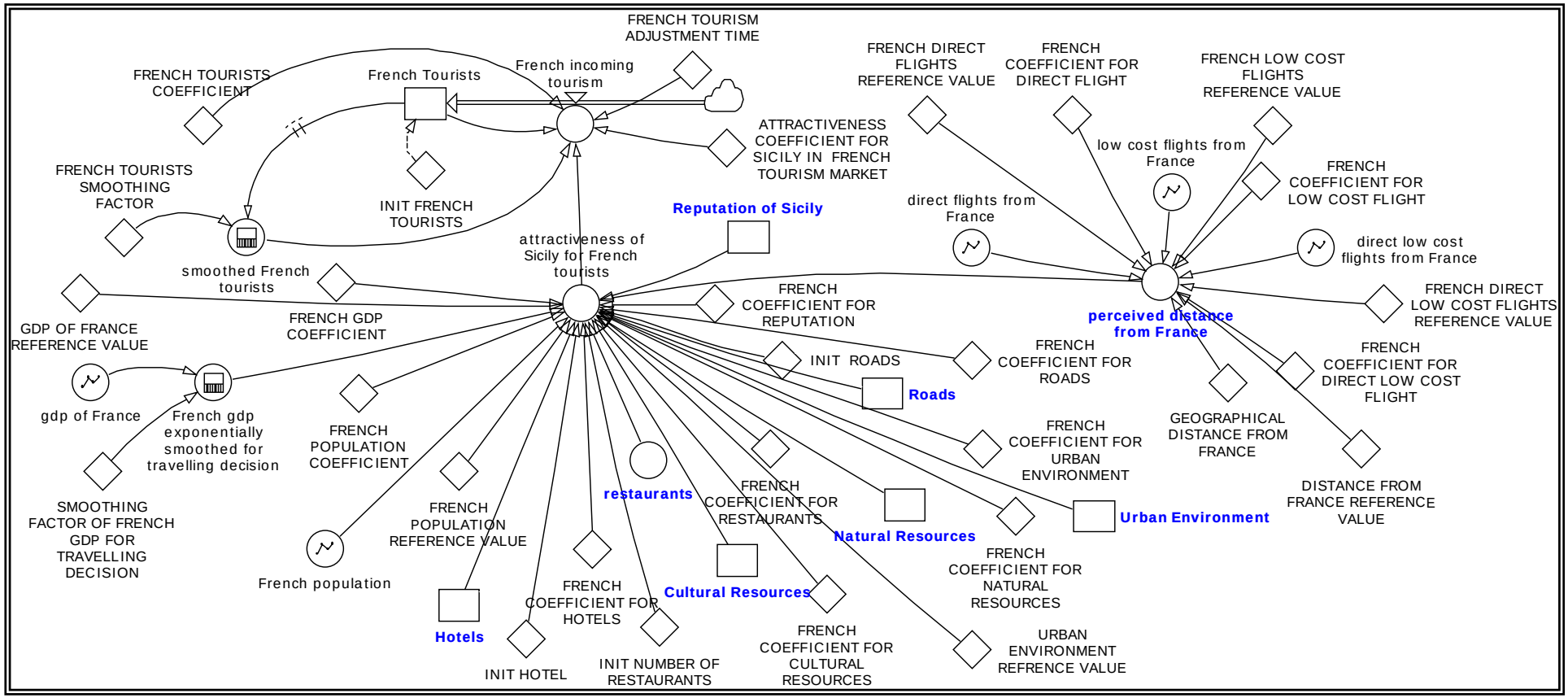


Figure 2.1: International tourism demand function implemented in System Dynamics using Powersim software (case: French tourism demand)

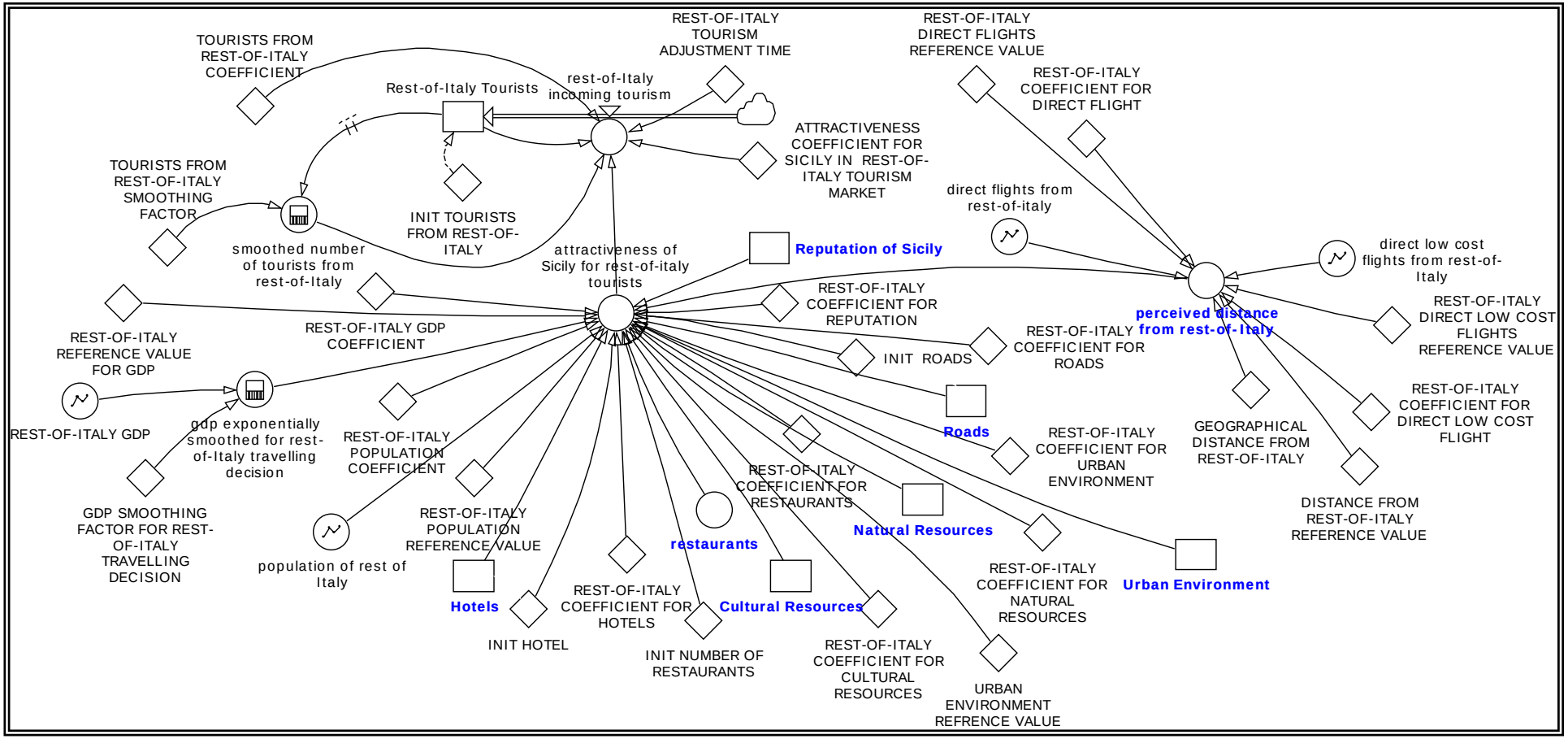


Figure 2.2: Rest-of-Italy tourism demand function implemented with System Dynamics methodology using Powersim software.

The log linear specification of (2.6) follows the specification of (2.4).
Figure 2.3 shows the system dynamics model implementing the local tourism demand function.

2.3.4 Parameters' estimation

From an implementing point of view, a model formulation on the basis of continent-wise origins translates into an econometric model where each variable has its own elasticity parameter.
In fact, the βs previously described as response coefficients are *ceteris paribus* elasticity parameters measuring the influence of independent variables on the dependent ones.
In most cases, the calibration of the model involves ordinary-least-squares methods but, when time lagged variables are introduced in the mathematical formulation of the problem, the estimation of the parameters by OLS will be inappropriate.
Also Barlas (Barlas 1996) stated that the standard statistical tests can not be used in dynamic models because of problems of autocorrelations and multicollinearity.
The real solution for gravity model calibration is provided by panel analysis. Generally, a fixed-effects estimation is applied, that is, the existence of non-random individual (country specific) effects is assumed, and these individual effects are treated by either Least Squares Dummy Variable estimation or by first-differencing and under the assumption of strict exogeneity of the regressors.
Yet, static panel data analysis is misleading when introducing past experience in today's expectations (as it has be done in the proposed model by introducing lagged variables).
In this case, therefore, dynamic panel data should be preferred to static ones, even if also dynamic panel data are biased and this bias diminishes only if T (the time horizon) is relatively large (above 30 time units). Of course, some other techniques are available for panel data when T is little and N (number of observations) is large. But the real problem of applying this dynamic techniques to the estimation of the parameter of the problem under study is not the time horizon or the number of observations. The real problem is that the panel data analysis yields a set of βs that summarizes the differences between the countries belonging to the panel (cross-section analysis) and the temporal effect (time series analysis). In other words, the result of a panel analysis is not anymore an elasticity parameter per country and variable considered, but a β equal for all the countries involved in the study.
For these reasons the author decided to calibrate the model using a more traditional optimization technique. Parameters have been calibrated to lead to the most accurate reproduction of the

observed tourism flows. A very sophisticated tool for excel, called Risk Solver Platform[34], has been used for the calibration. An optimization problem has been set up for each of the sectors of the model and the tourism demands. For each optimization to run, variables have been gradually added in the formalization of the problem, in order to evaluate also the sensitivity of the specific sector to that variable, getting to the final parameter estimation with the maximum confidence in the values obtained.

Data including historical tourism flows as well as characteristics of the influencing factors have been used.

[34] Visit the web page www.solver.com for more details.

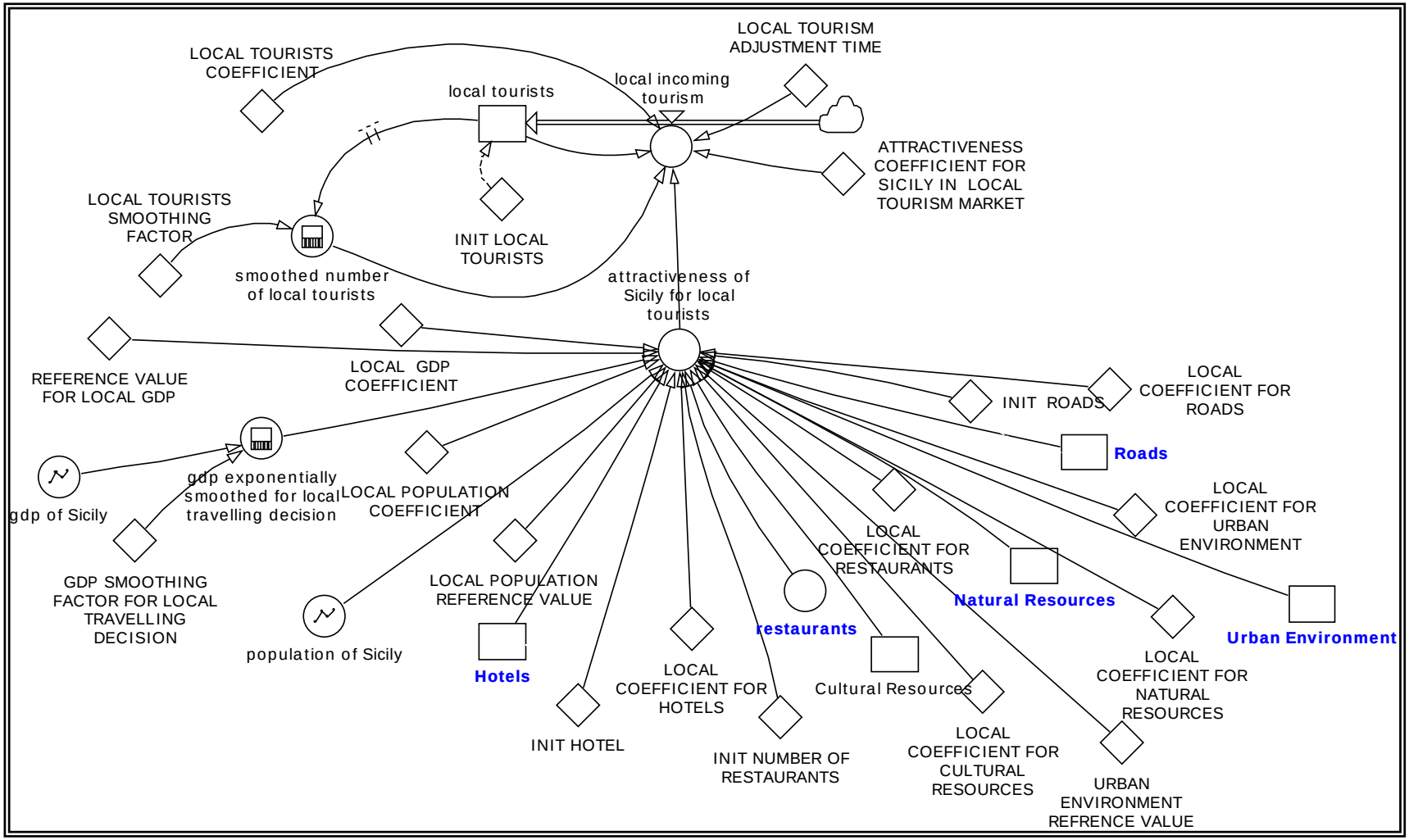


Figure 2.3: Local tourism demand function implemented with System Dynamics methodology using Powersim software

Chapter 3. The Dynamic Model

This section is intended to give the reader an idea of the way the different sectors of the model work, and to describe the behavior resulting from their interactions. In fact, each endogenous variable used in previously formalized tourism demand functions (international, national and local) has been inserted in a specific sector of the model in order to study its behavior over time.
Without specifying the sector structures in great detail, I simply describe, for each sector, what I intend it to represent, what kind of structures I use to implement my intention, and how it contributes in a substantial way to the overall model's behavior. In the description of the sectors, the names of the variables are written in *italics*.
To make all the sketches presented below more easily understandable, in addition to the normal stock and flow notation, the following standards have been applied:

- The names of stock variables have been written with an initial capital letter;
- The names of variables holding constants have been capitalized;
- The names of auxiliaries have not been capitalized;
- A blue color indicates input from another sector or sectors;
- A red color indicates output to another sector or sectors.

In the following description, the adjective local is used to describe anything that comes from Sicilian people while the term national refers to all the other Italian regions.

3.1 The hotel sector

The local hotel sector presents two main characteristics.
On one hand, the gross and the net utilization index [35] for Sicilian hotels are both lower than the national average and they have been decreasing in 2007[36]. On the other hand, the lodging

[35] The gross utilization index (GUI) is equal to the ratio between the actual number of days of occupancy (occupancy = (arrivals)×(average length of stay)) and the maximum number of days of occupancy given by the product (number of beds)×(days in the year). GUI = $\frac{Occupancy}{(number\ \ of\ \ beds)\times(days\ \ in\ \ the\ \ year)}$;

The net utilization index (NUI), instead, takes the real number of days of activity in the year into account.
NUI = $\frac{Occupancy}{(number\ \ of\ \ beds)\times(days\ \ of\ \ activity\ \ in\ \ the\ \ year)}$.

[36] See table 9 in the appendix for the regional values of GUI and NUI in 2006 and 2007.

industry in Sicily has been growing both in number of hotels and in their dimension measured by the average number of bed-places per hotel.

Therefore, it seems clear that the growing number of hotels in Sicily is not the effect of an unsatisfied demand for lodging but, instead, the result of a strong competition among the tourism operators mixed with their speculations about the future trends in tourism arrivals.

The hotel sector aims at describing and explaining such dynamics and their effect on the Sicilian tourism.

The variable *Hotels* is initialized with the number of hotels in 1999[37]. Then, the inflow of *hotels acquisition* and the outflow of *hotels depreciation* determine the value of the stock over time.

The *hotels depreciation* is a normal outflow ruled by the constant AVERAGE HOTEL LIFE.

The *hotels acquisition*, instead, is the first-order information delay of *desired number of new hotels* resulting from the *TIME TO DECIDE TO START A NEW HOTEL* and a given *INITIAL NUMBER OF NEW HOTELS*. Once the decision to start a new hotel has been taken, the constant AVERAGE *TIME TO SET UP A NEW HOTEL* introduces the time interval before the hotel becomes operative.

TIME TO SET UP A NEW HOTEL is also the time interval determining how far into the future the forecast of *expected future presences* is going to be and the delay with which the *bed-places acquisition* closes the gap between the *desired bed-places capacity* and the actual *Bed-Places Capacity*.

The operative level of the hotels already in the lodging market has been calculated by making use of the ordinary *gui*[38]. This index participates in the definition of the *desired number of new hotels* setting the reference value for those who have to decide if and when to start a new hotel in Sicily. In other words, it is assumed that an entrepreneur will decide to start a new hotel if the future tourism presences allow him to have an operative level at least equal to the average in the sector.

The GUI varies over time with the *Bed-Places Capacity.* This stock increases because of the *bed-places acquisition* and decreases with the bed-places lost because of the *hotel depreciation.*

The bed-places acquisition is the first-order exponential smoothing[39] of the variable *gap in bed-places capacity* with a delay time equal to the AVERAGE *TIME TO SET UP A NEW HOTEL*

Finally, the variable *desired bed-places capacity* keeps both the *expected percentage of growth in tourism presences* and the *actual percentage of growth in tourism presences* into

[37] The complete time series of hotels in Sicily is shown in table 8 in the appendix.

[38] The use of the NUI instead of the GUI would have not changed the influence of this index in the general behaviour of the sector since the two indexes differ just for a constant in the denominator (the number of days).

[39] The meaning and the mathematical formulation of the exponential smoothing is presented in Appendix 2.

consideration. The effect of such variables in defining the desired bed-capacity is measured by the constants *EFFECT OF ACTUAL GROWTH ON IDEAL NUMBER OF BED-PLACES* and EFFECT OF EXPECTED PERCENTAGE OF GROWTH ON IDEAL NUMBER OF BED-PLACES respectively.

3.2 The restaurant sector

In this sector the author tries to find an endogenous explanation to the continuous growth in the number of restaurants in Sicily in the period 1999-2007.

The structure of the sector first makes a difference between *Restaurants Inside the Tourism Area* and *Restaurants Outside the Tourism Area*. In fact, these two categories of restaurants experience different dynamics over time: the former have a more stable and tourism related activity, the latter are more subject to temporary fashions and, except for few cases, they work in the shadow of the tourism restaurants welcoming customers reluctant to wait for a seat in the crowded restaurants of the historical centre.

In terms of customers, both resident people and non-resident tourists have been taken into consideration for the demand of seats in restaurants. It is assumed that there is a percentage of residents eager to have a meal inside the tourism area no matter what is the price (in any sense) to pay. *residents eager to have a meal in restaurants inside the tourism area*, local tourists and non-resident tourists therefore compete for a seat in the restaurants and together form the *total demand for seats in restaurants inside the tourism area.* In this structure it is assumed that the *AVERAGE NUMBER OF MEALS FOR NON RESIDENT TOURISTS* is higher than the *AVERAGE NUMBER OF MEALS FOR LOCAL TOURISTS*, meaning non-local tourists eat more often in a restaurant than local ones.

The supply of seats is strictly dependent of the *rotation of seat*, meaning the number of times the same seat is used during the restaurants' *AVERAGE WORKING HOURS PER DAY* taking the *AVERAGE TIME TO COMPLETE A MEAL* into consideration.

The flows in and out of the stocks of restaurants (*Restaurants Inside the Tourism Area* and *Restaurants Outside the Tourism Area*) have the same structure for the stock of hotels already discussed.

The *AVERAGE SIZE OF RESTAURANT IN SICILY* and the *AVERAGE ROOM PER SEAT* determine the *average number of seats per restaurant* that, together with the *AVERAGE WORKING DAYS PER RESTAURANT INSIDE THE TOURISM AREA* and the stock of *Restaurants Inside the Tourism Area*, sets the supply of seats in restaurants inside the tourism area. The gap between the supply and the *demand for seats in restaurants inside the tourism area*

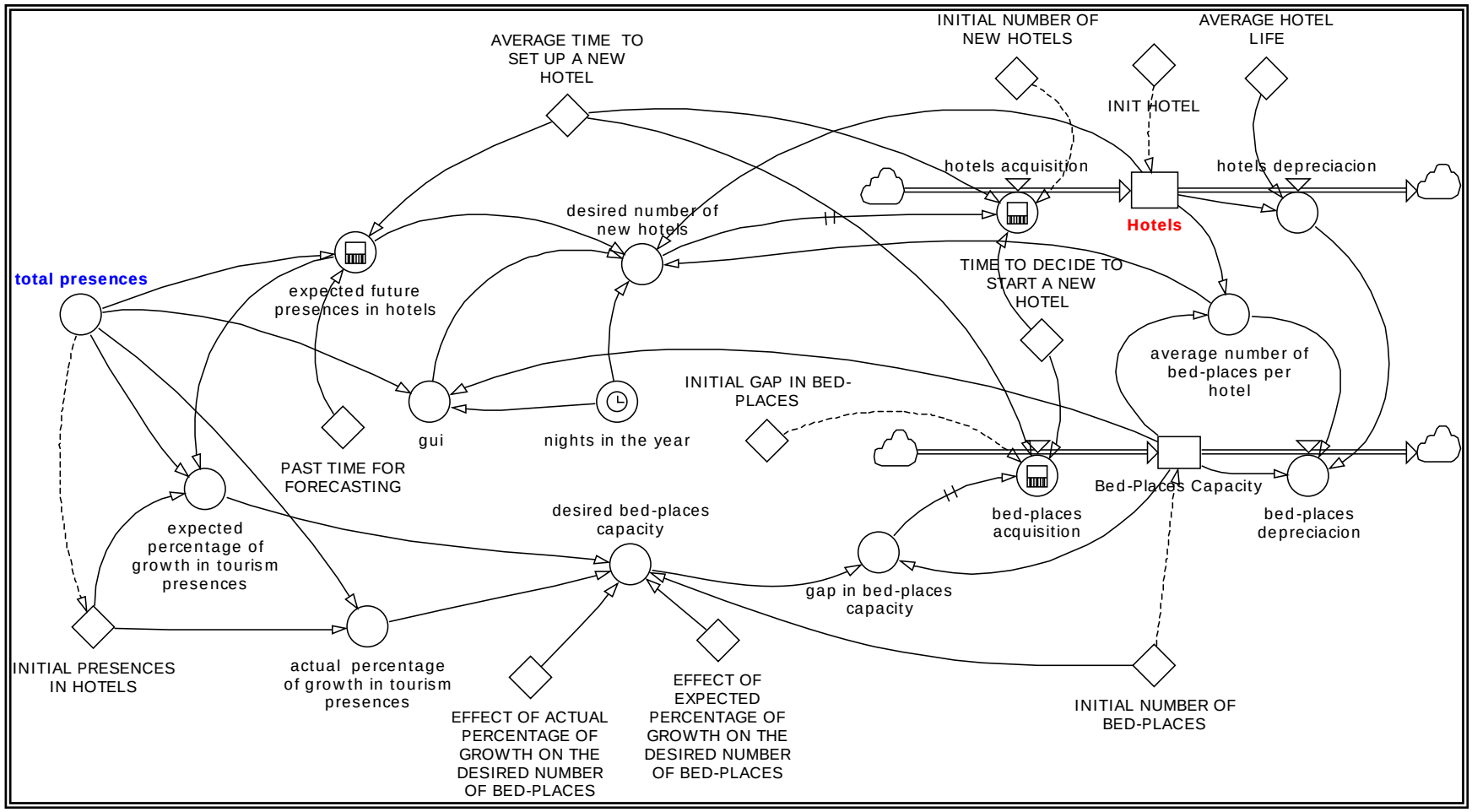


Figure 3.1: Sketch of the Hotel sector

determines the *desired number of new restaurants inside the tourism area* and indirectly, by the parameter *EFFECT OF UNSATISFIED DEMAND INSIDE THE TOURISM AREA ON THE NUMBER OF RESTAURANTS OUTSIDE THE TOURISM AREA*, the *desired number of new restaurants outside the tourism area.*

The *percentage of meals at the restaurants for non-travelling locals* is mainly influenced by their wealth, as measured by an exponential smoothing of the variable *gdp Sicily,* and the coefficient *EFFECT OF LOCAL WEALTH ON THE AVERAGE NUMBER OF MEALS AT THE RESTAURANT*.

The *average number of meals consumed in restaurants for non-travelling locals* determines the number of *seats for non-travelling locals looking for a seat in restaurants outside the tourism area* that complete the set of variables defining the *desired number of new restaurants outside the tourism area*.

3.3 The culture sector

Culture is one of the main strengths for tourism supply in Sicily.

In the last years, probably because of the increased tourism demand for these resources, there has been greater attention towards the exploitation of the cultural heritage of Sicily. In fact, the increased demand has allowed the local administrations to give new sites and cultural locations back to the public enjoyment.

The Culture sector describes the evolution of such exploitation of the stock of *Cultural Resources* generated by the tourism pressure in Sicily in the period under study[40].

The evolution of the supply of cultural resources has been calculated by adding the number of museums, antiquaria, archaeological sites and archaeological museums in for every year.

Figure 3.3 shows the stock and flow structure of this model's sector.

The *total number of non-resident tourists in Sicily*, is the starting point of this structure. Related with the *population of Sicily*, this variable determines the *tourism pressure*, meaning the percentage of tourists with respect to the resident population.

[40] The supply of cultural resources from 1995 to 2007 is shown in Table 5 in Appendix 1.

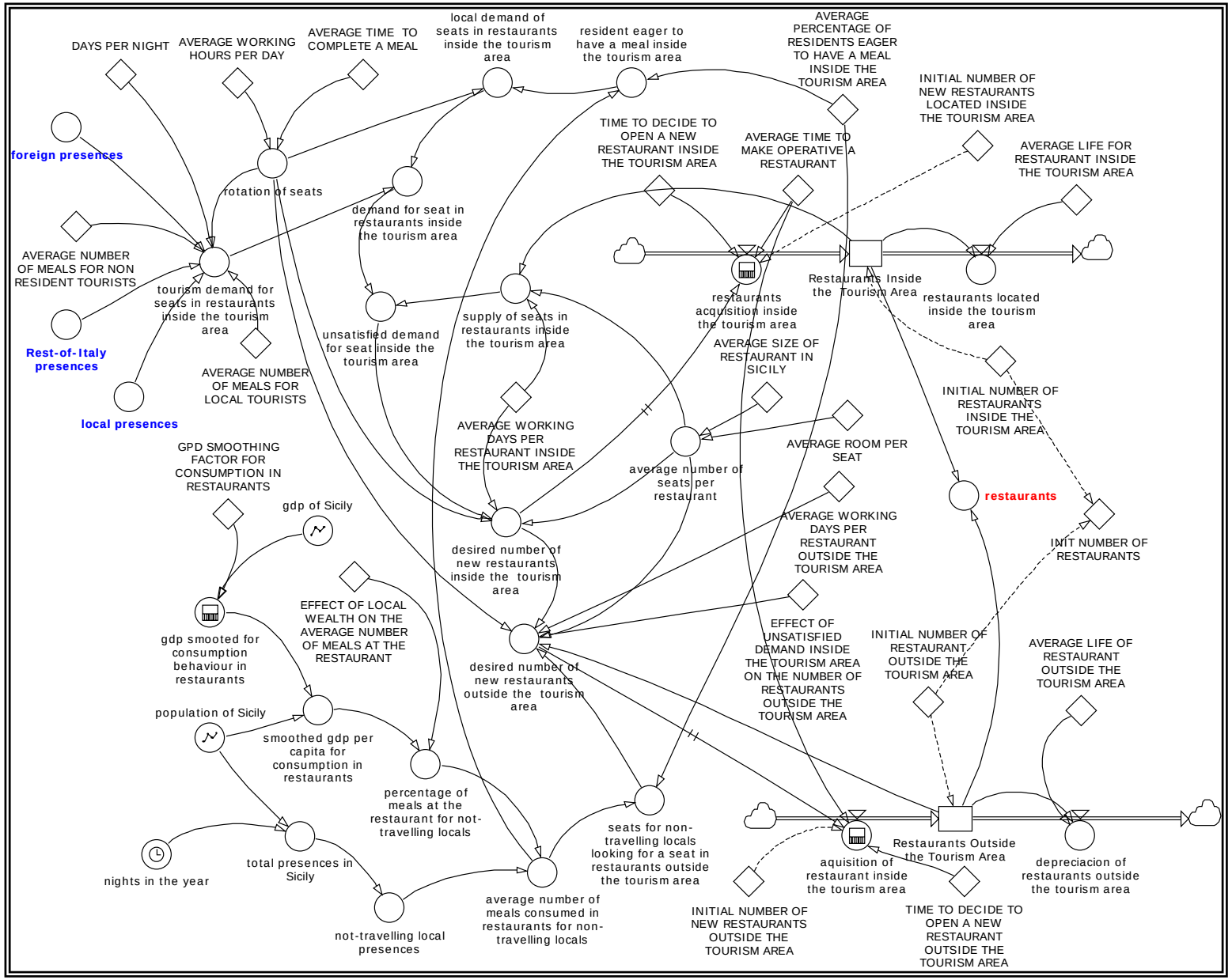


Figure 3.2: Sketch of the restaurant sector

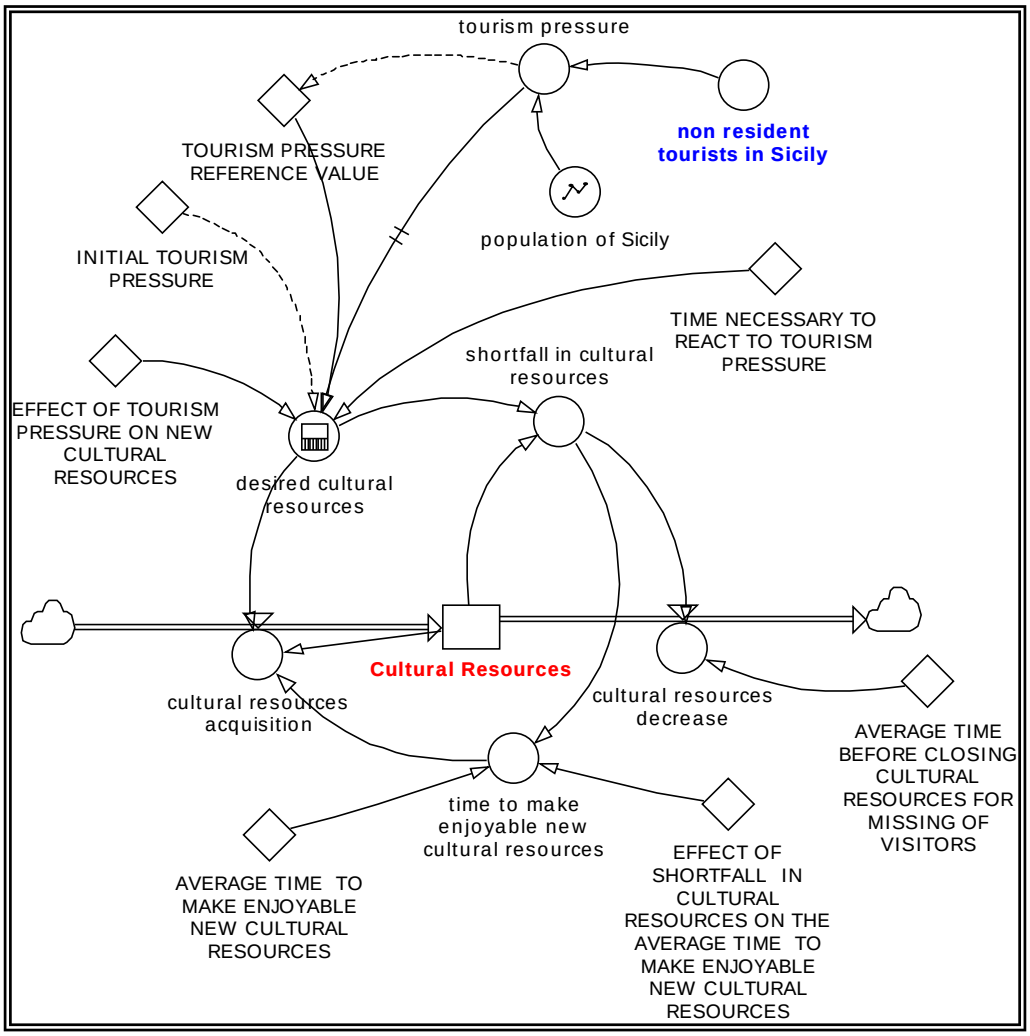


Figure 3.3: Sketch of the culture sector

The current tourism pressure, normalized to its value in 1999, determines the stock of cultural resources needed to satisfy the tourism demand by the constant *EFFECT OF TOURISM PRESSURE ON NEW CULTURAL RESOURCES* and a delay equal to *TIME NECESSARY TO REACT TO TOURISM PRESSURE*.

The delay in filling the gap between the desired and the actual stock of cultural resources is fixed by the constant *AVERAGE TIME TO MAKE ENJOYABLE NEW CULTURAL RESOURCES* instead. In fact, the delay time varies in accordance with the amplitude of the gap to fill, meaning the more is the gap to fill, the faster is the process of opening new cultural resources to the public. The constant *EFFECT OF SHORTFALL IN CULTURAL RESOURCES ON THE AVERAGE TIME TO MAKE ENJOYABLE NEW CULTURAL RESOURCES*, indeed, settles the answer of the local public administration to the demand of new cultural resources.

Since the administration of cultural resources is very expensive in terms of people to hire and infrastructures to create, the stock of cultural resources decreases (for instance, a museum can

reduce the visiting days) if the number of visitors reduces for a time equal to *AVERAGE TIME BEFORE CLOSING CULTURAL RESOURCES FOR MISSING OF VISITORS.*

3.4 The nature sector

The general attitude of tourists worldwide interested in an environmentally friendly holiday experience is becoming increasingly popular in Sicily.

Driven by the growing demand for a nature-based tourism, Sicily has sped up the process of acquisition of land and sea areas to its protected heritage[41].

The nature sector, indeed, describes the evolution over time of the Sicilian supply for natural resources resulting from the tourism pressure.

The structure of the nature sector is not explicitly showed here since it is very similar to the structure of the culture sector. The only difference with the culture sector is that once a land or marine area has been designated to the protected heritage of the region[42], it saves this status for the future whatever is the flow of visitors.

Therefore the stock of *Natural Resources* does not have any outflow from it.

3.5 The urban environment sector

The urban environment sector describes the quality of public areas, such as city centers, beaches, roads, and other places in which tourists experience their holidays.

Three main variables (urban solid waste, social crowding and road crowding) will be representative of the local environmental conditions, quality of social interactions and traffic related problems (road safety, noise, air pollution, and so on) in Sicily for the period under study. For each variable, the current value will refer to the value of year 1999, and the resulting index will be considered a measure of how much the variation of the urban condition it wants to represent influences the normal deterioration of the environment.

The variable *usw production index* refers to the production of urban solid waste, namely the waste type that includes mainly household waste (domestic waste), with, at times, the addition of commercial waste. Therefore, consistent with this definition, the *usw production* is the effect of the number of residents, *population of Sicily*, and their consumption behavior as depending on the local economy trend measured by the variable *GDP exponentially smoothed for consumption behavior*. The relative contribution of these variables to the total production of urban solid waste

[41] The composition of natural resources since 1981 to 2007 is shown in Table 6 in Appendix 1.
[42] The designation takes place by a national or regional law.

is expressed by the constants *EFFECT OF POPULATION ON USW* and *EFFECT OF HOUSEHOLD CONSUMPTION ON USW*, respectively.

The *social crowding index* intends to measure the crowding effect of public sites on the urban amenities when, besides local people, places are also frequented by tourists. In fact, because of the way in which it is formulated, this index is strictly related to tourism arrivals and captures the negative effects, both tangible and intangible, of a mass tourism, if any. In particular, the variable *social crowding ratio* is the ratio between the *total density* of people (tourists + residents) and the population density in Sicily. A value larger than 1 indicates and measures the presence of tourists, whereas a value equal to 1 indicates no tourism at all.

Finally, the *road crowding index* measures the variation in the total number of vehicles circulating in Sicily compared with the reference value of year 1999.

The *road crowding* variable is the result of the interaction between two sectors: the urban sector and the road sector. In the urban sector, the *number of vehicles circulating in Sicily* is calculated as the sum of *active vehicles in Sicily* and *vehicles belonging to Italian tourists travelling in their own car*.

The variable *active vehicles in Sicily* is the *number of vehicles registered in Sicily*[43] multiplied by the *local utilization index of vehicles*. This last variable is the result of the estimated average number of days[44] a vehicle is utilized in Sicily divided by the total number of days in the year and represents the extent to which vehicles are preferred with respect to other means of transportation in Sicily.

The *number of vehicles registered in Sicily* is the result of the *population of Sicily*, the trend in the local economy (the *GDP exponentially smoothed for vehicle acquisition* variable) and the tourism flow that prompts the renting of vehicles.

The *AVERAGE PERCENTAGE OF ITALIANS TRAVELLING WITH THEIR OWN VEHICLE* and the *AVERAGE NUMBER OF PEOPLE PER VEHICLE* have been taken from official statistics[45]. In particular, the *AVERAGE NUMBER OF PEOPLE PER VEHICLE* has been assumed to be equal to the average number of people per family in Italy.

The Road Sector participates in defining the road crowding with two variables: the *density of vehicles in Sicily* and the *AVERAGE SUSTAINABLE NUMBER OF VEHICLES PER KM OF ROAD*[46].

[43] For a complete description of vehicles registered in Sicily from 1999 to 2005 see Table 11 in the Appendix 1.
[44] The estimation of the *AVERAGE DAYS OF UTILIZATION OF VEHICLES IN SICILY* is personal.
[45] See ISTAT: *I viaggi in Italia e all'estero* (various editions in Italian).
[46] See next paragraph for the description of the sector.

Once the three indexes have been calculated, the *urban environment deterioration* is the result of their product multiplied by the *NORMAL DETERIORATION* coefficient.

On the other side of the stock *Urban Environment*, the restoration process exclusively comes from waste management activity. In fact, the government of the Region of Sicily has not effectively intervened against road crowding and its negative effects on the environment. In many cities, Palermo among others, a "traffic plan," which could conceivably convince citizens to leave their cars at home and use public transportation, does not exist and the measures against the air pollution have always yielded scant results. Therefore, road crowding is only reduced by the construction of new roads (as shown in the road sector), which lags behind actual necessity.

Social crowding is something that escapes any form of external control and, as a consequence, its negative effects on the urban environment add to the effect produced by the resident population.

The *Waste Management Capacity* is under the control of municipalities. There are no official statistics available on the efficiency of waste collection and treatment in Sicily. Therefore, this efficiency has been indirectly estimated[47] by making use of the statistics on the percentage of families complaining about the quantity of waste in their living area, and the quantity of urban solid waste produced in the same period of time. It is assumes that if the quantity of urban solid waste has increased while complaints have decreased in the same period of time, then the working capacity of the waste management has increased as well.

Following this argument, waste management capacity in Sicily has been estimated as shown in Table 3.1.

REGION	Time	1999	2000	2001	2002	2003	2004	2005	2006
Sicily	**Usw production (*1000 kg)[48]**	2.553	2.604	2.423	2.521	2.540	2.544	2.608	2.718
	% of families complaining[49]	34,40	37,89	34,90	29,30	32,00	32,12	30,10	31,10
	Waste management capacity	1	0,90796	0,9857	1,1741	1,0751	1,0710	1,1429	1,1062

Table 3.1: Waste Management Capacity in Sicily[50]

[47] The estimation is personal.
[48] Source: *ISPRA. http://www.apat.gov.it/site/it-IT/APAT/.*
[49] Source: *ISPRA. http://www.apat.gov.it/site/it-IT/APAT/*

The *Waste Management Capacity* multiplied by the *usw production index* yields the *intervention for restoration* and, as a consequence, the *urban environment restoration*.

The stock *Waste Management Capacity* increases because of the *wmc inflow* that takes the gap between the *desired wmc* and the actual capacity into consideration, with a delay equal to *DELAY IN PERCEPTION OF THE NECESSITY OF NEW WMC*. The variable *desired wmc* is the result of the pressure exerted on a greater management capacity both by the future *forecast of usw production* and the resources needed to restore the capacity saturated over time. This pressure is measured by the *EFFECT OF FORECASTED USW PRODUCTION ON DESIRED WMC*.

Finally, since the main problem in the management of waste is the progressive saturation of the municipal dumps, the waste management capacity is reduced by the *capacity saturation*, which increases when urban solid waste production increases. The stock and flow diagram of the urban sector is shown in Figure 3.4.

3.6 The road sector

Sicily, with its total area of 25,708 square kilometers, and a land area of 25,405 square kilometers[51], is the largest region in Italy, and the largest island in the Mediterranean Basin. The regional land mass is 61% hills, 25% mountain and 14% plains. The north is mostly mountainous, the central-south mostly hilly, and the south-east typical of the highlands (the Ibleo plateau, for instance), whereas the eastern area is characterized by the mountain chain of the Etna volcano. Plains are mainly located near the coastal areas.

As in most southern Italian regions, most of the transportation infrastructure in Sicily has developed in parallel with the coastal areas; starting from Mazara del Vallo and continuing in a clockwise direction to Trapani, Palermo, Messina, Catania, Siracusa and Gela by motorways, and from Gela to Trapani by state roads in the remaining coastal route. The motorway Palermo-Catania connects Caltanissetta and Enna to the road system. Finally, a network of state and provincial roads connects all the main urban centers of the Sicilian hinterland[52]. Therefore, there are two main road axes in Sicily: the east-west axis and the north-south axis.

Compared with the rest of the Italian peninsula, Sicily clearly shows a lack both in road networks and in motorway hubs, which combined generate a low efficiency level of the road system as a whole. Moreover, while an increasing resident population and a growing economic activity in

[50] The evolution, from 1999 to 2005, of the Sicilian road system is presented in Table 13 in Appendix 1.
[51] Both values are calculated as the average of the total and land area measured from 1999 to 2005 and reported by EUROSTAT (see Table 1 in Appendix 1).
[52] For the road network composition in Sicily in 1998 in km see Table 12 in Appendix 1.

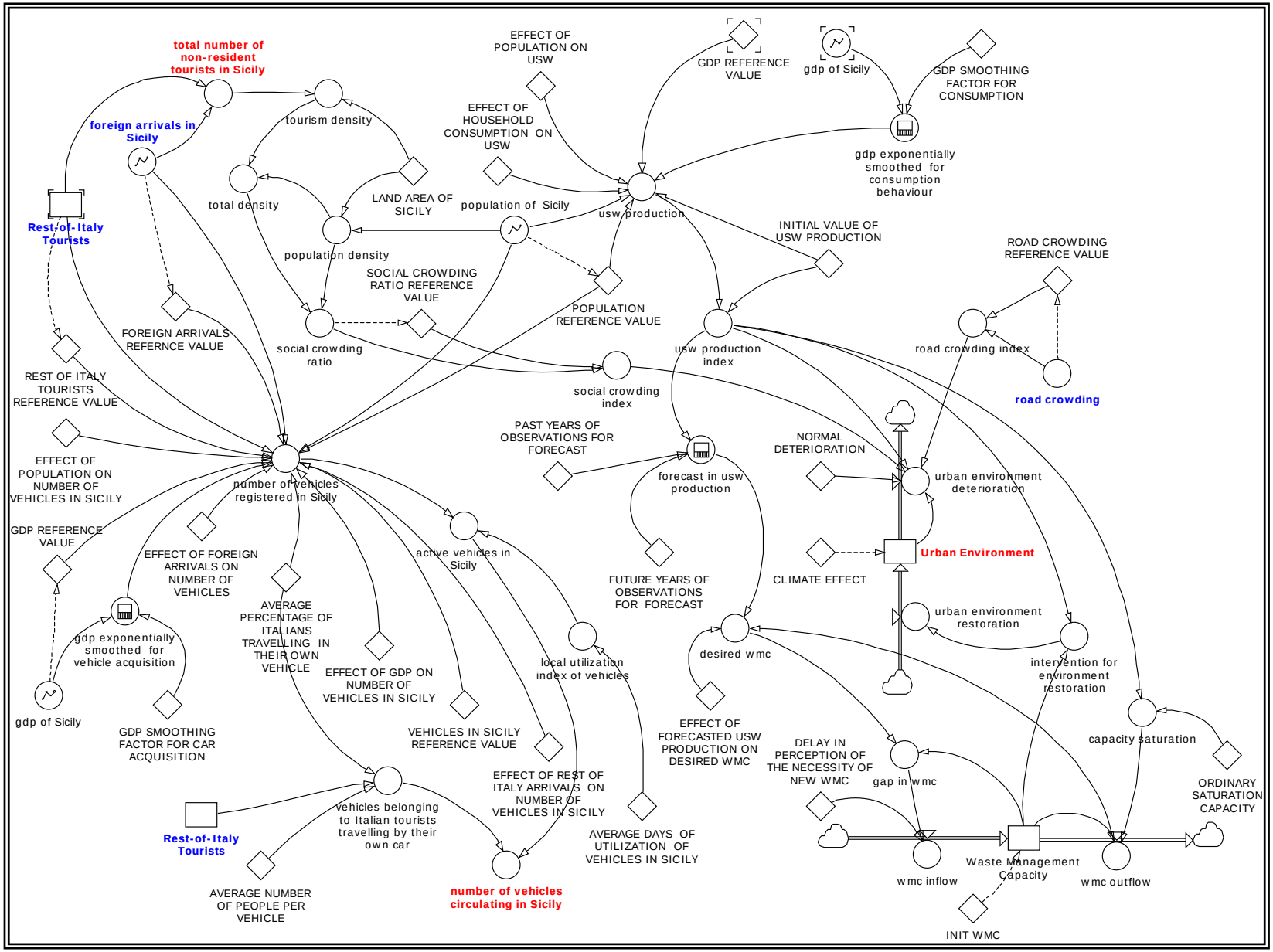


Figure 3.4: Sketch of the urban environment sector.

Sicily have augmented the total number of vehicles circulating on the roads, the supply of transport infrastructure has not undergone substantial improvements[53]

One of the main problems arising from this lack of transport infrastructure is related to the low level of land accessibility, and the tourism sector, as any other local economic activity, has necessarily experienced the negative effects of this lack.

The Road Sector is designed to study the evolution, over time, of the road network and its effect on the land accessibility in order to evaluate its contribution to the total attractiveness of Sicily as a tourism destination. The stock and flow diagram of the Road Sector is presented in Figure 3.5.

The road network is represented by the stock *Roads* initialized with the total kilometers of roads in 1999.

Roads is augmented by the flow *road construction* and decreased by the flow *road disruption*. The construction of new roads is the combined effect of a *gap in land accessibility* and the variable *new roads to construct because of crowding*. The former is dependent on the ramification of the road network, whereas the latter relates to the number of vehicles per kilometer of road. The *IDEAL KM OF ROAD PER SQUARE KILOMETER* has been calculated as two times the length of the diagonal of a square, with side measuring 1 Km (length of diagonal = $\sqrt{1^2 + 1^2}$ =1,414214[54]). In this way it is possible to draw an X connecting the four vertices of the square, from northwest to southeast, and from northeast to southwest (and vice versa), allowing the accessibility of each vertex of the square from any other one and from any starting point on the diagonals. The variables *gap in land accessibility* and *LAND AREA OF SICILY* represent the kilometers of *new roads to construct for accessibility* improvement. The *new roads to construct because of crowding* variable takes *road crowding* into consideration as a result of the ratio between the *density of vehicles circulating in Sicily* and the *AVERAGE SUSTAINABLE NUMBER OF VEHICLES PER KM OF ROAD*. The variable *density of vehicles circulating in Sicily* is the ratio between the *total number of vehicles in Sicily*, as calculated in the urban environment sector, and the kilometers of *Roads*. Finally, the *road disruption flow* depends on the *AVERAGE ROAD LIFE*, the effect produced by the *road crowding* on average road life, and *AVERAGE ROAD MAINTENANCE*.

[53] The evolution from 1999 to 2005 of the Sicilian road system is presented in Table 14 in Appendix 1.
[54] The Pythagorean Theorem never abandons the scholar.

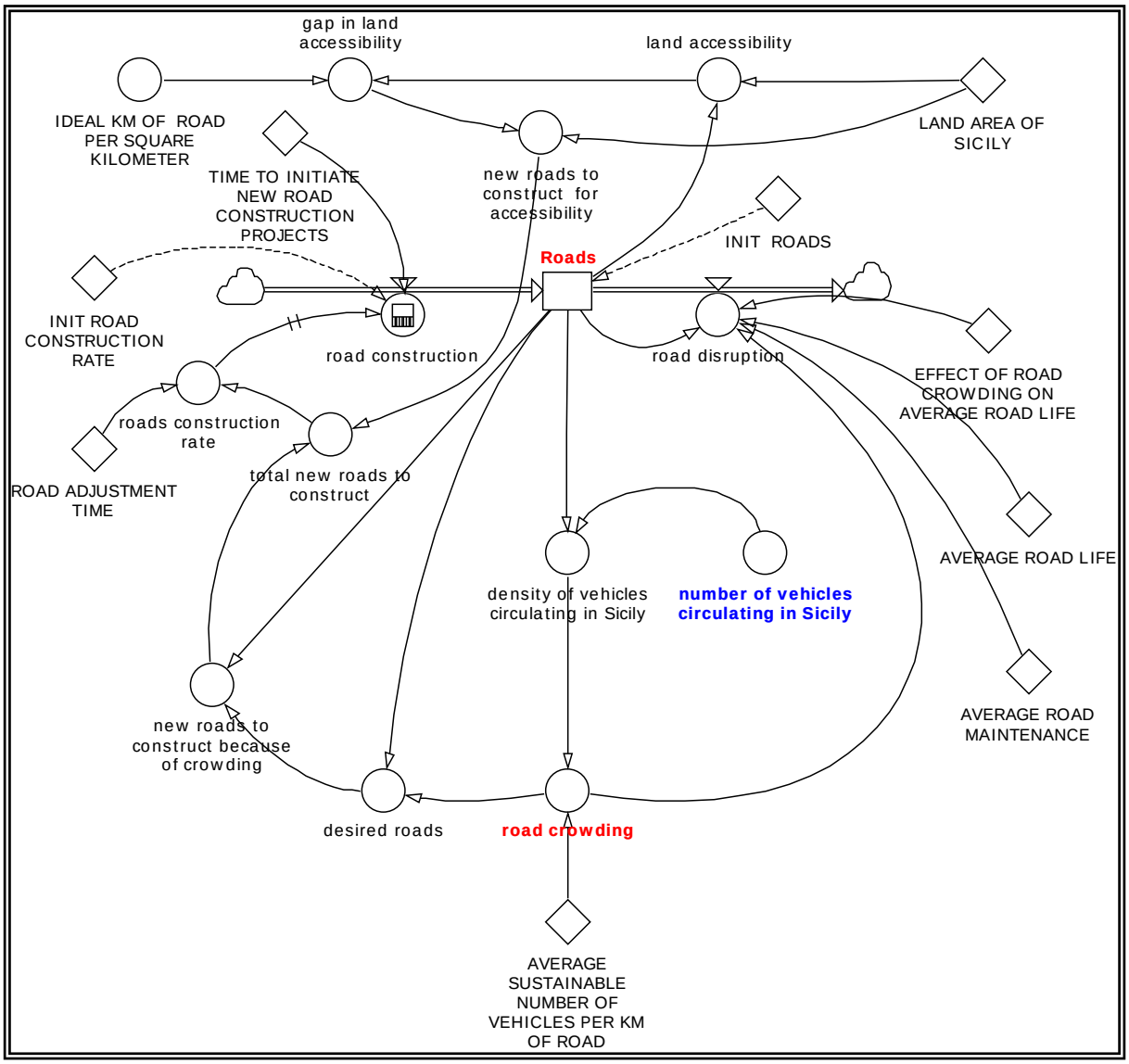


Figure 3.5: Sketch of the Road sector

3.7 The reputation sector

In international tourism, as in some other types of trade in services, the exporting country supplies itself and not only its products. Therefore, tourism flows are very sensitive to factors as resort reputation and internal/external conflicts.

To take this aspect of tourism into consideration, the reputation sector has been introduced in the structure of the model in order to capture the national and international increasing confidence in Sicily against the traditional preconception of the island association with crime.

Though the Mafia is still active in Sicily, tourists are extremely unlikely to be affected by Sicilian organized crime, and the more they are aware of that, the more the traditional Mafia locales (such as the city of Corleone, or places where the *Godfather* movies were shot) become attractive.

On the other hand, petty crime, such as pick-pocketing or bag-snatching, is a more realistic threat to the tourist, although even this risk is not much greater in Sicily than in any other Italian region.

The variables *Perception of Dangers Posed by the Mafia* and *petty crime* in this sector are intended therefore to capture these two different aspects of the image of tourism in Sicily.

Perception of Dangers Posed by the Mafia is a stock that represents the risk, perceived as Mafia activity, that the average tourist evaluates before coming to Sicily. This perception is updated over time by the flow *change in perception of dangers posed by the Mafia,* calculated by summing the difference between the actual value of her/his perception of danger and the current number of Mafia murders[55,56], normalized to the value of the year 1999, plus the *variation of Mafia murders*. In this way, both the current number of murders with respect to the reference value of year 1999 and the trend in murders are taken into consideration. Two constants *TIME FOR A POSITIVE CHANGE IN THE PERCEPTION OF DANGERS POSED BY THE MAFIA* and *TIME FOR A NEGATIVE CHANGE IN THE PERCEPTION OF DANGERS POSED BY THE MAFIA* introduce a different delay in the updating process, in accordance with a negative or null value (a growing confidence) in the variable *gap in perception*, and a positive one (a decreasing confidence). The relative stock and flow structure is shown on the right side of Figure 3.6

Petty crime[57] (pick-pocketing and bag-snatching, to be precise) is considered to be strictly related to the literacy and the unemployment rate of the male population in Sicily.

Indeed, in accordance with a survey presented at the VI National Conference of Statistics[58], 80 - 90% of criminals are males and, in most of the cases of pick-pocketing and bag-snatching, they are also very young. Therefore two stocks, *Males in Sicily Aged 15 and Over with Primary or*

[55] The value of Mafia murders is strictly related to both the volume of forces (Police, Carabinieri and Guardia di Finanza) operating in Sicily against the Mafia, and the effectiveness of their activity. Unfortunately, the number of soldiers and policemen employed in Sicily is highly confidential and, as a result, there is no way to build a feedback structure between the control of the Sicilian territory and Mafia crimes. Hence, the number of Mafia murders has necessarily been introduced in this sector as an exogenous variable.

[56] The time series of Mafia murders has been taken from the "Statistiche giudiziarie penali" (penal judicial statistics) published yearly at a regional level by ISTAT (the Italian Institute of Statistics) (see Table 15 in Appendix 1) .

[57] As for the number of Mafia murders, the number of pick-pocketings and bag-snatchings has been taken from the "Statistiche giudiziarie penali" (penal judicial statistics), published yearly at a regional level by ISTAT. A survey carried out by ISTAT in 1999 revealed that only 35.7% of crimes are reported to the police and, therefore, the petty crime phenomenon is probably underestimated by the figures. Nevertheless, the statistics published by ISTAT can be considered as closer to the real number of crimes attempted or committed against tourists because of their greater propensity to reflect crimes reported to the police by tourists compared with the propensity of people in the South of Italy to report the same crimes.

[58] Sabatini L.L., Muratore M.G. 2002. *L'indagine di vittimizzazione: una fonte fondamentale per capire la situazione della criminalità del paese*. Survey presented at the VI National Conference of Statistics, Rome, Italy, November 6-7-8. Available online at www.istat.it/istat/eventi/conferenze/sestaconf/interventi/muratore.ppt (in Italian).

Lower Education and *Unemployed Males in Sicily Aged 15 and Over*[59] have been introduced in this sector. The stock *Males in Sicily Aged 15 and Over with Primary or Lower Education* is increased by the flow *lower education completion rate* and decreased by the flow *higher education completion rate*.

Since schools in Italy are compulsory by law until the age of 15, the number of males aged 15 and over getting primary and lower secondary education per year is derived from the population of Sicily only. On the other hand, the *higher education completion rate* is considered to be influenced by the delayed value of the *gdp per capita in Sicily* as a way of taking the standard of living in Sicily into consideration[60].

The stock *Unemployed Males in Sicily Aged 15 and Over* varies over time according to both a delayed value of the economic production of Sicily (the variable *Sicilian GDP smoothed for employment-related considerations*) and the percentage of low-literacy among males with respect to the total population of Sicily (the variable *Percentage of males in Sicily aged 15 and over with primary or lower secondary education*)[61]. These two variables will define the socio-economic condition of Sicily over time. The *INIT UNEMPLOYMENT NET INFLOW FOR MALES AGED 15 AND OVER* has been estimated by the author as the net unemployment rate related to the economic and cultural situation in Sicily in 1999. The variable *unemployment net inflow for males in Sicily aged 15 and over* updates, over time, the male unemployment for the age class under study, with a delay time given by the constant *DELAY TIME FOR SICILIAN SOCIO-ECONOMIC CONDITIONS TO AFFECT MALE UNEMPLOYMENT*. *Petty crime* and *Perception of Dangers Posed by the Mafia* together define the *total threat to the tourist in Sicily* as the arithmetic mean of the two crimes whose contribution to the total threat is measured by the constants *EFFECT OF PETTY CRIME ON TOTAL THREAT* and *EFFECT OF PERCEPTION OF DANGERS POSED BY THE MAFIA ON TOTAL THREAT,* respectively. The choice of using the arithmetic mean instead of the product between the two criminal phenomena was to avoid the possibility that a zero value over time (improbable, though desirable) for one of the two crimes (for instance, for Mafia murders), with the other maintaining a high value, could result in a null and unreal figure for the total threat to the tourist in Sicily.

[59] The time series of these variables is presented in Tables 15 and 16 in Appendix 1.

[60] Disaggregating population of Sicily by gender, age and social conditions would result in a more precise analysis of the interactions between the population growth, the average income per capita, and the higher level of education attained by people in Sicily. Yet, the simplified structure proposed, fortified with the econometric estimation of the behavioral parameters, is considered sufficient for the particular purpose of this sector.

[61] A better analysis of the male unemployment rate in Sicily for people aged 15 and over would require the study of the labor market structure in Sicily. Yet, for the particular purpose of the reputation sector, the proposed simplification of the relation existing between economy, literacy and unemployment in Sicily is considered suitable.

The *total threat to the tourist in Sicily,* representing a measure of the reputation of Sicily over time, compared with the *INITIAL REPUTATION* of Sicily defines which of the two flows, *reputation inflow* or *reputation outflow,* will work to update the stock *Reputation of Sicily*, with a different delay time depending on whether the variation is an improvement or worsening in reputation.

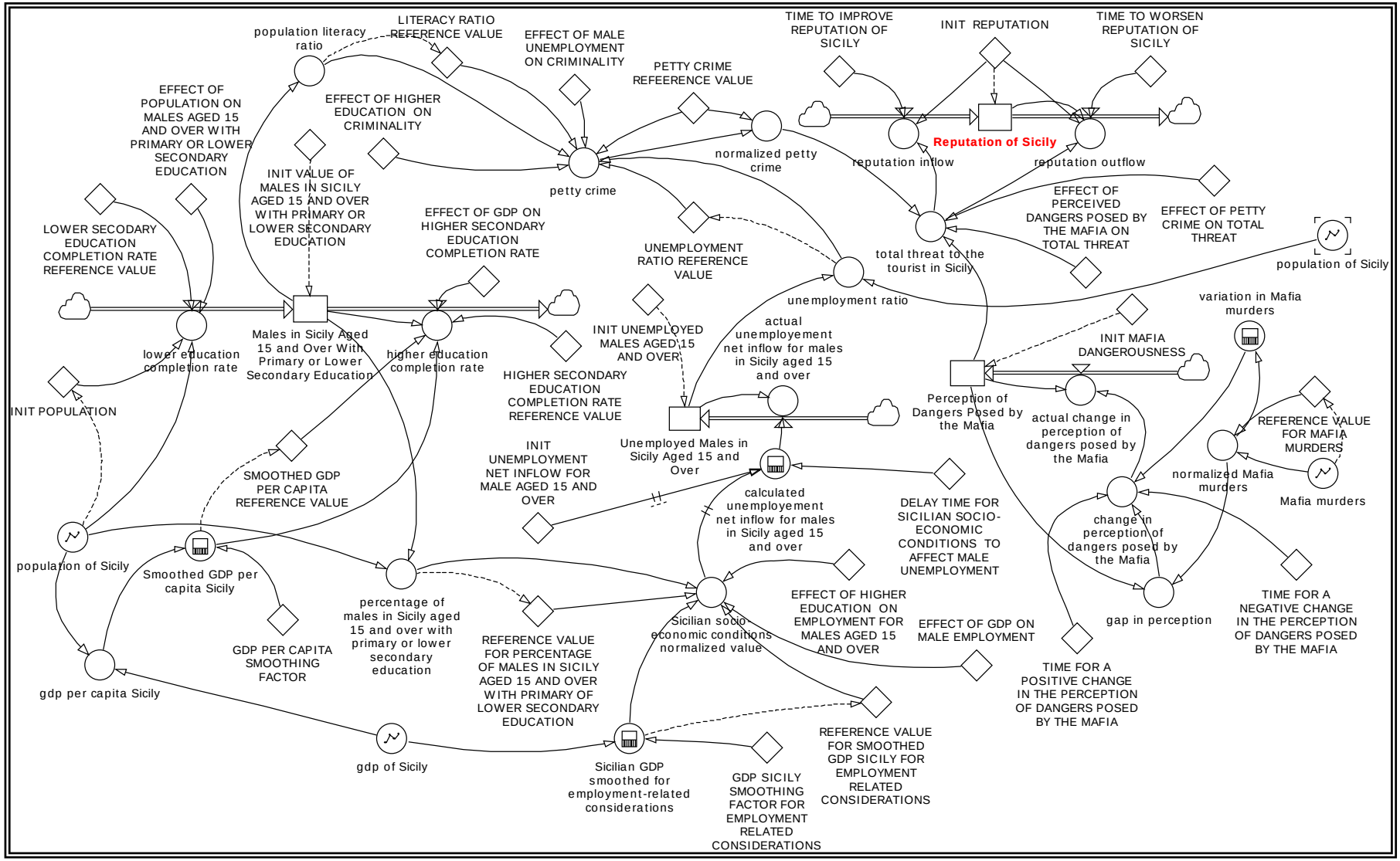


Figure 3.6: Sketch of the Reputation sector

Chapter 4. Model Validation

Validity of results in a model-based study is crucially dependent on the validity of the model itself.

Specifically for causal-descriptive models, meaning statements as to how real systems actually operate, an accurate output behavior (a model output that matches the real behavior under study) is not sufficient for model validity; what is crucial is the validity of the internal structure of the model. In other words, a design-oriented model, being a simplified representation of the real system, must not only reproduce/predict its behavior, but also explain how the behavior is generated, and possibly suggest ways of changing the existing behavior.

Model validation is therefore the way to build confidence in the usefulness of the model since the first step of the modeling process. Indeed, although model validation is typically (and technically) defined to take place right after model construction and before policy analysis/design step, in practice it exists from the very beginning and in every stage of the modeling process: from problem identification to the analysis of the results.

This chapter describes some of the most significant tests conducted for the validation of the model presented in this study.

Both the formal structure of the different sectors of the model and the behavior they generate have been validated following the widely accepted series of tests proposed by Barlas (Yaman Barlas, 1996). This actually does not mean that the entire model validation has been carried out by single sequential steps. The model has been revised from the beginning every time the results of the tests have provided information on potential model's flaws.

The results of the validation process are reported along with the discussion of their significance for the model validity.

4.1 Philosophical and technical problems in model validation

The concept of model validity is tightly coupled with the reliability of the model with respect to the purpose for which it has been created. Therefore judging the validity of a model ultimately involves judging the validity of its purpose too, which is essentially a non technical, informal and qualitative process.

Yet, in order to make the present discussion as rigorous as possible, just the formal aspects of model validity and model validation will be considered knowing already that judging the internal structure of a model is in the same way problematic.

From a philosophical point of view, indeed, there are no formal test (such as statistical hypothesis tests) to verify the truth of a scientific statement implemented in a model structure

whereas, from a technical point of view, standard statistical tests can not even be used in validating the behavior of a system dynamics model, because of problems of autocorrelations and multicollinearity.

The validity of the model presented in this study is therefore evaluated looking at the internal structure that adequately represents the aspects of the system relevant to the problem behavior in hand.

A model is actually valid when it can support the analysis of those issues the final user is interested in, when it can improve her/his understanding of the mechanisms that generate the behavior over time of the variable under study and provide sound policy recommendations.

It is exactly in this perspective that validation tests have been carried out and are reported in the following sections.

Therefore, the validity of the model has been judged on the basis of its ability to explain the dynamics of tourism flows in Sicily as resulting from the evolution of local tourism supply in the time horizon considered: the "right behavior for the right reason".

4.2 Structure validity

Structure validity results from carrying out two types of structure tests: Direct structure tests and Structure-oriented tests. Direct structure tests aim at valuing the validity of the model structure by direct comparison between each relationship (a mathematical equation or any form of logical relationship) individually and the available knowledge obtained directly from the real system being modeled or from the existing literature. In the first case the direct structure tests are classified as empirical, in the second case as formal. No simulations are involved anyway.

The Structure-oriented confirmation tests, instead, assess the validity of the structure indirectly, by applying certain behavior tests on model-generated behavior patterns. These tests involve simulations of the entire model and/or simulations of sub-models of it.

The first four tests reported below belong to the first of the two categories, while the structure-oriented behavior tests have been summarized in section 4.2.5.

4.2.1 The structure confirmation test

This confirmation test characterizes the way the model has been created from the very beginning. Indeed, the comparison between the equations of the model with the relationships that exist in the real system/literature is a process that starts with the definition of the first variable of the model and ends with the definition of last one.

In the present study, the main source of information for defining the model equations has been the generalized knowledge in the literature. Indeed, the analysis of determinants for tourism in a resort area (just like the analysis of the relationships between all the economic and non-economic variables that define the characteristics of the resort area itself) involves such a big number of relationships that it would impossible to obtain them directly from the real system and, at the same time, come out with a model still updated (by the time necessary to collect all the information directly from the real system, some relationships could be already out of date).
Therefore, the relationships between the variables of the model have been formalized by making use of the general structure of gravity models as discussed in chapter 3.
In fact, both the generalized use of gravity model in the context of tourism flows between countries or towards a specific country and the great success that these models have experienced in the empirical applications in social sciences, makes the author confident about their capacity to represent relationships as they are in the real system.
In some cases, the relationships between the model's variables have been formalized strictly following the conclusions of the statistical surveys used to drive the construction of some sector of the model (the relationship between criminality and the sex and age of criminals, for instance).

4.2.2 Parameter confirmation test

This crucial test is intended to compare the parameters used in the model with existing knowledge about the real world system. This comparison has been carried out on two levels: conceptual and numerical.
From a conceptual point of view, parameter confirmation test implies that the parameters used in the model find a similar significance in real world concepts or elements.
For the model under analysis, the parameter confirmation comes directly from the common sense and the everyday life. In fact, most parameters introduced in the model measure the elasticity of the variables of interest. The concept of elasticity, intended as the reaction of an entity (tangible or intangible) to a change in its normal state, is very common in the everyday language. For instance, the sentence "mental elasticity" is commonly used to express the capacity of a person to adapt her/his way of thinking to a new situation.
Model parameters like *EFFECT OF GDP ON NUMBER OF VEHICLES IN SICILY* has a clear match in the real system because it measures the acquisition of vehicles for people in Sicily as influenced by their wealth. In the same way, the parameter *EFFECT OF TOURISM PRESSURE ON NEW CULTURAL RESOURCES* represents the capacity of the public administration to respond to the demands for cultural resources made by the incoming tourists.

A second category of model parameters deals with the smoothing factor for changes in information.

Even in this case, although the concept of smoothing factor is very intangible, the model parameter has an element in the real system: the delay with which a person filters new information.

Finally, a third category of parameters concerns the initial value or the reference value for some model variables. For these parameters, it is sure that exists in the real system a corresponding element or concept.

In addiction to the conceptual confirmation, parameter validation also means estimating the values of the parameters used in the model with sufficient accuracy. In other words, from a numerical point of view, parameters have to be tested in order to verify that their values are close enough to those observed in the real world. What "sufficient accuracy" and "close enough" mean in a quantitative sense depends on the purpose of the analysis and the sensitivity of model's behavior.

The accuracy with which parameters have been estimated has already been discussed in the previous chapter. In fact, the choice to rely on an optimization technique is mainly due to the author's will to avoid the multicollinearity and correlation problems that normally come with the traditional statistical analyses and the significance problems of the more advanced longitudinal analysis.

About the accuracy of the estimation made with the optimization technique, having introduced the variables one at a time and having observed that all the parameters present the correct polarity when generating the expected model behavior, allow the author to be confident of the accuracy of the parameters estimation.

Concerning the issue of the sensitivity of the model to changes in parameters values, it has to be observed that some of the parameters can effectively influence the model behavior from a qualitative point of view. The sensitivity analysis reported later in this chapter aims at identifying these sensitive points and discuss what level of accuracy should be used to guarantee the reliability of the produced results.

To complete this section about the parameters numerical confirmation, the most accurate data come from the high-quality information service provided by the local, national and international statistical offices. Some data are the result of personal elaborations of official data and some others have been personally collected by the author. Finally, even the time horizon for the dynamic analyses has been chosen in order to have ready-to-use real data in the level of aggregation suitable for the present study.

Yet, it has to be kept in mind that System Dynamics models generally describe not only physical relationships for which hard data are available, but they often includes data on "soft" relationships that are unlikely to be present in any database, even in a developed country.
This is the case, for instance, of the parameter *EFFECT OF DANGER POSED BY THE MAFIA ON TOTAL THREAT* introduced in the reputation sector of the model.
In this case, as in the few others, the parameter has been estimated using the common sense.

4.2.3 Direct extreme-condition tests

According to this direct structure test, the validity of the model equations has to be assessed under extreme conditions. More precisely, these tests aim at assessing the plausibility of the variables resulting value against the knowledge/anticipation of what would happen under similar conditions in real life. This kind of tests have been run for all the variables of the model, although, in the process of definition of each model equation, some of the typical extreme analysis had already carried out. For instance, the equation for incoming tourists has been tested by setting the value of the variables GDP and Population to zero in two different moments. In both cases the value of the flow of tourists became zero as well.

4.2.4 Dimensional consistency test

Testing the dimensional consistency of a model simply means to compare the left and right sides of each of the equations formalized in the model to verify that the same units of measure are used for both sides. This process is very long if the software used to build the model has not an automatic dimensional consistency verification functions. Powersim, which is the software used for the present study, does not have an automatic function for consistency verification and, therefore, the consistency test has been carried out by checking the model variables manually one by one.

4.2.5 Structure oriented behavior tests

The structure of the proposed model has also been indirectly validated applying certain behavior tests on the model-generated behavior pattern. The extreme-condition (indirect) test has been carried out by setting the variables' elasticity parameters inside each sector, separately considered, to the extreme values of zero. In all the simulations, as expected, the sectors have shown a total rigidity towards the tourism demand for products and services. In the same way, the attractiveness of the destination area has been evaluated in the case of a null exponent for

each of the variables representing a specific tourism aspect. As the real system would exhibit, the simulated flow of tourists has not changed over time.
This extreme-condition test has also allowed the author to figure out the sensitivity of the model to the elasticity parameters of its variables as requested by behavior sensitivity test.
Instead, it has not been possible to do any modified-behavior predictions because data about the behavior of a modified version of the real system are not available.
Finally, the Turing test has not been carried out for the difficulty to find a pool of experts to present with a collection of real and simulated data.

4.3 Behavior validity

After having verified the level of confidence in the validity of the model structure, one can start measuring how accurately the model reproduces the major behavior patterns exhibited by the real system. Behavior pattern tests are, indeed, the way to figure out the model capacity to endogenously create the dynamic behavior seen in the real world, starting with a set of initial conditions. In fact, this is the first condition for the model to be useful with respect to the purpose of the analysis.
It is very important to notice that the emphasis of this test is placed on pattern correspondence and not on the exact duplication of the observed behavior. A very high level of accuracy in reproducing those behavior patterns would be unnecessary for policy analysis, and point prediction is not the aim of this model.
Though a failure of this test can strongly prove that a model does not include all the necessary structures to produce a specific behavior, on the other hand, passing it does not prove anything about the adequacy of the model's structure. A modeller can use many different formulations to reproduce a specific behavior and, therefore, matching a behavior with what is observed in the real world does not imply that the formulation actually used is correct. In other words, this test represents a necessary but not sufficient condition to prove the validity of the model. This is the reason why behavior pattern tests are said to be "weak" tests.
To implement this test all the data series available for the variables of major interest have been used and compared with the model's simulated results. The results from such comparison have been very positive and encouraging. The proposed model reproduces patterns of behavior very similar to those observed in the real system, sometimes even for short-term fluctuations observed in reality.
As this test assumes significance in terms of model validity only when it fails, the cases in which the model proved to be able to reproduce the desired behavior are not shown here. Instead, the

failures of the model in replicating the short term fluctuations of some variable and the implications of these ones for the model validity are specifically discussed.

A first case of variable for which the model has produced a short-term behavior different from that observed in the real system is represented by the *average number of bed-places per hotel*[62].

As shown in Figure 4.1, the model's red line produces a smooth behavior over time that does not replicate the oscillations of the data series shown by the blue line. Yet, for the fact that the hotels in Sicily (as in the specific model sector) present a GUI[63] around 32% (in average), the smooth behavior of the variable is not actually able to affect the reception capacity of the hotels as it is simulated in the model specific sector.

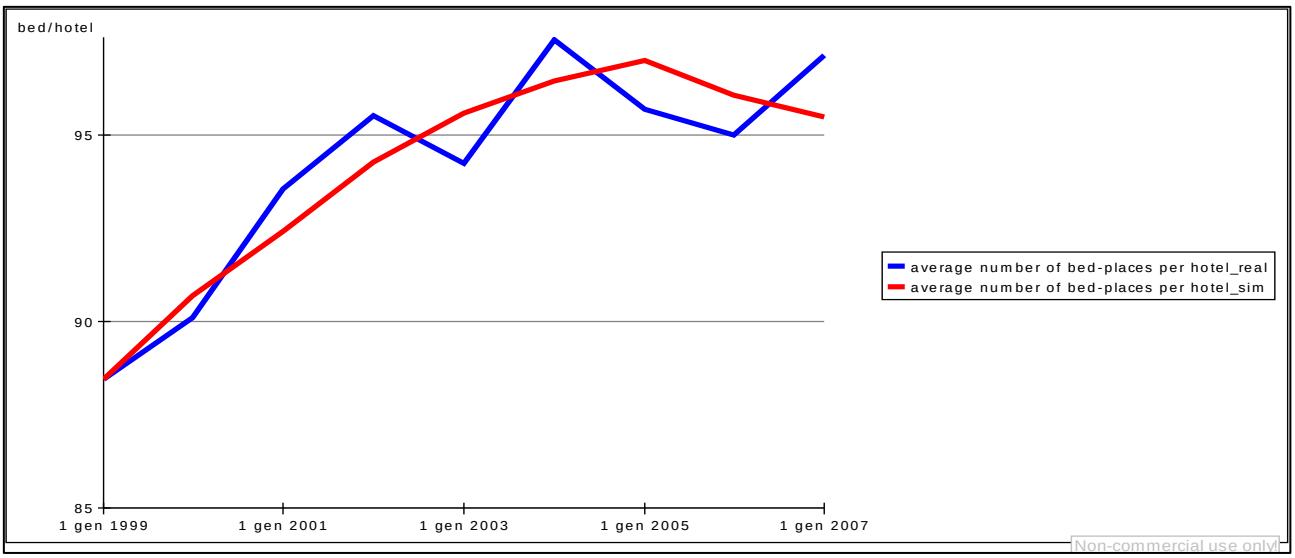


Figure 4.1: Real vs simulated average number of bed-places per hotel in Sicily.

Figure 4.2, instead, shows the behavior of the variable *Roads* in the model. It is clear that capacity of the model sector is able to reproduce the short term oscillations of the real kilometers of road in Sicily in the period under study, except for the value in 2000.

Two hypotheses have been formulated to explain such a different value in 2000.

The first one is very simple: the 2000 value in the data series is largely a measurement error, and therefore there is not any interest in reproducing the same behavior with the model. Though this hypothesis may seem extremely naïve, the capacity of the sector to closely reproduce the observed values for the rest of the years seems to justify the doubts about the level of reliability of the year 2000 value.

According with a second hypothesis, the value observed in 2000 really occurred as a result of some event in the history of Sicily. Actually the year 2000 was the year of the Jubilee and a lot

[62] In reporting the name of the model's variables the same standard of Chapter 3 is used.
[63] The meaning of this index has been described in Chapter 3.

of public money was spent in 1999 to prepare Sicily to this event. Therefore, it is possible that an additional quantity of money was assigned to the renovation and the maintenance of Sicilian roads in 1999. Yet, this is just an hypothesis/explanation.

Clearly, the model does not consider the mechanism that can produce this kind of events, and their study is certainly not the object of the analysis conducted.

However, aside from the reason of the difference between the observed value and the simulated one, its nature of single point is not able to threaten the validity of the model.

Figure 4.2: Real vs simulated Km of roads in Sicily.

More severe discrepancies have been reported between the real and the simulated number of urban solid wastes produced in Sicily in the period under study. Figure 4.3 clearly shows a low point prediction capacity of the sector involved in the USW analysis. Yet, since the emphasis of the behavior analysis is on the pattern prediction rather than on the point prediction, the model structure is considered able to reproduce the oscillations experienced in the real system, even if with a lower amplitude. The effect of this gap in point prediction on tourism trends is therefore considered negligible.

For all the other sectors, the discrepancies between the data series collected and the model's generated behavior are insignificant if compared with the one already discussed. Therefore the model, as a whole, has consistently proved to be capable of reproducing the desired behavior. Certainly, longer data series would have been very useful for this study, but, as already mentioned, 2007 is the last year available for official statistics and before 1999 data present a

level of aggregation that does not allow the author to carry out a reliable study with respect to Sicilian tourism.

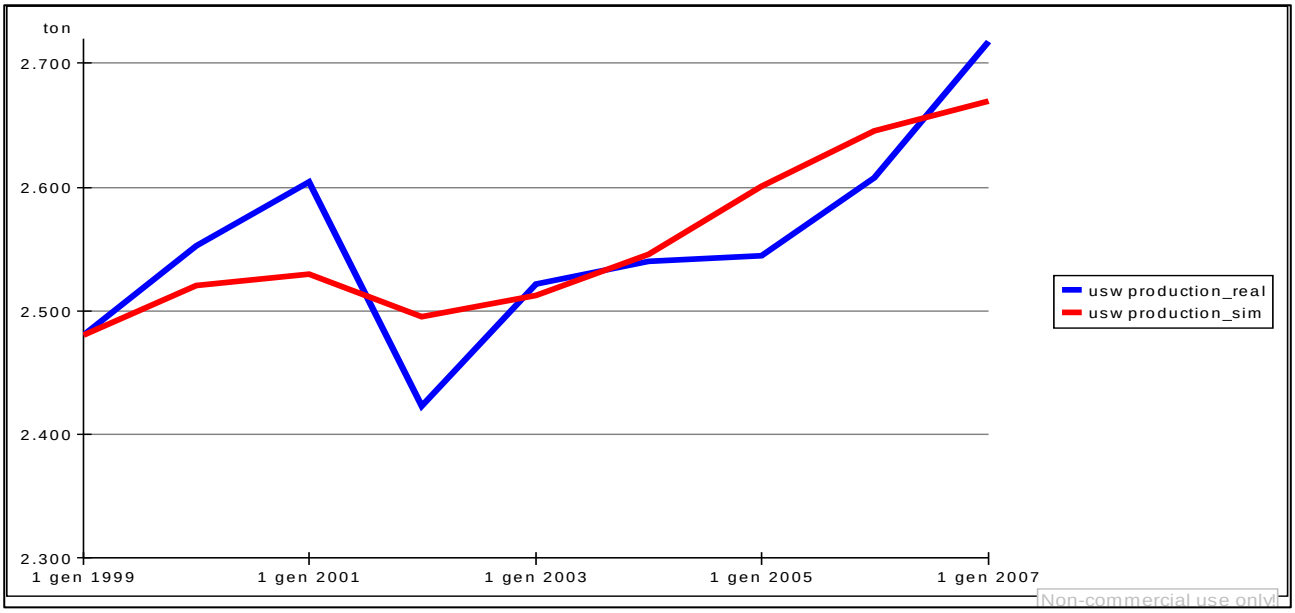


Figure 4.3: Real vs simulated usw produced in Sicily.

Some structure-behavior graphs have also been plotted in order to check whether the structure of each sector produces the behavior seen in the real world or not.

For each sector, four hypotheses have been tested: equilibrium, a step increase, a pulse increase, and a ramp increase in the main variable influencing the behavior of the sector under study all other variables being equal (*ceteris paribus* principle).

Each sector has showed the expected behavior with respect to its specific structure. Two cases are reported here: restaurants inside the tourism area and cultural resources.

For the restaurant sector:

- The equilibrium hypothesis keeps the variable *tourism demand for seats in restaurants inside the tourism area* at its initial value of 4.791.470 seats corresponding to 2000 restautants;
- The step function increases the initial demand for seats of 10% from time 2000;
- The pulse function produces a pulse in the initial demand for seats that occurs just once in the simulation period at time 2000, with size equal to 0,30;
- The ramp function starts at time 2000 with a slope equal to 1%.

For the culture sector:

- The equilibrium hypothesis keeps the variable *total number of non-resident tourists in Sicily* at its initial value of 2.729.434 people;
- The step function increases the number of non-residents tourists of 25% from time 2000;

- The pulse function produces a pulse that occurs just once in the simulation period at time 2000, with size equal to 0,25;
- The ramp function starts at time 2000 with a slope equal to 10%.

Figure 4.4 and Figure 4.5 relate to the flow *restaurants acquisition inside the tourism area* and the stock *Restaurants Inside the Tourism Area* respectively. Figure 4.6 and Figure 4.7, instead, relate to the flow *cultural resources acquisition* and the stock *Cultural Resources* respectively.

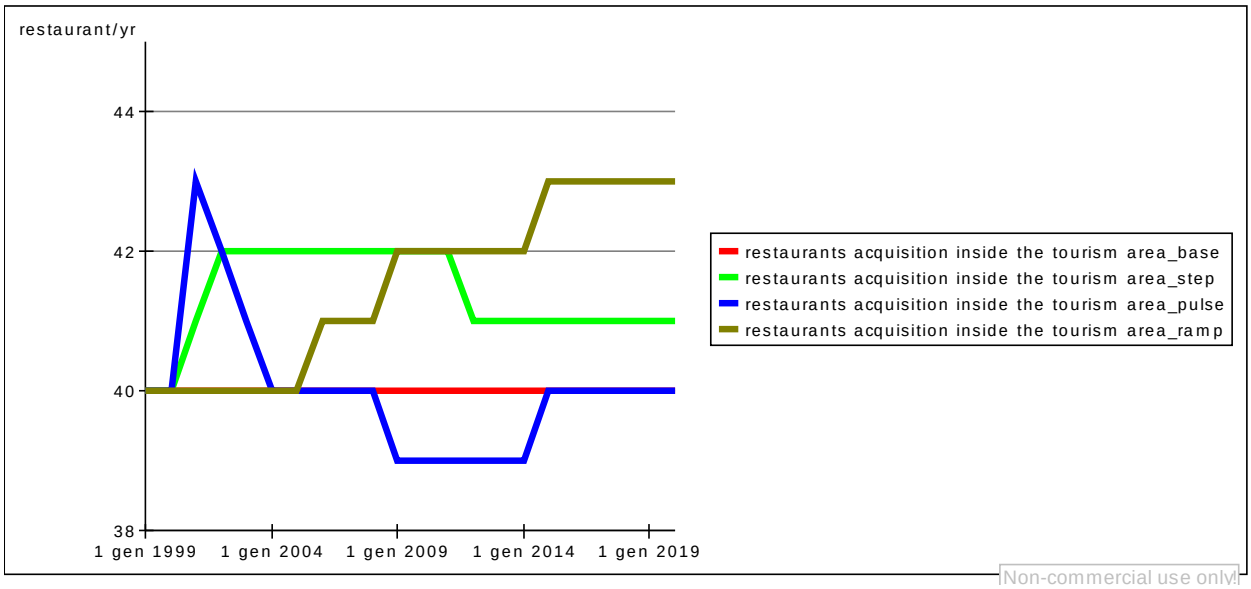


Figure 4.4: Restaurants acquisition inside the tourism area (equilibrium, step increase, pulse increase and ramp increase hypotheses).

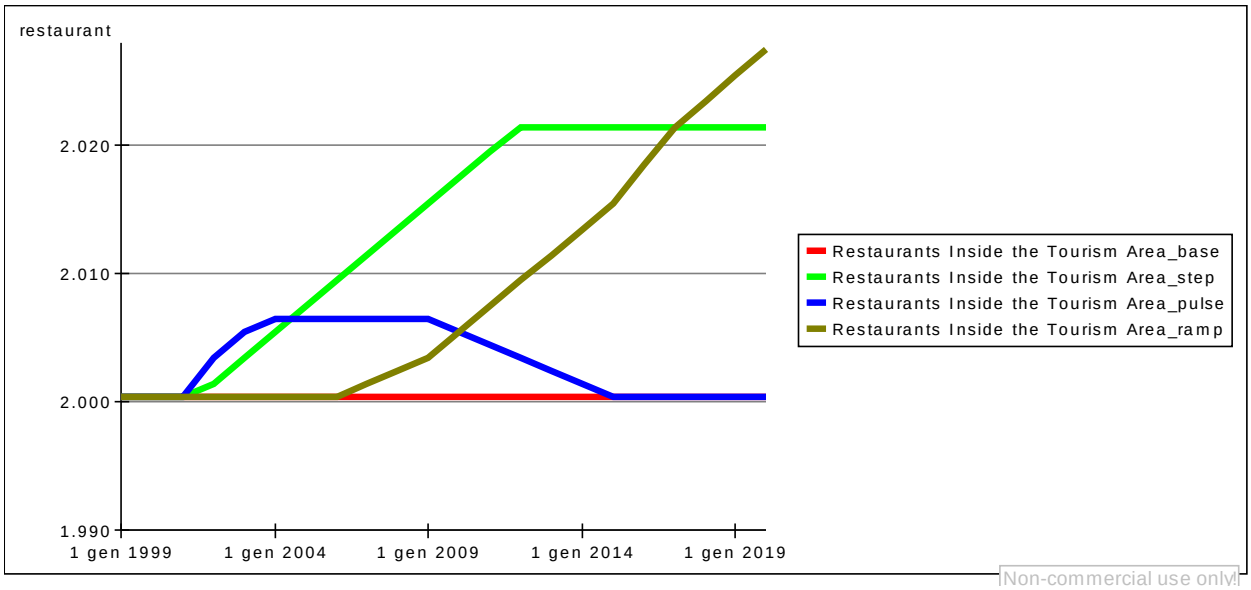


Figure 4.5: Restaurants inside the tourism area (equilibrium, step increase, pulse increase and ramp increase hypotheses).

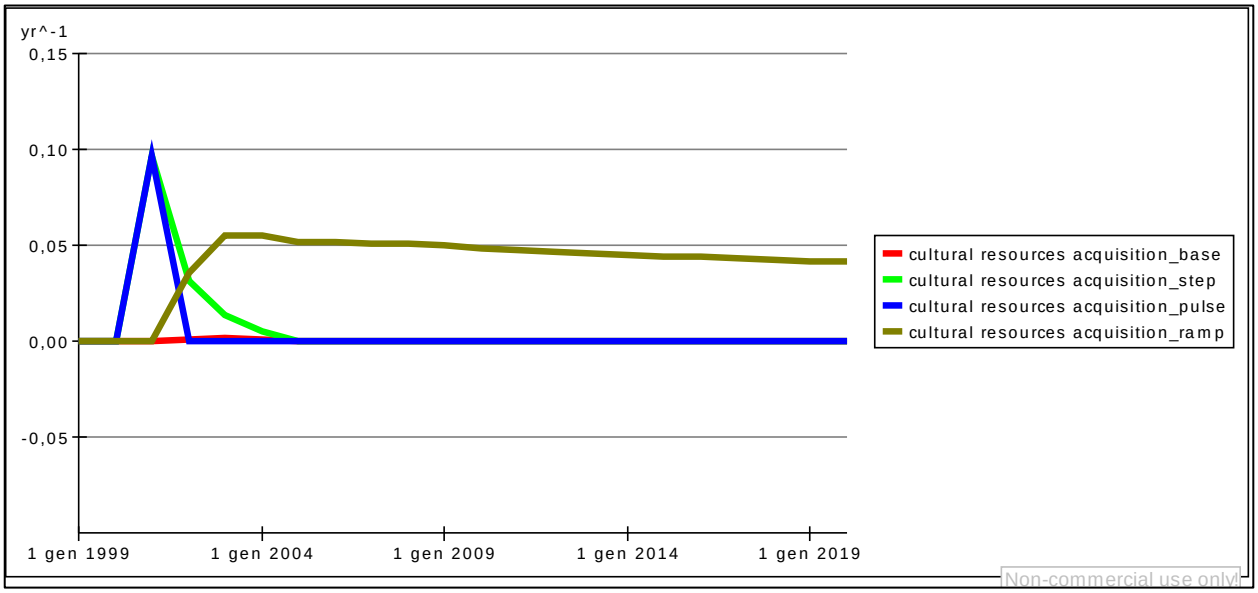


Figure 4.6: Cultural resources acquisition (equilibrium, step increase, pulse increase and ramp increase hypotheses).

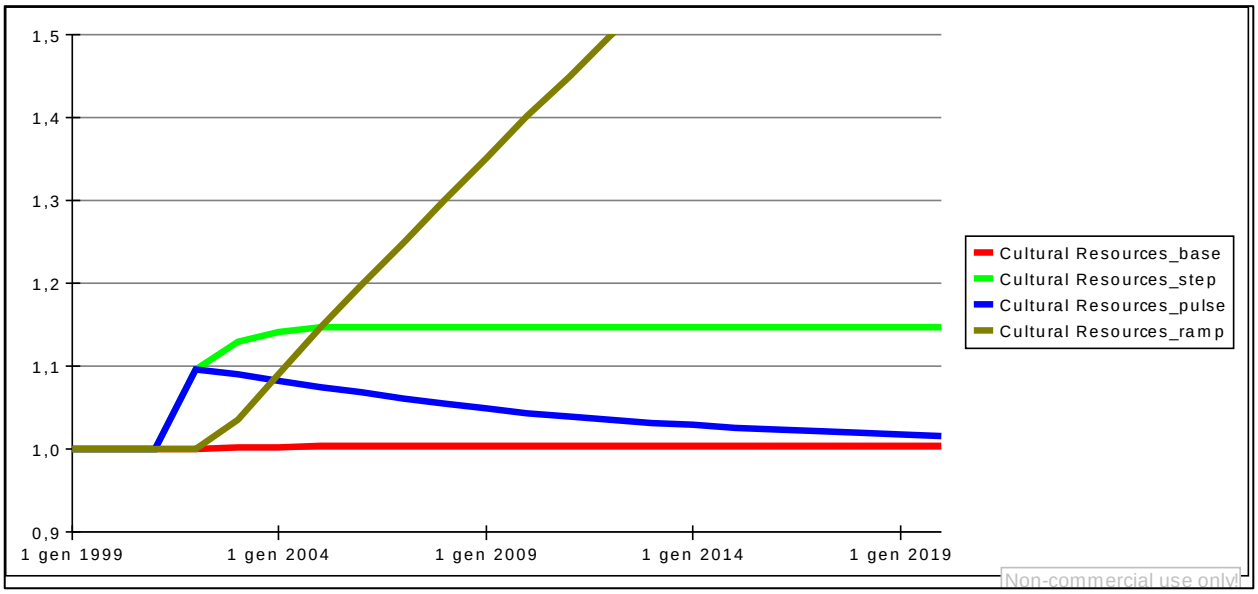


Figure 4.7: Cultural resources (equilibrium, step increase, pulse increase and ramp increase hypotheses).

Figure 4.4 shows a step-shaped behavior of the curves because the number of restaurants changes per integers.

Therefore, as long as the increase in the variable *tourism demand for seats in restaurants inside the tourism area* is not big enough to call for at least a new restaurant (considered the average number of seats per restaurant, the rotation of seats, and so on), the number of restaurants stays constant. This, also, is the reason why the curves corresponding to the ramp increase in the demand of seats show a delayed behavior if compared to the others. Indeed, while the step and

the pulse increase are big enough to call for new restaurants since the first year, the ramp function increases the *desired number of new restaurants inside the tourism area* of one restaurant more only after three years.

A new equilibrium position is reached by the system after the step increase. The pulse increase, instead, because of the delays of the system, generates a little oscillation and, eventually, comes back to the initial number of restaurant.

About cultural resources, two remarks are worthy.

In the hypothesis of a pulse increase in the number of visitors, the stock of cultural resources increases as well (to satisfy the increased demand for cultural resources) after the delay time needed to make enjoyable new cultural resources. Since the increase in the number of visitors is only temporary, the stock of cultural resources start decreasing afterwards until it reaches its initial value again.

The second remark is about the behavior of the variable *cultural resources acquisition* generated by the ramp increase in the number of visitors. As shown in Figure 4.6, because of the presence of delays, the system initially overreact to the difference between the desired number of cultural resources and the stock of cultural resources. Then, the rate of acquisition starts decreasing until it reaches the equilibrium with the rump increase.

4.4 Sensitivity Analysis

Sensitivity basically consists of measuring the relative changes in the model behavior happening as one or more parameters' values are modified. This kind of investigation has two main related scopes. First, it facilitates the search of those parameters to which the model is particularly sensitive, and therefore helps the modeller to concentrate her/his efforts on the estimation of the values of these key elements. This activity is crucial for the validity of the model. Second, sensitivity analysis is an important tool to establish a level of confidence for the results produced by the model.

Regarding the first objective of sensitivity analysis, the author has regularly performed sensitivity tests every time a new parameter was included in the model or some structures substantially changed. In the initial phase of model construction, the sensitivity analysis was carried out changing one parameter at the time. As the model started assuming a more definitive shape and it became clear which were the parameters having a strong influence on its behavior, the objective of the sensitivity analysis gradually moved towards the second of the scopes above mentioned. At this point the question became what was the indicated level of confidence in the model's results, given the assumed level of confidence on the parameters' values used.

To perform the sensitivity analyses, the Risk Assessment task of Powersim has been used.

Assumptions, decisions and effects have been selected in accordance with the sector of the model to evaluate. Since the parameters to vary during the sensitivity analysis have a finite range of variation (some of them can not become negative, for instance) the truncated normal distribution has been used for the sensitivity analysis, with lower and upper limit properly defined.

The Latin Hypercube sampling technique has been used as sampling method and 500 generation (samples) have been originated from the probability distribution of each assumption.

In all the sensitivity analyses carried out, results were satisfactory. Two cases are reported as example: the sensitivity analysis carried out for the hotel sector (Figure 4.8) and the sensitivity analysis carried out for the road sector (Figure 4.9). The graphs show that the variation for the specific variable considered is comprised between an acceptable range.

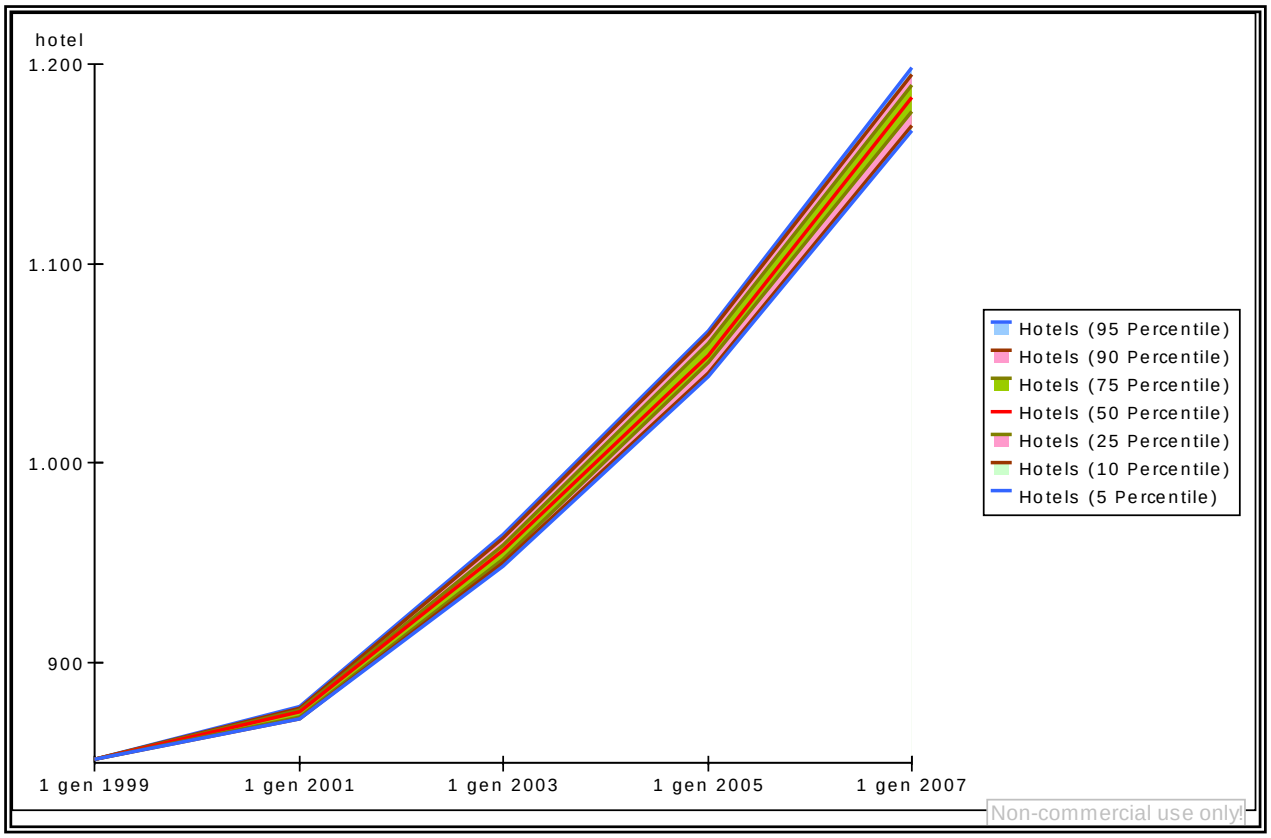


Figure 4.8: Sensitivity analysis for the variable Hotels.

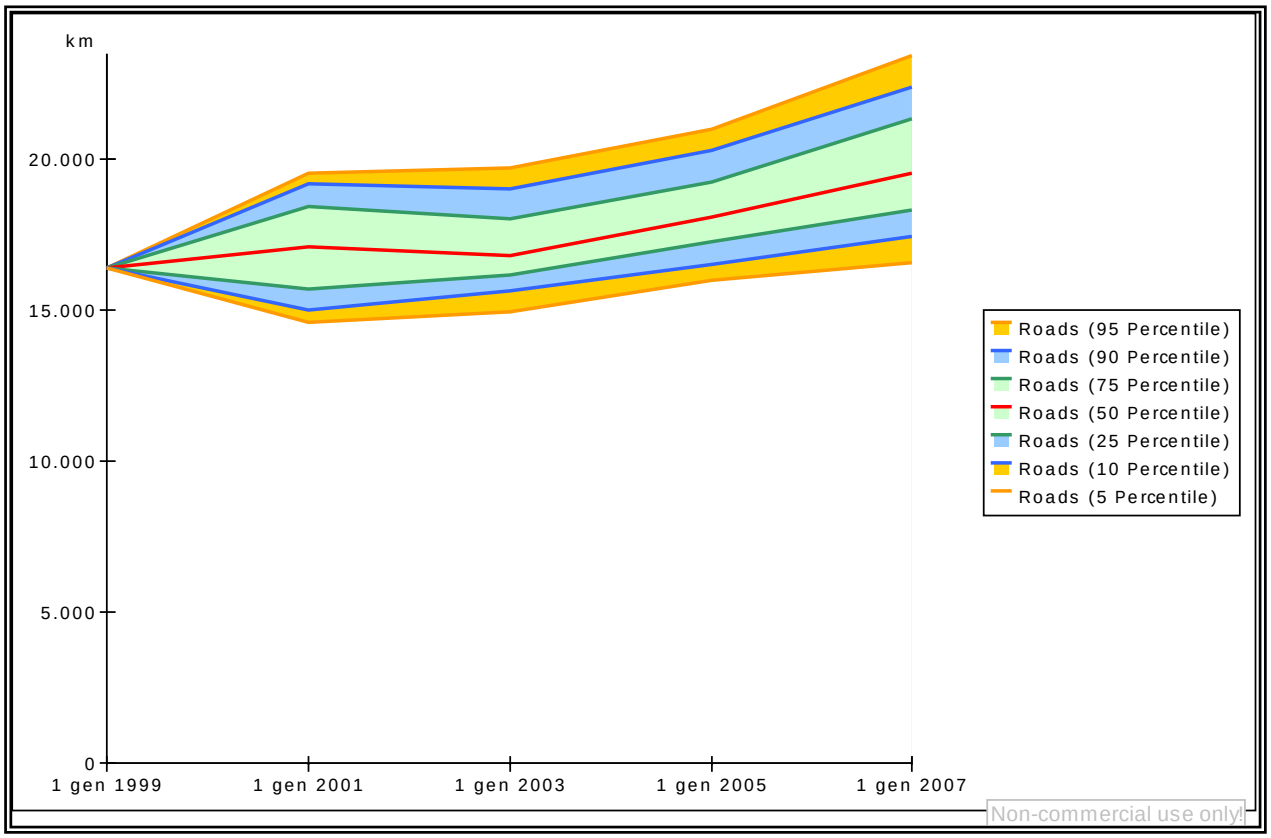


Figure 4.9: Sensitivity analysis for the variable Roads.

Chapter 5. Simulations Result

In this chapter, simulations are presented per sector of the model and the output of the simulation is compared with the real behavior. The last set of simulations relates to the tourism flows from the specific international, national and local regions considered in the present study.

A short comment about the simulations result explains possible deviations of the simulated behavior compared to the real one. In the presented time graphs the red line always represents the simulated behavior, meaning the result of the model, whereas the blue one represents the observed time series.

At the end of this chapter the values used for the parameters of the tourism demand functions are properly presented and discussed.

5.1 Simulation result in the hotel sector

Figure 5.1 compares the time series of the hotels in Sicily with the behavior simulated in the specific sector. The red and the blue lines almost overlap, so the simulated trend in the number of hotels in Sicily reproduces the real values with very negligible deviations.

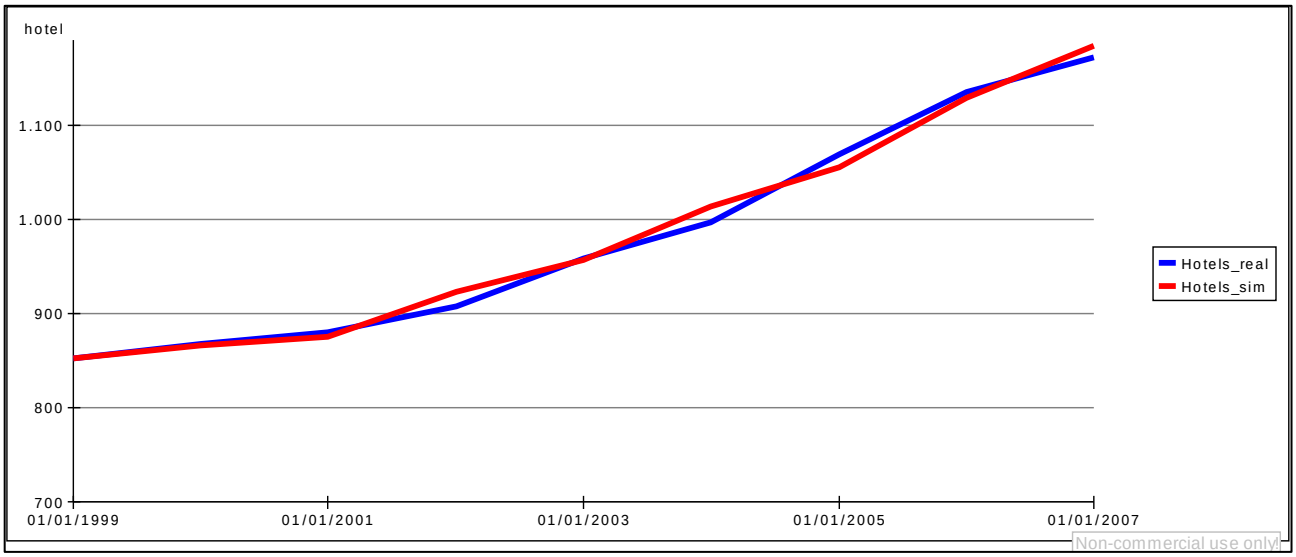


Figure 5.1: Real vs simulated number of hotel in Sicily.

Figure 5.2 shows the behavior over time of the average number of bed-places per hotel in Sicily. Even though, at first glance, the comparison between the two lines may look not very promising, it is important to notice that the simulated behavior, instead, perfectly reproduces the increasing average dimension observed in the lodging sector. Indeed, the real figures show not only a growing number of hotels in Sicily but, also, the trend in building bigger and bigger hotels.

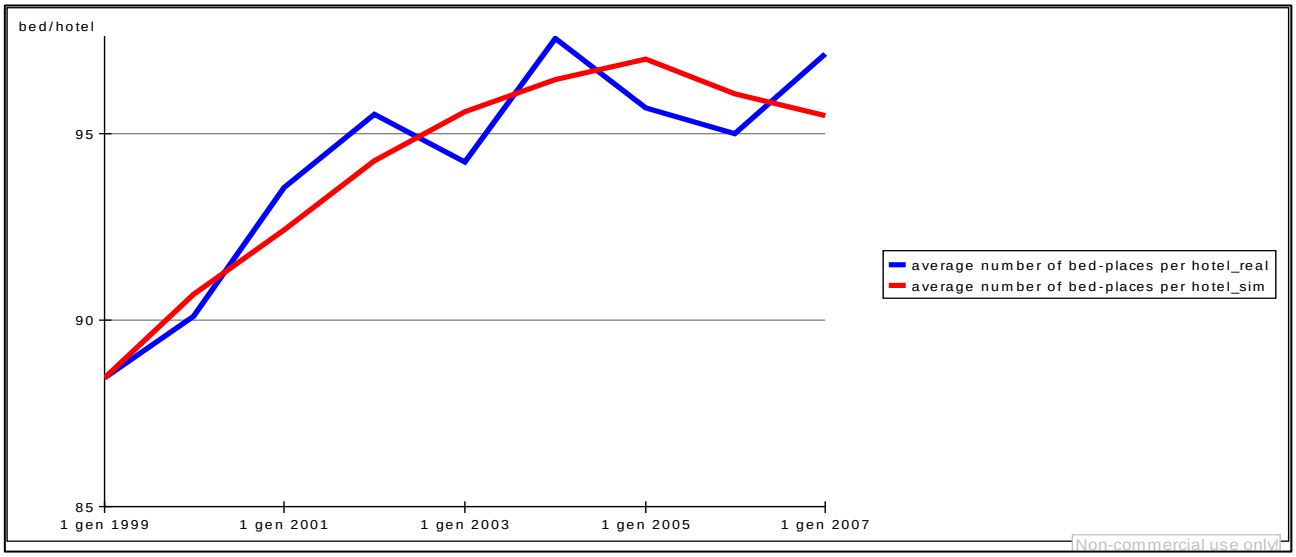


Figure 5.2: Real vs simulated average number of bed-places per hotel in Sicily.

The possible consequences for the validity of the model of the difference between the real and the simulated values of bed-places have already been discussed in the validation chapter.

5.2 Simulation result in the restaurant sector

Figure 5.3 shows the behavior of the restaurant sector versus its observed trend. No remarks as the curves almost overlap.

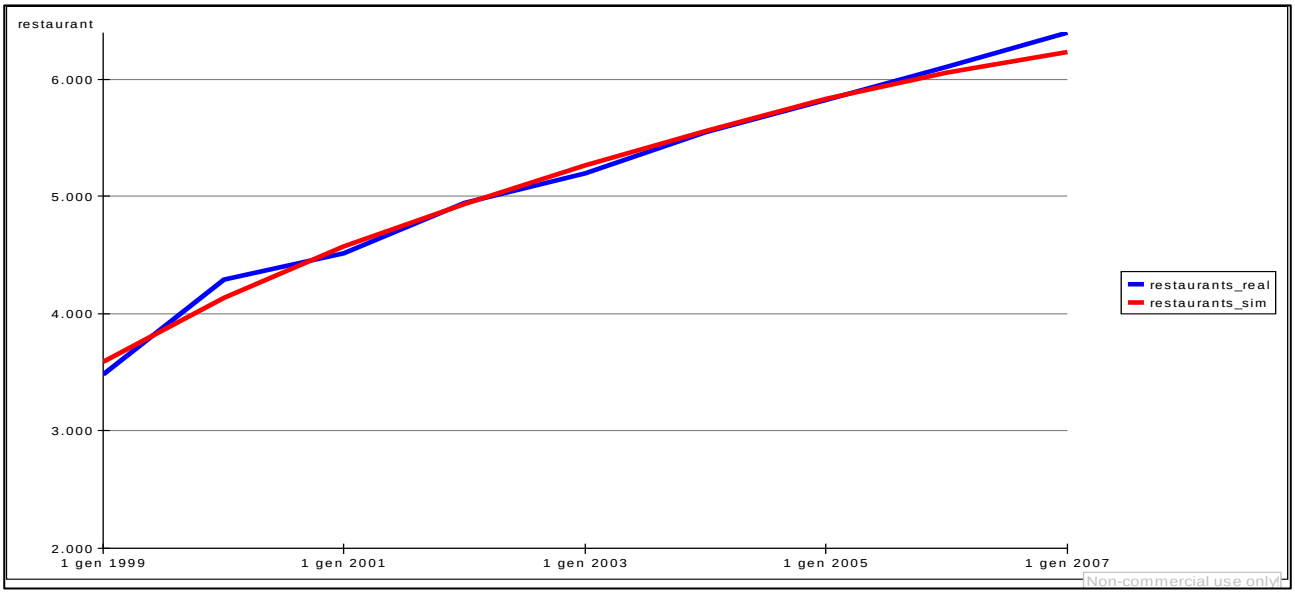


Figure 5.3: Real vs simulated number of restaurants in Sicily.

5.3 Simulation result in the culture sector

The culture sector allows the author some remarks.

Indeed, as shown in Figure 5.4, at the beginning and the end of the period considered, the simulated number of cultural resources (percentage of variation) and the real one show a different behavior.

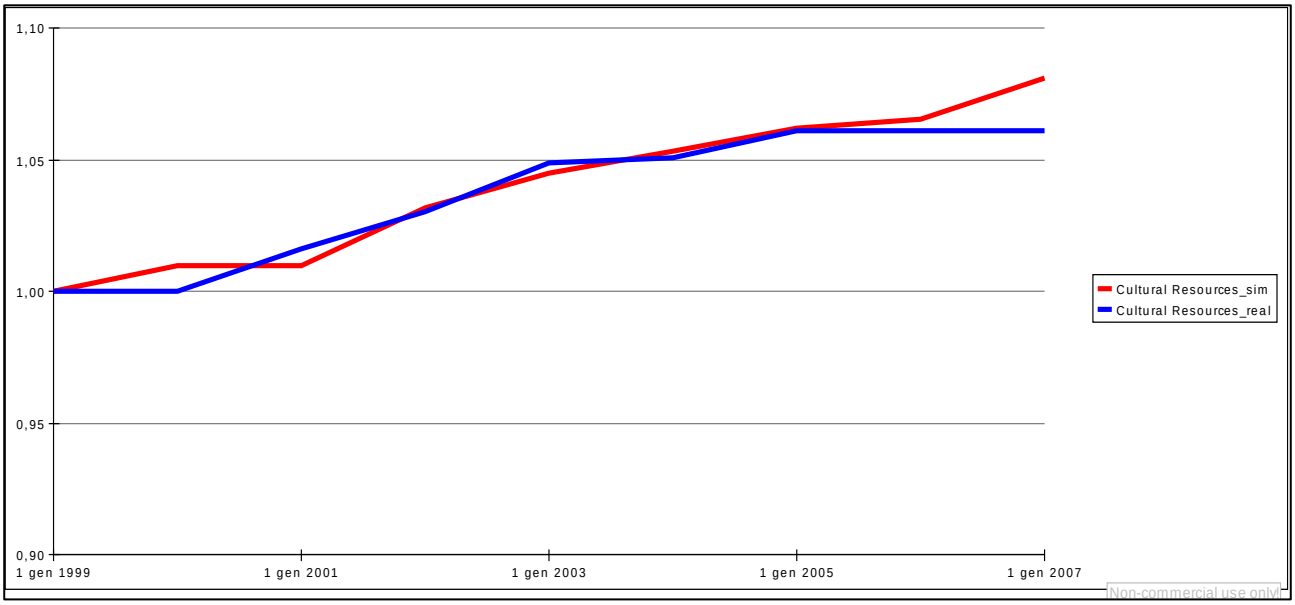


Figure 5.4: Real vs simulated number of cultural resources in Sicily.

Actually, the percentage of variation used as reference behavior, comes from data personally processed by the author. In fact, the official site for cultural resources in Sicily presents a list of archaeological sites, museums, antiquaria, and so on, but does not indicate the year since when these resources are available to visitors. This last information is the result of a personal research activity of the author on the Internet and, therefore, it could be affected by errors.

Yet, since most of the behavior pattern is reproduced, the sector is of benefit for studying the determinants of tourism in Sicily.

5.4 Simulation result in the nature sector

As shown in Figure 5.5, the nature sector strictly reproduces the real behavior of natural resources over the simulation period.

In fact, the sector simulates very well the big increase in the number of natural resources recorded between 1999 and 2000 along with the general trend afterwards.

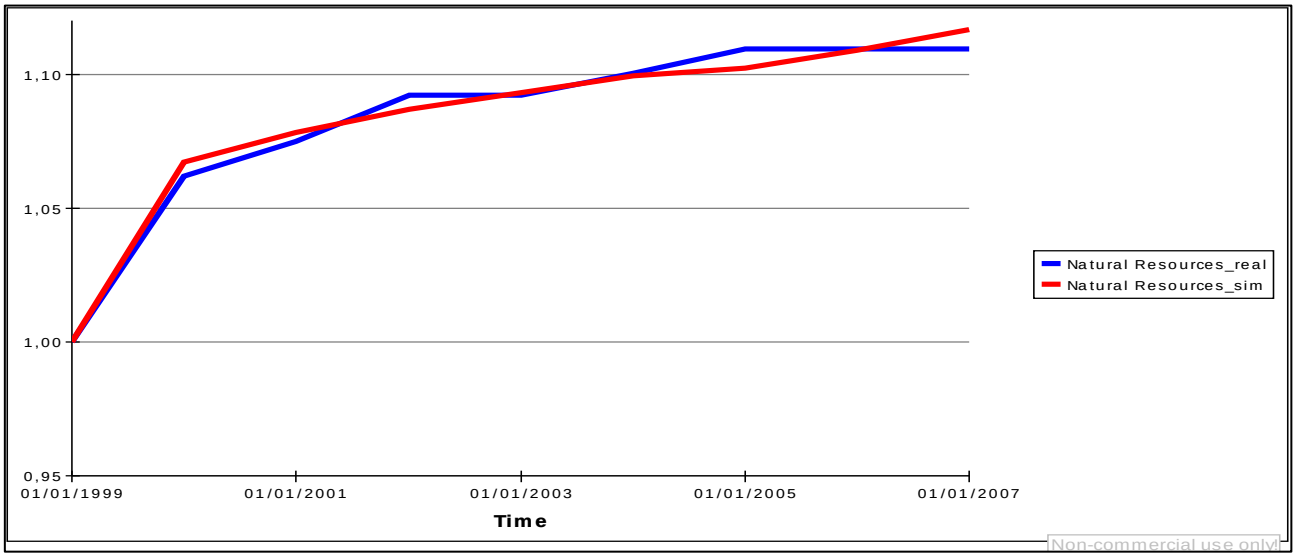


Figure 5.5: Real vs simulated number of natural resources in Sicily.

5.5 Simulation result in the urban environment sector

For the urban environment, the official statistics do not provide a time series summarizing its quality and behavior pattern over time. The quality of the air, the CO_2 emissions, the produced urban solid wastes, the urban noise, and so on, are all reported by the official sources but, however, a unique index is missing. For this reason the behavior pattern of the urban environment simulated in the model does not have any real behavior pattern to be compared to.

Therefore, this paragraph is about the comparison between the real and the simulated behavior of the variables used to build the urban environment index in this study.

Figure 5.6 shows the real[64] and simulated behavior of the urban solid waste production in Sicily. This time graph has already been discussed in the Chapter 4.

Figure 5.7, instead, represents the increasing trend in the number of vehicles registered in Sicily. The simulated number of vehicles is enough close to the real trend.

Finally, Figure 5.8 shows the pattern behavior of the urban environment resulting from the previously described sub-sectors along with the social crowding and the usw management system[65].

The time graph clearly shows the constant worsening of the general conditions of the urban environment.

[64] The time series of the usw production in Sicily is shown in Table 18 in Appendix 1.
[65] See Chapter 3 for the description of the sector.

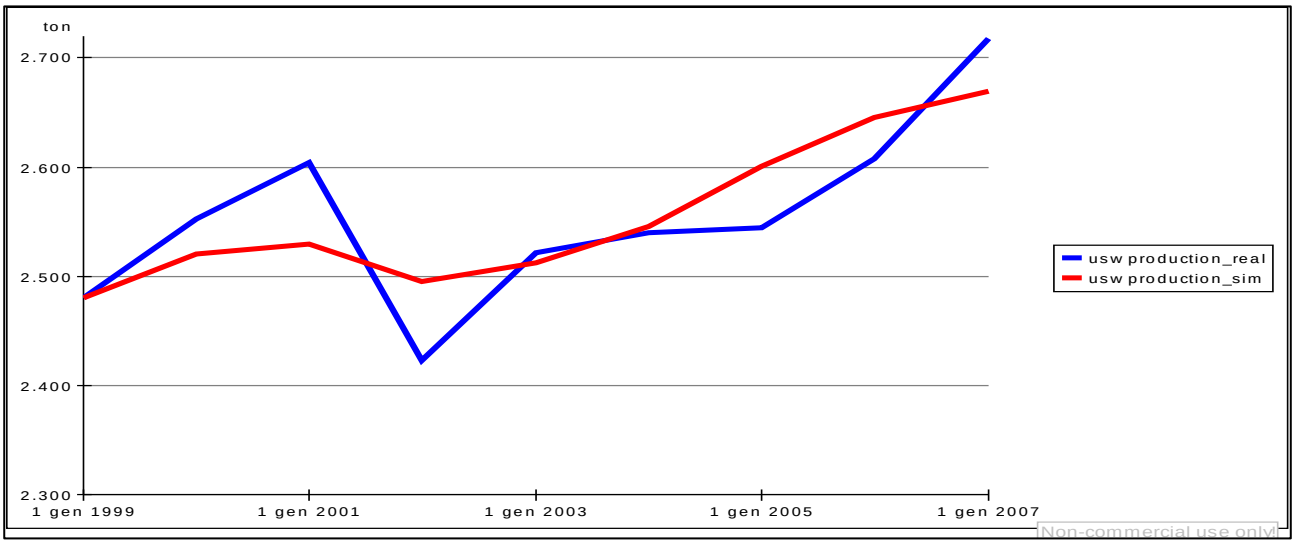


Figure 5.6: Real vs simulated tons of urban solid wastes produced in Sicily.

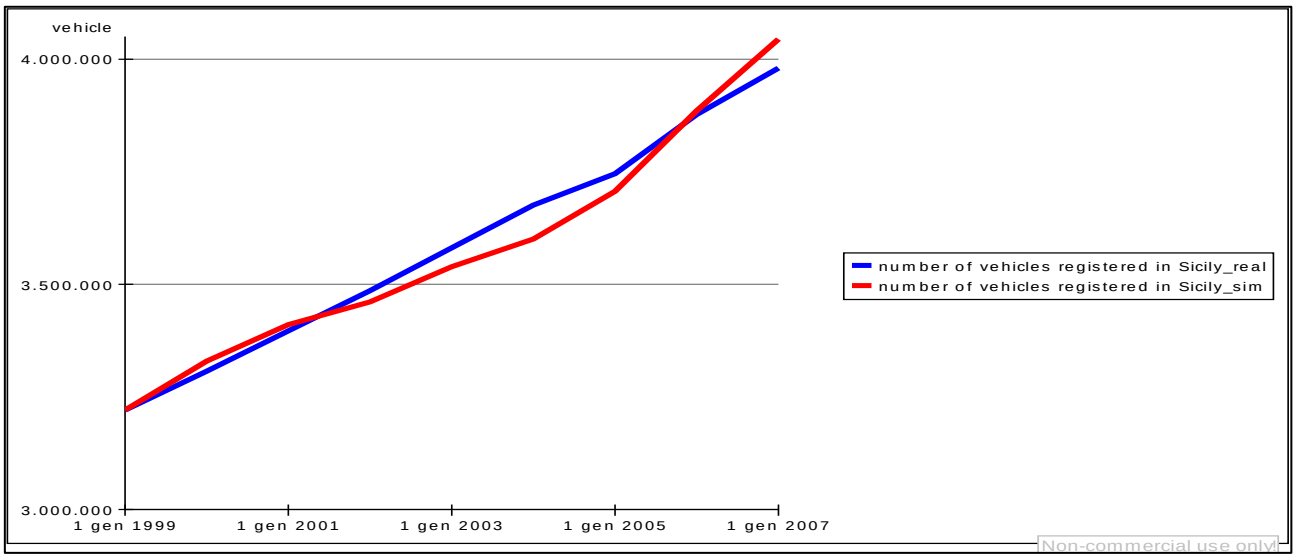


Figure 5.7: Real vs simulated number of vehicles registered in Sicily.

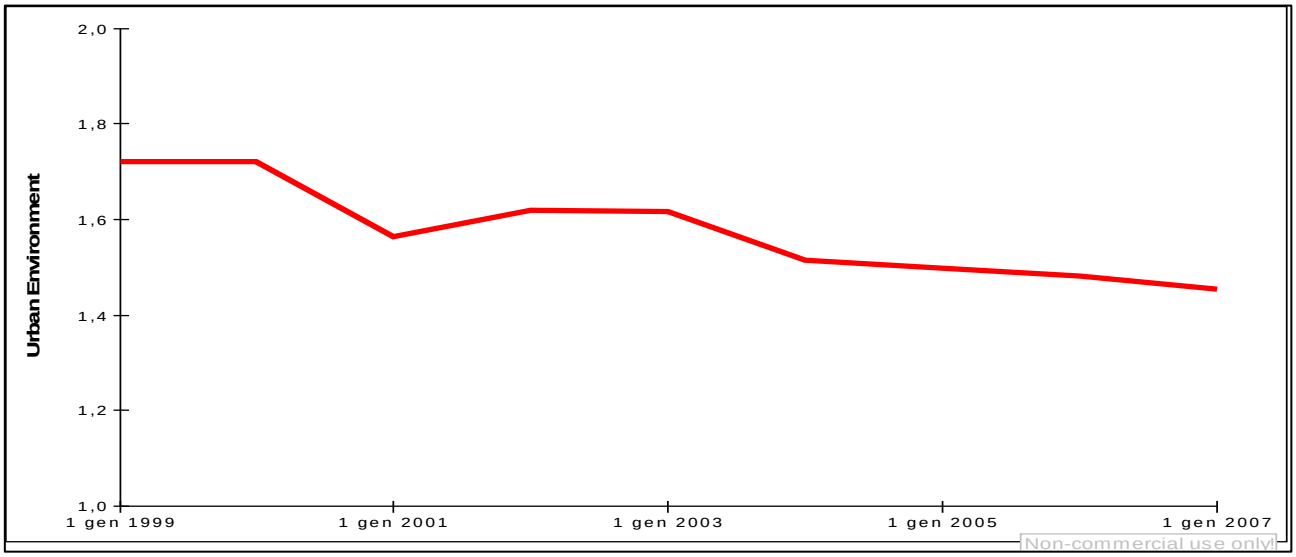


Figure 5.8: Simulated urban environment's conditions.

5.6 Simulation result in the road sector

The simulation of the variable *Roads* over time reproduces quite well the observed values except for the year 2000. A possible explanation of the higher real value in comparison with the simulated one has been given in Chapter 4.

Figure 5.9 shows the real and simulated behavior patterns.

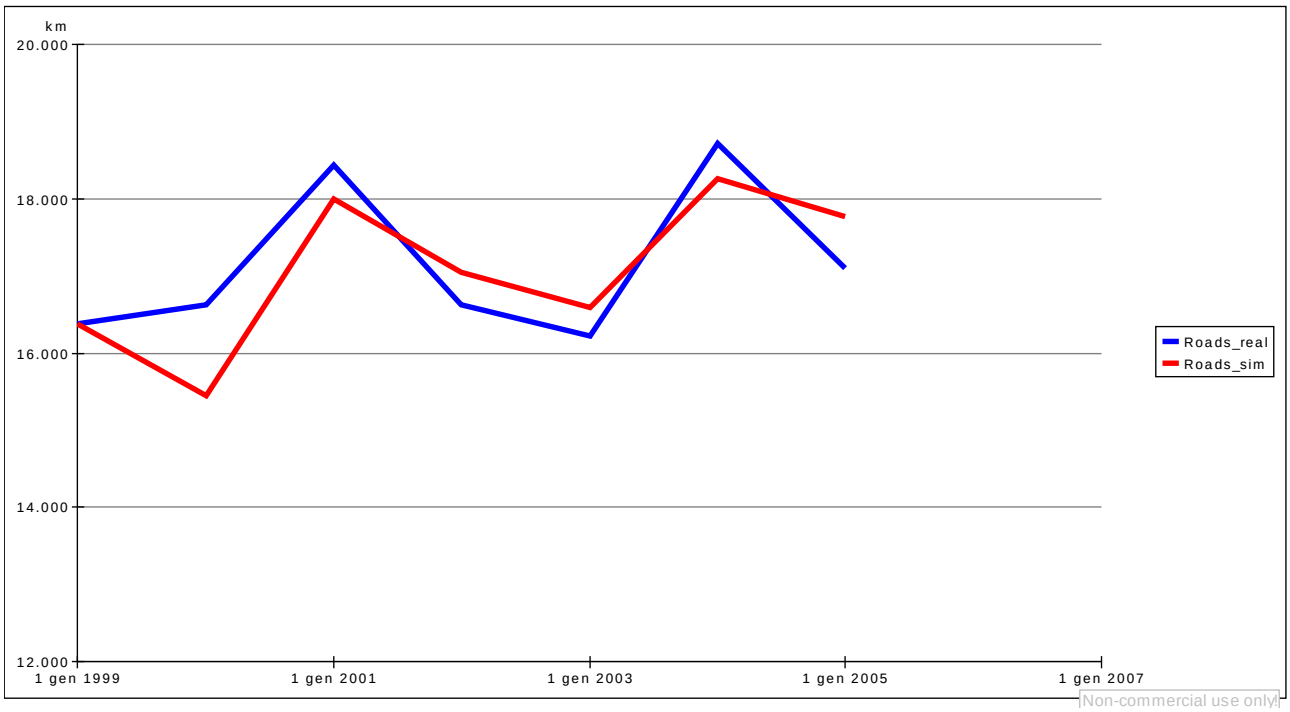


Figure 5.9: Real vs simulated km of road in Sicily.

5.7 Simulation result in the reputation sector

The reputation sector, as the urban environment sector, does not have a real behavior pattern to reproduce. Indeed, there is not any official study concerning the reputation of Sicily.

The time graphs regarding the main variables used to build this sector, as described in Chapter 3, are presented to show, at least, how accurately these variables reproduce the behavior patterns exhibited by the real system.

Figure 5.10 shows the behavior over time of the real and simulated number of bag snatching and pick-pocketing in Sicily whereas Figure 5.11 presents the comparison between the real and simulated number of unemployed males in Sicily aged 15 and over.

In both cases the behavior pattern exhibited by the sub-sectors reproduces the real one.

Finally, Figure 5.12 shows the real and simulated number of males in Sicily (*1000 ppl) aged 15 and over with primary or lower secondary education. The two curves perfectly overlap.

The behavior of the variable *Reputation* over time is shown in figure 5.13.

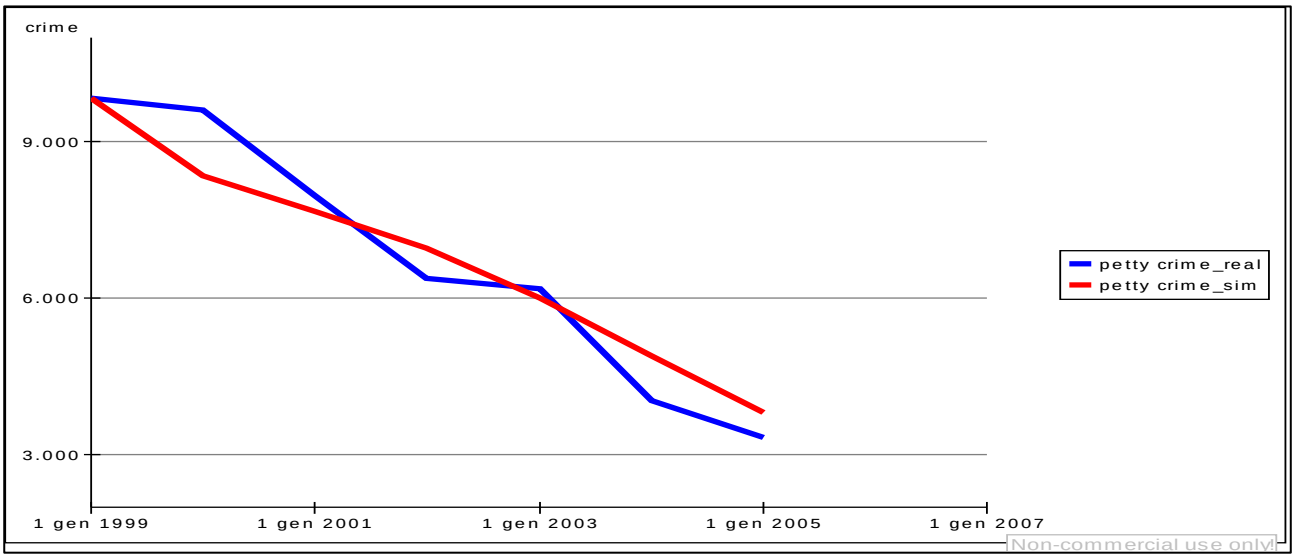


Figure 5.10: Real vs simulated petty crime in Sicily.

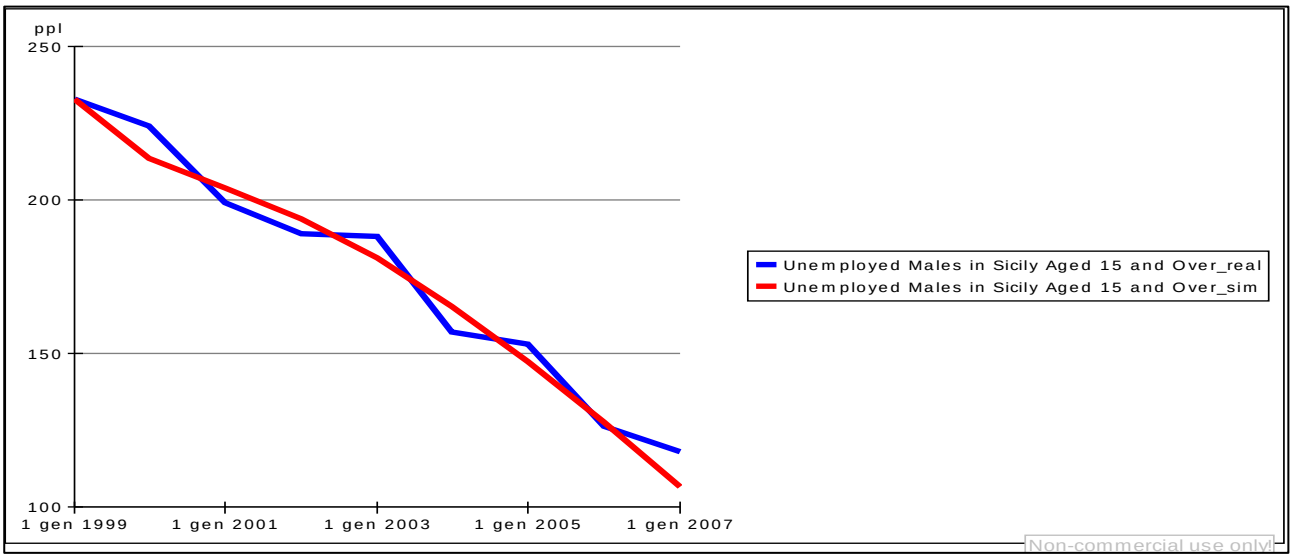


Figure 5.11: Real vs simulated number of unemployed males (*1000 ppl) in Sicily aged 15 and over.

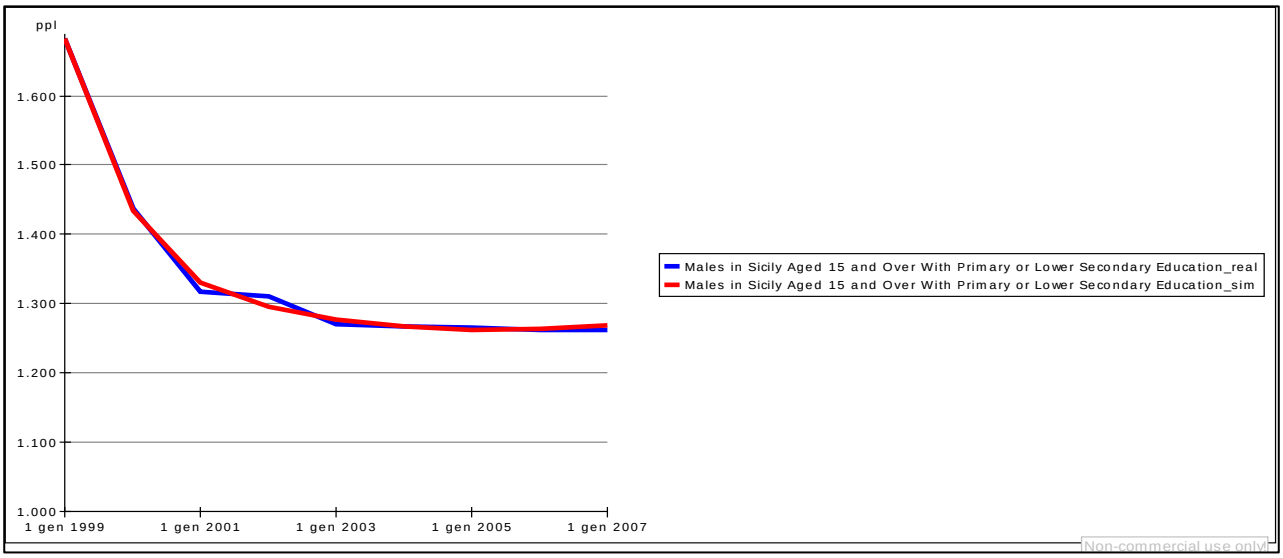


Figure 5.12: Real vs simulated number of males (*1000 ppl) in Sicily aged 15 and over with primary or lower secondary education.

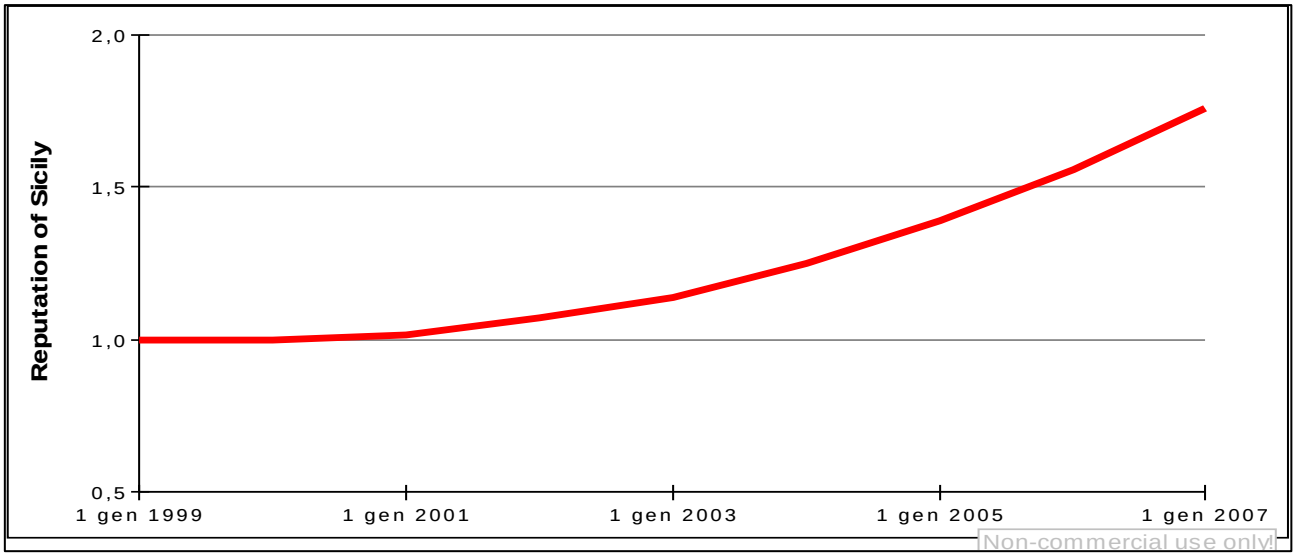


Figure 5.13: Simulated reputation of Sicily.

5.8 French tourists

Figure 5.14 shows the real versus the simulated trend of French tourism in Sicily.

Except for the value in 2002 that looks one year deferred in the simulation, the sector reproduces quite well the general trend observed during the years. In particular, the sector closely reproduces the growing number of French tourists in Sicily since 2005 resulting from the increased number of low cost flights from France to the international airports of Milan and Rome, and the increased number of low cost flights companies flying directly to the cities of Palermo and Catania. Figure 5.14 shows the real and the simulated time series.

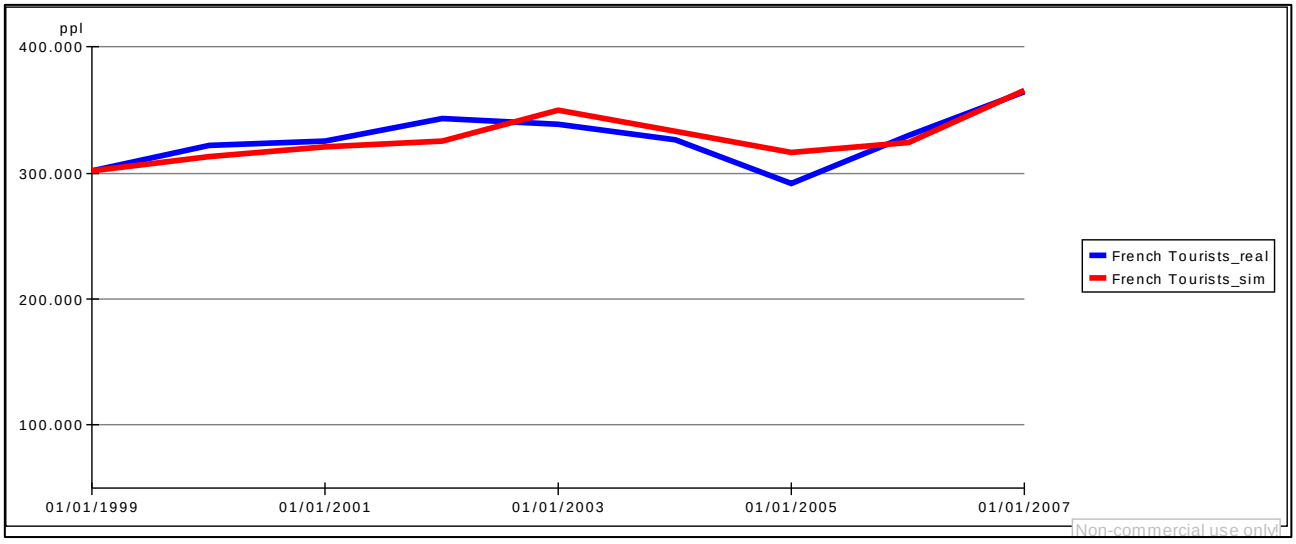


Figure 5.14: Real vs simulated French tourists in Sicily.

5.9 German tourists

The simulation's results for German tourists overlap the time series with great precision. Specifically, the simulation accurately reproduces the decreasing trend in the number of German tourists recorded in Sicily in the period 2000-2003. Figure 5.15 shows the real and the simulated results.

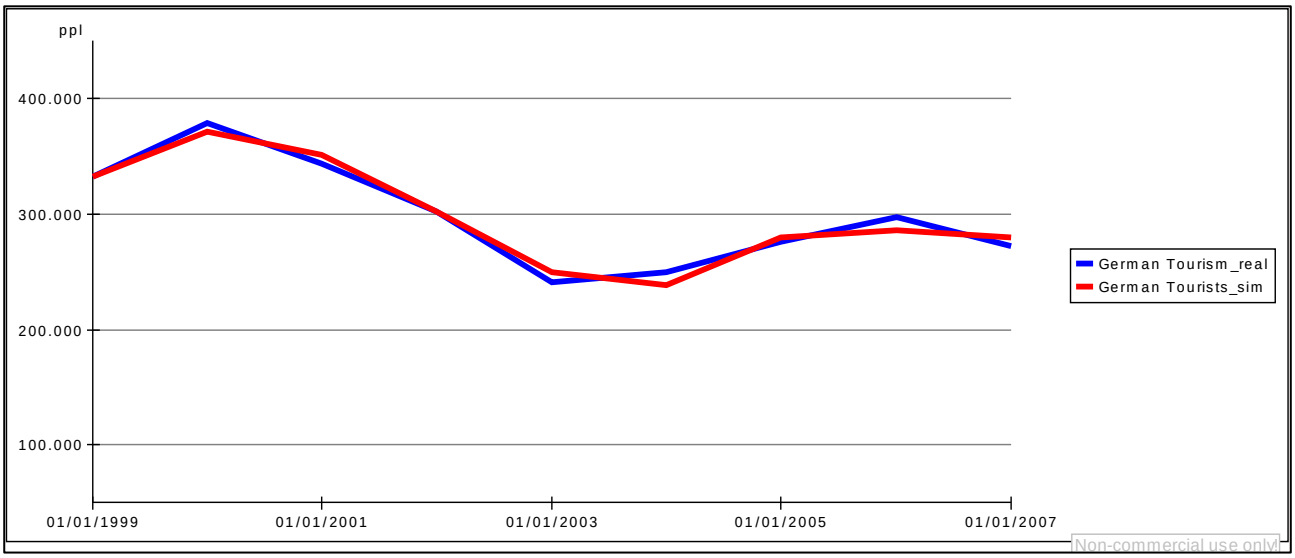


Figure 5.15: Real vs simulated German tourists in Sicily.

5.10 Norwegian tourists

Figure 5.16 reports the real and the simulated time series for Norwegian tourism.

The simulation is able to follow the general trend in the number of Norwegian tourists but not the observed values.

Actually, the case of Norwegian tourism in Sicily has to be treated differently from the others for being the Scandinavian tourism a new market for Sicily.

Generally speaking, indeed, it is normal for a new market to show some oscillations if compared to a consolidated market that, over time, generate a more stable and predictable demand.

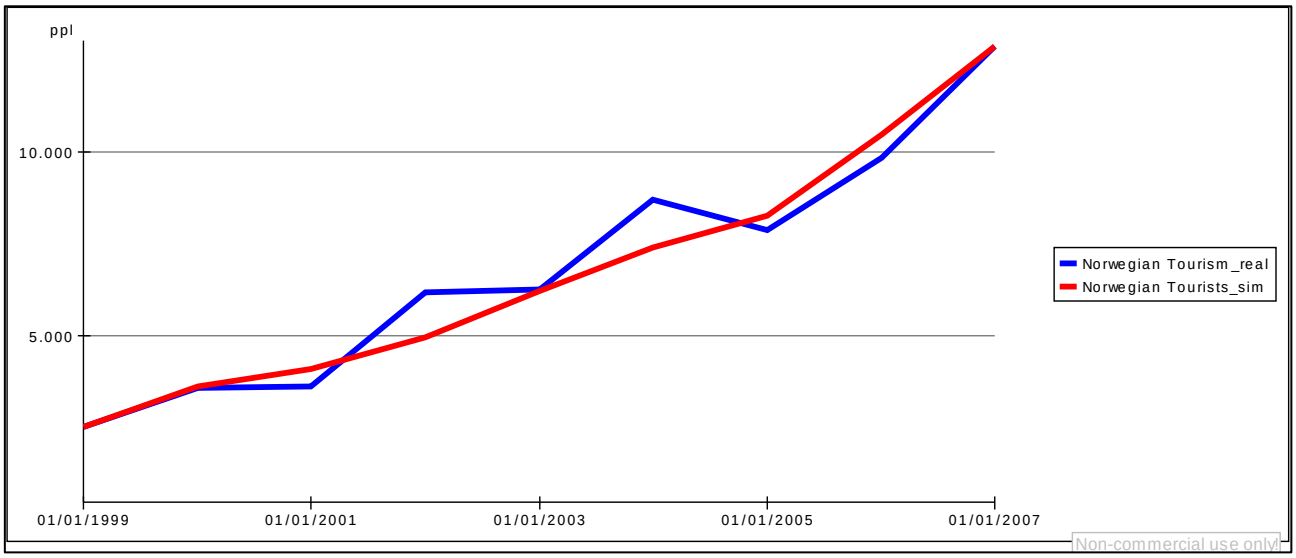


Figure 5.16: Real vs simulated Norwegian tourists in Sicily.

5.11 Spanish tourists

Spanish tourism is reproduced quite well.

Only at the end of the simulation period, the comparison between the real and the simulated value of Spanish tourists presents some discrepancies. Looking at the simulations' result regarding the different sectors of the Sicilian tourism supply, this discrepancy could be generated by the different value of the real availability of roads compared with the simulated one, also considering the importance that Spanish tourists give to the quality and safety of roads (this point will be better explained in the section where the parameters are analyzed).

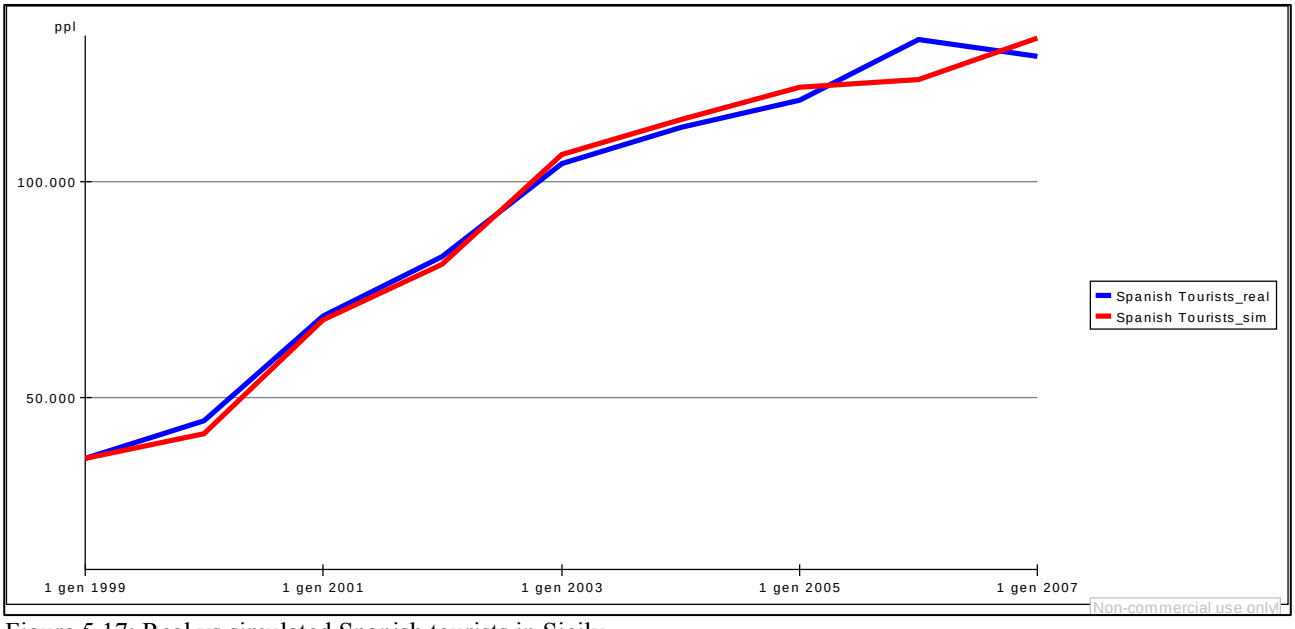


Figure 5.17: Real vs simulated Spanish tourists in Sicily.

5.12 British tourists

As shown in Figure 5.18, the simulated trend of tourists coming from United Kingdom follows the real one with satisfactory precision. No remarks on this simulation's result.

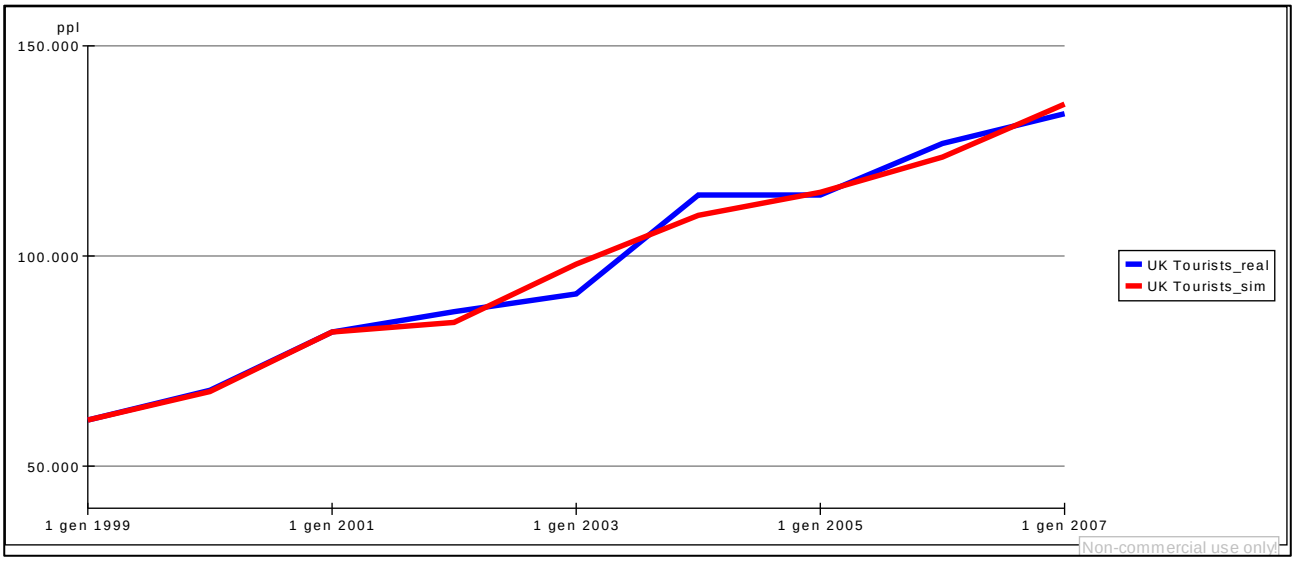


Figure 5.18: Real vs simulated British tourists in Sicily.

5.13 Rest-of-Italy tourists

The behavior pattern showed by tourists travelling to Sicily from all the other Italian regions seems easily predictable with the specific sector introduced in the model.

In fact, the simulated behavior strictly follows the annual oscillations recorded in the first two year and, then, accurately reproduces the observed trend.

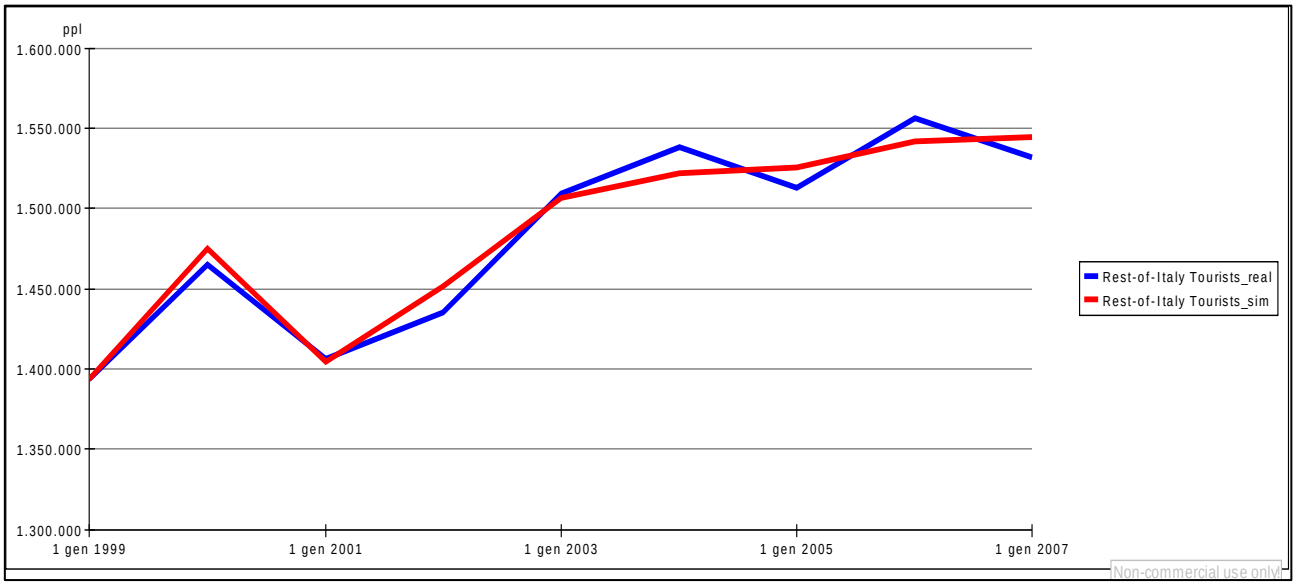


Figure 5.19: Real vs simulated rest-of-Italy tourists in Sicily.

5.14 Local tourists

The simulated trend of local tourists, meaning Sicilian spending vacations in Sicily, shows a behavior able to reproduce the real one with great precision. Actually, for several years there is not any relevant difference between the simulated values and the real ones.

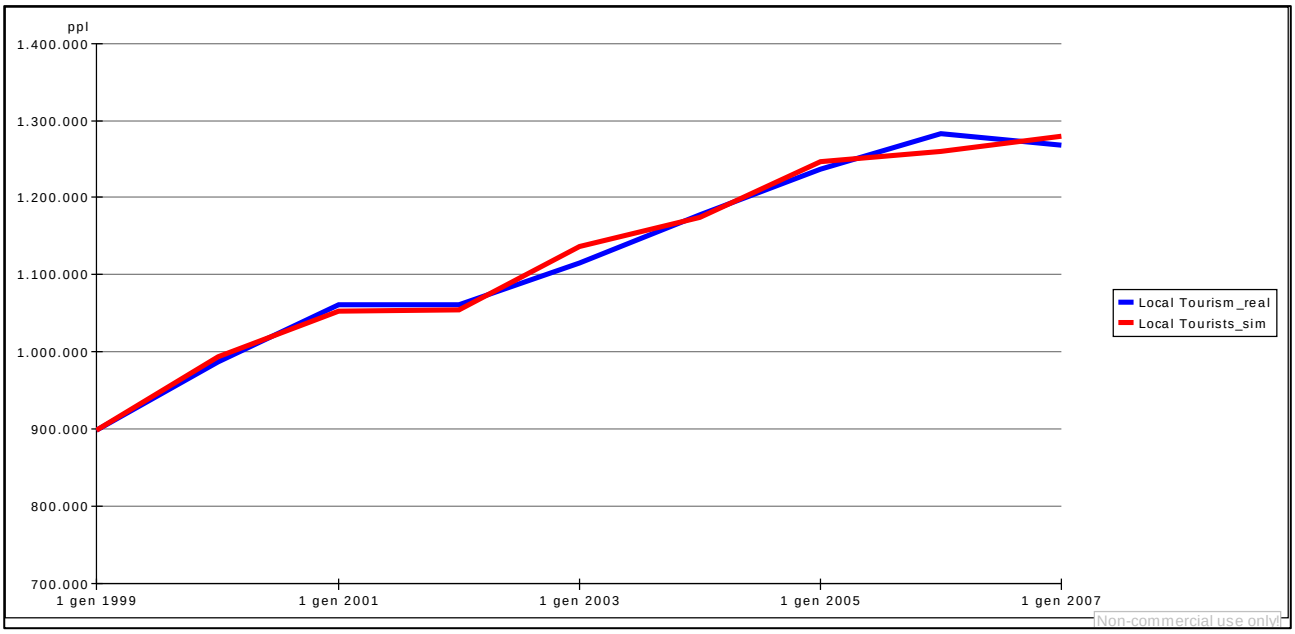


Figure 5.20: Real vs simulated local tourists in Sicily.

5.15 Coefficients of the variables

The simulations' result showed and discussed up to now are the result of the elasticity coefficient estimated for each variable in each demand function.

Table 5.1 summarizes such coefficients for each country/location originating tourism towards Sicily and each variable of the specific demand function.

The table can be read in the direction of the rows and in the direction of the columns depending on whether the analysis is directed to clarify the determinant of tourism in Sicily with respect to a specific country or with respect to a specific tourism product.

Starting with the analysis in the direction of the columns, the results of this study definitely stress the importance of roads and quality of the urban environment in defining the attractiveness of Sicily for four out of five of the foreign countries considered (probably British, familiar with their right-hand drive, do not even try to drive in Sicily and disregard a mass tourism or the general conditions of the urban environment).

Cultural and natural resources are very relevant in the definition of the attractiveness of Sicily. Actually, French tourists do not seem very interested in the cultural resources of Sicily or, the new cultural resources acquired to the heritage of Sicily have not been promoted in France.

Reputation of Sicily still plays an important role for Germany and United Kingdom. The other countries do not seem scared at all of the presence of the Mafia in Sicily or, more likely, their confidence in Sicily was already high in 1999. In this sense, any other improvement in the police activity against the perception of dangers posed by the Mafia does not have any relevant effect on the attractiveness of Sicily.

According to this study, the Sicilian cuisine has its loyal customers among Spanish and British tourists whereas the other countries seem enough satisfied of the Sicilian food.

As expected, the increased number of hotels in Sicily did not have any effect on the attractiveness of Sicily. This happened because the number of hotels in the island was (and still is) high with respect to the total demand (number of nights spent by tourists in Sicily per year).

Finally, the increased number of low cost flights in the international airport of Milan and Rome, and the direct low cost flights to Sicily have increased the number of tourists in the period under study. Yet, in the case of Spanish and British tourism, the increased number of direct low cost flights did not have any effect on the number of arrivals in Sicily. This is possibly due to the small number of seats available on the aircrafts used in the routes to Sicily. A deeper analysis of this aspect is left to further research.

Finally, the last column of the table shows the attractiveness coefficient of Sicily for each of the foreign countries considered. France confirms its high preference for the typical Mediterranean vacation in Sicily closely followed by Norwegian tourists that have approached the Sicilian appeal just recently.

Looking at the results of the estimations in the direction of the rows, instead, four main considerations have to be done.

Regarding the French tourism, it seems that the market is saturated. The increased number of hotels, restaurant and cultural resources did not produce any effect in terms of attractiveness of Sicily for the French market. Only the supply of new natural resources and the increased availability of direct low cost flight have been able to still attract French tourists. In the case of French tourism, it has also to be said that, the high elasticity coefficient of the lagged variable (0,83) confirms that French travel to Sicily very often, and this sounds as a prove of the strong attractiveness that Sicily has in France.

Norwegian tourism, as a new and growing market, presents a strong dependence on the arrivals of the past years (the variable related to the lagged arrivals). Cultural and natural resources are the main concerns for Norwegian tourists travelling to Sicily, although the quality of the urban environment can strongly modify their decision to travel to Sicily.

The determinants of the arrivals from the Rest-of-Italy confirm that Sicily can always count on a substantial flow of national tourists (expressed by both the high value for the smoothing factor of the arrivals and the high value for the coefficient of the lagged arrivals). Moreover, the high value of the coefficient for the quality of the roads confirms that national tourists mainly arrive in Sicily driving their own car. For them, therefore, is very important to find the roads in very good conditions.

Finally, local tourists show a clear preference for spending their vacations abroad when their personal wealth increases. Yet, the coefficient for the lagged dependent variable (0,86) shows that, every year, a strong percentage of residents spend part of their vacation in Sicily.

The considerations regarding the characteristics of tourism in Sicily for the remaining studied countries are left to the reader.

	GDP smoot. factor	Arr. smoot. factor	GDP	Lag. arrivals	Popul.	Hotels	Rest.	Cult.	Nat.	Urb. Env.	Roads	Reput.	Dir flight	Low cost flight	Dir. low cost flight	Attr. coeff.
France	1	0,11	0,43	0,83	0	0	0	0	1,47	3,99	1,80	0	-	0,15	0,23	8,38
Germany	0,20	0,01	0,60	0,95	0,12	0,00	0,14	0,68	0,66	8,83	4,17	0,87	0,35	0,23	-	2,21
Norway	0,10	1	0,20	0,81	0,00	0,00	0,30	1,45	1,64	3,00	0,79	0,00	-	0,12	-	6,30
Spain	0,90	0	0,67	0,94	0,00	0,00	1,72	0,26	5,95	6,40	3,27	0,02	-	0,02	0	2,10
United Kingdom	0,62	0,91	0,00	0,00	0,97	0,64	0,73	1,53	0,20	0,18	0,00	0,62	-	0,03	0	3,10
Rest-of-Italy	0,32	1	0,12	0,91	0,00	0,16	0,53	1,37	0,13	4,98	2,55	0,00	0,13	-	0,17	3,56
Sicily (local tourism)	0,40	0,52	-2,04	0,86	0,80	0,32	0,05	0,19	1,42	0,23	0,05	-	-	-	-	7,76

Table 5.1: Variables' coefficients in tourism demand functions.

CONCLUSIONS

A dynamic model regarding the determinants of tourism flows in Sicily from 5 foreign countries (France, Germany, Norway, Spain, and United Kingdom) and all the Italian regions (Sicily is included for the local tourism) is presented in this study.

In accordance with its purpose, this study does not try to forecast possible future trends in the considered tourism flows. Indeed, for the general form of the economic model used to generate endogenously the tourism demand, it would be misleading to try to make forecasts. Gravity models, indeed, do not take financial and/or structural constraints (the funds and land area needed to build new hotels, for instance) into consideration. This would be possible in a system dynamics model and the extension of the basic approach to include constraints is already in the schedule for the future research.

In the general purpose of gravity models, therefore, this study aims at understanding the key determinants for travelling in Sicily. In fact, this is a very important starting point for any further research looking into the future trends of tourism.

At a general level, results strongly suggest that the road infrastructures and the urban environment are important determinants for tourism in Sicily. Even though it may sound strange, the reputation of Sicily did not play a particular role in the definition of tourism arrivals.

A policy maker looking for a strategy to foster tourism in Sicily should have among her/his main concerns the quality of the urban environment and the land accessibility.

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APPENDIXES

APPENDIX 1

(Tables)

Table 1: Area of the region of Sicily

Date of extraction: Fri, 14 Nov 08 10:44:20											
Last update: Thu Nov 11 06:30:04 MEST 2008											
Copyright © Eurostat. All Rights Reserved.											
table	**reg_d3area**										
	Area of the regions										
geo	**itg1**										
	Sicilia										
unit	**km2**										
	Square kilometer										
		time	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
landuse											
total	**Total area**		25707	25708	25703	25703	25711	25711	25711	25711	25711,4
l0008	**Land area – Total**		25404	25405	25400	25400	25408	25409	25409	25409	25409

Source: *EUROSTAT.*

Table 2: Population at 1st January from 1999 onwards

Date of extraction: Fri, 28 Nov 08 12:05:52										
Last update: Thu Aug 28 06:30:37 MEST 2008										
Copyright © Eurostat. All Rights Reserved.										
sex	**T**									
	Total									
age	**total**									
	Total									
unit	**pers**									
	Persons									
table	**reg_d2jan**									
	Population at 1st January from 1999 onwards									
		time	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
geo										
de	**Germany (including ex-GDR from 1991)**		82037011	82163475	82259540	82440309	82536680	82531671	82500849	82437995	82314906
es	**Spain**		39802827	40049708	40476723	40964244	41663702	42345342	43038035	43758250	44474631
fr	**France**		60158533	60537977	60963775	61399344	61831779	62251817	62637596	62998773	63392140
uk	**United Kingdom**		58579685	58785246	58999781	59217592	59437723	59699828	60059900	60393100	60816701
no	**Norway**		4445329	4478497	4503436	4524066	4552252	4577457	4606363	4640219	4681134
it	**Italy**		56909109	56923524	56960692	56993742	57321070	57888245	58462375	58751711	59131287
itg1	**Sicilia**		5004493	4994427	4979647	4965669	4972124	5003262	5013081	5017212	5016861
Itg11	**Palermo**		1243800	1240600	1236800	1236000	1237700	1238900	1239500	1240500	1242300

Source: *EUROSTAT*

Table 3: Population density from 1999 onwards

Date of extraction: Fri, 17 Jul 09 02:46:52										
Last update: Wed Jul 15 06:30:04 MEST 2009										
Copyright © Eurostat. All Rights Reserved.										
table	**reg_d3dens**									
	Population density									
		time	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
geo										
de	**Germany (including ex-GDR from 1991)**		230	230,2	230,6	231	231,2	231,1	230,9	230.7	230.4
es	**Spain**		78,9	79,6	80,5	81,6	83	84,4	85,8	87.2	:
fr	**France**		95,3	96	96,7	97,4	98	98,7	99,3	100.2	:
uk	**United Kingdom**		240,4	244	240,5	242,4	243,3	244,3	246,9		
no	**Norway**		14,5	14,7	14,7	14,8	14,9	15,1	15,2	15.3	:
it	**Italy**		192.9	193.0	193.1	193.7	195.2	197.1	198.6	199.7	201.2
Itg1	**Sicilia**		196.8	196.3	195.8	195.6	196.3	197.1	197.4	197.5	197.7

Source: *EUROSTAT*

Table 4: Composition of the cultural resources in Sicily.

Archaeological resources	Churches, sanctuaries, monastries and abbeys	Museumsm and art galleries,	Museums of natural history	Folk museums	Total
38%	25%	22%	9%	6%	100%

Source: *Regione Siciliana – Assessorato Beni Culturali, Ambientali e P.I. – Dipartimento Beni Culturali, Ambientali ed E.P.*

Table 5: Cultural resources in Sicily - Years 1995-2007

Cultural resource	Province	Location		Name	Availablility as cultural resource
Antiquaria	Agrigento	Sciacca		Antiquarium di Monte Kronio - Stufe di S. Calogero	1995
Antiquaria	Agrigento	Sambuca di Sicilia		Antiquarium documentario di Monte Adranone	2003
Museums and Galleries	Agrigento	Agrigento		Casa Natale Luigi Pirandello	1995
Archaeological Museums	Agrigento	Licata		Museo Archeologico della Badia	1995
Archaeological Museums	Agrigento	Agrigento		Museo Regionale Archeologico	1995
Archaeological Sites	Agrigento	Licata		Zona Archeologica	1995
Archaeological Sites	Agrigento	Sant'Angelo Muxaro		Zona Archeologica	1995
Archaeological Sites	Agrigento	Sambuca di Sicilia		Zona Archeologica di Monte Adranone	1995
Archaeological Sites	Agrigento	Agrigento		Zona Archeologica Monumentale della Valle dei Templi	1995
Archaeological Sites and Antiquarium	Agrigento	Cattolica Eraclea	Eraclea Minoa	Zona Archeologia e Antiquarium Eraclea Minoa	1995
Archaeological Sites	Agrigento	Licata	Monte Sant'Angelo	Zona Archeologica di Monte Sant'Angelo e Castel Sant'Angelo	1995
Antiquaria	Caltanissetta	Gela		Antiquarium Iconografico e Mura Timoleontee di Capo Soprano	1995
Archaeological Sites	Caltanissetta	Gela		Bagni Greci	1995
Archaeological Sites	Caltanissetta	Gela		Bosco Littorio (Emporio Greco)	1995

Table 5 (continues)

Cultural resource	Province	Location		Name	Availablility as cultural resource
Archaeological Sites	Caltanissetta	Gela		Castelluccio	2008
Archaeological Museums	Caltanissetta	Marianopoli		Museo Archeologico	1997
Archaeological Museums	Caltanissetta	Caltanissetta		Museo Archeologico di Caltanissetta	1995
Archaeological Museums	Caltanissetta	Gela		Museo Archeologico di Gela	1995
Archaeological Sites	Caltanissetta	San Cataldo		Vassallaggi	1995
Archaeological Sites	Caltanissetta	Gela		Zona Archeologica Acropoli (Molino a Vento)	1995
Archaeological Sites and Antiquarium	Caltanissetta	Caltanissetta		Zona Archeologica e Antiquarium di Sabucina	1995
Archaeological Sites	Caltanissetta	Caltanissetta		Zona Archeologica Gibil Gabib	1995
Archaeological Sites	Caltanissetta	Mazzarino	Contrada Sofiana	Area Archeologica di Sophiana	1995
Archaeological Sites	Catania	Catania		Anfiteatro Romano	1997
Museums and Galleries	Catania	Catania		Casa Museo Giovanni Verga	1995
Archaeological Sites	Catania	Catania		Chiesa di San Francesco Borgia	1995
Archaeological Sites	Catania	Catania		Ipogeo Romano	1995
Archaeological Sites	Catania	Adrano		Mura Dionigiane	2008
Archaeological Museums	Catania	Adrano		Museo Archeologico	1995
Museums and Galleries	Catania	Caltagirone		Museo Regionale della Ceramica	1995
Archaeological Sites	Catania	Catania		Teatro Romano e Odèon	1995
Archaeological Sites	Catania	Catania		Terme della Rotonda	1995
Archaeological Sites	Catania	Aci Catena		Terme Romane dell'Indirizzo	1995
Archaeological Sites	Catania	Mineo		Zona Archeologica di Palikè	1995
Archaeological Sites	Catania	Aci Catena		Zona Archeologica Santa Venera al Pozzo	1995
Archaeological Museums	Enna	Aidone		Museo Archeologico di Aidone	1995
Archaeological Museums	Enna	Enna		Museo Archeologico di Palazzo	1995

Table 5 (continues)

Cultural resource	Province	Location		Name	Availablility as cultural resource
				Varisano	
Archaeological Sites	Enna	Aidone		Zona Archeologica di Morgantina	1995
Archaeological Sites	Enna	Piazza Armerina	Contrada Casale	Museo Regionale e Zona Archeologica della Villa Imperiale del Casale	1995
Museums and Galleries	Messina	Spadafora		Castello di Spadafora	1995
Museums and Galleries	Messina	Taormina		Castello di Tauro	1995
Archaeological Sites	Messina	Taormina		Isola Bella	1995
Archaeological Museums e Archaeological Sites	Messina	Giardini-Naxos		Museo Archeologico e Zona Archeologica	1995
Archaeological Museums	Messina	Lipari		Museo Archeologico Regionale Eoliano Luigi Benabò Brea	1995
Museums and Galleries	Messina	Messina		Museo Regionale	1995
Musei etnoantropologici	Messina	Mistretta		Museo Regionale delle Tradizioni silvo-pastorali "G. Cocchiara"	1995
Archaeological Sites	Messina	Taormina		Teatro Greco Romano	1995
Archaeological Sites	Messina	Terme Vigliatore		Villa Romana di San Biagio	1995
Archaeological Sites	Messina	Capo d'Orlando		Zona Archeologica	1995
Archaeological Sites	Messina	Tusa		Zona Archeologica Halaesa Arconidea	1995
Archaeological Sites	Messina	Patti	Patti Marina	Villa Romana	1995
Archaeological Sitese Antiquarium	Messina	Patti	Tindari	Zona Archeologica Teatro antico e Antiquarium di Tindari	1995
Museums and Galleries	Palermo	Marineo		Castello Beccadelli Bologna	1995
Archaeological Sites	Palermo	Palermo		Castello della Cuba e Necropoli	1995

Table 5 (continues)

Cultural resource	Province	Location		Name	Availablility as cultural resource
				Punica	
Museums and Galleries	Palermo	Palermo		Castello della Zisa	1995
Museums and Galleries	Palermo	Caccamo		Castello Medievale	1999
Archaeological Sites	Palermo	Palermo		Chiostro di San Giovanni degli Eremiti	1995
Archaeological Sites	Palermo	Monreale		Chiostro Santa Maria la Nuova (Duomo)	1995
Museums and Galleries	Palermo	Palermo		Convento della Magione	1995
Museums and Galleries	Palermo	Palermo		Galleria Regionale della Sicilia Palazzo Abatellis	1995
Museums and Galleries	Palermo	Palermo		Giardino di Villa Napoli e Piccola Cuba	1997
Archaeological Museums	Palermo	Palermo		Museo Archeologico Regionale Antonino Salinas	1995
Archaeological Museums	Palermo	Ustica		Museo Archeologico sito nella Torre di S. Maria	1995
Civil Museums	Palermo	Polizzi Generosa		Museo Civico	1995
Museums and Galleries	Palermo	Palermo		Museo di Palazzo Mirto	1995
Museums and Galleries	Palermo	Palermo		Museo Regionale d'arte moderna e contemporanea - Palazzo Belmonte Riso	2008
Museums and Galleries	Palermo	Terrasini		Museo Regionale di storia naturale e mostra permanente del carretto siciliano	2001
Museums and Galleries	Palermo	Palermo		Oratorio dei Bianchi	1995
Archaeological Sites	Palermo	Palermo		Villino Florio e Giardino	2002
Archaeological Sites	Palermo	Palermo		Zona Archeologica Castello a Mare	2009
Archaeological Sites and Antiquarium	Palermo	Termini		Zona Archeologica e	2001

Table 5 (continues)

Cultural resource	Province	Location		Name	Availablility as cultural resource
		Imerese		Antiquarium di Himera	
Archaeological Sites and Antiquarium	Palermo	Santa Flavia		Zona Archeologica e Antiquarium di Solunto	2003
Archaeological Sites	Palermo	San Cipirello		Zona Archeologica Monte Jato	1995
Archaeological Sites	Palermo	Palermo		Zona Archeologica Villa Bonanno	1995
Archaeological Sites	Ragusa	Modica		Cava d'Ispica	1995
Archaeological Museums	Ragusa	Ragusa		Museo Archeologico Ibleo	1995
Archaeological Museums	Ragusa	Ragusa		Museo Archeologico regionale di Camarina	1995
Archaeological Sites	Ragusa	Pozzallo		Torre Cabrera	1995
Archaeological Sites	Ragusa	Ragusa		Zona Archeologica Agora' - Camarina	1995
Archaeological Sites	Ragusa	Santa Croce Camerina		Zona Archeologica Caucana	1995
Archaeological Sites	Ragusa	Ispica		Zona Archeologica Parco Forza	1995
Antiquaria	Siracusa	Siracusa		Antiquarium del Tempio Jonico	1995
Antiquaria	Siracusa	Augusta		Antiquarium di Megara Hyblaea	1995
Archaeological Sites	Siracusa	Palazzolo Acreide		Area Archeologica di Akrai	1995
Musei etnoantropologici	Siracusa	Palazzolo Acreide		Casa Museo Antonino Uccello	1995
Archaeological Sites	Siracusa	Siracusa		Castello Maniace	1995
Antiquaria	Siracusa	Siracusa		Gabinetto di numismatica	1997
Museums and Galleries	Siracusa	Siracusa		Galleria Regionale di Palazzo Bellomo	1995
Archaeological Sites	Siracusa	Siracusa		Ginnasio Romano	1995
	Siracusa	Siracusa		Complesso di Montevergini	1997

Table 5 (continues)

Cultural resource	Province	Location		Name	Availablility as cultural resource
Archaeological Sites	Siracusa	Siracusa		Itinerario degli Ipogei	2005
Archaeological Museums	Siracusa	Lentini		Museo Archeologico	1995
Archaeological Museums	Siracusa	Siracusa		Museo Archeologico Regionale Paolo Orsi	1995
Archaeological Sites	Siracusa	Siracusa		Zona Archeologica Castello Eurialo	1995
Archaeological Sites	Siracusa	Siracusa		Zona Archeologica della Neapolis e Orecchio di Dionisio	1995
Archaeological Sites	Siracusa	Lentini		Zona Archeologica di Leontinoi	1995
Archaeological Sites	Siracusa	Noto		Zona Archeologica e Villa Romana del Tellaro	1995
Archaeological Sites	Siracusa	Noto	C/da Caddeddi	Zona Archeologica di Eloro	1995
Archaeological Sites	Trapani	Campobello di Mazara		Cave di Cusa	1995
Archaeological Museums	Trapani	Marsala		Museo Archeologico Baglio Anselmi	1995
Archaeological Museums	Trapani	Mazara del Vallo		Museo del Satiro (Chiesa di Sant'Egidio)	1998
Museums and Galleries	Trapani	Trapani		Museo Regionale Agostino Pepoli	1995
Archaeological Sites	Trapani	Calatafimi		Pianto Romano	1995
Archaeological Sites	Trapani	Pantelleria		Zona Archeologica dell'Antica Cossyra	1995
Archaeological Sites	Trapani	Favignana	Levanzo	Grotta del Genovese - Levanzo	1995
Archaeological Sites	Trapani	Marsala	Mozia	Zona Archeologica Mozia	1995
Archaeological Sites	Trapani	Calatafimi	Segesta	Zona Archeologica Segesta	1995

Table 5 (end)

Cultural resource	Province	Location		Name	Availablility as cultural resource
Archaeological Sites	Trapani	Castelvetrano	Selinunte	Zona Archeologica Selinunte	1995

Source: Department of Arts and Education (Regione Sicilia - Assessorato Beni Culturali, Ambientali e P.I. – Dipartimento Beni Culturali, Ambientali ed E.P.)

Table 6: Composition of the natural resources in Sicily (1981-2007).

Year	Regional Natural Reserves		Regional Parks		Marine Natural Reserves and Protected Marine Areas		Humid Areas		Other Protected Areas	
	ha	Description	ha	Description	Ha	Description	Ha	Description	ha	Description
1981	1600,00	Riserva Naturale dello Zingaro								
1982										
1983										
1984	6667,44	Riserva Naturale dello Zingaro								
1985	134,70	Macchia Foresta del Fiume Irminio								
1986					15951,00	Isola di Ustica			4,76	Parco Urbano di Cosentini
1987	1828,86	Fiume Ciane e Saline di Siracusa, Oasi faunistica di vendicari	58095,00	Parco dell'Etna						

Table 6: (continues)

Year	Regional Natural Reserves		Regional Parks		Marine Natural Reserves and Protected Marine Areas		Humid Areas		Other Protected Areas	
	ha	Description	ha	Description	Ha	Description	Ha	Description	ha	Description
1988							256	Biviere di Gela – Caltanissetta		
1989			39941,18	Parco delle Madonie	623,00	Isole Ciclopi	1450	Siracusa-Vendicari		
1990	3632,00	Pino D'Aleppo								
1991					53992,00	Isole Egadi				
1992										
1993			85587,37	Parco dei Nebrodi						
1994										
1995	952,25	Pino D'Aleppo								
1996										
1997	27610,86	Pino D'Aleppo								
1998	10366,2	Pino D'Aleppo								
1999	8044,50	Monte Capodarso e Valle dell'Imera Meridionale								

Table 6: (continues)

Year	Regional Natural Reserves		Regional Parks		Marine Natural Reserves and Protected Marine Areas		Humid Areas		Other Protected Areas	
	ha	Description	ha	Description	Ha	Description	Ha	Description	ha	Description
2000	19548,21	Grotta di S. Angelo Muxaro, Vallone Calagna sopra Tortorici, Torre Salsa, Capo Rama, Bosco della Ficuzza, Rocca Busambra, Bosco del Cappelliere e Gorgo del Drago, Monte San Calogero (Kronio), Vallone di Piano della Corte, Pizzo Cane, Pizzo Trigna e Grotta Mazzamuto,								

Table 6: (continues)

Year	Regional Natural Reserves		Regional Parks		Marine Natural Reserves and Protected Marine Areas		Humid Areas		Other Protected Areas	
	ha	Description	ha	Description	Ha	Description	Ha	Description	ha	Description
		Monte Cammarata, Sambuchetti-Campanito, Rossomanno, Grottascura, Bellia								
2001	2145,39	Grotta dei Puntali, Lago Soprano, Isola di Vulcano, Saline di Priolo, Capo Gallo, Laguna di	1927,48	Parco Fluviale dell'Alcantara						

Table 6 (end)

Year	Regional Natural Reserves		Regional Parks		Marine Natural Reserves and Protected Marine Areas		Humid Areas		Other Protected Areas	
	ha	Description	ha	Description	Ha	Description	Ha	Description	ha	Description
		Capo Peloro								
2002					5403,00	Isole Pelagie, Capo Gallo Isola delle Femmine				
2003										
2004					2600,00	Plemmirio				
2005	3360,38		273,00	273 ha more in Parco dei Nebrodi						
2006										
2007										
TOTAL	**85180,4**		**185824,03**		**78569,00**		**1706**		**4,76**	

Source: Personal elaboration of data collected from *Ministero dell'ambiente e della tutela del territorio – Direzione per la protezione della natura, Assessorato Territorio ed ambiente della regione Siciliana – Servizio 6 – Protezione del patrimonio naturale*.

Table 7: Tourism flows in Sicily - Years 1999-2007

		Time	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
France	Arrivals		301248	321437	325319	343429	338187	326178	291285	329925	364906
	Occupancy		1062323	1164166	1223484	1299863	1268326	1163643	1036835	1124067	1184953
Germany	Arrivals		332509	378497	343180	302899	240322	249516	275867	297043	271885
	Occupancy		1194503	1426690	1284211	1073431	842785	857432	978512	1120400	1017406
Norway	Arrivals		2535	3602	3645	6162	6254	8671	7850	9807	12833
	Occupancy		8341	18004	11330	25506	27535	32472	32771	35964	54911
Spain	Arrivals		35841	44552	68839	85734	104335	112808	118897	132967	129083
	Occupancy		82362	100270	146954	175841	211388	234509	242410	274912	287463
U.K.	Arrivals		60890	68022	81926	86697	90734	114259	114342	126811	133628
	Occupancy		263395	281033	358544	403684	401241	490660	508408	539931	567517
Japan	Arrivals		56271	74046	72899	78530	55348	60138	61685	64648	58389
	Occupancy		92816	117074	116362	124101	90323	99042	103707	104452	97626
U.S.A.	Arrivals		143657	160684	172918	158702	159465	175549	160746	183958	178231
	Occupancy		448631	450588	504292	448513	507081	474957	443803	464872	446748
Italy	Arrivals		2292146	2453319	2467737	2495544	2624497	2716267	2750576	2838899	2800255
	Occupancy		7452384	8214924	8024235	7946932	8123447	8331311	8629420	8872589	8474855
Sicily	Arrivals		898152	898152	898152	898152	898152	898152	898152	898152	898152
	Occupancy		2603147	2603147	2603147	2603147	2603147	2603147	2603147	2603147	2603147

Source: *Department of Tourism, Sport and Culture (Regione Sicilia - Assessorato del Turismo, delle Comunicazioni e dei Trasporti – Dipartimento Turismo, Sport e Spettacolo)*

Table 8: Number of establishments, bedrooms and bed-places.

Date of extraction: Fri, 28 Nov 08 05:52:01										
Last update: Thu Oct 23 09:55:01 MEST 2008										
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Table	**tour_cap_nuts3**									
	Number of establishments, bedrooms and bed-places – NUTS 3 - annual data									
activity	**a100**									
	Hotels and similar establishments									
indic_to	**a001**									
	Establishments									
Unit	**nbr**									
	Number/Absolute value/Unit									
		time	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
Geo											
It	**Italy**		33341	33361	33421	33411	33480	33518	33527	33768	34037
itg1	**Sicilia**		852	868	879	907	958	996	1068	1134	1171
indic_to	**a003**										
	Bed-Places										
unit	**nbr**										
	Number/Absolute value/Unit										
geo											
It	**Italy**		1807275	1854101	1891281	1929544	1969495	1999729	2028452	2086942	2141952
itg1	**Sicilia**		75369	78227	82239	86636	90272	97151	102176	107722	113749

Source: *Eurostat*

Table 9: Gross and Net Utilization Index of the hotel accommodation by region - Years 2006-2007

Gross and Net Utilization Index of the hotel accommodation by region - Year 2006						
	Gross Utilization Index			Net Utilization Index		
	2006	2007	Mean value	2006	2007	Mean value
REGIONS						
Piemonte	27,0	22,7	24,85	30,8	26,5	28,65
Valle d'Aosta/Vallée d'Aoste	28,7	28,1	28,4	38,3	37,3	37,8
Lombardia	34,3	34,1	34,2	36,6	38,2	37,4
Trentino-A. Adige	35,0	35,7	35,35	50,4	60,0	55,2
Bolzano/Bozen	36,7	*37,7*	37,2	59,0	*59,8*	59,4
Trento	32,2	*32,5*	32,35	39,3	*60,4*	49,85
Veneto	41,1	39,3	40,2	51,6	51,7	51,65
Friuli-V. Giulia	24,3	25,8	25,05	30,2	32,1	31,15
Liguria	38,3	35,3	36,8	44,3	40,4	42,35
Emilia-Romagna	28,2	28,8	28,5	47,6	46,7	47,15
Toscana	31,9	32,8	32,35	36,3	37,3	36,8
Umbria	32,4	32,2	32,3	34,6	34,2	34,4
Marche	27,9	27,5	27,7	38,2	36,0	37,1
Lazio	48,7	49,6	49,15	49,2	50,2	49,7
Abruzzo	28,8	28,1	28,45	33,4	32,5	32,95
Molise	22,7	17,3	20	24,3	18,6	21,45
Campania	36,9	36,5	36,7	38,7	40,8	39,75
Puglia	23,9	24,8	24,35	27,6	29,9	28,75
Basilicata	16,0	16,0	16	20,9	22,7	21,8
Calabria	20,6	20,4	20,5	28,7	31,8	30,25
Sicilia	32,4	30,9	31,65	38,0	36,9	37,45
Sardegna	22,9	31,4	27,15	34,9	37,3	36,1
ITALIA	**32,6**	**32,8**	**32,7**	**40,8**	**41,8**	**41,3**

Source: *ISTAT*

Table 10: Restaurants in Sicily - Years 1999-2007

	time	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
Restaurants		3483	4291	4516	4945	5201	5546	5822	6100	6396

Source: Chamber of Commerce, Industry, Craft Trade and Agriculture (C.C.I.A.A.) of Palermo.

Table 11: Composition of the vehicles fleet at regional level

REGION		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		Absolute values										
Sicily	**Cars**	*2509716*	*2557821*	*2605926*	2.669.793	*2702136*	*2750241*	*2798346*	*2846451*	2.876.953	*2942661*	3.006.924
	Total Vehicles	*3053939*	*3135950*	*3220164*	3.307.034	*3395436*	*3486618*	*3580249*	*3676393*	3.744.968	*3876498,2*	3.981.662

Souce: A.C.I. - Statistiche automobilistiche and personal estimation[66].

Table 12: Road network composition in Sicily in 1998 (Km)

REGION	Motorways	State roads	Motorway Hubs	Provincial roads	Total
Sicily	587	3869	0	13055	17511
Italy	6467	46009	350	112862	165688

Source: *ANAS* and *Ministero dei lavori pubblici*.

[66] Italic type values are the result of a personal estimation made in accordance with the exponential trend line y = 3E+06*EXP(0,0265x) (R^2 = 0,9996) for vehicles and the linear trend line y = 48121x + 2E+06 (R^2 = 0,9985) for cars.

Table 13: Road networks at regional level.

Date of extraction: Thu, 20 Nov 08 05:38:23												
Last update: Wed Oct 15 08:21:12 MEST 2008												
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table	**Tran_r_net**											
	Road, rail and navigable inland waterways networks at regional level											
trannet	**motorway**											
	Motorways											
unit	**km**											
	Kilometer											
		time	1995a00	1996a00	1997a00	1998a00	1999a00	2000a00	2001a00	2002a00	2003a00	2004a00	2005a00
geo													
itg1	**Sicilia**		582	582	582	587	591	591	582	582	591	632	632
trannet	**road_oth**												
	Other roads												
unit	**km**												
	Kilometer												
geo													
itg1	**Sicilia**		21803	37244	37244	16924	15782	16028	17864	16050	15637	18094	16466
trannet	**total**												
	Total roads												
unit	**km**												
	Kilometer												
geo													
itg1	**Sicilia**		22385	37826	37826	17511	16373	16619	18446	16632	16228	18726	17098

Source: *Eurostat*

Table 14: Mafia murders, pickpoketing and bag-snatching in Sicily.

	Time	1999a00	2000a00	2001°00	2002a00	2003a00	2004a00	2005a00
Mafia murders		28	18	20	11	10	8	5
Pickpoketing and bag-snatching		9847	9170	7963	6378	6173	4030	3331

Source: *ISTAT (Statistiche giudiziarie penali).*

Table 15: Unemployment by sex and age.

Date of extraction: Fri, 14 Nov 08 12:17:25										
Last update: Thu Nov 06 06:31:10 MET 2008										
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table	**reg_lfu3pers**									
	Unemployment by sex and age, at NUTS levels 1, 2 and 3 (1000)									
sex	**m**									
	Males									
age	**y15_max**									
	15 years and over									
		Time	**1999a00**	**2000a00**	**2001a00**	**2002a00**	**2003a00**	**2004a00**	**2005a00**	**2006a00**	**2007°00**
geo										
itg1	**Sicilia**	233,01	224,07	199	189,07	188,02	157,09	153,06	126,04	233,01	118,05

Source: *EUROSTAT.*

Table 16: Level of education by sex and age.

Date of extraction: Fri, 14 Nov 08 08:52:41										
Last update: Tue Nov 11 06:31:10 MET 2008										
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table	**reg_lfsd2pedu**									
	Population aged 15 and over by sex, age and highest level of education attained, at NUTS levels 1 and 2 (1000)									
age	**y15_max**									
	15 years and over									
geo	**itg1**									
	Sicilia									
sex	**M**									
	Males									
		Time	**1999a00**	**2000a00**	**2001a00**	**2002a00**	**2003a00**	**2004a00**	**2005a00**	**2006a00**	**2007a00**
isced97										
isced0_2	**Pre-primary, primary and lower secondary education - levels 0-2 (ISCED 1997)**	233,01	224,07	199	189,07	188,02	157,09	153,06	126,04	233,01	118,05

Source: *EUROSTAT*.

Table 17: GDP in PPS.

Date of extraction: Fri, 14 Nov 08 08:02:43										
Last update: Thu Nov 13 20:14:51 MET 2008										
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Table	**nama_gdp_c**									
	GDP and main components - Current prices									
unit	**mio_pps**									
	Millions of PPS (Purchasing Power Standard)									
indic_na	**b1gm**									
	Gross domestic product at market prices									
		time	1999a00	2000°00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
geo										
de	**Germany (including ex-GDR from 1991)**		1544416,2	1603504,1	1785825,2	1854482,7	1899128,2	2077503,5	2125893,2	2211816	2211816
es	**Spain**		684916,4	746444	790100,6	849699,3	879074,2	933297,5	1001463,4	1090103,3	1090103,3
fr	**France**		1233190,6	1334454,5	1399633,5	1462335,7	1437429,8	1487997,9	1582677,4	1663854,7	1663854,7
uk	**United Kingdom**			961927,8	1231350,4	1334949,6	1400126,9	1464498,1	1599149,4	1632783,6	1704655,8
no	**Norway**		115058,1	141074,7	143766,3	143723,4	147846,9	163399,4	186193,6	204517	204517
it	**Italy**		1191322,7	1267140	1327195,1	1309017,2	1321666,3	1342402,6	1375758,5	1446735	1446735
itg1	**Sicilia**		67759,38	71549,47	73427,46	71979,11	72755,38	72723,03	76122,76	79346,54	81352,37

Source: *EUROSTAT*.

Table 18: Urban Solid Waste production in Sicily.

	Time	1999a00	2000°00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00
Total USW (*1000 kg)		2552,727	2603,582	2423	2521	2540	2544	2608	2718
USW per inhabitant (Kg/I)		502	513	488	507	511	508	520	542

Source: *APAT.*

Table 19: Companies flying to Sicily.

	Time	1999a00	2000°00	2001a00	2002a00	2003a00	2004a00	2005a00	2006a00	2007a00
France										
DIRECT		1	1	1	1	1	1	1	1	1
LOWCOST		1,648721	1,648721271	2,718282	2,718282	2,718282	2,718282	4,481689	2,718282	4,481689
DIRECTLOWCOST		1	1	1	1	2,718282	2,718282	2,718282	2,718282	2,718282
Germany										
DIRECT		7,389056099	7,389056	7,389056	2,718282	2,718282	2,718282	2,718282	2,718282	2,718282
LOWCOST		1	1,648721	1,648721	1,648721	1,648721	4,481689	7,389056	7,389056	7,389056
DIRECTLOWCOST		1	1	1	1	1	1	1	1	1
Norway										
DIRECT		1	1	1	1	1	1	1	1	1
LOWCOST		1	1	1	1	1	1	2,718282	7,389056	7,389056
DIRECTLOWCOST		1	1	1	1	1	1	1	1	1
Spain										
DIRECT		1	1	1	1	1	1	1	1	1
LOWCOST		1	1	1	1	1	1	1	1	1
DIRECTLOWCOST		1	1	1	1	1	1	1	1	1
United Kingdom										
DIRECT		1	7,389056	2,718282	1	7,389056	2,718282	1	7,389056	2,718282
LOWCOST		1	7,389056	2,718282	1	7,389056	2,718282	1	7,389056	2,718282
DIRECTLOWCOST		1	12,18249	2,718282	1	12,18249	2,718282	1	12,18249	2,718282

Source*: ICAO*

APPENDIX 2

(The exponential smoothing)

The exponential smoothing.

Human behavior is characterized by a gradual reaction to changes in information and external factors. In fact, perceptions (upon which a decision is based) require time to adjust to changes in incoming information, and the more mental models and behavioral rules are deeply rooted in the decision maker, the slower this updating process will be.

For example, a company does not hire more employees if its workers are overexerted for just one day. After all, the increased activity might be temporary. Major actions, such as increasing a work force, are taken only after one is convinced that observed indicators are reflective of real, long-lasting environmental changes, so as not to overreact to what may turn out to be short term changes.

The result of this smoothing process is that fluctuations are filtered out and actions are delayed.

The simplest form of exponential smoothing is given by the formulas

$$s_0 = x_0$$

$$s_t = \alpha x_t + (1-\alpha)s_{t-1} = s_{t-1} + \alpha(x_t - s_{t-1})$$

where x_t is the observation at time t, s_t is the smoothed value at time t, and α is the *smoothing factor*, with $0 \leq \alpha \leq 1$. A value of α = 0 means that any new information about the environmental changes is disregarded, and decisions will be taken on the basis of the initial value x_0, forever. On the other hand, a value of α = 1 entails an immediate reaction to change in information, and decisions will always be influenced by the latest observation x_t.

For any $0 < \alpha < 1$, the smoothed statistic s_t is a simple weighted average of the latest observation x_t and the previous smoothed statistic s_{t-1}. Values of α close to one have less of a smoothing effect and give greater weight to recent changes in the data, while values of α closer to zero have a greater smoothing effect and are less responsive to recent changes. In any event, there is no formally correct procedure for choosing α. A statistical technique can be used to optimize the value of α. For example, the method of least squares can be used to determine the value of α for which the sum of the quantities $(s_{n-1} - x_n)^2$ is minimized.

This simple form of exponential smoothing is also known as Brown's exponential smoothing, or as an "exponentially weighted moving average." Technically, it can also be classified as an ARIMA(0,1,1) model with no constant term.

The name of this smoothing method comes from the fact that, as time passes, the weights assigned to previous observations are, in general, proportional to the terms of the geometric progression $\{1, (1-\alpha), (1-\alpha)^2, (1-\alpha)^3, \ldots\}$, and a geometric progression is the discrete version of an exponential function.

In the present study, the exponential smoothing is formulated with the following model equations

$$S_0 = Obs_0$$

$$R_t = \alpha(Obs_t - S_{t-1})$$

$$S_t = S_{t-1} + R_t dt = (\alpha Obs_t)dt + (1 - \alpha dt)S_{t-1} = S_0 + \int_0^t R_s ds$$

and implemented with the DELAYINF function in Powersim.

APPENDIX 3

(Model's equations)

Name	Unit	Definition	Documentation
active vehicles in Sicily	vehicle	'number of vehicles registered in Sicily'*'local utilization index of vehicles'	Number of vehicles circulating in Sicily
actual percentage of growth in tourism presences		'total presences'/'INITIAL PRESENCES IN HOTELS'	Observed percentage of growth in tourism presences
actual change in perception of dangers posed by the Mafia	yr^-1	IF('calculated change in perception of Mafia dangerousness'<0<<yr^-1>>; -1*MIN('Perception of Mafia Dangerousness'*1<<yr^-1>>;ABS('calculated change in perception of Mafia dangerousness')); 'calculated change in perception of Mafia dangerousness')	Observed change in people perception of the danger represented by the Mafia
actual unemployment net inflow for males in Sicily aged 15 and over	ppl/yr	IF('calculated unemployment net inflow for males in Sicily aged 15 and over'<0<<ppl/yr>>; -1*MIN('Unemployed Males in Sicily Aged 15 and Over'*1<<yr^-1>>; ABS('calculated unemployment net inflow for males in Sicily aged 15 and over')); 'calculated unemployment net inflow for males in Sicily aged 15 and over')	Real net inflow of unemployment for males in Sicily aged 15 and over (1000 ppl/yr))
acquisition of restaurants inside the tourism area	restaurant/yr	INTEGER(NUMBER(DELAYINF('desired number of new restaurants outside the tourism area';'TIME TO DECIDE TO OPEN A NEW RESTAURANT OUTSIDE THE TOURISM AREA';1;'INITIAL NUMBER OF NEW RESTAURANTS OUTSIDE THE TOURISM AREA')))*1<<restaurant>>/'AVERAGE TIME TO MAKE OPERATIVE A RESTAURANT'	Acquisition rate of new restaurants outside the tourism area.
ATTRACTIVENESS COEFFICIENT FOR SICILY IN FRENCH TOURISM MARKET		8,380019027	Indicator of tourism attractiveness of Sicily for French tourism
ATTRACTIVENESS COEFFICIENT FOR SICILY IN GERMAN TOURISM MARKET		2,214675223	Indicator of tourism attractiveness of Sicily for German tourism
ATTRACTIVENESS COEFFICIENT FOR SICILY IN LOCAL TOURISM MARKET		7,762374177	Indicator of tourism attractiveness of Sicily for local tourism

Name	Unit	Definition	Documentation
ATTRACTIVENESS COEFFICIENT FOR SICILY IN NORWEGIAN TOURISM MARKET		6,299819546	Indicator of tourism attractiveness of Sicily for Norwegian tourism
ATTRACTIVENESS COEFFICIENT FOR SICILY IN REST-OF-ITALY TOURISM MARKET		3,559338363	Indicator of tourism attractiveness of Sicily for "rest of Italy" tourism
ATTRACTIVENESS COEFFICIENT FOR SICILY IN SPANISH TOURISM MARKET		2,095921101	Indicator of tourism attractiveness of Sicily for Spanish tourism
ATTRACTIVENESS COEFFICIENT FOR SICILY IN UK TOURISM MARKET		3,0968767	Indicator of tourism attractiveness of Sicily for UK tourism
attractiveness of Sicily for French tourists		(('French gdp exponentially smoothed for travelling decision'/'GDP OF FRANCE REFERENCE VALUE')^'FRENCH GDP COEFFICIENT' *('French population'/'FRENCH POPULATION REFERENCE VALUE')^'FRENCH POPULATION COEFFICIENT' *(Hotels/'INIT HOTEL')^'FRENCH COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'FRENCH COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'FRENCH COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'FRENCH COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'FRENCH COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'FRENCH COEFFICIENT FOR ROADS' *'Reputation of Sicily'^'FRENCH COEFFICIENT FOR REPUTATION' *'perceived distance from France')	Attractiveness index for French tourism

Name	Unit	Definition	Documentation
attractiveness of Sicily for German tourists		(('German gdp exponentially smoothed for travelling decision'/'GDP OF GERMANY REFERENCE VALUE')^'GERMAN GDP COEFFICIENT' *('German population'/'GERMAN POPULATION REFERENCE VALUE')^'GERMAN POPULATION COEFFICIENT' *(Hotels/'INIT HOTEL')^'GERMAN COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'GERMAN COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'GERMAN COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'GERMAN COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'GERMAN COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'GERMAN COEFFICIENT FOR ROADS' *'Reputation of Sicily'^'GERMAN COEFFICIENT FOR REPUTATION' *'perceived distance from Germany')	Attractiveness index for German tourism
Attractivi9ty of Sicily for local tourists		(('gdp exponentially smoothed for local travelling decision'/'REFERENCE VALUE FOR LOCAL GDP')^'LOCAL GDP COEFFICIENT' *('population of Sicily'/'LOCAL POPULATION REFERENCE VALUE')^'LOCAL POPULATION COEFFICIENT' *(Hotels/'INIT HOTEL')^'LOCAL COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'LOCAL COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'LOCAL COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'LOCAL COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'LOCAL COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'LOCAL COEFFICIENT FOR ROADS')	Attractiveness index for local tourism

Name	Unit	Definition	Documentation
attractiveness of Sicily for Norwegian tourists		(('Norwegian gdp exponentially smoothed for travelling decision'/'GDP OF NORWAY REFERENCE VALUE')^'NORWEGIAN GDP COEFFICIENT' *('Norwegian population'/'NORWEGIAN POPULATION REFERENCE VALUE')^'NORWEGIAN POPULATION COEFFICIENT' *(Hotels/'INIT HOTEL')^'NORWEGIAN COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'NORWEGIAN COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'NORWEGIAN COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'NORWEGIAN COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'NORWEGIAN COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'NORWEGIAN COEFFICIENT FOR ROADS' *'Reputation of Sicily'^'NORWEGIAN COEFFICIENT FOR REPUTATION' *'perceived distance from Norway')	Attractiveness index for Norwegian tourism
attractiveness of Sicily for rest-of-Italy tourists		(('gdp exponentially smoothed for rest-of-Italy travelling decision'/'REST-OF-ITALY REFERENCE VALUE FOR GDP')^'REST-OF-ITALY GDP COEFFICIENT' *('population of rest of Italy'/'REST-OF-ITALY POPULATION REFERENCE VALUE')^'REST-OF-ITALY POPULATION COEFFICIENT' *(Hotels/'INIT HOTEL')^'REST-OF-ITALY COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'REST-OF-ITALY COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'REST-OF-ITALY COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'REST-OF-ITALY COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'REST-OF-ITALY COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'REST-OF-ITALY COEFFICIENT FOR ROADS' *'Reputation of Sicily'^'REST-OF-ITALY COEFFICIENT FOR REPUTATION' *'perceived distance from rest-of-Italy')	Attractiveness index for rest-of-Italy tourism

Name	Unit	Definition	Documentation
attractiveness of Sicily for Spanish tourists		(('gdp of Spain exponentially smoothed for travelling decision'/'GDP OF SPAIN REFERENCE VALUE')^'SPANISH GDP COEFFICIENT' *('population of Spain'/'SPANISH POPULATION REFERENCE VALUE')^'SPANISH POPULATION COEFFICIENT' *(Hotels/'INIT HOTEL')^'SPANISH COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'SPANISH COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'SPANISH COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'SPANISH COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'SPANISH COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'SPANISH COEFFICIENT FOR ROADS' *'Reputation of Sicily'^'SPANISH COEFFICIENT FOR REPUTATION' *'perceived distance from Spain')	Attractiveness index for Spanish tourism
attractiveness of Sicily for UK tourists		(('gdp of UK exponentially smoothed for travelling decision'/'GDP OF UK REFERENCE VALUE')^'UK GDP COEFFICIENT' *('population of United Kingdom'/'UK POPULATION REFERENCE VALUE')^'POPULATION OF UK COEFFICIENT' *(Hotels/'INIT HOTEL')^'UK COEFFICIENT FOR HOTELS' *(restaurants/'INIT NUMBER OF RESTAURANTS')^'UK COEFFICIENT FOR RESTAURANTS' *'Cultural Resources'^'UK COEFFICIENT FOR CULTURAL RESOURCES' *'Natural Resources'^'UK COEFFICIENT FOR NATURAL RESOURCES' *('Urban Environment'/'URBAN ENVIRONMENT REFRENCE VALUE')^'UK COEFFICIENT FOR URBAN ENVIRONMENT' *(Roads/'INIT ROADS')^'UK COEFFICIENT FOR ROADS' *'Reputation of Sicily'^'UK COEFFICIENT FOR REPUTATION' *'perceived distance from UK')	Attractiveness index for UK tourism
AVERAGE DAYS OF UTILIZATION OF VEHICLES IN SICILY	da	100	Average number of days of utilization of vehicles in Sicily
AVERAGE HOTEL LIFE	yr	100<<yr>>	Average ageing rate for hotels
average length of stay for French tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3,53; 3,62; 3,76; 3,78; 3,75; 3,57; 3,56; 3,41; 3,25 //Min:3;Max:5//}<<night/ppl>>)	Average length of stay for French tourists
average length of stay for German tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3,59; 3,77; 3,74; 3,54; 3,51; 3,44; 3,55; 3,77; 3,74 //Min:3;Max:5//}<<night/ppl>>)	Average length of stay for German tourists

Name	Unit	Definition	Documentation
average length of stay for local tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 2,90; 3,06; 2,90; 2,90; 2,79; 2,72; 2,76; 2,70; 2,69 //Min:1;Max:5//}<<night/ppl>>)	Average length of stay for local tourists
average length of stay for Norwegian tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3,29; 5,00; 3,11; 4,14; 4,40; 3,74; 4,17; 3,67; 4,28 //Min:3;Max:5//}<<night/ppl>>)	Average length of stay for Norwegian tourists
average length of stay for Rest-of-Italy tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3,48; 3,54; 3,52; 3,40; 3,32; 3,34; 3,44; 3,48; 3,30 //Min:1;Max:5//}<<night/ppl>>)	Average length of stay for Rest-of-Italy tourists
average length of stay for rest-of-the-World tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3,07; 2,96; 3,04; 2,99; 3,09; 2,90; 2,98; 3,06; 3,19 //Min:1;Max:5//}<<night/ppl>>)	Average length of stay for rest-of-the-World tourists
average length of stay for Spain tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 2,30; 2,25; 2,13; 2,05; 2,03; 2,08; 2,04; 2,07; 2,23 //Min:1;Max:5//}<<night/ppl>>)	Average length of stay for Spain tourists
average length of stay for UK tourists	night/ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 4,33; 4,13; 4,38; 4,66; 4,42; 4,29; 4,45; 4,26; 4,25 //Min:1;Max:5//}<<night/ppl>>)	Average length of stay for UK tourists
AVERAGE LIFE FOR RESTAURANT INSIDE THE TOURISM AREA	yr	49,29553037<<yr>>	Average life for restaurant inside the tourism area.
AVERAGE LIFE OF RESTAURANT OUTSIDE THE TOURISM AREA	yr	7,00047685	Average life for restaurant outside the tourism area.
average number of bed-places per hotel	bed/hotel	'Bed-Places Capacity'/Hotels	Average number of bed-places per hotel
average number of bed-places per hotel_real	bed/hotel	GRAPHCURVE(NUMBER(TIME);1999;1;{ 88,46; 90,12; 93,56; 95,52; 94,23; 97,54; 95,67; 94,99; 97,13//Min:850;Max:1175//}<<bed/hotel>>)	Average number of bed-places per hotel_real
average number of meals consumed in restaurants for non-travelling locals	seat	'percentage of meals at the restaurant for not-travelling locals'*'not-travelling local presences'	Average number of meals consumed in restaurant for not-travelling locals.
AVERAGE NUMBER OF MEALS FOR LOCAL TOURISTS	seat/da	1,40<<seat/da>>	Average number of meals for resident tourist.

Name	Unit	Definition	Documentation
AVERAGE NUMBER OF MEALS FOR NON RESIDENT TOURISTS	seat/da	1,6<<seat/da>>	Average number of meals for non-resident tourist.
AVERAGE NUMBER OF PEOPLE PER VEHICLE	ppl/vehicle	2,7	Average number of people per car (this value has been set equal to the average number of components in an Italian family)
average number of seats per restaurant	seat/restaurant	('AVERAGE SIZE OF RESTAURANT IN SICILY'/'AVERAGE ROOM PER SEAT')	Average number of seats per restaurant.
AVERAGE PERCENTAGE OF ITALIANS TRAVELLING IN THEIR OWN VEHICLE		0,681285048	Percentage of Italians travelling by their own vehicle (car, camper or roulotte)
AVERAGE PERCENTAGE OF RESIDENTS EAGER TO HAVE A MEAL INSIDE THE TOURISM AREA		0,599958263	Percentage of resident people eager to have a meal inside the tourism area
AVERAGE ROAD LIFE	yr	3	Average life of roads in hypothesis of normal utilization
AVERAGE ROAD MAINTENANCE	yr^-1	0,01<<yr^-1>>	Average Kilometers of road maintained per Kilometer of road each year
AVERAGE ROOM PER SEAT	m^2/seat	2,196249653	Average room needed per seat in a restaurant.
AVERAGE SIZE OF RESTAURANT IN SICILY	m^2/restaurant	84,50099875	Average size of restaurants in Sicily
AVERAGE SUSTAINABLE NUMBER OF VEHICLES PER KM OF ROAD	vehicle/km	80<<vehicle/km>>	Average sustainable number of vehicles per kilometer of road

Name	Unit	Definition	Documentation
AVERAGE TIME TO MAKE ENJOYABLE NEW CULTURAL RESOURCES	yr	0,764359852	Average time to find funds, people and/or locations to make enjoyable new cultural resources.
AVERAGE TIME TO MAKE ENJOYABLE NEW NATURAL RESOURCES	yr	2	Average time to find funds, people and/or locations to make enjoyable new natural resources.
AVERAGE TIME TO COMPLETE A MEAL	min	85,1488635<<min>>	Average time needed to complete a meal.
AVERAGE TIME TO SET UP A NEW HOTEL	yr	3,018233465<<yr>>	Number of years needed to build and open a new hotel
AVERAGE TIME BEFORE CLOSING CULTURAL RESOURCES FOR MISSING OF VISITORS	yr	10<<yr>>	Average time to close cultural resources (museums, archeological sites…) because of poor number of visitors
AVERAGE TIME TO MAKE OPERATIVE A RESTAURANT	yr	0,994467028<<yr>>	Average time needed to open a new restaurant.
AVERAGE WORKING DAYS PER RESTAURANT INSIDE THE TOURISM AREA	da	200	Average number of days of activity of a restaurant inside the tourism area.
AVERAGE WORKING DAYS PER RESTAURANT OUTSIDE THE TOURISM AREA	da	333,5236825	Average days of activity per restaurant outside the tourism area.
AVERAGE WORKING HOURS PER DAY	hr	6,11385433916531<<hr>>	Average number of hours of activity per day

Name	Unit	Definition	Documentation
bed-places acquisition	bed/yr	DELAYINF('gap in bed-places capacity';'TIME TO DECIDE TO START A NEW HOTEL';1;'INITIAL GAP IN BED-PLACES')/'AVERAGE TIME TO SET UP A NEW HOTEL'	Number of additional bed-places per year
Bed-Places Capacity	bed	'INITIAL NUMBER OF BED-PLACES'	Total number of bed-places
bed-places depreciation	bed/yr	MIN('Bed-Places Capacity'*1<<yr^-1>>;'average number of bed-places per hotel'*'hotels depreciation')	Bed-places lost per year
calculated unemployment net inflow for males in Sicily aged 15 and over	ppl/yr	DELAYINF('INIT UNEMPLOYMENT NET INFLOW FOR MALE AGED 15 AND OVER'*('Sicily socio-economic conditions normalized value'-1);'DELAY TIME FOR SICILY SOCIO-ECONOMIC CONDITIONS TO AFFECT MALE UNEMPLOYMENT';1;'INIT UNEMPLOYMENT NET INFLOW FOR MALE AGED 15 AND OVER')	Calculated net inflow of unemployment for males in Sicily aged 15 and over (1000 ppl/yr))
capacity saturation	yr	'ORDINARY SATURATION CAPACITY'/'usw production index'	Number of years needed to saturate WMC
change in perception of dangers posed by the Mafia	yr^-1	'gap in perception'/(IF('gap in perception'<=0;'TIME FOR A POSITIVE CHANGE IN THE PERCEPTION OF MAFIA DANGEROUSNESS'; 'TIME FOR A NEGATIVE CHANGE IN THE PERCEPTION OF MAFIA DANGEROUSNESS'))+ 'variation of Mafia murders'*(1/NUMBER(IF('gap in perception'<=0;'TIME FOR A POSITIVE CHANGE IN THE PERCEPTION OF MAFIA DANGEROUSNESS'; 'TIME FOR A NEGATIVE CHANGE IN THE PERCEPTION OF MAFIA DANGEROUSNESS')))	'Perception of Mafia Dangerousness for Tourists'*(('Normalized Mafia Murders'* NUMBER('Variation Of Mafia Murders'))/ IF('Variation Of Mafia Murders'<=0<<yr^-1>>; 'Time to Change Perception of Mafia Dangerousness in a Positive Direction'; 'Time to Change Perception of Mafia Dangerousness in a Negative Direction'))
CLIMATE EFFECT		1,72	Effect of climate on the attractiveness of Sicily
Cultural Resources		1	stock of cultural resources.
Cultural Resources _real		GRAPHCURVE(NUMBER(TIME);1999;1;{ 1,00; 1,00; 1,016408163284; 1,030612244926; 1,048920408211; 1,051020408211; 1,061224489853; 1,061224489853; 1,061224489853 //Min:1;Max:1,20//})	Actual stock of cultural resources.
cultural resources acquisition	yr^-1	MAX('desired cultural resources'-'Cultural Resources';0)/'time to make enjoyable new cultural resources'	Additional number of cultural resources per year
cultural resources decrease	yr^-1	MIN('shortfall in cultural resources';0)/'AVERAGE TIME BEFORE CLOSING CULTURAL RESOURCES FOR MISSING OF VISITORS'	Decreased number of cultural resources per year
DAYS PER NIGHT	da/night	1,198507364<<da/night>>	Average number of mornings per night spent on vacation.

Name	Unit	Definition	Documentation
DELAY IN PERCEPTION OF THE NECESSITY OF NEW WMC	yr	1,291713942<<yr>>	Number of years needed to perceive a shortfall in waste management capacity
DELAY TIME FOR SICILIAN SOCIO-ECONOMIC CONDITIONS TO AFFECT MALE UNEMPLOYMENT	yr	2<<yr>>	Number of years for Sicily socio-economic conditions to affect male unemployment
demand for seat in restaurants inside the tourism area	seat	'local demand of seats in restaurants inside the tourism area'+'tourism demand for seats in restaurants inside the tourism area'	Total number of seats demanded inside the tourism area.
density of vehicles circulating in Sicily	vehicle/km	'number of vehicles circulating in Sicily'/Roads	Average number of active vehicles per kilometer of road
depreciation of restaurants outside the tourism area	restaurant/yr	INTEGER(NUMBER('Restaurants Outside the Tourism Area'/'AVERAGE LIFE OF RESTAURANT OUTSIDE THE TOURISM AREA')+0,5)*1<<restaurant/yr>>	Number of restaurants lost per year
desired bed-places capacity	bed	INTEGER((NUMBER('INITIAL NUMBER OF BED-PLACES'*('actual percentage of growth in tourism presences')^'EFFECT OF ACTUAL PERCENTAGE OF GROWTH ON THE DESIRED NUMBER OF BED-PLACES')+ NUMBER('INITIAL NUMBER OF BED-PLACES'*('expected percentage of growth in tourism presences')^'EFFECT OF EXPECTED PERCENTAGE OF GROWTH ON THE DESIRED NUMBER OF BED-PLACES')))*1<<bed>>	Total number of desired bed-places
desired cultural resources		((DELAYINF(('tourism pressure');'TIME NECESSARY TO ACT UPON TOURISM PRESSURE';1;'INITIAL TOURISM PRESSURE'))/'TOURISM PRESSURE REFERENCE VALUE')^'EFFECT OF TOURISM PRESSURE ON NEW CULTURAL RESOURCES' //((DELAYPPLINF(('tourism pressure');'TIME NECESSARY TO ACT UPON TOURISM PRESSURE';10<<yr>>;'INITIAL TOURISM PRESSURE'))/'TOURISM PRESSURE REFERENCE VALUE')^'EFFECT OF TOURISM PRESSURE ON NEW CULTURAL RESOURCES'//	Stock of desired cultural resources

Name	Unit	Definition	Documentation
desired natural resources		(DELAYINF('tourism pressure';'TIME TO DECIDE FOR NEW NATURAL RESOURCES';1;0,608280267)/'INIT VALUE FOR TURISM PRESSURE')^'EFFECT OF TOURISM PRESSURE ON NEW NATURAL RESOURCES'* (DELAYINF('population pressure';'TIME TO DECIDE FOR NEW NATURAL RESOURCES';1;1)/'REFERENCE VALUE FOR POPULATION PRESSURE')^'EFFECT OF POPULATION PRESSURE ON NEW NATURAL RESOURCES'	Desired stock of natural resources
desired number of new hotels	hotel	MAX('expected future presences in hotels'/('average number of bed-places per hotel'*gui*'nights in the year'*1<<bed^-1>>)-Hotels;0<<hotel>>)	Desired number of new hotels.
desired number of new restaurants inside the tourism area	restaurant	INTEGER('unsatisfied demand for seat inside the tourism area'/('average number of seats per restaurant'*'AVERAGE WORKING DAYS PER RESTAURANT INSIDE THE TOURISM AREA'*1<<da^-1>>*'rotation of seats'))	Desired number of restaurant inside the tourism area
desired number of new restaurants outside the tourism area	restaurant	MAX(INTEGER((('seats for locals willing to have a meal in restaurants outside the tourism area'/('rotation of seats'*'average number of seats per restaurant'*1<<da^-1>>*'AVERAGE WORKING DAYS PER RESTAURANT OUTSIDE THE TOURISM AREA')) -'Restaurants Outside the Tourism Area')+((NUMBER('desired number of new restaurants inside the tourism area')^'EFFECT OF UNSATISFIED DEMAND INSIDE THE TOURISM AREA ON THE NUMBER OF RESTAURANTS OUTSIDE THE TOURISM AREA'*1<<restaurant>>)+0,5<<restaurant>>));0<<restaurant>>)	Desired number of new restaurant outside the tourism area.
desired roads	km	Roads*'road crowding'	Desired Kilometers of road
desired wmc		('forecast in usw production')^'EFFECT OF FORECASTED USW PRODUCTION ON DESIRED WMC'+'wmc outflow'*1<<yr>>	Desired waste management capacity
direct flights from France	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1;1;1;1;1;1;1;1;1//Min:0;Max:10//}<<flight>>)	Direct flights from France to Palermo
direct flights from Germany	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{7,389056099; 7,389056099; 7,389056099; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828 //Min:0;Max:10//}<<flight>>)	Direct flights from Germany to Palermo
direct flights from Norway	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1;1;1;1;1;1;1;1;1//Min:0;Max:10//}<<flight>>)	Direct flights from Norway to Palermo

Name	Unit	Definition	Documentation
direct flights from rest-of-Italy	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1; 1; 0,8; 0,8; 0,8; 0,6; 0,6; 0,6 //Min:0;Max:10//}<<flight>>)	Direct flights from rest-of -Italy to Palermo
direct flights from Spain	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1;1;1;1;1;1;1;1;1//Min:0;Max:10//}<<flight>>)	Direct flights from Spain to Palermo
direct flights from UK	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1;1;1;1;1;1;1;1;1//Min:0;Max:10//}<<flight>>)	Direct flights from UK to Palermo
direct low cost flights from France	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1; 1; 1; 1; 1; 1; 2,718281828; 2,718281828 //Min:0;Max:10//}<<flight>>)	Number of low cost companies flying from France to Sicily
direct low cost flights from Germany	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1; 1; 1; 1; 1; 1; 1; 1 //Min:0;Max:10//}<<flight>>)	Number of low cost companies flying from Germany to Sicily
direct low cost flights from Norway	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1;1;1;1;1;1;1;1;1//Min:0;Max:10//}<<flight>>)	Number of low cost companies flying from Norway to Sicily
direct low cost flights from rest-of-Italy	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 5,754602676; 7,389056099; 4,48168907 //Min:0;Max:10//}<<flight>>)	Number of low cost companies flying from rest-of-Italy to Sicily
direct low cost flights from Spain	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1; 1; 1; 1; 1; 1; 2,718281828; 2,718281828 //Min:0;Max:10//}<<flight>>)	Number of low cost companies flying from Spain to Sicily
direct low cost flights from UK	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828; 2,718281828 //Min:0;Max:10//}<<flight>>)	Number of low cost companies flying from UK to Sicily
DISTANCE FROM FRANCE REFERENCE VALUE	km	1486<<km>>	Number of Kilometers from Paris to Palermo
DISTANCE FROM GERMANY REFERENCE VALUE	km	1602<<km>>	Number of Kilometers from Berlin to Palermo
DISTANCE FROM NORWAY REFERENCE VALUE	km	2433<<km>>	Number of Kilometers from Oslo to Palermo
DISTANCE FROM REST-OF-ITALY REFERENCE VALUE	km	427 <<km>>	Number of Kilometers from Rome to Palermo

Name	Unit	Definition	Documentation
DISTANCE FROM SPAIN REFERENCE VALUE	km	1022 <<km>>	Number of Kilometers from Madrid to Palermo
DISTANCE FROM UKREFERENCE VALUE	km	1825 <<km>>	Number of Kilometers from London to Palermo
EFFECT OF ACTUAL PERCENTAGE OF GROWTH ON THE DESIRED NUMBER OF BED-PLACES		0,080000557	Coefficient measuring the effect of the actual percentage of growth in presences in hotels on the desired number of bed-places per hotel.
EFFECT OF EXPECTED PERCENTAGE OF GROWTH ON THE DESIRED NUMBER OF BED-PLACES		0,576631404	Coefficient measuring the effect of the expected percentage of growth in presences in hotels on the desired number of bed-places per hotel.
EFFECT OF FORECASTED USW PRODUCTION ON DESIRED WMC		3	Coefficient measuring the effect of forecasted USW production on the desired WMC
EFFECT OF FOREIGN ARRIVALS ON NUMBER OF VEHICLES		0	Coefficient measuring the effect of foreign arrivals on number of vehicles
EFFECT OF GDP ON HIGHER SECONDARY EDUCATION COMPLETION RATE		-52,66207191	Coefficient measuring the effect of GDP on high secondary education completion rate
EFFECT OF GDP ON MALE EMPLOYMENT		0,9	Coefficient measuring the effect of GDP on male employment

Name	Unit	Definition	Documentation
EFFECT OF GDP ON NUMBER OF VEHICLES IN SICILY		1,738643702	Coefficient measuring the effect of GDP on number of vehicles in Sicily
EFFECT OF HIGHER EDUCATION ON CRIMINALITY		-0,098828586	Coefficient measuring the effect of higher education on criminality
EFFECT OF HIGHER EDUCATION ON EMPLOYMENT FOR MALES AGED 15 AND OVER		-2,604188711	Coefficient measuring the effect of higher education on employment for males (15 years of age or more)
EFFECT OF HOUSEHOLD CONSUMPTION ON USW		0,373352094	Coefficient measuring the effect of household consumption on urban solid wastes
EFFECT OF LOCAL WEALTH ON THE AVERAGE NUMBER OF MEALS AT THE RESTAURANT.		0,5	Effect of local richness on the average number of meals in restaurant for non-travelling locals.
EFFECT OF MALE UNEMPLOYMENT ON CRIMINALITY		2,125094012	Effect of male unemployment on criminality level
EFFECT OF PERCEIVED DANGERS POSED BY THE MAFIA ON TOTAL THREAT		1,4	Effect of perceived dangerousness of mafia
EFFECT OF PETTY CRIME ON TOTAL THREAT		0,6	Effect of petty crime

Name	Unit	Definition	Documentation
EFFECT OF POPULATION ON MALES AGED 15 AND OVER WITH PRIMARY OR LOWER SECONDARY EDUCATION		29,47231788	Effect of population on males (15 years of age or above) with secondary education
EFFECT OF POPULATION ON NUMBER OF VEHICLES IN SICILY		0,6	Effect of population on number of vehicles in Sicily
EFFECT OF POPULATION ON USW		2,115251955	Effect of population on USW
EFFECT OF POPULATION PRESSURE ON NEW NATURAL RESOURCES		0	Effect of population on new natural resources
EFFECT OF REST OF ITALY ARRIVALS ON NUMBER OF VEHICLES IN SICILY		0,15	Effect of rest of Italy arrivals on number of vehicles in Sicily
EFFECT OF ROAD CROWDING ON AVERAGE ROAD LIFE		22,85369163	Effect produced by road traffic on average road life

Name	Unit	Definition	Documentation
EFFECT OF SHORTFALL IN CULTURAL RESOURCES ON THE AVERAGE TIME TO MAKE ENJOYABLE NEW CULTURAL RESOURCES		-0,163534505	Effect that the shortfall in cultural resources produces on the average time to make enjoyable new cultural resources.
EFFECT OF TOURISM PRESSURE ON NEW CULTURAL RESOURCES		0,611894101	Effect of tourism pressure on new cultural resources
EFFECT OF TOURISM PRESSURE ON NEW NATURAL RESOURCES		1,156625954	Effect of tourism pressure on new natural resources
EFFECT OF UNSATISFIED DEMAND INSIDE THE TOURISM AREA ON THE NUMBER OF RESTAURANTS OUTSIDE THE TOURISM AREA		0,15225044	Effect of unsatisfied demand inside the tourism area on the number of restaurants outside the tourism area
expected future presences in hotels	night	FORECAST('total presences';'PAST TIME FOR FORECASTING';'AVERAGE TIME TO SET UP A NEW HOTEL')	Forecasted presences in hotel.
expected percentage of growth in tourism presences		MAX(('expected future presences in hotels'-'total presences');0<<night>>)/'INITIAL PRESENCES IN HOTELS'	Expected percentage of growth in tourism presences
forecast in usw production		FORECAST('usw production index';'PAST YEARS OF OBSERVATIONS FOR FORECAST';'FUTURE YEARS OF OBSERVATIONS FOR FORECAST')	Expected future USW production

Name	Unit	Definition	Documentation
FOREIGN ARRIVALS REFERENCE VALUE	ppl	'foreign arrivals in Sicily'	Number of tourists arrived from abroad in 1999
foreign presences	night	'French presences'+'German presences'+'Norwegian presences'+'Spanish presences'+'UK presences'+'rest-of-the-World presences'	Number of nights of foreign presences
foreign tourists in Sicily	ppl	'French Tourists'+'German Tourists'+'Norwegian Tourists'+'Spanish Tourists'+'UK Tourists'+'rest-of-the-World tourists'	Number of foreign tourists
FRENCH COEFFICIENT FOR CULTURAL RESOURCES		0	Effect of cultural resources in Sicily on French tourists' arrivals
FRENCH COEFFICIENT FOR DIRECT FLIGHT		0	Effect of number of direct flights to Sicily on French tourists' arrivals
FRENCH COEFFICIENT FOR DIRECT LOW COST FLIGHT		0,23302481	Effect of number of direct low cost flights on French tourists' arrivals
FRENCH COEFFICIENT FOR HOTELS		0	Effect of number of hotels in Sicily on French tourists' arrivals
FRENCH COEFFICIENT FOR LOW COST FLIGHT		0,154526656	Effect of number of low cost flights to the international airports of Milano and Rome on French tourists' arrivals
FRENCH COEFFICIENT FOR NATURAL RESOURCES		1,465716381	Effect of natural resources in Sicily on French tourists' arrivals
FRENCH COEFFICIENT FOR REPUTATION		0	Effect of Sicily reputation on French tourists' arrivals
FRENCH COEFFICIENT FOR RESTAURANTS		0	Effect of number of restaurants in Sicily on French tourists' arrivals

Name	Unit	Definition	Documentation
FRENCH COEFFICIENT FOR ROADS		1,797296862	Effect of roads in Sicily on French tourists' arrivals
FRENCH COEFFICIENT FOR URBAN ENVIRONMENT		3,99	Effect of urban environment in Sicily on French tourists' arrivals
FRENCH DIRECT FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct flights from France to Palermo in 1999
FRENCH DIRECT LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct low cost flights from France to Palermo in 1999
FRENCH GDP COEFFICIENT		0,433	Effect of French GDP on the decision to travel in Sicily
French gdp exponentially smoothed for travelling decision	PPS	'SMOOTHING FACTOR OF FRENCH GDP FOR TRAVELLING DECISION'*'gdp of France'+(1-'SMOOTHING FACTOR OF FRENCH GDP FOR TRAVELLING DECISION')*DELAYINF('gdp of France';(1/'SMOOTHING FACTOR OF FRENCH GDP FOR TRAVELLING DECISION')*1<<yr>>)	GDP of France in Purchasing Power Standards exponentially smoothed for travelling decision
French incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed French tourists')^'FRENCH TOURISTS COEFFICIENT'*'attractiveness of Sicily for French tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN FRENCH TOURISM MARKET')*1<<ppl>>-'French Tourists')/NUMBER('FRENCH TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of French tourists in Sicily
FRENCH LOW COST FLIGHTS REFERENCE VALUE	flight	1,648721271<<flight>>	Low cost flights from France to Palermo in 1999
French population	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 60158533; 60537977; 60963775; 61399344; 61831779; 62251817; 62637596; 62998773; 63392140 //Min:61000000;Max:64000000//}<<ppl>>)	Population in France
FRENCH POPULATION COEFFICIENT		0	Effect of French population on the decision to travel to Sicily.

Name	Unit	Definition	Documentation
FRENCH POPULATION REFERENCE VALUE	ppl	60158533<<ppl>>	Population of France in 1999
French presences	night	'French Tourists'*'average length of stay for French tourists'	Number of nights French tourists spend in Sicily
FRENCH TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in French tourism market
French Tourists	ppl	'INIT FRENCH TOURISTS'	French tourists in Sicily
FRENCH TOURISTS COEFFICIENT		0,834468625	Effect of past French tourism arrivals on future arrivals
FRENCH TOURISTS SMOOTHING FACTOR		0,11	French tourists smoothing factor
French Tourists_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 301248; 321437; 325319; 343429; 338187; 326178; 291285; 329925; 364906 //Min:61000000;Max:64000000//}<<ppl>>)	Real number of French tourists in Sicily
FUTURE YEARS OF OBSERVATIONS FOR FORECAST	yr	4<<yr>>	Number of future years of observation for estimates
gap in bed-places capacity	bed	MAX('desired bed-places capacity'-'Bed-Places Capacity';0<<bed>>)	Difference between the desired and actual bed-places capacity
gap in land accessibility	km^-1	MAX('IDEAL KM OF ROAD PER SQUARE KILOMETER'-'land accessibility';0<<km^-1>>)	Difference between the desired and actual km of road per squared kilometer
gap in perception		'normalized Mafia murders'-'Perception of Mafia Dangerousness'	Difference between the desired and actual perception of Sicily
gap in wmc		'desired wmc'-'Waste Management Capacity'	Difference between the desired and actual wmc
gdp exponentially smoothed for consumption behavior	PPS	DELAYINF('gdp of Sicily';(1/'GDP SMOOTHING FACTOR FOR CONSUMPTION')*1<<yr>>)+'GDP SMOOTHING FACTOR FOR CONSUMPTION'*('gdp of Sicily'-DELAYINF('gdp of Sicily';(1/'GDP SMOOTHING FACTOR FOR CONSUMPTION')*1<<yr>>))	GDP Exponentially smoothed for consumption behavior
gdp exponentially smoothed for vehicle acquisition	PPS	DELAYINF('gdp of Sicily';(1/'GDP SMOOTHING FACTOR FOR CAR ACQUISITION')*1<<yr>>)+'GDP SMOOTHING FACTOR FOR CAR ACQUISITION'*('gdp of Sicily'-DELAYINF('gdp of Sicily';(1/'GDP SMOOTHING FACTOR FOR CAR ACQUISITION')*1<<yr>>))	GDP Exponentially smoothed for vehicle acquisition

Name	Unit	Definition	Documentation
gdp exponentially smoothed for local travelling decision	PPS	'GDP SMOOTHING FACTOR FOR LOCAL TRAVELLING DECISION'*'gdp of Sicily'+(1-'GDP SMOOTHING FACTOR FOR LOCAL TRAVELLING DECISION')*DELAYINF('gdp of Sicily';(1/'GDP SMOOTHING FACTOR FOR LOCAL TRAVELLING DECISION')*1<<yr>>)	GDP of Sicily in Purchasing Power Standards exponentially smoothed for local travelling decision
gdp exponentially smoothed for rest-of-Italy travelling decision	PPS	'GDP SMOOTHING FACTOR FOR REST-OF-ITALY TRAVELLING DECISION'*'REST-OF-ITALY GDP'+(1-'GDP SMOOTHING FACTOR FOR REST-OF-ITALY TRAVELLING DECISION')*DELAYINF('REST-OF-ITALY GDP';(1/'GDP SMOOTHING FACTOR FOR REST-OF-ITALY TRAVELLING DECISION')*1<<yr>>)	GDP of rest of Italy in Purchasing Power Standards exponentially smoothed for rest-of-Italy travelling decision
GDP Norway	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 115058,10; 141074,70; 143766,30; 143723,40; 147846,90; 163399,40; 186193,60; 204517,00; 214975,00 //Min:110000;Max:220000;Zoom//}<<PPS>>)	Gross Domestic Product of Norway in Purchasing Power Standards.
gdp of France	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 1233190,6; 1334454,5; 1399633,5; 1462335,7; 1437429,8; 1487997,9; 1582677,4; 1663854,7; 1754188,8 //Min:1230000;Max:1800000//}<<PPS>>)	Gross Domestic Product of France in Purchasing Power Standards.
GDP OF FRANCE REFERENCE VALUE	PPS	1233190,6<<PPS>>	French GDP in 1999 in PPS
gdp of Germany	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 1785825,2; 1854482,7; 1899128,2; 1944562,4; 1993440,6; 2077503,5; 2125893,2; 2211816; 2308953,2 //Min:1230000;Max:1800000//}<<PPS>>)	Gross Domestic Product of Germany in Purchasing Power Standards.
GDP OF GERMANY REFERENCE VALUE	PPS	1785825,2<<PPS>>	German GDP in 1999 in PPS
GDP OF GERMANY SMOOTHING FACTOR FOR TRAVELLING DECISION		0,200028659	GDP of Germany smoothing factor for travelling decision.
GDP OF NORWAY REFERENCE VALUE	PPS	115058,10<<PPS>>	Norwegian GDP in 1999 in PPS
GDP OF NORWAY SMOOTHING FACTOR FOR TRAVELLING DECISION		0,100045124	GDP of Norway smoothing factor for travelling decision.

Name	Unit	Definition	Documentation
gdp of Sicily	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 67759,38141; 71549,47455; 73427,45703; 71979,11214; 72755,38072; 72723,02727; 76122,75791; 79346,53861; 81352,368 //Min:57500;Max:82000//}<<PPS>>)	GDP of Sicily (1000 PPS)
GDP of Spain	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 684916,40; 746444,00; 790100,60; 849699,30; 879074,20; 933297,50; 1001463,40; 1090103,30; 1190020,10 //Min:530000;Max:1270000//}<<PPS>>)	Gross Domestic Product of Spain in Purchasing Power Standards.
gdp of Spain exponentially smoothed for travelling decision	PPS	'GDP OF SPAIN SMOOTHING FACTOR FOR TRAVELLING DECISION'*'GDP of Spain'+(1-'GDP OF SPAIN SMOOTHING FACTOR FOR TRAVELLING DECISION')*DELAYINF('GDP of Spain';(1/'GDP OF SPAIN SMOOTHING FACTOR FOR TRAVELLING DECISION')*1<<yr>>)	GDP of Spain in Purchasing Power Standards exponentially smoothed for travelling decision
GDP OF SPAIN REFERENCE VALUE	PPS	684916,40<<PPS>>	Spanish GDP in 1999 in PPS
GDP OF SPAIN SMOOTHING FACTOR FOR TRAVELLING DECISION		0,897981238	Spanish GDP smoothing factor for travelling decision.
gdp of UK exponentially smoothed for travelling decision	PPS	'GDP OF UK SMOOTHING FACTOR FOR TRAVELLING DECISION'*'GDP United Kingdom'+(1-'GDP OF UK SMOOTHING FACTOR FOR TRAVELLING DECISION')*DELAYINF('GDP United Kingdom';(1/'GDP OF UK SMOOTHING FACTOR FOR TRAVELLING DECISION')*1<<yr>>)	UK GDP in Purchasing Power Standards exponentially smoothed for travelling decision
GDP OF UK SMOOTHING FACTOR FOR TRAVELLING DECISION		0,277608379	UK GDP smoothing factor for travelling decision.
GDP OF UK REFERENCE VALUE	PPS	1231350,4<<PPS>>	UK GDP in 1999 in PPS
gdp per capita Sicily	PPS/ppl	'gdp of Sicily'/'population of Sicily'	GDP per capita in Sicily
GDP per capita SMOOTHING FACTOR		0,277038908	GDP per capita in Sicily smoothing factor

Name	Unit	Definition	Documentation
GDP REFERENCE VALUE	PPS	'gdp of Sicily'	GDP of Sicily in 1999 (1000 PPS)
GDP SICILY SMOOTHING FACTOR FOR EMPLOYMENT RELATED CONSIDERATIONS		0,031635964	GDP Sicily smoothing factor for employment related considerations
gdp smoothed for consumption behavior in restaurants	PPS	'GPD SMOOTHING FACTOR FOR CONSUMPTION IN RESTAURANTS'*'gdp of Sicily'+(1-'GPD SMOOTHING FACTOR FOR CONSUMPTION IN RESTAURANTS')*DELAYINF('gdp of Sicily';(1/'GPD SMOOTHING FACTOR FOR CONSUMPTION IN RESTAURANTS')*1<<yr>>)//DELAYINF('gdp Sicily';(1/'gdp smoothing factor restaurant')*1<<yr>>)+'gdp smoothing factor restaurant'*('gdp Sicily'-DELAYINF('gdp Sicily';(1/'gdp smoothing factor restaurant')*1<<yr>>))	Smoothed gdp for consumption behavior of locals in restaurants
GDP SMOOTHING FACTOR FOR CAR ACQUISITION		0,279473332	GDP smoothing factor for car acquisition
GDP SMOOTHING FACTOR FOR CONSUMPTION		1	GDP Sicily smoothing factor for consumption behavior considerations
GDP SMOOTHING FACTOR FOR LOCAL TRAVELLING DECISION		0,399402093	GDP of Sicily smoothing factor for local travelling decision.
GDP SMOOTHING FACTOR FOR REST-OF-ITALY TRAVELLING DECISION		0,315816184	GDP of rest of Italy smoothing factor for rest of Italy travelling decision.
GDP United Kingdom	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 1231350,4; 1334949,6; 1400126,90; 1464498,10; 1503287,50; 1599149,40; 1632783,60; 1704655,80; 1771246,70 //Min:960000;Max:1864000//}<<PPS>>)	UK Gross Domestic Product in Purchasing Power Standards.

Name	Unit	Definition	Documentation
GEOGRAPHICAL DISTANCE FROM FRANCE	km	1486<<km>>	Distance in km from Paris to Palermo
GEOGRAPHICAL DISTANCE FROM GERMANY	km	1602<<km>>	Distance in km from Berlin to Palermo
GEOGRAPHICAL DISTANCE FROM NORWAY	km	2433<<km>>	Distance in km from Oslo to Palermo
GEOGRAPHICAL DISTANCE FROM REST-OF-ITALY	km	427 <<km>>	Distance in km from Rome to Palermo
GEOGRAPHICAL DISTANCE FROM SPAIN	km	1022 <<km>>	Distance in km from Madrid to Palermo
GEOGRAPHICAL DISTANCE FROM UK	km	1825 <<km>>	Distance in km from London to Palermo
GERMAN COEFFICIENT FOR CULTURAL RESOURCES		0,683027578	Effect of cultural resources in Sicily on German tourists' arrivals
GERMAN COEFFICIENT FOR DIRECT FLIGHT		0,348391786	Effect of number of direct flights to Sicily on German tourists' arrivals
GERMAN COEFFICIENT FOR DIRECT LOW COST FLIGHT		0	Effect of number of direct low cost flights to the international airports of Milan and Rome on German tourists' arrivals
GERMAN COEFFICIENT FOR HOTELS		0	Effect of number of hotels in Sicily on German tourists' arrivals
GERMAN COEFFICIENT FOR LOW COST FLIGHT		0,229256707	Effect of number of low cost flights to the international airports of Milan and Rome on German tourists' arrivals

Name	Unit	Definition	Documentation
GERMAN COEFFICIENT FOR NATURAL RESOURCES		0,658292818	Effect of natural resources in Sicily on German tourists' arrivals
GERMAN COEFFICIENT FOR REPUTATION		0,866396377	Effect of Sicily reputation on German tourists' arrivals
GERMAN COEFFICIENT FOR RESTAURANTS		0,141141906	Effect of number of restaurants in Sicily on German tourists' arrivals
GERMAN COEFFICIENT FOR ROADS		4,172128809	Effect of roads in Sicily on German tourists' arrivals
GERMAN COEFFICIENT FOR URBAN ENVIRONMENT		8,827207103	Effect of urban environment in Sicily on German tourists' arrivals
GERMAN DIRECT FLIGHTS REFERENCE VALUE	flight	7,389056099<<flight>>	Direct flights from Berlin to Palermo in 1999
GERMAN DIRECT LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct low cost flights from Berlin to Palermo in 1999
GERMAN GDP COEFFICIENT		0,600123606	Effect of German GDP on the decision to travel in Sicily
German gdp exponentially smoothed for travelling decision	PPS	'GDP OF GERMANY SMOOTHING FACTOR FOR TRAVELLING DECISION'*'gdp of Germany'+(1-'GDP OF GERMANY SMOOTHING FACTOR FOR TRAVELLING DECISION')*DELAYINF('gdp of Germany';(1/'GDP OF GERMANY SMOOTHING FACTOR FOR TRAVELLING DECISION')*1<<yr>>)	German GDP in Purchasing Power Standards exponentially smoothed for travelling decision

Name	Unit	Definition	Documentation
German incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed German tourists')^'GERMAN TOURISTS COEFFICIENT'*'attractiveness of Sicily for German tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN GERMAN TOURISM MARKET')*1<<ppl>>-'German Tourists')/NUMBER('GERMAN TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of German tourists in Sicily
GERMAN LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Low cost flights from Berlin to Palermo in 1999
German population	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 82037011; 82163475; 82259540; 82440309; 82536680; 82531671; 82500849; 82437995; 82314906 //Min:61000000;Max:64000000//}<<ppl>>)	Population in Germany
GERMAN POPULATION COEFFICIENT		0,115881137	Effect of German population on the decision to travel in Sicily.
GERMAN POPULATION REFERENCE VALUE	ppl	82037011<<ppl>>	Population in Germany in 1999
German presences	night	'German Tourists'*'average length of stay for German tourists'	Number of nights German tourists spend in Sicily
GERMAN TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in German tourism market
German Tourism_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 332509; 378497; 343180; 302899; 240322; 249516; 275867; 297043; 271885 //Min:61000000;Max:64000000//}<<ppl>>)	Real number of German tourists in Sicily
German Tourists	ppl	'INIT GERMAN TOURISTS'	German tourists in Sicily
GERMAN TOURISTS COEFFICIENT		0,946236268	Effect of past German tourists' arrivals on future arrivals
GERMAN TOURISTS SMOOTHING FACTOR		0,005470037	German tourists smoothing factor
GPD SMOOTHING FACTOR FOR CONSUMPTION IN RESTAURANTS		1	GDP Smoothing factor for consumption behavior in restaurants.

Name	Unit	Definition	Documentation
gui		'total presences'/('Bed-Places Capacity'*'nights in the year'*1<<bed^-1>>)	Gross Utilization Index
higher education completion rate	ppl/yr	MIN('HIGHER SECONDARY EDUCATION COMPLETION RATE REFERENCE VALUE'*('Smoothed GDP per capita Sicily'/'SMOOTHED GDP PER CAPITA REFERENCE VALUE')^'EFFECT OF GDP ON HIGHER SECONDARY EDUCATION COMPLETION RATE';'Males in Sicily Aged 15 and Over With Primary or Lower Secondary Education'*1<<yr^-1>>)	Rate of males completing the secondary school (1000 people)
HIGHER SECONDARY EDUCATION COMPLETION RATE REFERENCE VALUE	ppl/yr	255,342<<ppl/yr>>	Rate of males completing the secondary school (1000 people per year) in 1999
Hotels	hotel	'INIT HOTEL'	Total number of hotels in Sicily
hotels acquisition	hotel/yr	INTEGER(NUMBER(DELAYINF('desired number of new hotels';'TIME TO DECIDE TO START A NEW HOTEL';1;'INITIAL NUMBER OF NEW HOTELS')/'AVERAGE TIME TO SET UP A NEW HOTEL'))*1<<hotel/yr>>	New hotels per year in the lodging market of Sicily
hotels depreciation	hotel/yr	INTEGER(NUMBER(Hotels/'AVERAGE HOTEL LIFE'))*1<<hotel/yr>>	Number of hotels closing down per year
IDEAL KM OF ROAD PER SQUARE KILOMETER	km^-1	2*1,414214<<km^-1>>	desired km of road per square kilometer of land
INIT REPUTATION		1	Reference value of the reputation of Sicily in 1999
INIT ROADS	km	'Real Km of Roads in Sicily'	Total road network in Sicily in 1999
INIT FRENCH TOURISTS	ppl	301248	Number of French tourists in Sicily in 1999.
INIT GERMAN TOURISTS	ppl	332509	Number of German tourists in Sicily in 1999.
INIT HOTEL	hotel	852	Number of Hotels in Sicily in 1999
INIT LOCAL TOURISTS	ppl	898152	Number of local tourists in Sicily in 1999.
INIT MAFIA DANGEROUSNESS		1	Initial danger posed by mafia

Name	Unit	Definition	Documentation
INIT NATURAL RESOURCES		1	Initial natural resources
INIT NORWEGIAN TOURISTS	ppl	2535	Number of Norwegian tourists in Sicily in 1999.
INIT NUMBER OF RESTAURANTS	restaurant	'INITIAL NUMBER OF RESTAURANTS INSIDE THE TOURISM AREA'+'INITIAL NUMBER OF RESTAURANT OUTSIDE THE TOURISM AREA'	Total number of restaurants in Sicily in 1999
INIT POPULATION OF SICILY	ppl	5004493<<ppl>>	Population in Sicily in 1999
INIT ROAD CONSTRUCTION RATE	km/yr	4362,473082<<km/yr>>	Initial rate of construction of new roads
INIT SPANISH TOURISTS	ppl	35841	Number of Spanish tourists in Sicily in 1999.
INIT TOURISTS FROM REST-OF-ITALY	ppl	1393994	Number of tourists in Sicily coming from the rest of Italy in 1999
INIT TOURISTS FROM UK	ppl	60890	Number of UK tourists in Sicily in 1999.
INIT UNEMPLOYED MALES AGED 15 AND OVER	ppl	233,01<<ppl>>	Unemployed males in 1999 (aged 15 years and above)
INIT UNEMPLOYMENT NET INFLOW FOR MALE AGED 15 AND OVER	ppl/yr	-19,46216625	Net rate of male (aged 15 years and above) unemployment in 1999 (1000 people per year)
INIT VALUE FOR TURISM PRESSURE		'tourism pressure'	Initial value for tourism pressure

Name	Unit	Definition	Documentation
INIT VALUE OF MALES IN SICILY AGED 15 AND OVER WITH PRIMARY OR LOWER SECONDARY EDUCATION	ppl	1683,00<<ppl>>	Males aged 15 and above with primary or lower level of education attained (1000 people) in 1999
INIT WMC		1	Initial waste management capacity
INITIAL GAP IN BED-PLACES	bed	11749 <<bed>>	Initial gap in bed-places
INITIAL NUMBER OF BED-PLACES	bed	75369	Initial number of bed-places
INITIAL NUMBER OF NEW HOTELS	hotel	67<<hotel>>	Initial number of new hotels to build
INITIAL NUMBER OF NEW RESTAURANTS LOCATED INSIDE THE TOURISM AREA	restaurant	602,1614343<<restaurant>>	Initial umber of new restaurants located inside the tourism area
INITIAL NUMBER OF NEW RESTAURANTS OUTSIDE THE TOURISM AREA	restaurant	200<<restaurant>>	Initial number of new restaurants outside the tourism area
INITIAL NUMBER OF RESTAURANT OUTSIDE THE TOURISM AREA	restaurant	1591,493585<<restaurant>>	Initial number of restaurants outside the tourism area
INITIAL NUMBER OF RESTAURANTS INSIDE THE TOURISM AREA	restaurant	2000,449378	Initial number of restaurants inside the tourism area.
INITIAL PRESENCES IN HOTELS	night	'total presences'	Initial number of nights tourists spent in hotels

Name	Unit	Definition	Documentation
INITIAL TOURISM PRESSURE		0,559077904	Tourism pressure initial value
INITIAL VALUE OF USW PRODUCTION		2480,571	Urban solid wastes produced in Sicily in 1999 (1000 kg)
intervention for environment restoration		'usw production index'*'Waste Management Capacity'	restoration o the urban environment.
land accessibility	km^-1	Roads/'LAND AREA OF SICILY'	km of road per km^2 of land
LAND AREA OF SICILY	km^2	25405	Total land area of Sicily
LITERACY RATIO REFERENCE VALUE		'population literacy ratio'	
LOCAL GDP COEFFICIENT		-2,040433542	Effect of local GDP on the decision to travel in Sicily
LOCAL COEFFICIENT FOR CULTURAL RESOURCES		0,190058588	Effect of cultural resources in Sicily on local tourists' arrivals
LOCAL COEFFICIENT FOR HOTELS		0,322354198	Effect of number of hotels in Sicily on local tourists' arrivals
LOCAL COEFFICIENT FOR NATURAL RESOURCES		1,41651042	Effect of natural resources in Sicily on local tourists' arrivals
LOCAL COEFFICIENT FOR RESTAURANTS		0,047507124	Effect of number of restaurants in Sicily on local tourists' arrivals
LOCAL COEFFICIENT FOR ROADS		0,0451465	Effect of roads in Sicily on local tourists' arrivals
LOCAL COEFFICIENT FOR URBAN ENVIRONMENT		0,234575437	Effect of urban environment in Sicily on local tourists' arrivals

Name	Unit	Definition	Documentation
local demand of seats in restaurants inside the tourism area	seat	'resident eager to have a meal inside the tourism area'/'rotation of seats'	Demand for seat in restaurant inside the tourism area generated by local people.
local incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed number of local tourists')^'LOCAL TOURISTS COEFFICIENT'*'attractiveness of Sicily for local tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN LOCAL TOURISM MARKET')*1<<ppl>>-'local tourists')/NUMBER('LOCAL TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of local tourists in Sicily
LOCAL POPULATION COEFFICIENT		0,796861312	Effect of local population on the decision to travel within Sicily.
LOCAL POPULATION REFERENCE VALUE	ppl	5004493<<ppl>>	Local population in 1999
local presences	night	'local tourists'*'average LENGTH of stay for local tourists'	Number of nights local tourists spend in Sicily
LOCAL TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in local tourism market
local tourism_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 898152; 987862; 1061618; 1060538; 1115275; 1177700; 1237115; 1282784; 1268105 //Min:4965000;Max:5014000//}<<ppl>>)	Real number of local tourists
local tourists	ppl	'INIT LOCAL TOURISTS'	Local tourists in Sicily
LOCAL TOURISTS SMOOTHING FACTOR		0,515975959	Local tourists smoothing factor
LOCAL TOURISTS COEFFICIENT		0,857920228	Effect of past local tourists' arrivals on future arrivals
local utilization index of vehicles		'AVERAGE DAYS OF UTILIZATION OF VEHICLES IN SICILY'/365<<da>>	Utilization index of vehicles in Sicily
low cost flights from France	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1,648721271;1,648721271;2,718281828;2,718281828;2,718281828;2,718281828;4,48168907;2,718281828;4,48168907//Min:0;Max:10//}<<flight>>)	Number of low cost flights from Paris to Sicily
low cost flights from Germany	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1,648721271; 1,648721271; 1,648721271; 1,648721271; 4,48168907; 7,389056099; 7,389056099; 7,389056099 //Min:0;Max:10//}<<flight>>)	Number of low cost flights from Berlin to Sicily
low cost flights from Norway	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1; 1; 1; 1; 1; 2,718281828; 7,389056099; 7,389056099 //Min:0;Max:10//}<<flight>>)	Number of low cost flights from Oslo to Sicily

Name	Unit	Definition	Documentation
low cost flights from Spain	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{1; 1; 1; 1; 1; 1; 2,718281828; 7,389056099; 7,389056099 //Min:0;Max:10//}<<flight>>)	Number of low cost flights from Madrid to Sicily
low cost flights from UK	flight	GRAPHCURVE(NUMBER(TIME);1999;1;{7,389056099; 7,389056099; 12,18249396; 7,389056099; 12,18249396; 33,11545196; 33,11545196; 90,0171313; 90,0171313 //Min:0;Max:100//}<<flight>>)	Number of low cost flights from London to Sicily
lower education completion rate	ppl/yr	'LOWER SECODARY EDUCATION COMPLETION RATE REFERENCE VALUE'*('population of Sicily'/'INIT POPULATION')^'EFFECT OF POPULATION ON MALES AGED 15 AND OVER WITH PRIMARY OR LOWER SECONDARY EDUCATION'	Rate of males completing the lower education (1000 people)
LOWER SECONDARY EDUCATION COMPLETION RATE REFERENCE VALUE	ppl/yr	6,383<<ppl/yr>>	Rate of males completing the lower secondary education (1000 people per year) in 1999
Mafia murders	crime	GRAPHCURVE(NUMBER(TIME);1999;1;{ 28; 18; 20; 11; 10; 8; 5; 4; 3; 2 //Min:0;Max:69//}<<crime>>)	Time series of Mafia murders since 1999 to 2005
Males in Sicily Aged 15 and Over With Primary or Lower Secondary Education	ppl	'INIT VALUE OF MALES IN SICILY AGED 15 AND OVER WITH PRIMARY OR LOWER SECONDARY EDUCATION'	Males aged 15 and above by highest level of education attained (1000 people)
Males in Sicily Aged 15 and Over With Primary or Lower Secondary Education_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 1683,00; 1438,17; 1318,02; 1311,01; 1270,03; 1267,01; 1266,01; 1262,05; 1262,02 //Min:280;Max:1320//}<<ppl>>)	Real number of males aged 15 and above by primary or lower level of education attained (1000 people)
Natural Resources		'INIT NATURAL RESOURCES'	Actual stock of natural resources.
natural resources inflow	yr^-1	'Shortfall in natural resources'/'AVERAGE TIME TO MAKE ENJOYABLE NEW NATURAL RESOURCES'	Number of additional natural resources per year
natural resources_real		GRAPHCURVE(NUMBER(TIME);1999;1;{ 1; 1,062052617; 1,074981281; 1,092132227; 1,092132227; 1,100385504; 1,109610351; 1,109664315; 1,109664315 //Min:0;Max:2//})	Real Number of natural resources

Name	Unit	Definition	Documentation
new roads to construct for accessibility	km	'LAND AREA OF SICILY'*'gap in land accessibility'	New road to build to increase accessibility of Sicily
new roads to construct because of crowding	km	MAX('desired roads'-Roads;0<<km>>)	New road to build to face traffic issue
nights in the year	night	IF((FRAC(YEAR(TIME)/4)=0);366;365)*1<<night>>	Number of nights in the year
non resident tourists in Sicily	ppl	'Rest-of-Italy Tourists'+'foreign tourists in Sicily'	Number of non-resident tourists in Sicily
NORMAL DETERIORATION		1	normal deterioration
normalized Mafia murders		'Mafia murders'/'REFERENCE VALUE FOR MAFIA MURDERS'	Mafia murders normalized to the value of 1999
normalized petty crime		'petty crime'/'PETTY CRIME REFEERENCE VALUE'	Petty crime cases normalized to the value of 1999
NORWEGIAN COEFFICIENT FOR CULTURAL RESOURCES		1,445447844	Effect of cultural resources in Sicily on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR DIRECT FLIGHT		0	Effect of number of direct flights to Sicily on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR DIRECT LOW COST FLIGHT		0	Effect of number of direct low cost flights to the international airports of Milan and Rome on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR HOTELS		0	Effect of number of hotels in Sicily on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR LOW COST FLIGHT		0,119355358	Effect of number of low cost flights to the international airports of Milan and Rome on Norwegian tourists' arrivals

Name	Unit	Definition	Documentation
NORWEGIAN COEFFICIENT FOR NATURAL RESOURCES		1,638070959	Effect of natural resources in Sicily on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR REPUTATION		2,50E-06	Effect of Sicily reputation on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR RESTAURANTS		0,299	Effect of number of restaurants in Sicily on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR ROADS		0,793293912	Effect of roads in Sicily on Norwegian tourists' arrivals
NORWEGIAN COEFFICIENT FOR URBAN ENVIRONMENT		2,999867124	Effect of urban environment in Sicily on Norwegian tourists' arrivals
NORWEGIAN DIRECT FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct flights from Norway to Palermo in 1999
NORWEGIAN DIRECT LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct low cost flights from Norway to Palermo in 1999
NORWEGIAN GDP COEFFICIENT		0,2	Effect of Norwegian GDP on the decision to travel in Sicily
Norwegian gdp exponentially smoothed for travelling decision	PPS	'GDP OF NORWAY SMOOTHING FACTOR FOR TRAVELLING DECISION'*'GDP Norway'+(1-'GDP OF NORWAY SMOOTHING FACTOR FOR TRAVELLING DECISION')*DELAYINF('GDP Norway';(1/'GDP OF NORWAY SMOOTHING FACTOR FOR TRAVELLING DECISION')*1<<yr>>)	GDP of Norway in Purchasing Power Standards exponentially smoothed for travelling decision

Name	Unit	Definition	Documentation
Norwegian incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed Norwegian tourists')^'NORWEGIAN TOURISTS COEFFICIENT'*'attractiveness of Sicily for Norwegian tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN NORWEGIAN TOURISM MARKET')*1<<ppl>>-'Norwegian Tourists')/NUMBER('NORWEGIAN TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of Norwegian tourists in Sicily
NORWEGIAN LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct flights from Norway to Palermo in 1999
Norwegian population	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 4445329; 4478497; 4503436; 4524066; 4552252; 4577457; 4606363; 4640219; 4681134 //Min:4000000;Max:5000000//}<<ppl>>)	Population in Norway
NORWEGIAN POPULATION COEFFICIENT		0,000178689	Effect of Norwegian population on the decision to travel to Sicily.
NORWEGIAN POPULATION REFERENCE VALUE	ppl	4445329<<ppl>>	Population of Norway in 1999
Norwegian presences	night	'Norwegian Tourists'*'average length of stay for Norwegian tourists'	Number of nights Norwegian tourists spend in Sicily
NORWEGIAN TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in Norwegian tourism market
Norwegian Tourism_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 2535; 3602; 3645; 6162; 6254; 8671; 7850; 9807; 12833 //Min:2000;Max:15000//}<<ppl>>)	Real number of tourists from Norway
Norwegian Tourists	ppl	'INIT NORWEGIAN TOURISTS'	Norwegian tourists in Sicily
NORWEGIAN TOURISTS COEFFICIENT		0,811654248	Effect of past Norwegian tourists' arrivals on future arrivals
NORWEGIAN TOURISTS SMOOTHING FACTOR		0,999998055	Norwegian tourists smoothing factor
not-travelling local presences	da	('total presences in Sicily'-'local presences')*1<<da/night>>	Presences in Sicily of locals not on vacation.

Name	Unit	Definition	Documentation
number of tourists in Sicily	ppl	'French Tourists'+'German Tourists'+'Norwegian Tourists'+'Spanish Tourists'+'UK Tourists'+'Rest-of-Italy Tourists'+'local tourists'+'rest-of-the-World tourists'	Number of tourists in Sicily
number of vehicles circulating in Sicily	vehicle	'active vehicles in Sicily'+'vehicles belonging to Italian tourists travelling by their own car'	Total number of circulating vehicles in Sicily
number of vehicles registered in Sicily	vehicle	'VEHICLES IN SICILY REFERENCE VALUE'*(('exponentially smoothed gdp for vehicle acquisition'/'GDP REFERENCE VALUE')^'EFFECT OF GDP ON NUMBER OF VEHICLES IN SICILY'* ('population of Sicily'/'POPULATION REFERENCE VALUE')^'EFFECT OF POPULATION ON NUMBER OF VEHICLES IN SICILY'* (('Rest-of-Italy Tourists'*(1-'AVERAGE PERCENTAGE OF ITALIANS TRAVELLING BY THEIR OWN VEHICLE')/('REST OF ITALY TOURISTS REFERENCE VALUE'*(1-'AVERAGE PERCENTAGE OF ITALIANS TRAVELLING BY THEIR OWN VEHICLE'))))^'EFFECT OF REST OF ITALY ARRIVALS ON NUMBER OF VEHICLES IN SICILY'* ('foreign arrivals in Sicily'/'FOREIGN ARRIVALS REFERNCE VALUE')^'EFFECT OF FOREIGN ARRIVALS ON NUMBER OF VEHICLES')	Total number of registered vehicles in Sicily
ORDINARY SATURATION CAPACITY	yr	15<<yr>>	ordinary numbers of years to saturate the wmc
PAST TIME FOR FORECASTING	yr	0,515817996292832<<yr>>	The average number of years used in computing the trend in presences in hotels
PAST YEARS OF OBSERVATIONS FOR FORECAST	yr	12<<yr>>	Past years of observation for forecast
perceived distance from France	Km	('GEOGRAPHICAL DISTANCE FROM FRANCE'* ('direct flights from France'/'FRENCH DIRECT FLIGHTS REFERENCE VALUE')^'FRENCH COEFFICIENT FOR DIRECT FLIGHT'* ('low cost flights from France'/'FRENCH LOW COST FLIGHTS REFERENCE VALUE')^'FRENCH COEFFICIENT FOR LOW COST FLIGHT'* ('direct low cost flights from France'/'FRENCH DIRECT LOW COST FLIGHTS REFERENCE VALUE')^'FRENCH COEFFICIENT FOR DIRECT LOW COST FLIGHT')/'DISTANCE FROM FRANCE REFERENCE VALUE'	perceived distance from France

Name	Unit	Definition	Documentation
perceived distance from Germany	Km	('GEOGRAPHICAL DISTANCE FROM GERMANY'* ('direct flights from Germany'/'GERMAN DIRECT FLIGHTS REFERENCE VALUE')^'GERMAN COEFFICIENT FOR DIRECT FLIGHT'* ('low cost flights from Germany'/'GERMAN LOW COST FLIGHTS REFERENCE VALUE')^'GERMAN COEFFICIENT FOR LOW COST FLIGHT'* ('direct low cost flights from Germany'/'GERMAN DIRECT LOW COST FLIGHTS REFERENCE VALUE')^'GERMAN COEFFICIENT FOR DIRECT LOW COST FLIGHT')/'DISTANCE FROM GERMANY REFERENCE VALUE'	perceived distance from Germany
perceived distance from Norway	Km	('GEOGRAPHICAL DISTANCE FROM NORWAY'* ('direct flights from Norway'/'NORWEGIAN DIRECT FLIGHTS REFERENCE VALUE')^'NORWEGIAN COEFFICIENT FOR DIRECT FLIGHT'* ('low cost flights from Norway'/'NORWEGIAN LOW COST FLIGHTS REFERENCE VALUE')^'NORWEGIAN COEFFICIENT FOR LOW COST FLIGHT'* ('direct low cost flights from Norway'/'NORWEGIAN DIRECT LOW COST FLIGHTS REFERENCE VALUE')^'NORWEGIAN COEFFICIENT FOR DIRECT LOW COST FLIGHT')/'DISTANCE FROM NORWAY REFERENCE VALUE'	perceived distance from Norway
perceived distance from rest-of-Italy	Km	('GEOGRAPHICAL DISTANCE FROM REST-OF-ITALY'* ('direct flights from rest-of-Italy'/'REST-OF-ITALY DIRECT FLIGHTS REFERENCE VALUE')^'REST-OF-ITALY COEFFICIENT FOR DIRECT FLIGHT'* ('direct low cost flights from rest-of-Italy'/'REST-OF-ITALY DIRECT LOW COST FLIGHTS REFERENCE VALUE')^'REST-OF-ITALY COEFFICIENT FOR DIRECT LOW COST FLIGHT')/'DISTANCE FROM REST-OF-ITALY REFERENCE VALUE'	perceived distance from rest-of-Italy
perceived distance from Spain	Km	('GEOGRAPHICAL DISTANCE FROM SPAIN'* ('direct flights from Spain'/'SPANISH DIRECT FLIGHTS REFERENCE VALUE')^'SPANISH COEFFICIENT FOR DIRECT FLIGHT'* ('low cost flights from Spain'/'SPANISH LOW COST FLIGHTS REFERENCE VALUE')^'SPANISH COEFFICIENT FOR LOW COST FLIGHT'* ('direct low cost flights from Spain'/'SPANISH DIRECT LOW COST FLIGHTS REFERENCE VALUE')^'SPANISH COEFFICIENT FOR DIRECT LOW COST FLIGHT')/'DISTANCE FROM SPAIN REFERENCE VALUE'	perceived distance from Spain

Name	Unit	Definition	Documentation
perceived distance from UK	Km	('GEOGRAPHICAL DISTANCE FROM UK'* ('direct flights from UK'/'UK DIRECT FLIGHTS REFERENCE VALUE')^'UK COEFFICIENT FOR DIRECT FLIGHT'* ('low cost flights from UK'/'UK LOW COST FLIGHTS REFERENCE VALUE')^'UK COEFFICIENT FOR LOW COST FLIGHT'* ('direct low cost flights from UK'/'UK DIRECT LOW COST FLIGHTS REFERENCE VALUE')^'UK COEFFICIENT FOR DIRECT LOW COST FLIGHT')/'DISTANCE FROM UKREFERENCE VALUE'	perceived distance from UK
percentage of males in Sicily aged 15 and over with primary or lower secondary education		'Males in Sicily Aged 15 and Over With Primary or Lower Secondary Education'*1000/'population of Sicily'	Males aged 15 and above in comparison with the total population in Sicily with primary or lower secondary education
percentage of meals at the restaurant for not-travelling locals	seat/da	NUMBER('smoothed gdp per capita for consumption in restaurants')^'EFFECT OF LOCAL REACHNESS ON THE AVERAGE NUMBER OF MEALS AT THE RESTAURANT'*1<<seat/da>>	Percentage of meals in restaurant for non-travelling locals.
Perception of Dangers Posed by the Mafia		'INIT MAFIA DANGEROUSNESS'	Perception of Mafia Dangerousness
petty crime	crime	'PETTY CRIME REFEERENCE VALUE'*('unemployment ratio'/'UNEMPLOYMENT RATIO REFERENCE VALUE')^'EFFECT OF MASCULIN UNEMPLOYMENT ON CRIMINALITY'*('population literacy ratio'/'LITERACY RATIO REFERENCE VALUE')^'EFFECT OF HIGHER EDUCATION ON CRIMINALITY'	Cases of microcriminality (pick-pocketings and bag-snatchings) reported to Police, Carabinieri or Guardia di Finanza
PETTY CRIME REFEERENCE VALUE	crime	9847	Cases of microcriminality (pick-pocketings and bag-snatchings) reported to Police, Carabinieri or Guardia di Finanza in 1999
petty crime_real	crime	GRAPHCURVE(NUMBER(TIME);1999;1;{ 9847; 9600; 7963; 6378; 6173; 4030; 3331//Min:3000;Max:10000//}<<crime>>)	Real number of petty crimes
population density	ppl/km²	'population of Sicily'/'LAND AREA OF SICILY'	Number of inhabitants in Sicily per square kilometer
population literacy ratio		'Males in Sicily Aged 15 and Over With Primary or Lower Secondary Education'*1000/'population of Sicily'	percentage of Males in Sicily Aged 15 and Over With Primary or Lower Secondary Education

Name	Unit	Definition	Documentation
population of rest of Italy	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 51904616; 51929097; 51981045; 52028073; 52348946; 52884983; 53449294; 53734499; 54114426 //Min:58500000;Max:63300000//}<<ppl>>)	Population of rest of Italy
population of Sicily	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 5004493; 4994427; 4979647; 4965669; 4972124; 5003262; 5013081; 5017212; 5016861 //Min:4965000;Max:5014000//}<<ppl>>)	Population in Sicily
population of Spain	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 39802827; 40049708; 40476723; 40964244; 41663702; 42345342; 43038035; 43758250; 44474631//Min:38000000;Max:45000000//}<<ppl>>)	Population of Spain
POPULATION OF UK COEFFICIENT		0,000141808	Effect of UK population on the decision to travel to Sicily.
population of United Kingdom	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 58579685; 58785246; 58999781; 59217592; 59437723; 59699828; 60059900; 60393100; 60816701 //Min:58500000;Max:63300000//}<<ppl>>)	Population of UK
population pressure		('population of Sicily'/'INIT POPULATION OF SICILY')	Pressure exerted by tourism on local population.
POPULATION REFERENCE VALUE	ppl	'population of Sicily'	Population of Sicily in year 1999
Real Km of Roads in Sicily	km	GRAPHCURVE(NUMBER(TIME);1995;1;{ 22385; 37826; 37826; 17511; 16373; 16619; 18446; 16632; 16228; 18726; 17098 //Min:16200;Max:37900//}<<km>>)	Real Km of Roads in Sicily
Real Number of Hotels	hotel	GRAPHCURVE(NUMBER(TIME);1999;1;{ 852; 868; 879; 907; 958; 996; 1068; 1134; 1171//Min:850;Max:1175//}<<hotel>>)	Real Number of Hotels
Real Number of Restaurant in Sicily	restaurant	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3483; 4291; 4516; 4945; 5201; 5546; 5822; 6100; 6396 //Min:3450;Max:6550//}<<restaurant>>)	Real Number of Restaurant in Sicily
REFERENCE VALUE FOR LOCAL GDP	PPS	67759,38<<PPS>>	Local GDP in 1999 in PPS
REFERENCE VALUE FOR MAFIA MURDERS	crime	'Mafia murders'//28<<crime>>	Number of Mafia murders in 1999

Name	Unit	Definition	Documentation
REFERENCE VALUE FOR PERCENTAGE OF MALES IN SICILY AGED 15 AND OVER WITH PRIMARY OF LOWER SECONDARY EDUCATION		'percentage of males in Sicily aged 15 and over with primary or lower secondary education'	Percentage of males in Sicily with primary or lower secondary education for year 1999
REFERENCE VALUE FOR POPULATION PRESSURE		'population pressure'	Reference value for population pressure
REFERENCE VALUE FOR SMOOTHED GDP SICILY FOR EMPLOYMENT RELATED CONSIDERATIONS	PPS	'smoothed gdp Sicily for employment related considerations'	Sicilian GDP reference value smoothed for employment related considerations
reputation inflow	yr^-1	IF ('INIT REPUTATION'-'total threat to the tourist in Sicily'>=0;('INIT REPUTATION'-'total threat to the tourist in Sicily')/'TIME TO IMPROVE REPUTATION OF SICILY';0<<yr^-1>>)	Improving reputation
Reputation of Sicily		'INIT REPUTATION'	Reputation of Sicily over time
reputation outflow	yr^-1	MIN('Reputation of Sicily'*1<<yr^-1>>;IF ('INIT REPUTATION'-'total threat to the tourist in Sicily'<0;('total threat to the tourist in Sicily'-'INIT REPUTATION')/'TIME TO WORSEN REPUTATION OF SICILY';0<<yr^-1>>))	Worsening reputation
resident eager to have a meal inside the tourism area	seat	'average number of meals consumed at the restaurant for not-travelling locals'*'AVERAGE PERCENTAGE OF RESIDENTS EAGER TO HAVE A MEAL INSIDE THE TOURISM AREA'	Resident people eager to have a meal inside the tourism area
REST OF ITALY TOURISTS REFERENCE VALUE	ppl	'Rest-of-Italy Tourists'	Tourists arrived in Sicily in 1999 from other Italian regions
restaurants	restaurant	'Restaurants Inside the Tourism Area'+'Restaurants Outside the Tourism Area'	Total number of restaurants in Sicily

Name	Unit	Definition	Documentation
restaurants acquisition inside the tourism area	restaurant/yr	INTEGER(NUMBER(DELAYINF('desired number of new restaurants inside the tourism area';'TIME TO DECIDE TO OPEN A NEW RESTAURANT INSIDE THE TOURISM AREA';1;'INITIAL NUMBER OF NEW RESTAURANTS LOCATED INSIDE THE TOURISM AREA')))*1<<restaurant>>/'AVERAGE TIME TO MAKE OPERATIVE A RESTAURANT'	Rate of acquisition of new hotels inside the tourism area.
Restaurants Inside the Tourism Area	restaurant	'INITIAL NUMBER OF RESTAURANTS INSIDE THE TOURISM AREA'	Number of restaurants inside the tourism area
restaurants located inside the tourism area	restaurant/yr	INTEGER(NUMBER('Restaurants Inside the Tourism Area'/'AVERAGE LIFE FOR RESTAURANT INSIDE THE TOURISM AREA'))*1<<restaurant/yr>>	Restaurants located inside the tourism area.
Restaurants Outside the Tourism Area	restaurant	'INITIAL NUMBER OF RESTAURANT OUTSIDE THE TOURISM AREA'	Number of restaurants outside the tourism area
REST-OF-ITALY DIRECT FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct flights from Rome to Palermo in 1999
REST-OF-ITALY DIRECT LOW COST FLIGHTS REFERENCE VALUE	flight	2,718281828<<flight>>	Direct low cost flights from rest-of-Italy to Palermo in 1999
REST-OF-ITALY REFERENCE VALUE FOR GDP	PPS	1123563,319<<PPS>>	rest-of-Italy GDP in 1999 in PPS
REST-OF-ITALY COEFFICIENT FOR CULTURAL RESOURCES		1,370071542	Effect of cultural resources in Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR DIRECT FLIGHT		0,130587655	Effect of number of direct flights to Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR DIRECT LOW COST FLIGHT		0,165939364	Effect of number of direct low cost flights to Palermo on rest-of-Italy tourists' arrivals

Name	Unit	Definition	Documentation
REST-OF-ITALY COEFFICIENT FOR HOTELS		0,158130583	Effect of number of hotels in Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR NATURAL RESOURCES		0,129572886	Effect of natural resources in Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR REPUTATION		0	Effect of Sicily reputation on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR RESTAURANTS		0,525495989	Effect of number of restaurants in Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR ROADS		2,550708354	Effect of roads in Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY COEFFICIENT FOR URBAN ENVIRONMENT		4,982598367	Effect of urban environment in Sicily on rest-of-Italy tourists' arrivals
REST-OF-ITALY GDP	PPS	GRAPHCURVE(NUMBER(TIME);1999;1;{ 1123563,319; 1195590,525; 1253767,643; 1237038,088; 1248910,919; 1269679,573; 1299635,742; 1367388,461; 1425388,032 //Min:960000;Max:1800000//}<<PPS>>)	Rest of Italy Gross Domestic Product in Purchasing Power Standards.
REST-OF-ITALY GDP COEFFICIENT		0,118025	Effect of rest of Italy GDP on the decision to travel to Sicily
rest-of-Italy incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed number of tourists from rest-of-Italy')^'TOURISTS FROM REST-OF-ITALY COEFFICIENT'*'attractiveness of Sicily for rest-of-Italy tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN REST-OF-ITALY TOURISM MARKET')*1<<ppl>>-'Rest-of-Italy Tourists')/NUMBER('REST-OF-ITALY TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of rest of Italy tourists in Sicily
REST-OF-ITALY POPULATION COEFFICIENT		6,19E-07	Effect of rest of Italy population on the decision to travel to Sicily.

Name	Unit	Definition	Documentation
REST-OF-ITALY POPULATION REFERENCE VALUE	ppl	51904616<<ppl>>	Population of rest-of-Italy in 1999
Rest-of-Italy presences	night	'Rest-of-Italy Tourists'*'average length of stay for Rest-of-Italy tourists'	Number of nights rest of Italy tourists spend in Sicily
REST-OF-ITALY TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in rest-of-Italy tourism market
Rest-of-Italy Tourists	ppl	'INIT TOURISTS FROM REST-OF-ITALY'	Rest of Italy tourists in Sicily
rest-of-the-World presences	night	'rest-of-the-World tourists'*'average length of stay for rest-of-the-World tourists'	Number of nights rest of World tourists spend in Sicily
rest-of-the-World tourists	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 602417,00; 694570,00; 734500,00; 723615,00; 666302,00; 701811,00; 738899,00; 769022,00; 799145,00 //Min:3500000;Max:5000000//}<<ppl>>)	Total number of rest of World tourists in Sicily
ROAD ADJUSTMENT TIME	yr	8	Time to build a new road
road construction	km/yr	DELAYMTR('roads construction rate';'TIME TO PLACE NEW ROAD CONSTRUCTION PROJECTS';1;'INIT ROAD CONSTRUCTION RATE')	New road construction rate
road crowding		'density of vehicles in Sicily'/'AVERAGE SUSTAINABLE NUMBER OF VEHICLES PER KM OF ROAD'	Ratio between the average number of active vehicles per km in Sicily and the average sustainable number of vehicles per km
road crowding index		'road crowding'/'ROAD CROWDING REFERENCE VALUE'	Index of crowding of roads
ROAD CROWDING REFERENCE VALUE		'road crowding'	Value in 1999 of the road crowding ratio
road disruption	km/yr	MAX((Roads/('AVERAGE ROAD LIFE'*IF('road crowding'<=1;1;'road crowding'^'EFFECT OF ROAD CROWDING ON AVERAGE ROAD LIFE'))))-Roads*'AVERAGE ROAD MAINTENANCE'; 0<<km/yr>>)	Road disruption rate (Roads/('Average Road Life'/IF('road crowding'<=1;1;'road crowding'^'Effect of Road Crowding on Road Disruption')))-Roads*'Average Road Maintenance'
Roads	km	'INIT ROADS'	Total road network in Sicily
roads construction rate	km/yr	'total new roads to construct'/'ROAD ADJUSTMENT TIME'	New km of road per year
rotation of seats		'AVERAGE WORKING HOURS PER DAY'/'AVERAGE TIME TO COMPLETE A MEAL'	Average number of times a new customer succeeds the old one in the same seat in a restaurant (turnover value)

Name	Unit	Definition	Documentation
seats for non-travelling locals looking for a seat in restaurants outside the tourism area	seat	'average number of meals consumed at the restaurant for not-travelling locals'*(1-'AVERAGE PERCENTAGE OF RESIDENTS EAGER TO HAVE A MEAL INSIDE THE TOURISM AREA')	Local people willing to have a meal in restaurants outside the tourism area.
('desired cultural resources-'Cultural Resources')+0,0000000000000000000000000000001		MAX('desired cultural resources'-'Cultural Resources';0)+0,0000000000000000000000000000001	Gap in cultural resources.
Shortfall in natural resources		MAX('desired natural resources'-'Natural Resources';0)+0,0000000000000000000000000000001	Gap in natural resources.
Sicilian GDP smoothed for employment-related considerations	PPS	'GDP SICILY SMOOTHING FACTOR FOR EMPLOYMENT RELATED CONSIDERATIONS'*'gdp of Sicily'+(1-'GDP SICILY SMOOTHING FACTOR FOR EMPLOYMENT RELATED CONSIDERATIONS')*DELAYINF('gdp of Sicily';(1/'GDP SICILY SMOOTHING FACTOR FOR EMPLOYMENT RELATED CONSIDERATIONS')*1<<yr>>)	Sicilian GDP exponentially smoothed for employment related considerations
Sicilian socio-economic conditions normalized value		(('smoothed gdp Sicily for employment related considerations'/'REFERENCE VALUE FOR SMOOTHED GDP SICILY FOR EMPLOYMENT RELATED CONSIDERATIONS')^'EFFECT OF GDP ON MALE EMPLOYMENT'* ('percentage of males in Sicily aged 15 and over with primary or lower secondary education'/'REFERENCE VALUE FOR PERCENTAGE OF MALES IN SICILY AGED 15 AND OVER WITH PRIMARY OF LOWER SECONDARY EDUCATION')^'EFFECT OF HIGHER EDUCATION ON EMPLOYMENT FOR MALES AGED 15 AND OVER')	Sicily socio economic conditions with reference to1999
smoothed French tourists	ppl	DELAYINF('French Tourists';(1/'FRENCH TOURISTS SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of French tourists
SMOOTHED GDP PER CAPITA REFERENCE VALUE	PPS/ppl	'Smoothed GDP per capita Sicily'	Exponential smoothed value of GDP per capita in Sicily for year 1999

Name	Unit	Definition	Documentation
smoothed gdp per capita for consumption in restaurants		NUMBER('gdp smoothed for consumption behavior in restaurants'/'population of Sicily')	Smoothed gdp per capita for local consumption behavior in restaurants .
Smoothed GDP per capita Sicily	PPS/ppl	'GDP PER CAPITA SMOOTHING FACTOR'*'gdp per capita Sicily'+(1-'GDP PER CAPITA SMOOTHING FACTOR')*DELAYINF('gdp per capita Sicily';(1/'GDP PER CAPITA SMOOTHING FACTOR')*1<<yr>>)	Exponential smoothing of GDP per capita in Sicily
smoothed German tourists	ppl	DELAYINF('German Tourists';(1/'GERMAN TOURISTS SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of German tourists
smoothed Norwegian tourists	ppl	DELAYINF('Norwegian Tourists';(1/'NORWEGIAN TOURISTS SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of Norwegian tourists
smoothed number of local tourists	ppl	DELAYINF('local tourists';(1/'LOCAL TOURISTS SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of local tourists
smoothed number of Spanish tourists	ppl	DELAYINF('Spanish Tourists';(1/'SPANISH TOURISTS SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of Spanish tourists
smoothed number of tourists from rest-of-Italy	ppl	DELAYINF('Rest-of-Italy Tourists';(1/'TOURISTS FROM REST-OF-ITALY SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of rest of Italy tourists
smoothed number of UK tourists	ppl	DELAYINF('UK Tourists';(1/'UK TOURISTS SMOOTHING FACTOR')*1<<yr>>)	Exponentially smoothed number of UK tourists
SMOOTHING FACTOR OF FRENCH GDP FOR TRAVELLING DECISION		1	GDP of France smoothing factor for travelling decision.
social crowding index		'social crowding ratio'/'SOCIAL CROWDING RATIO REFERENCE VALUE'	Social interactions quality index
social crowding ratio		'total density'/'population density'	Ratio between the total number of people in Sicily and the local population
SOCIAL CROWDING RATIO REFERENCE VALUE		'social crowding ratio'	Value of the crowding ratio in 1999

Name	Unit	Definition	Documentation
SPANISH COEFFICIENT FOR DIRECT LOW COST FLIGHT		0	Effect of number of direct low cost flights to the international airports of Milan and Rome on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR REPUTATION		0,024992863	Effect of reputation on Spanish tourists' arrivals
SPANISH LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Low cost flights from Spain to Palermo in 1999
SPANISH COEFFICIENT FOR CULTURAL RESOURCES		0,264016163	Effect of cultural resources in Sicily on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR DIRECT FLIGHT		0	Effect of number of direct flights to Sicily on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR HOTELS		0	Effect of number of hotels in Sicily on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR LOW COST FLIGHT		0,021477111	Effect of number of low cost flights to the international airports of Milan and Rome on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR NATURAL RESOURCES		5,954392893	Effect of natural resources in Sicily on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR RESTAURANTS		1,719780796	Effect of number of restaurants in Sicily on Spanish tourists' arrivals
SPANISH COEFFICIENT FOR ROADS		3,268274359	Effect of roads in Sicily on Spanish tourists' arrivals

Name	Unit	Definition	Documentation
SPANISH COEFFICIENT FOR URBAN ENVIRONMENT		6,403741025	Effect of urban environment in Sicily on Spanish tourists' arrivals
SPANISH DIRECT FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct flights from Spain to Palermo in 1999
SPANISH DIRECT LOW COST FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct low cost flights from Spain to Palermo in 1999
SPANISH GDP COEFFICIENT		0,671917724	Effect of Spanish GDP on the decision to travel in Sicily
Spanish incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed number of Spanish tourists')^'SPANISH TOURISTS COEFFICIENT'*'attractiveness of Sicily for Spanish tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN SPANISH TOURISM MARKET')*1<<ppl>>-'Spanish Tourists')/NUMBER('SPANISH TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of Spanish tourists in Sicily
SPANISH POPULATION COEFFICIENT		0,000638189	Effect of Spanish population on the decision to travel to Sicily.
SPANISH POPULATION REFERENCE VALUE	ppl	39802827<<ppl>>	Population of Spain in 1999
Spanish presences	night	'Spanish Tourists'*'average length of stay for Spain tourists'	Number of nights Spanish tourists spend in Sicily
SPANISH TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in Spanish tourism market
Spanish Tourists	ppl	'INIT SPANISH TOURISTS'	Spanish tourists in Sicily
SPANISH TOURISTS COEFFICIENT		0,943722127	Effect of past Spanish tourists' arrivals on future arrivals
SPANISH TOURISTS SMOOTHING FACTOR		1,09E-06	Spanish tourists smoothing factor

Name	Unit	Definition	Documentation
Spanish Tourists_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 35841; 44552; 68839; 82734; 104335; 112808; 118897; 132967; 129083 //Min:38000000;Max:45000000//}<<ppl>>)	Real number of Spanish tourists
supply of seats in restaurants inside the tourism area	seat	INTEGER('Restaurants Inside the Tourism Area'*'average number of seats per restaurant'*'AVERAGE WORKING DAYS PER RESTAURANT INSIDE THE TOURISM AREA'*1<<da^-1>>)	Total number of seats in restaurants inside the tourism area.
TIME FOR A NEGATIVE CHANGE IN THE PERCEPTION OF DANGERS POSED BY THE MAFIA	yr	1	Number of years to modify the idea of danger posed by mafia into negative
TIME FOR A POSITIVE CHANGE IN THE PERCEPTION OF DANGERS POSED BY THE *MAFIA*	yr	5	Number of years to modify the idea of danger posed by mafia into positive
TIME NECESSARY TO REACT TO TOURISM PRESSURE	yr	1,398083604<<yr>>	Average time to react to tourism demand
TIME TO DECIDE FOR NEW NATURAL RESOURCES	yr	3<<yr>>	Average time to take the decision to invest on new natural resources
TIME TO DECIDE TO OPEN A NEW RESTAURANT INSIDE THE TOURISM AREA	yr	2,507272015<<yr>>	Average time to take the decision to open a new restaurant outside the tourism area
TIME TO DECIDE TO OPEN A NEW RESTAURANT OUTSIDE THE TOURISM AREA	yr	2,513598829<<yr>>	Average time to take the decision to open a new restaurant inside the tourism area

Name	Unit	Definition	Documentation
TIME TO DECIDE TO START A NEW HOTEL	yr	4,594876364 <<yr>>	Number of year before the decision to build a new hotel.
TIME TO IMPROVE REPUTATION OF SICILY	yr	3	Years needed for people to change in positive the image of Sicily
TIME TO INITIATE NEW ROAD CONSTRUCTION PROJECTS	yr	10<<yr>>	Time needed to start the construction of new roads
time to make enjoyable new cultural resources	yr	'AVERAGE TIME TO MAKE ENJOYABLE NEW CULTURAL RESOURCES'*IF('shortfall in cultural resources'=0;INFINITY;'shortfall in cultural resources'^'EFFECT OF SHORTFALL IN CULTURAL RESOURCES ON THE AVERAGE TIME TO MAKE ENJOYABLE NEW CULTURAL RESOURCES')	time to make enjoyable new cultural resources
TIME TO WORSEN REPUTATION OF SICILY	yr	1	Years needed for people to change in negative the image of Sicily
total density	ppl/km²	'population density'+'tourism density'	Total number of people in Sicily per square kilometer
total new roads to construct	km	'new roads to construct because of crowding'+'new roads to construct for accessibility'	Total kilometers of new roads to build
total number of non-resident tourists in Sicily	ppl	'foreign arrivals in Sicily'+'Rest-of-Italy Tourists'	Total number of tourists arrived from outside Sicily
total number of tourists in Sicily	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3627586; 3963999; 4025146; 4044080; 4070631; 4229510; 4297716; 4568914; 4588011 //Min:3500000;Max:5000000//}<<ppl>>)	total number of tourists in Sicily
total presences	night	'French presences'+'German presences'+'Norwegian presences'+'Spanish presences'+'UK presences'+'Rest-of-Italy presences'+'local presences'+'rest-of-the-World presences'	Total number of nights spent by locals
total presences in Sicily	night	'population of Sicily'*'nights in the year'*1<<ppl^-1>>	Total local presences in Sicily.

Name	Unit	Definition	Documentation
total threat to the tourist in Sicily		((('Perception of Mafia Dangerousness'^'EFFECT OF PERCEIVED DANGER POSED BY THE MAFIA ON TOTAL THREAT')+ ('normalized petty crime'^'EFFECT OF PETTY CRIME ON TOTAL THREAT'))/2)	Reputation of Sicily over time
tourism demand for seats in restaurants inside the tourism area	seat	INTEGER(((('foreign presences'+'Rest-of-Italy presences')*'AVERAGE NUMBER OF MEALS FOR NON RESIDENT TOURISTS')+ ('local presences'*'AVERAGE NUMBER OF MEALS FOR LOCAL TOURISTS'))*'DAYS PER NIGHT'/'rotation of seats')	Total number of demanded seats in restaurants inside the tourism area.
tourism density	ppl/km²	'total number of non-resident tourists in Sicily'/'LAND AREA OF SICILY'	Number of tourists over population in Sicily
tourism pressure		'non resident tourists in Sicily'/'population of Sicily'	Pressure exerted by tourism on local population.
TOURISM PRESSURE REFERENCE VALUE		'tourism pressure'	Tourism pressure in year 1999.
TOURISTS FROM REST-OF-ITALY COEFFICIENT		0,914260514	Effect of past French tourism arrivals on future arrivals
TOURISTS FROM REST-OF-ITALY SMOOTHING FACTOR		0,999999767	French tourists smoothing factor
Tourists from rest-of-Italy_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 1393994; 1465457; 1406119; 1435006; 1509222; 1538567; 1513461; 1556115; 1532150 //Min:58500000;Max:63300000//}<<ppl>>)	Tourists from rest-of-Italy_real
UK COEFFICIENT FOR CULTURAL RESOURCES		0,635269068	Effect of cultural resources in Sicily on UK tourists' arrivals
UK COEFFICIENT FOR DIRECT FLIGHT		0	Effect of number of direct flights to Sicily on UK tourists' arrivals
UK COEFFICIENT FOR DIRECT LOW COST FLIGHT		0	Effect of number of Direct low cost flights to the international airports of Milan and Rome on UK tourists' arrivals
UK COEFFICIENT FOR HOTELS		0	Effect of number of hotels in Sicily on UK tourists' arrivals

Name	Unit	Definition	Documentation
UK COEFFICIENT FOR LOW COST FLIGHT		0,026861408	Effect of number of low cost flights to the international airports of Milan and Rome on UK tourists' arrivals
UK COEFFICIENT FOR NATURAL RESOURCES		0,729739281	Effect of natural resources in Sicily on UK tourists' arrivals
UK COEFFICIENT FOR REPUTATION		0,182106952	Effect of Sicily reputation on UK tourists' arrivals
UK COEFFICIENT FOR RESTAURANTS		0,972284474	Effect of number of restaurants in Sicily on UK tourists' arrivals
UK COEFFICIENT FOR ROADS		0,199195935	Effect of roads in Sicily on UK tourists' arrivals
UK COEFFICIENT FOR URBAN ENVIRONMENT		1,533521734	Effect of natural resources in Sicily on UK tourists' arrivals
UK DIRECT FLIGHTS REFERENCE VALUE	flight	1<<flight>>	Direct flights from UK to Palermo in 1999
UK DIRECT LOW COST FLIGHTS REFERENCE VALUE	flight	2,718281828<<flight>>	Direct low cost flights from UK to Palermo in 1999
UK GDP COEFFICIENT		0,620676356	Effect of UK GDP on the decision to travel to Sicily
UK incoming tourism	ppl/yr	INTEGER(((NUMBER('smoothed number of UK tourists')^'UK TOURISTS COEFFICIENT'*'attractiveness of Sicily for UK tourists'*'ATTRACTIVENESS COEFFICIENT FOR SICILY IN UK TOURISM MARKET')*1<<ppl>>-'UK Tourists')/NUMBER('UK TOURISM ADJUSTMENT TIME'))*1<<yr^-1>>	Flow of UK tourists in Sicily
UK LOW COST FLIGHTS REFERENCE VALUE	flight	7,389056099<<flight>>	Direct flights from UK to Palermo in 1999
UK POPULATION REFERENCE VALUE	ppl	58579685<<ppl>>	Population of UK in 1999
UK presences	night	'UK Tourists'*'average length of stay for UK tourists'	Number of night UK tourists spend in Sicily
UK TOURISM ADJUSTMENT TIME	yr	1<<yr>>	Adjustment time for Sicily's attractiveness in UK tourists' market

Name	Unit	Definition	Documentation
UK Tourists	ppl	'INIT TOURISTS FROM UK'	UK tourists in Sicily
UK TOURISTS COEFFICIENT		0,90681411	Effect of past UK tourists' arrivals on future arrivals
UK TOURISTS SMOOTHING FACTOR		5,15E-07	UK tourists smoothing factor
UK Tourists_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{60890; 68022; 81926; 86697; 90734; 114259; 114342; 126811; 133628 //Min:0;Max:10//}<<ppl>>)	Real number of UK tourists
Unemployed Males in Sicily Aged 15 and Over	ppl	'INIT UNEMPLOYED MALES AGED 15 AND OVER'	Males in Sicily aged 15 and above being unemployed (1000 people)
Unemployed Males in Sicily Aged 15 and Over_real	ppl	GRAPHCURVE(NUMBER(TIME);1999;1;{ 233,01; 224,07; 199,00; 189,07; 188,02; 157,09; 153,06; 126,04; 118,05 //Min:117;Max:234//}<<ppl>>)	Real number of unemployed males in Sicily (15 years and above)
unemployment ratio		'Unemployed Males in Sicily Aged 15 and Over'*1000/'population of Sicily'	Number of unemployed people over population
UNEMPLOYMENT RATIO REFERENCE VALUE		'unemployment ratio'	Number of unemployed people over population in 1999
unsatisfied demand for seat inside the tourism area	seat	MAX('demand for seat in restaurants inside the tourism area'-'supply of seats in restaurants inside the tourism area';0<<seat>>)	Number of people who have not found a seat in a restaurant inside the tourism area.
Urban Environment		'CLIMATE EFFECT'	Quality of the environment
urban environment deterioration	yr^-1	MIN('NORMAL DETERIORATION'*'social crowding index'*'road crowding index'*'usw production index';'Urban Environment')*1<<yr^-1>>	Lost Quality of the environment
URBAN ENVIRONMENT REFRENCE VALUE		1,72	Quality of the environment in 1999
urban environment restoration	yr^-1	'intervention for environment restoration'*1<<yr^-1>>	Increase in quality environment

Name	Unit	Definition	Documentation
usw production		'INITIAL VALUE OF USW PRODUCTION'* ('population of Sicily'/'POPULATION REFERENCE VALUE')^'EFFECT OF POPULATION ON USW'* ('exponentially smoothed gdp for consumption behavior'/'GDP REFERENCE VALUE')^'EFFECT OF HOUSEHOLD CONSUMPTION ON USW'	Urban solid wastes production
usw production index		'usw production'/'INITIAL VALUE OF USW PRODUCTION'	Local environmental conditions index
usw_real	ppl	GRAPHCURVE(NUMBER(TIME);1997;1;{ 2493,270; 2546,580; 2480,571; 2552,727; 2603,582; 2423,000; 2521,000; 2540,000; 2544,000; 2608,000; 2718,000 //Min:2400;Max:2800//}<<ppl>>)	Real production of usw
variation in Mafia murders	yr^-1	DERIVN('normalized Mafia murders';1)	New mafia murders
vehicles belonging to Italian tourists travelling by their own car	vehicle	('Rest-of-Italy Tourists'*'AVERAGE PERCENTAGE OF ITALIANS TRAVELLING BY THEIR OWN VEHICLE')/'AVERAGE NUMBER OF PEOPLE PER VEHICLE'	Number of vehicles belonging to Italian tourists travelling by their own car
VEHICLES IN SICILY REFERENCE VALUE	vehicle	3220164<<vehicle>>	Number of vehicles in Sicily in 1999
vehicles in Sicily_real	vehicle	GRAPHCURVE(NUMBER(TIME);1999;1;{ 3220164; 3307034; 3395436; 3486618; 3580249; 3676393; 3744968; 3876498; 3981662; 4087495 //Min:4960000;Max:5030000//}<<vehicle>>)	Real number of vehicles in Sicily
Waste Management Capacity		'INIT WMC'	Capacity of the waste management system
wmc inflow	yr^-1	MAX('gap in wmc';0)/'DELAY IN PERCEPTION OF THE NECESSITY OF NEW WMC'	WMC increase
wmc outflow	yr^-1	'Waste Management Capacity'/'capacity saturation'	WMC decrease