MISTAKES AND ERRONEOUS SOLUTIONS IN URBAN PLANNING: THE PROJECT FOR A BRIDGE OVER THE STRAITS OF MESSINA

(preliminary version)

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Messina develops its urban space on a “Libeccio line” in the SW-NE direction, being constrained on the South-East side by the sea and on the North-West side by the Peloritani mountains. This configuration makes it very similar to the ideal “long narrow city” modelled by Solow and Vickrey (1971), where traffic direction is essentially longitudinal, moving people, goods and commodities from one side to the other of the city.
Solow and Vickrey do not consider problems of urban rent or demographic and residential density. Rather, they focus their attention on the optimal shape of the urban road, and their problem is to define the best equilibrium between the width of a central road and the dimension of a surrounding business area within a linear city, under the assumption of a uniform distribution of destinations over the longitudinal urban space.

Implicit to this model there is the idea that urban space (and geographical space, more generally) can be used for two main functions within any anthropization pattern: a “transport” function (the “Urban Road” devoted to the movement of persons or things from one location to another over the space) and a “relational” function (the “Business Area”, responding to the necessity of using space in order to meet people and realize productive, residential or social relations).
In general, one can say that cities owe their existence to people’s convenience in converging into specific zones of the space in order to multiply relations, while economizing transportation costs. A liveable city is a place where a correct (though dynamically changing) equilibrium is built between “relational” and/or “mobility” functions of the land.

The long narrow city of Messina had developed its “natural” equilibrium between transport and relational destinations of urban space up to the 1960’s, when a political mistake in planning urban land destination allowed ferry boat docks to be localized in central places of the town, without any direct connection with the regional motorway network, so creating huge traffic problems for the town. More than 4.000 trucks and more than 8.000 cars add daily to ordinary urban traffic; further, the territory morphology confers a longitudinal conformation on the town, while additional crossing flows impose a transversal cut on the access urban viability network to serve long distance link networks that exponentially increases urban congestion. As a result, the conflict for the use of urban territory between relational and mobility functions comes to be increasingly solved in favour of the transportation service.

Building a bridge over the Straits of Messina is often promoted as a radical solution to this problem. In this paper it is shown that this is in fact a wrong solution. Inaccuracies in traffic forecasts and CBA of project hide the economic and fiscal failures of a heavy impact infrastructure and lead to a second mistake.
A simple territorial analysis provides obvious, less costly and more rewarding alternatives.

After a brief sketch of the “functional equilibrium” theory of urban land, a short description of Messina’s urban structure and strategic location within the interregional transportation system is provided. The construction of a bridge over the Straits of Messina has been invoked, projected and

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approved, partly as a solution to this problem and partly as the completion of an alleged "Palermo-Berlin" axis within E.U. TENs. Then, the paper provides a critical appraisal of the project which highlights its economic failures, its financial and fiscal risks and its technical hazards. The conclusion of the paper is that more sensitive and more affordable solutions are available: both in the light of gaining transport efficiency and in the light of sustaining sound development paths for a depressed area of the Italian Mezzogiorno.

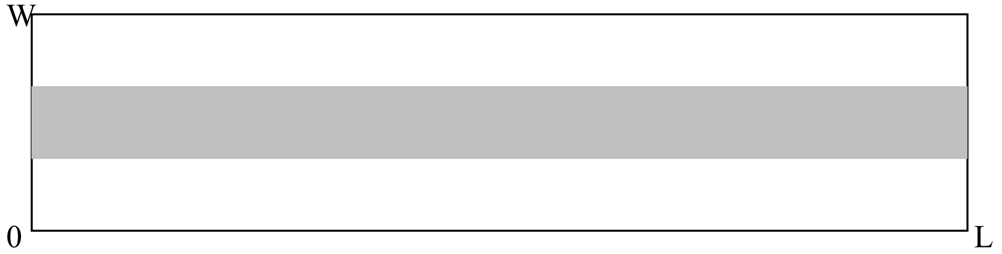
Functional equilibrium in urban land use: balancing Urban Road and Business Area shapes

In a seminal paper Solow and Vickrey (1971) model a linear "long narrow" city with given dimension and given total road surface. The SV-problem is to identify the optimal size of urban road in order to maximize social welfare (i.e. to minimize total transportation cost). A simplified and revised version of the SV model might be the following one.

Total urban surface is divided into "business area" (BA, that includes residential spaces and productive areas) and "urban road" (UR, devoted to transportation of people and goods). If we imagine a discrete configuration for BAs along the (perfectly) rectangular boundaries of the city, we can distribute n BA within urban space. Let us assume that: a) these areas are "centres" for local demand (bakeries, drug stores, markets, cinemas,…) b) each of these areas is "specialized", offering one production or service that other BAs do not offer; c) as "specialized" services are necessary to urban population, there is no "distance decay" effect in the demand for "specialized" services. As a result, starting from each BA, the demand for transportation over UR is due to the individuals' necessity of using "specialized" services localized in other than their proper residential BA. Assuming that familiar incomes are equivalent and that population density is uniform all over the city, we might have a kind of "isotropic traffic development" along urban road: each point of the city generates a uniform traffic attraction over other points, proportional to the dimension of its "business area".

Under these conditions, if we have m families allocated in each of the n BA, and if each one of the mn families needs one journey per day to satisfy its demand for every non-local "specialized" service, demand for use of UR attracted and generated by a single BA will be: $m(n-1)$, and total transportation is $nm(n-1)$. In other words, we save SV assumption that "the g tons of traffic originating in any unit of business area have destinations uniformly distributed over all other square yards of business area" (p. 431).

It is clear that minimizing transportation costs (defined in terms of congestion costs) requires that no bottleneck-kind restriction is created within the roadway shape and the optimal form of UR is a rectangular one, central to the uniform and linear urban space (W and L are, respectively, total width and length of urban space):

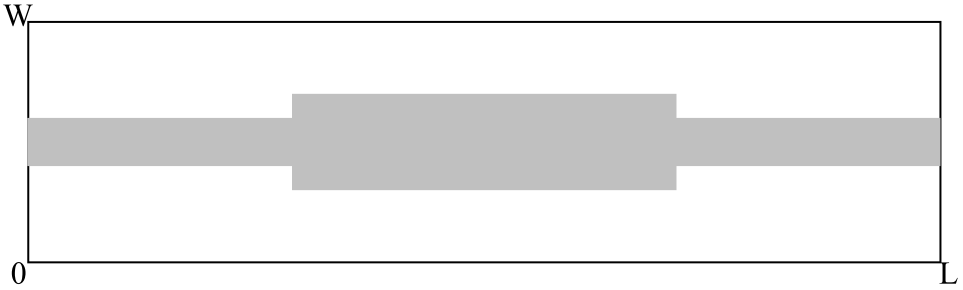


In fact, the hypothesis of uniform distribution of destinations implies that the demand of use for UR is identical in every point of the roadway

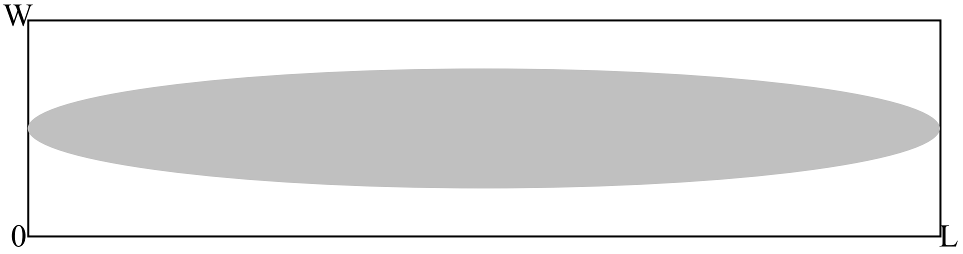
Any violation of "isotropic" conditions would change optimal roadway shape. If, for instance, specialized services are only (or mainly) available at the central location, the number of journeys will be minimized (assuming that each family needs to make at least one journey to the central area per day, the total demand of use of central roadway is: $m(n-1)$ in terms of return journeys). The breakdown of the homogeneous distribution of destinations implies that the optimal shape of the roadway is no longer rectangular. Let us assume that we have 5 BAs within the urban space, and that these are regularly distributed along the linear urban space:

BA1 BA2 BA3 BA4 BA5

Two-way journeys to BA3 will be balanced from its left and its right side, and the demand for use of the central roadway will be $m(n-1)/2$ per side. However, segments BA1-BA2 and BA5-BA4 will support only half of this burden ($m(m-1)/4$), while the central part of the road (BA2-BA4) will have a double burden. So, in order to minimize congestion costs, total roadway surface should be distributed with a different shape:



In a continuous distribution of BAs over the city space, optimal size for Urban Road should take the following form:



We are assuming that the population density (i.e. population per square km. of total urban area) is uniform, so that (differently from SV model) the generation of traffic by any given point in the space is proportional to the width of total urban space, rather than to that of the BA[1].

The Solow-Vickery model

In this section we provide a brief presentation of the Solow-Vickrey model, with some slight change in notations. If we indicate (as above) by W and L respectively total width and length of urban area and by R total Business (or "relational") Area of the city, the remaining surface: $T = WL - R$ will be the total area devoted to "transportation" function (the central Urban Road). At any given x localization on the horizontal city space, we define $w(x)$ the width of the road corresponding to the horizontal coordinate x ($0 \leq x \leq L$), so that the width of the Business Area at coordinate x will be: $W - w(x)$. Indicating by $t(x)$ total transportation space to the left of x, one has:

$$[1] \qquad t(x) = \int_0^L w(x)dx \qquad [t(0) = 0\ ;\ \ t(L) = T].$$

Total extension of BA to the left of x is then:

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[1] This implicates that moving from the city centre available space for relational functions is increasing (as roadway shape decreases, BA width increases), so that we find a better comfort for residents. Thinking in terms of individuals' welfare, this is not violating the general "isotropic" assumption: increases of available space compensate for the increase of distance from the service zone.

[2] $y(x) = \int_0^L (W - w(x))dx$ [$y(0) = 0$; $y(L) = R$]. It follows that:

[3] $y'(x) = W - w(x) \Rightarrow w(x) = W - y'(x)$ [$W \geq W - w(x) = y'(x) \geq 0$].

Assuming that each unit of BA (e.g. m^2) produces g units of traffic per time, the volume of traffic generated to the left of x is: $gy(x)$. Only a fraction of this traffic will pass x to reach destinations on its right side. Given the hypothesis of "uniform distribution of destinations over all business area" the proportion of traffic passing x left-to-right will be the same proportion "of all business area lying to the right of x": $(R - y(x))/R$ and total traffic passing x from left to right will be given by:

[4] $gy(x)(R - y(x)/R) = (g/R)y(x)(R - y(x))$.

Calling $z(x) = R - y(x)$ total BA to the right of x, total traffic passing x right-to-left will be:

[5] $gz(x)(R - z(x)/R) = g(R - y(x))(y(x)/R) = (g/R)y(x)(R - y(x))$.

As [4] and [5] are identical, the total volume of traffic passing x per unit of time ($v(x)$) is:

[6] $v(x) = (2g/R)y(x)(R - y(x))$

Let us define "density of traffic at x" ($\delta(x)$) the volume of traffic passing x per unit of roadway width: $\delta(x) = v(x)/w(x)$. As total transport cost (C) is proportional to $\delta(x)$, this will be: $C = f(\delta(x))$. We assume that the function takes the form: $f(\delta(x)) = b(v(x)/w(x))^k$ with $k \geq 1$, which assumes $f(0) = 0$ (so ignoring non-congestion costs of transport) and does not consider the existence of a "jam density"[2]. Total transport cost implied by moving over the UR rightwards from x to $x + dx$ is: $v(x)f\delta(x)dx$, so that total transport cost (TC) in the whole city for any given $y(x)$ is:

[7]
$$TC = \int_0^L v(x)f\delta(x)dx = \int_0^L (2g/R)y(x)(R - y(x))\, b(v(x)/w(x))^k dx =$$
$$= \int_0^L (2g/R)y(x)(R - y(x))\, b((2g/R)y(x)(R - y(x))/(W - y'(x))^k =$$
$$= \int_0^L (2g/R)^{k+1}\, b((y(x)(R - y(x))^{k+1}\, (W - y'(x))^{-k} =$$
$$= (2g/R)^{k+1}\, b \int_0^L ((y(x)(R - y(x))^{k+1}\, (W - y'(x))^{-k}$$

As social welfare is linked to the minimization of total transport cost "the solution to the allocation problem is given by the $y(x)$ that minimizes $\int((y(x)(R - y(x))^{k+1}\, (W - y'(x))^{-k}$" (p. 432). And this brings Solow and Vickrey to design optimal shapes for Urban Road similar to those developed in the first section of this paper.

However, what I want to emphasize in this paper is that the maximization of social well-being, according to eq. *[7]*, depends on the equilibrium in urban space between relational area (R, which we find at the nominator of the integrand) and transport surface (T, found at the denominator of the integrand: notice that, from eq. *[3]*, $W - y'(x) = w(x)$ and, from eq. *[1]*, $T = \int w(x)dx$, when $x = L$).

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[2] Solow and Vickrey (1971) also consider the case of costs of transport other than congestion (pp. 436-7), but we will not present this part of the model.

Further considerations about the functional equilibrium of urban space

A rationale for this formal conclusion is the following one: given total urban space, an excess of transport over residential areas reduces social welfare by an unnecessary decrease in the availability of residential, service, productive and amenity space for people; on the other hand, when "relational" areas are such as to cause an under-endowment of transport space, extra-traffic relative to roadway width causes congestion and reduces social welfare via increases of total transport cost.

Let us consider the model in a slightly different way. We can divide the whole city into n districts, each of which has a uniform longitudinal extension given by: $m = L/n$ and an identical total surface: $D = mW$ area. Within the district we find a total "relational" area given by: $R_d = \int_0^m y'(x)dx$ and a "transport" space given by: $T_d = \int_0^m w(x)dx$. T_d is the portion of UR passing through the district. Residents use UR in order to reach other Urban Districts and cross the road to reach other destinations within the district (to meet people or to reach internal services or businesses). "Specialized" services and businesses of the district may also offer their production to residents who are not internal because of the existence of T_d. Total wellbeing (B) for district residents is a positive function of the number of relations (ρ) happening inside the district and a negative function of congestion transport cost (γ) for residents: $B = \beta(\rho, \gamma)$ $[dB/d\rho > 0\ ;\ dB/d\gamma < 0]$. As the district is already existing, R_d and T_d are given and constrained in their dimension.

As already seen, total traffic τ passing through R_d has four different components in terms of origin and destination: internal origin and destination (internal relations); external origin and internal destination (relations attracted inside the district from outside); internal origin and external destination (we will not consider this flow); external origin and external destination ("exogenous" or foreign traffic crossing R_d). Forgetting the third component, the total amount of relations taking place inside the district, ρ, is proportional (and can be assumed as identical) to the sum of the first and the second component, while the fourth component (F) is totally external to the district. We will assume that ρ (the "district relations" generated demand of traffic) is a negative function of congestion cost, while F is given (its intensity cannot be controlled by residents).

In the usual demand-cost scheme, $\rho(\gamma)$ is the demand for internal relations, while F is considered as an exogenous flow reducing available R_d for "relational" travel. In other words, increases in F have the same effect of an upward shift in the transport cost function, generating exogenous congestion costs for the district residents. Let us represent graphically what we have said.

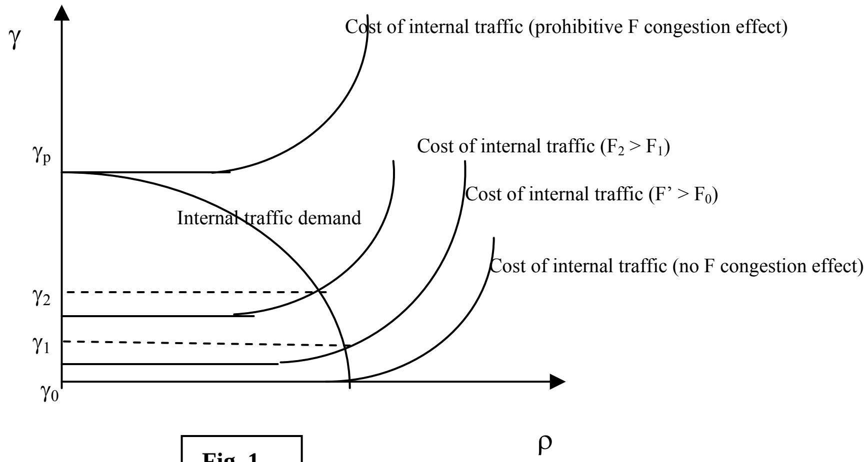


Fig. 1

Once R_d capacity has been fully exploited, every increase in F causes congestion costs and "crowds out" internal traffic demand, so reducing ρ and increasing γ. It is possible to make the hypothesis of a "prohibitive" F level (which entirely cancels internal traffic); alternatively, one can think of a necessary minimum level of internal traffic, so that increases in F only cause increments in γ (and consequent reductions in social wellbeing).

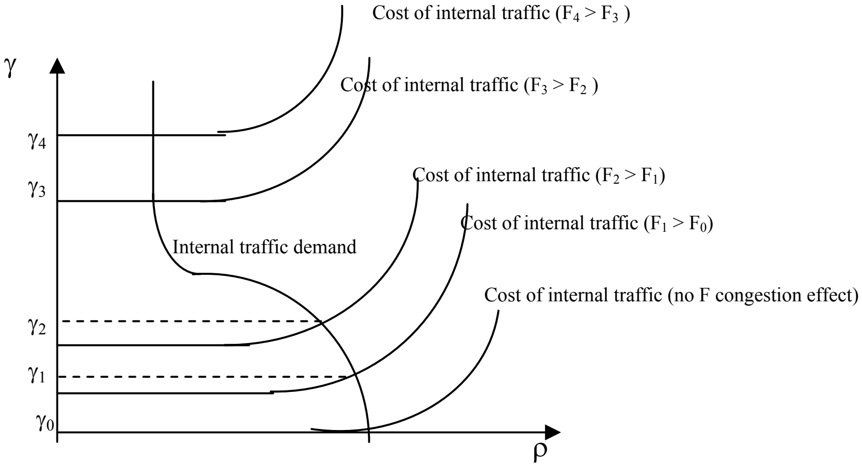
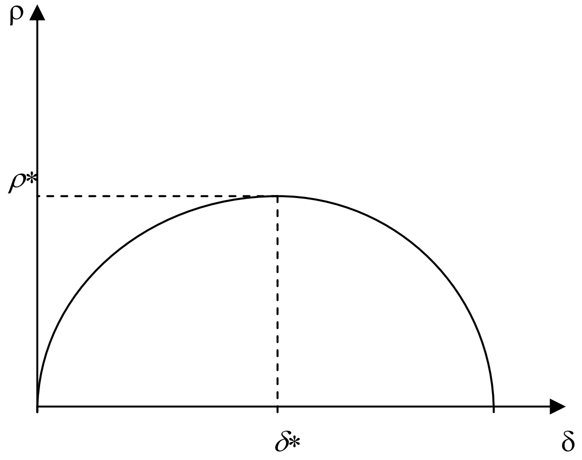


Fig. 2

Applying the above specified concept of "density of traffic" to the district area, we obtain a "district density of traffic": $\delta_{Rd} = [\int_0^m v(x)dx]/ [\int_0^m w(x)dx]$ and, as $v = F + \rho(\gamma)$, it is easy to derive an inverted-U function linking internal relation and the density of traffic:



When the density of traffic is low, internal relations (and related mobility) can increase without causing congestion costs. If the density of traffic exceeds a critical value, so detecting over-utilization of R_d, any increase of δ (which we assume is due to progressive increases of exogenous "foreign" crossing flows) reduces the number of relations inside the district while increasing congestion cost.

As social welfare B is increasing in ρ and decreasing in γ, the same inverted-U shape applies to the relation between B and δ. As a result, the existence of "through traffic" reduces social welfare for the residents of the district. In the words of Solow and Vickrey: "the city is saddled with the costs of moving through traffic over the whole interval from 0 to L" (p. 437).

The conclusion is that within urban districts (or cities) social welfare depends on a dynamic equilibrium between relational and transport (or "movement") functions deployied over the city space. Whenever the transport function exceeds its welfare maximization level, cities are spoiled of relational opportunities and development perspectives.

Breaking down a movement-relations equilibrium: the case of Messina

As already stated, Messina is a long-narrow city with a population of 250.000 people, facing the Italian Peninsula. After the 1908 destructive earthquake the city was rebuilt with a short skyline profile, expanding on a SW-NE linear direction.

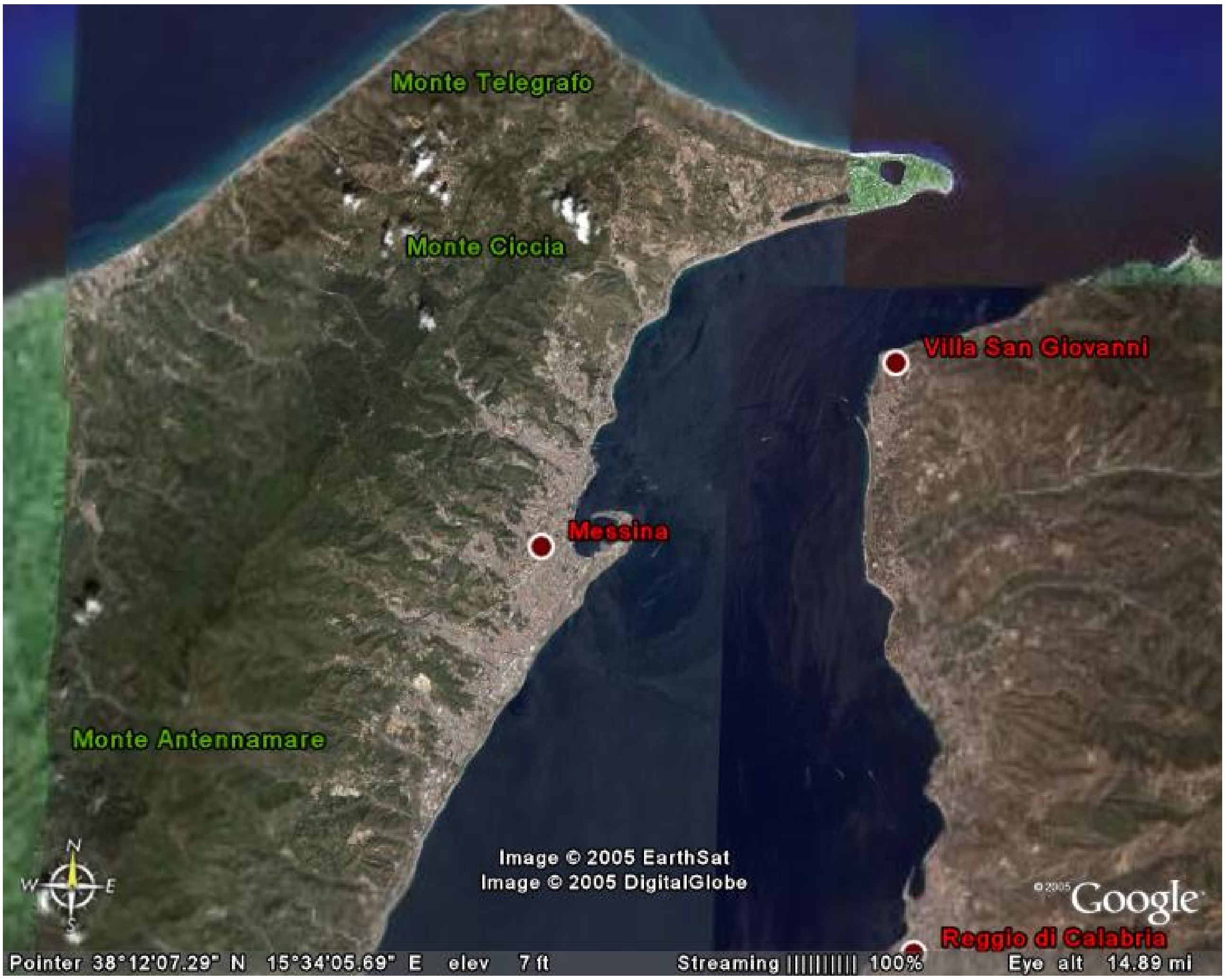


Photo 1

Urban roadways are essentially longitudinal and allow residents to move SW-NE; central roads are linear and their width increases at the centre of the town (see photo 2). The general plan of the town therefore recalls the ideal "long narrow city" described by the Solow-Vickrey model. After World War II, the city experienced a positive development path up to 1960s, when there begun a decline in the urban economy and a loss of centrality relative to the "Area of the Strait" (including the Calabrian territories of Reggio Calabria and Villa S. Giovanni).

The coincidence of this socio-economic decline with the expansion of private ferry-boat activities due to a politically provided positional rent proves that mistakes in urban planning may cause breakdowns in the relational-transport function balance in urban space, so inhibiting development opportunities for the whole city.

Photo 2

The mistake was to allow the localization of private ferry-boat docks in a central place of the town, while maintaining the State Railway ferries in the central harbour. So, as roadway transport increased exponentially following the development of the Italian motorway network and the "economic miracle" of the '50s and '60s, because of the connection with external motorways, the presence of two different docks within the centre of the town caused a transversal cut over the longitudinal direction of urban traffic.

In Fig. 3, the shaded area is a non-residential area, being used for railway connections; the black arrows indicate urban traffic direction; the green line outside the urban space represents motorway connections; the red network shows the overlapping of long-distance transport service on the local transport road network.

Photo 3 shows more clearly the impact of the localization of ferry-boat docks over urban traffic.

As a consequence of this urban-planning mistake, congestion increased reaching unsustainable levels, so that in 2001 the national Government had to promulgate a decree, declaring for Messina the "emergency state of traffic, due to the crossing flows of trucks" on the national communication networks.

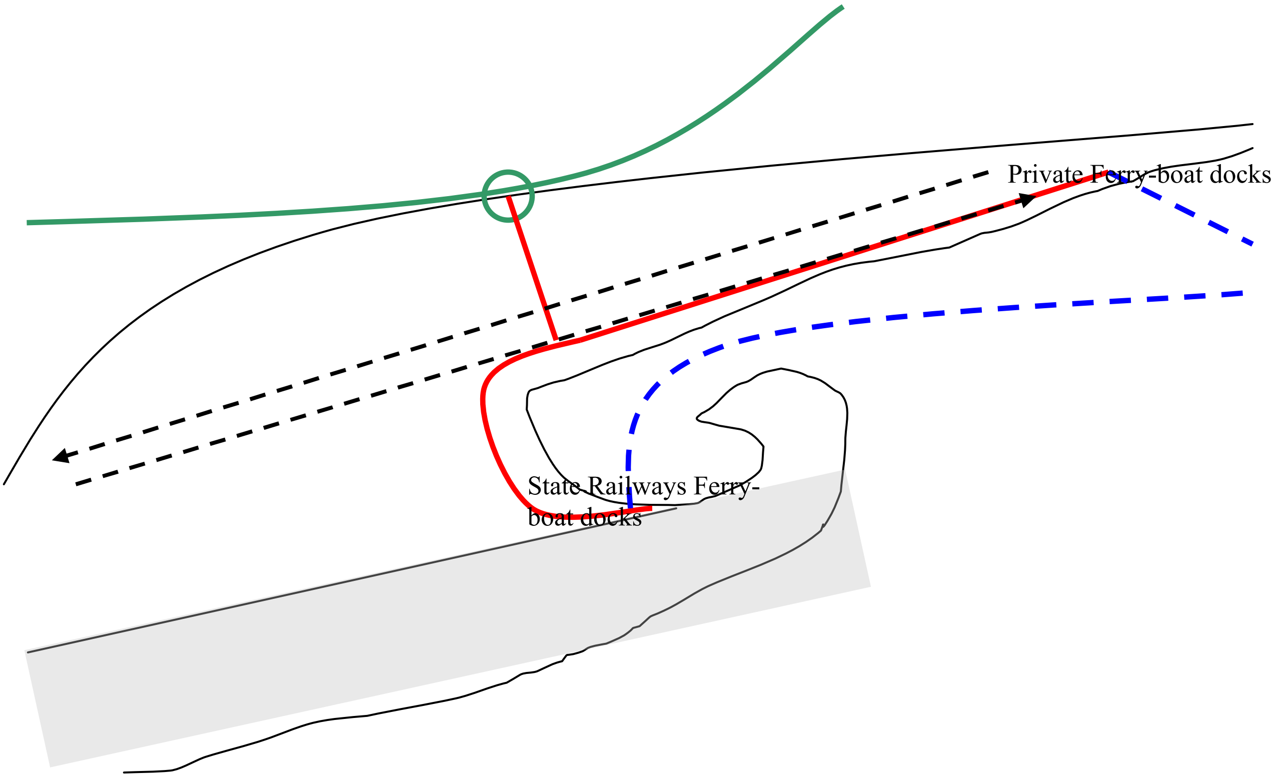

Private Ferry-boat docks
State Railways Ferry-boat docks

Fig. 3


E90
E45
Messina
State Railways Ferry docks
Private seaways docks
Private Ferry docks
Villa S. G.
Salerno
Villa S. G.
Reggio Cal.
© 2005 TeleAtlas
Image © 2005 DigitalGlobe
© 2005 Google
Pointer 38°11'51.05" N 15°33'22.14" E elev 55 ft
Streaming ||||||||| 100%
Eye alt 5708 ft

Photo 3

The "erroneous solution": a plan for building a bridge over the Straits of Messina

Within this context, the idea of building a bridge over the Straits of Messina may appear as a sound one. A stable infrastructure localized outside the city centre and directly connected with the national motorway network would expel additional traffic and allow the city to restore the original "equilibrium" between relational and transport functions, so increasing its residents' social welfare. Unfortunately, however, building a bridge would be the wrong solution leading to an evident second mistake.

Why is this project a misguided solution to the problem of the functional equilibrium of space? In this section, I will briefly synthesize some of the many reasons why the project appears completely uneconomical, both in a local and in a national perspective.

At a local level, the bridge reduces social welfare because of environmental and congestion costs.

Environmental costs of the bridge relate to its impact on the urban ecosphere: a) the natural reserve of Ganzirri (a European Communitary Interest Site) will be irreparably damaged; b) five or six sites to store more than 5 million m^3 of residuals from the excavation works are localized in very dangerous positions, on the slopes of the Peloritani mountains, adjacent to residential parts of the town, as the following map and picture clearly show; c) for at least 6,5 years an important part of the city on

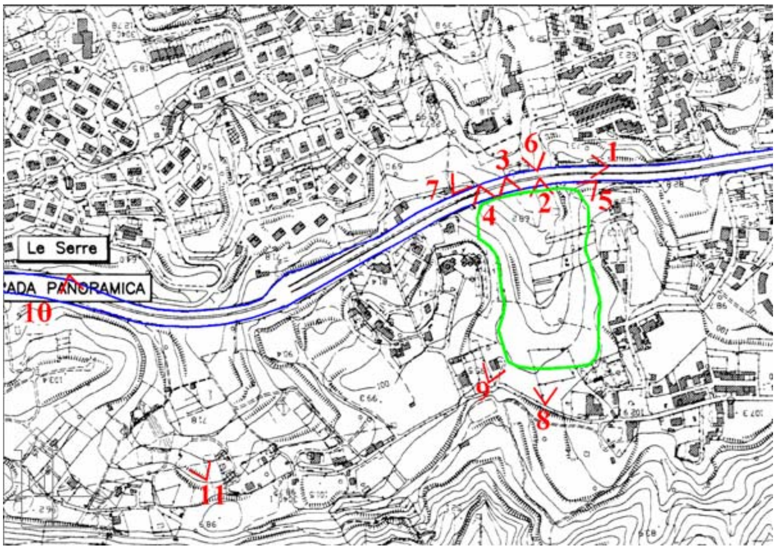


Fig. 4

Photo 4

the SW-NE direction (for more than 10 kms in length) will be charged with extra traffic estimated in 2.100 trucks per day on average, increasing emissions and heavy powder pollution. On the other hand, it is clear that the heavy impact of such an important exogenous increase of urban traffic will be unsustainable for a city that has already been declared under emergency because of the traffic. The whole project is actually tailored to maximize efficiency for the building of the bridge, rather than to minimize its impact on the city. As an example, the project does not consider the possibility of creating a new communication system to absorb the increase in urban traffic linked to the building of the bridge. As a result, in order to minimize transport time and global costs for the building area of the bridge, a whole track of an important urban roadway (the "Nuova Panoramica dello Stretto") will be subtracted from local use and devoted exclusively to the transportation of materials for the work. Worse than that, this double-track roadway converges into a single-track roadway (which is generally already congested, especially in spring and summer), with the obvious consequence that urban traffic will necessarily jam in the northern part of the city for the whole time of construction (which estimation ranges from 6 to 20 years). Further, even though the bridge will be built 15 kms from the city centre, a total of 25.7 kms of railway and roadway tunnels and viaducts will connect the bridge with the most central areas of the town, imposing a new transversal cut to the longitudinal fluency of local traffic.

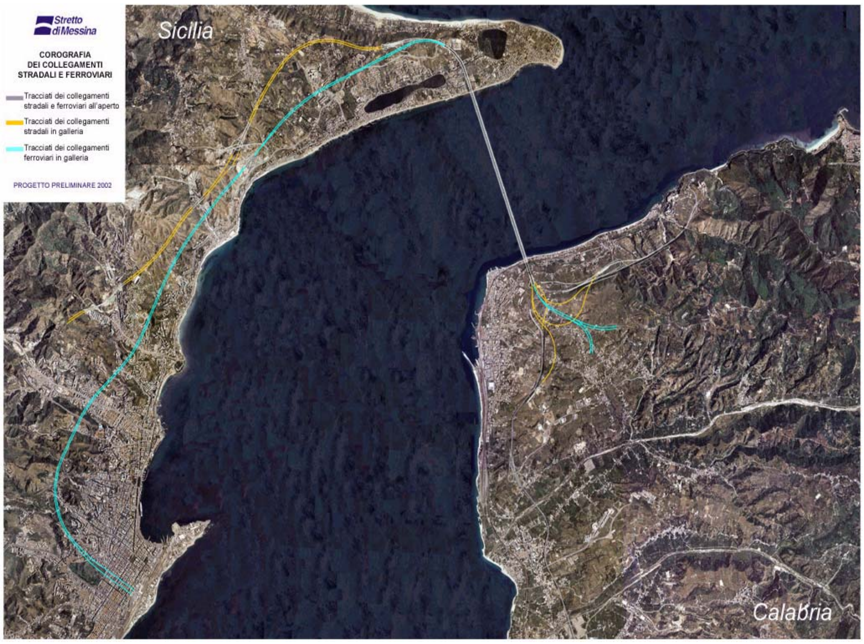


Photo 5

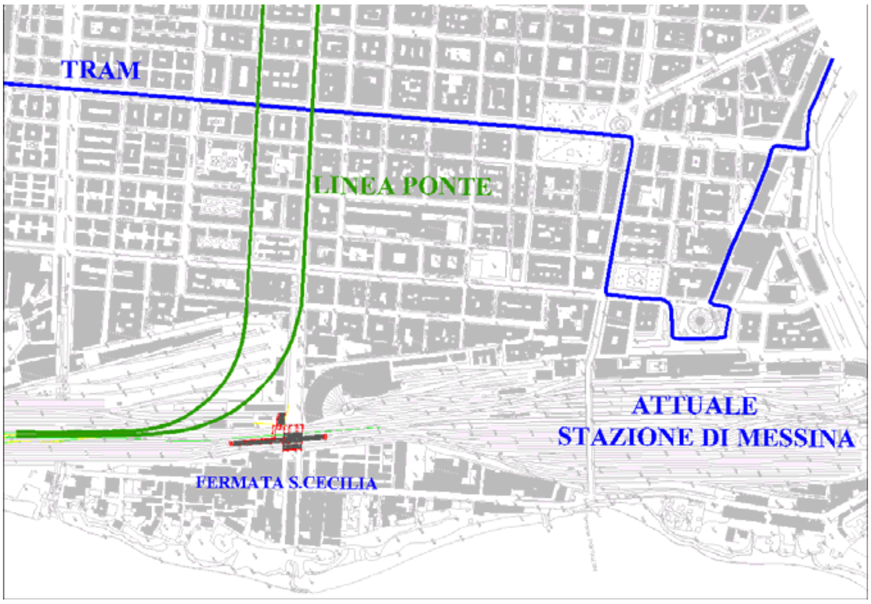


Fig. 5

Mistakes in the economic analysis of the project.

A public infrastructure has to be built whatever the environmental and social costs are, if the total benefit of its realization overcomes its total cost. The city of Messina would pay a heavy charge (and may be refunded with some important public works) in order to permit a strategic infrastructure to be built and to operate. Unfortunately the bridge over the Straits of Messina is clearly uneconomical and its balance is not convincing.

There are at least five sources of potential mistakes in the economic analysis of the bridge that suggest that the project should be rejected:

a) Over-evaluation of future demand (due to a lack of completeness in the analysis of future trends in the modal demand of transport);
b) (partly as a consequence) mistakes in the cost-benefit analysis conclusions;
c) Under-evaluation of financial costs and of construction time;
d) Hidden consequences on the State balance (in order to absorb the financial risk of the work)

Over-evaluated traffic forecasts

As far as the first point is concerned, it is worth remembering that Braathen, Nesset, Hervik (1994), while discussing critical factors of cost-benefit analysis state that: "*[a] very important uncertainty factor is the traffic forecast. (...) Some American researchers state that the uncertainty in public infrastructure investments is substantial and that a lot of erroneous investments have been made*" (pp. 458). Odeck and Skjeseth (1994) indicate that in Norway in 10 cases out of 14, actual traffic was lower than forecasted, and Skamris and Flyvbjerg (1997) conclude their evaluation of international experience stating that: "Traffic forecasts that are out by 20-60% compared with actual development are common for these projects. Forecasts of project viability for large transport infrastructure projects are often over-optimistic (…). The result is that decisions based on misleading forecasts may lead to a misallocation of funds, and to underperforming projects during construction and operation" (p. 145). The project for a bridge over the Straits of Messina is not an exception to this rule. Notice that a) the project (completed in 2002) bases its demand forecasts on "former reliable estimations" of flows crossing the Straits relative to year 2000 (rather than on real, available, data); b) forecasts indicate an increase of at least 1,5% per year in the most unfavourable scenario (4.4% per year in the most optimistic version) of "base" traffic for crossings of the Straits in the period 2000-2012 (i.e. before the bridge will actually operate).

This "estimation" is clearly misleading, as it does not consider that actual trends show a decline in Strait crossings in the period 1991-99, while the number of lorries on the whole Italian motorway network was rapidly increasing (see table 1).

		1991	1999	% Change 91-99
Strait Crossings	Cars and motor-cycles^	2.534.380	2.328.500	-8,1%
	Lorries and equivalents^	1.322.646	1.238.514	-6,4%
	Passenger Carriages^	111.810	102.805	-8,1%
	Railway trucks^	248.232	137.569	-44,6%
Lorries/Km on Italian motorways°		11.949	15.874	32,8%

^Source: Advisor (2001), p. 24; °Source: Aiscat

Tab. 1

Further, for the year 2000 the project estimates more than 8 million passengers (SdM, 2002) crossing the Straits: something incompatible with the official figures we have just presented. As an example, let us consider the voice: "cars and motor-cycles". On Italian roadways, cars transport on average 1.5 passengers. The project assumes a rate of utilization of 2 passengers per car. Considering that motor-cycles generally transport just one person, let us assume a rate of 1.9 for Strait crossings. According to tab. 1, passengers crossing the Straits with cars and motorcycles totalled 4.424.150 in 1999. The bridge project estimates that in year 2000 passengers using cars and motorcycles were 4.955.500: a 12% increase in just one year, after a ten-year decrease of 8.1% on average, while private ferries declare a 4% decrease in the transport lorries and an 8.1% decrease in that of cars in the period 1999-2003!

Finally, crossings over the bridge should absorb (according to the project) from 91.4% to 65% of total passengers and from 92.8% to 80% of total transport of goods, while 75% of passengers crossing the Straits are commuters (D.G., 2001; see also Brambilla, 2003), whose demand for the bridge is close to zero. A survey of people crossing the Straits (still to be completed) shows that passengers demanding the use of the bridge are no more than 40% of the actual flow. On top of that, the existence of the bridge should generate extra-traffic at a rate of 19.4% of "base" traffic during the first operative year of the bridge (2012), reaching 36.2% in 2017.

It is easy to see many sources of over-estimation in traffic forecasts: i. estimates of "base" traffic are based on unrealistic increase forecasts; ii. because of that, "generated" traffic is in absolute terms overestimated; iii. the percentage of demand attracted by the bridge has no analytical basis and is clearly excessive.

In fact, banks and financial institutions audited by the Government (MIT, 2001), assessed that "risk of traffic represents the most relevant critical element of the project. (…). The risk of traffic is in general perceived as a systemic risk, as it is connected to the economic growth of the Italian Mezzogiorno". Notice that (as SdM referred to the Italian Senate on Jan. 8, 2003), estimates on traffic evaluation are based on a minimum yearly growth rate of 1.8%.... The problem is that, for local transport (75% of total traffic in the Straits) and also for long distances, the use of the bridge is uneconomical, as ferries and seaways are much cheaper, so that distance-decay function may assume an inverted-U shape.

In other words, as short-sea-shipping is better than full-road transport, long distances (> 700 kms) will preferably be bridged with ro-ro inter-modality, and the projected infrastructure will never work as a European infrastructure, linking Palermo to Berlin.

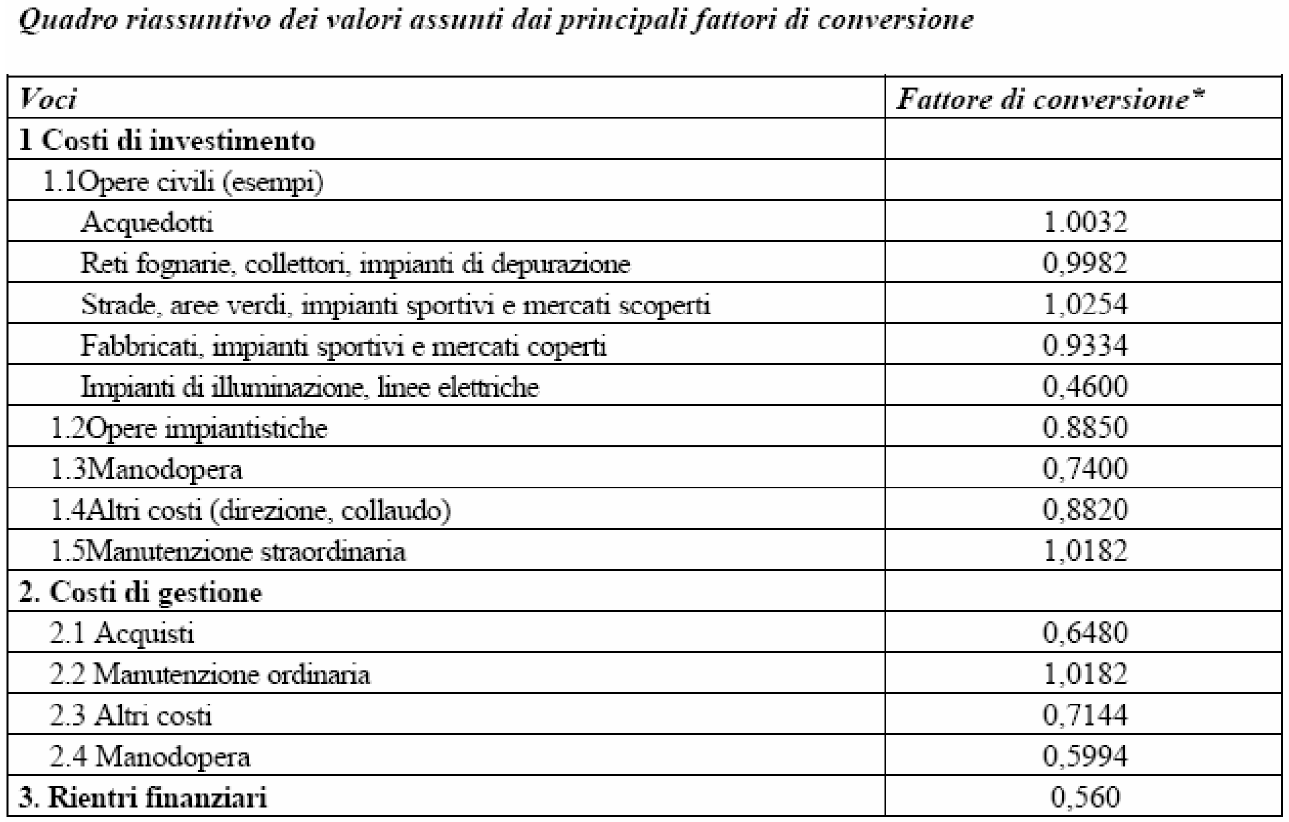
In other words "sensitivity analysis" of the project seems to be over-optimistic even in the more pessimistic scenario.

Doubts about cost-benefit analysis

As far as cost-benefit analysis is concerned, a general benefit over-evaluation and cost under-estimation can easily be detected.

Brambilla (2003, p. 9) notices that the project does not consider the “do-nothing” scenario, presenting the alternative project of a “multimodal system” to cross the Straits of Messina. As a result, the bridge is compared with a costly alternative investment, and its relative advantage is probably much higher than it would be when confronted with the existing scenario. However, a political decision could (and should) have been taken in order to alleviate Messina from the social and economic burden of the extra-traffic, so that the consideration of the “do-nothing” alternative could have been correctly eluded. Independently of this methodological aspect, many inaccuracies seem to characterize the analysis.

A first point is that the General Relation of the project (Sdm, 2002) states that: “In order to transform financial into economic costs, an average conversion coefficient of 0,65 has been used, obtained considering the categories of: materials, labour, transport and freight, expropriations” (General Relation, part. 3, Sect. B, p. 57). It is not clear how this average parameter has been estimated, and if a more analytic structure has actually been implemented; in Italy, a “Guide to the Regional Evaluation Groups for checking public investments” (2001) presents the following conversion table:



Quadro riassuntivo dei valori assunti dai principali fattori di conversione

Voci	*Fattore di conversione**
1 Costi di investimento	
1.1Opere civili (esempi)	
Acquedotti	1.0032
Reti fognarie, collettori, impianti di depurazione	0,9982
Strade, aree verdi, impianti sportivi e mercati scoperti	1,0254
Fabbricati, impianti sportivi e mercati coperti	0.9334
Impianti di illuminazione, linee elettriche	0,4600
1.2Opere impiantistiche	0.8850
1.3Manodopera	0,7400
1.4Altri costi (direzione, collaudo)	0,8820
1.5Manutenzione straordinaria	1,0182
2. Costi di gestione	
2.1 Acquisti	0,6480
2.2 Manutenzione ordinaria	1,0182
2.3 Altri costi	0,7144
2.4 Manodopera	0,5994
3. Rientri finanziari	0,560

Tab. 2

It is easy to check that (especially as far as investment costs are concerned) both materials and labour conversion factors are significantly higher than 0,65.

Further, Brambilla (2003) assesses that “conversion factors used in civil engineering projects similar to the one under examination [the Messina bridge]” are:

Labour	Transport and Freights	Materials
0,75	0,78	1,00

Tab. 3

Apparently, a 0,65 coefficient heavily under-estimates the total economic cost of the project.

Applying Tab.3 parameters leads Brambilla (2003) to conclude that: "economic N.P.V. is negative in whatever economic growth perspective and traffic forecast trend except one; that is to say, apart from unrealistic economic growth scenarios, the project of a bridge over the Strait of Messina does not generate sufficient benefit to future users, confronted with the economic resources needed to realize it" (p. 12).

Another source of cost under-evaluation is the estimation of run and time operational costs of the bridge. Faced with the alternative project, using the bridge implies an increase of run. The General Relation (SdM, 2002, tab. 1.3.1, pp. 60-67) implicitly applies to cars an extra-run of 8.4 km., and to lorries (which cost is at least double) the half extra-run of 4.3 km. A deeper evaluation of the alternative ways could actually justify some discrepancy between the two kinds of vehicles, but a new account of the differences results in an extra-run of more than 20 km. for cars, and of 5 to 19 km. for lorries, depending on their origin.

Further, in the evaluation of operational costs, in 2002 parameters relative to 1997 or 1998 were used. Applying simple methodologies, it is possible to estimate a € 0,13 differential for cars and a 0,1 differential for lorries.

On the contrary, the "time saving" benefit appears to be over-estimated, as every car saves € 22,00 per hour, and an average of 2 passengers per car is applied, while passengers per car in Italy are on average 1,53, and € 11,00 is the estimated value of time per car, meaning that the value of time per passenger should be € 7,75 per hour (Cappelli, 2004). As a result, using a rate of car utilization of 2, the value of saved time should be € 15,50: a 42% increase in the parameter!

A first (probably optimistic) estimate shows that benefit – cost difference is negative, being at least € -1,39 billions (Corriere della Sera, 2003).

About monetary costs

Not only economic, but also financial costs seem to be heavily under-estimated, for at least three reasons: i. steel price increase on the international market; ii. under-estimation of construction time; iii. the burden of prescriptions and observations that the Government imposed when approving the preliminary project.

The sum of € 4.6 billions was estimated in 2002. During the last four years, the price of steel has more than doubled on the international commodity markets, and this trend is long-lasting, as it responds to the demand of China, India, Brazil. According to some members of SdM staff, steel components account for about 50% of total cost. Doubling raw material price should imply a 15-30% increase in steel components so that, due to a 100% increase in steel price, the total cost would already have increased by 8-15% (more or less € 500 - 1.000 million).

As far as construction time is concerned, the project estimates 6.5 years for building construction, and operation of the bridge should start in 2012. This estimation has no historical precedent. The Store Baelt system (the most similar work in international large traffic projects), that has a 50% scale compared with the Messina bridge project[3], took 12 years to be completed: a rough estimate of real time of construction should triplicate the forecast, and 20 years appears to be a reliable reference value. The impact on labour cost, on interest account and on the financial balance of the project will necessarily be very large.

Another important cost underestimation factor is the number of prescriptions and observations that the Italian Government imposed when approving the project. Many of these are relative to technical topics that may significantly increase the cost of the work. Finally, expropriation is probably underevaluated, as only € 63 m. are accounted for in the project.

Skamris and Flyvbjerg (1997) conclude their examination of large transport projects saying that "the main lessons to be learnt are that cost overruns of 50-100% are common for large transport

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[3] The Store Baelt system accounts a 1.624 mt. roadway suspension bridge and 14,611 km. of rail and roadway tunnels and viaducts. The Messina project has a 3.300 mt. road and railway suspension bridge and more than 24 km. of rail and roadway tunnels and viaducts.

infrastructure projects and overruns above 100% are not uncommon" (p. 145): the Messina bridge is not going to be an exception to this rule.

Consequences for the public balance and for the Sicilian economy

Similarly to other apparently "privately funded" works[4], the Messina bridge has indeed important hidden implications as far as the public balance is concerned: a) because "Stretto di Messina S.p.A." is 100% owned by public companies and is financed with public funds; b) because the financial infrastructure of the project is conceived so as to mitigate the general risk of the work for the private sector, putting it on the Government side; c) because at least half of future operational revenues will come from enlarged public balance.

"Stretto di Messina S.p.A." (SdM) participates with € 2.5 billions of taxpayers' money (40% of the total estimated investment cost). 10% of the remaining part should be financed (hopefully) by the European Bank of Investments; the remaining 50% should be found under long run emissions in the international capital market. At the end of the concession period (2042), the Italian Government will correspond to SdM "half the invested value". In practice, 50% of finance comes from public sources, and the State entirely guarantees "private" finance.

Risk on returns is also mitigated by public money, as 50% of forecasted revenues will be provided by "Rete Ferroviaria Italiana" (RFI) with a pre-determined yearly "availability fee" of € 110 m. (going up to 140 m.), irrespective of actual utilization levels. As RFI is not going to suspend its ferry-boat service, and as the actual cost to the public balance for train crossing is € 41 m./year, taxpayers will transfer to SdM an extra-charge of at least € 70 m. unrelated to eventual social benefits for the infrastructure users.

As vehicular traffic is over-estimated, this impressive public transfer may not be enough to avoid financial failure of the project, so that re-selling the concession by the Government may be very hard in 2042, and the whole failure risk will be absorbed by the State, with stable, un-forecastable consequences on public finance for future generations.

Audited banks and financial institutions, indeed, asked the Government to guarantee acceptable vehicular traffic by rationing short-sea-shipping developments and local ferry-boat services, so as to "force" the demand for using the bridge. It has been estimated that for medium-long distances (> 500 km.), any additional 100 km. strip costs € 79 by sea, while the same distance is bridged by lorries at the cost of € 258. As a result, vehicular demand of use of the bridge will remain insufficient (causing its financial failure), unless drastic rationing measures are undertaken in order to stop seaways development. In this case, economic the consequences of the bridge for the Sicilian economy will be negative, as a higher transportation cost will be imposed on its products, with a clear loss of competitiveness on foreign markets; furthermore, a higher transport cost for import goods will cause higher prices for local consumers.

Conclusion: finding alternatives to the bridge

The conclusion of the economic analysis of the project is definitely negative, because of: a) mistakes in traffic forecasts; b) under-estimation of investment costs; c) inaccuracies in cost-benefit analysis; d) negative consequences for the public balance and the Sicilian economy.

The "multimodal" alternative to the bridge (exploiting the economic advantages of short-sea-shipping) would be less expensive and more reliable.

To free Messina from additional traffic, a simple reformulation of its port is easy and cheap: vehicular and railway ferry-boat services to Calabria should be fully confined outside the city-centre, at its southern border, where an initial docks endowment is already available; the traditional historical harbour (that is inadequate for commercial needs) should be transformed into a pleasure craft port and should be the terminal for high-speed boats to serve the important local commuters' demand; short-sea-shipping should start from the Tirrenic side of the Messina hinterland (close to Milazzo), where seaways to Gioia Tauro, Naples and Genoa should start.

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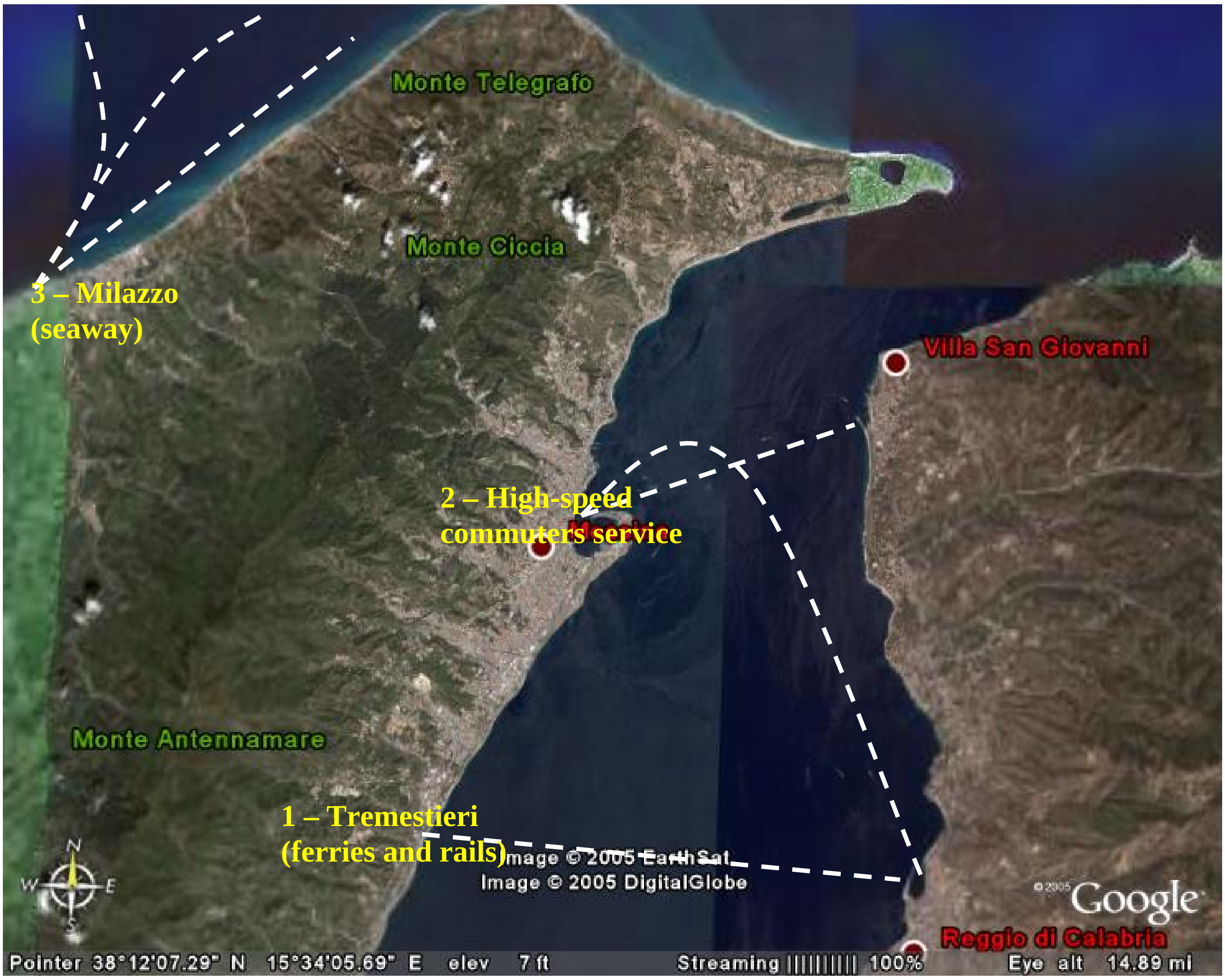
[4] See: Moles and Williams (1995).



The alternative multiport system is much cheaper than the bridge, is both more efficient and economically and financially sustainable and it ends to be socially more desirable.

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