Modelling sustainable human development in a capability perspective♦

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Abstract

In this paper we model sustainable human development as intended in Sen's capability approach in a system dynamic framework. Our purpose is to verify the variations over time of some achieved functionings, due to structural dynamics and to variations of the institutional setting and instrumental freedoms (IF Vortex).
The model is composed of two sections. The 'Left Side' one points out the 'demand' for functionings in an ideal world situation. The real world one, on the 'Right Side' indicates the 'supply' of functionings that the socio-economic system is able to provide individuals with.
The general model, specifically tailored for Italy, can be simulated over desired time horizons: for each time period, we carry out a comparison between ideal world and real world functionings. On the basis of their distances, the model simulates some responses of decision makers. These responses, in turn influenced by institutions and instrumental freedoms, ultimately affect the dynamics of real world functionings, i.e. of sustainable human development.

JEL: I31

Keywords: Functionings, Capabilities, Institutions, Instrumental Freedoms, Sustainable Human Development

Introduction

The notion of welfare highlighted by the utilitarian framework that forms the basis of mainstream economics offers only a limited perspective of human well-being. In fact this notion reflects only the class of differences captured by money metric, under the economic rationality of self-interested utility maximization. Moreover, the income approach to well-being doesn't account for the diversity in human beings and for the heterogeneities of contingent circumstances[1].
It is preferable therefore to enlarge the notion of well-being in order to encompass other important dimensions – social, environmental, institutional, intergenerational – for the flourishing of human beings that utility metric does not account for. This perspective can be intended as a model of development which advances economic and social justice, protects the environment, strengthens institutional capacities and protect the freedoms of future generations. In brief, this is the notion of sustainable human development, as intended in Sen's capability approach.

♦ *We are grateful to CRASL (Centro di Ricerche per l'Ambiente e lo Sviluppo Sostenibile della Lombardia) for its financial support*

♦ *Edited by: Luciano Canova (Università degli Studi di Milano Bicocca) for §§ 4.2 and 4.3; Enzo Di Giulio (Scuola Eni Enrico Mattei - Eni Corporate University San Donato Milanese - Milano) for §§ 5.2, 5.3; Marco Grasso (Università degli Studi di Milano Bicocca) for §§ 2, 4.1 and Introduction; Sara Lelli (Università Cattolica del Sacro Cuore Piacenza) for Concluding remarks; Stefania Migliavacca (Scuola Eni Enrico Mattei - Eni Corporate University San Donato Milanese – Milano) for §§ 5.4, 5.5 and 5.7; Stefano Pareglio (Università degli Studi di Milano) for §§ 1 ; Alessandro Vaglio (Università degli Studi di Bergamo) for §§ 3 and 5.1.*

[1] A complete critique of the drawbacks of utilitarianism is however beyond the goals of this paper.

The ultimate goal of this paper is to point out a possible a way of modeling and simulating the evolution of sustainable human development over time through system dynamic analysis. In doing so, we monitor the variations over time of some achieved functionings, due to structural dynamics and to variations in the institutional setting and in instrumental freedoms (IF Nexus).

Section 1 defines the notion of sustainable human development according to the capability approach. Section 2 deals with the operationalization of the capability approach. Section 3 highlights the generalities of the simulation model. Section 4 sets its underpinnings and main strengths and weaknesses. Section 5 depicts specifically the architecture of the proposed framework. The Concluding Remarks briefly consider the main theoretical and empirical implications of these results.

1. Sustainable human development

Sen's conception of sustainable human development departs from the traditional Bruntland's one[2] insofar its focus is on the broadening of human freedoms on a sustainable basis, rather than on needs. In fact he has continuously underlined the importance of entitlements, opportunities, and freedoms as conceptual foundations of social choice.

In the latest thirty years Sen has been developing an approach based on individuals' possibilities to pursue their own project of life in terms of doing valuable acts and of reaching valuable states of being. This perspective is the core of the capability approach, whose main novelty lies in the definition of a broader theoretical framework of well-being, stressing the importance of enjoying enduring essential freedoms to reach a specific project of life, dependent at the same time "on a number of contingent circumstances, both personal and social" (Sen, 1999:70).

In spite of the fact that Sen's interest seems to be mainly focused on the role played by the capability approach as a framework of thought aiming at highlighting the drawbacks of other social choices approaches, this approach can also be considered a method for making interpersonal comparison of well-being. In fact Sen himself, though acknowledging the empirical difficulties, ascribes significant importance to the practical usability of the theory he has put forward: "the approach must nevertheless be practical in the sense of being usable for actual assessment" (Sen, 1987(b):20). In this sense we intend to rely on the capability perspective, used for exploring a number of social issues such as well-being and poverty, liberty and freedom, living standards and development, gender bias and sexual division, justice and social ethics (Sen, 1993: 30, note 1), to analyse the evolution of sustainable human development.

In the capability approach human development implies the broadening of individuals' potential, being individuals the very ends of developments, rather than its mere means. Actually, in Sen's vocabulary sustainable human development is closer to the notion of agency than to the narrower one of well-being: the latter in fact refers to a personal situation in term of achieved functionings and includes also sympathy, a concern for others' achieved functionings (or *others'* well-being); while the former taking into account commitment, is more inclusive insofar it relates also to the willingness to actually support other individuals in pursuing their projects of life regardless of the impacts on one's own well-being[3]. Hence sustainable human development considers in its agency notion a real social commitment, stronger than the sort of proximity to other individuals put forward by the notion of well-being. So, basically, we use the term well-being interchangeably with sustainable human development, instead of the more appropriate agency to keep on with the traditional vocabulary of the literature on the argument.

This Senian approach has profound roots in philosophy and classic economic theory. Both in fact take extensive note of the issue of human development: "The approach [to human development] reclaims an old and established heritage, rather then importing or implanting a new

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[2] In the Bruntland Report (1987) sustainable development is intended as a form of development that satisfies the needs of the present generation without compromising the ability of future generations to meet their own needs.

[3] Furthermore, Sen pointed out a narrower notion, namely the standard of living, which involves only the aspects of well-being regarding «the nature of his own life, rather then [from] 'other-regarding' objectives or impersonal concerns" (Sen, 1993: 37)

diversion" (Anand and Sen, 1994b: 3). More specifically, Sen's work has evident relations with Aristotle's human flourishing and "strong connections with Adam Smith's analysis of 'necessities' and conditions of living" (Sen, 1999: 24), concerning the ability of people to choose a reasonable life. Furthermore, Sen in the critic of utilitarianism is also close to the Marxian approach. In fact the latter seems to valuate goods themselves as intrinsically good in what is called 'commodity fetishism'. What he tries to establish is a sort of ethic foundationalism not rooted in a metaphysical principle, rather in ethical concepts intrinsically important for human lives: "We must ask which things are so important that we will not count a life as a human life whitout them? Such an evaluative inquiry into what is deepest and most essential in our lives…can be a way of looking at ourselves, asking what we really think about ourselves and what olds our history together" (Sen, 1992: 210).

In Sen's view of human development individuals are not simply people with needs, but they are "agents of change who can -given the opportunity- think, assess, evaluate, resolve, inspire, agitate, and through these means reshape the world" (Sen, 2000: 1). The enlargement of substantive human freedoms is at the core of Sen's perspective. In brief, the capability approach requires "a broader informational base, focusing particularly on people's capability to choose the life they have reason to value" (Sen,1999: 63), to highlight the social and economic factors which give people the opportunity to achieve such a valuable project of life. Thus the capability approach concentrates directly on substantive freedoms of individuals involved. In this sense, Sen suggests that well-being be considered in terms of human functionings and capabilities. Functionings relate to what a person may value doing or being: they are the living conditions achieved by an individual and represent a set of interrelated activities and states ('doings' and 'beings') that form her life. Capabilities concern the ability of an individual to achieve different combinations of functionings, and define the freedom to choose the life that she prefers. These two categories are complementary but however distinct: "A functioning is an achievement, whereas a capability is the ability to achieve. Functionings are, in a sense, more directly related to living conditions, since they are different aspects of living conditions. Capabilities, in contrast, are notions of freedom, in the positive sense: what real opportunities you have regarding the life you may lead" (Sen, 1987: 36). It is not the aim of this paper to reconsider all the theoretical issues concerning this approach, since they have been thoroughly analysed in the literature. Rather, here we intend to define a model for monitoring the evolution of sustainable human development according to Sen's view.

Sustainable human development, as pointed out, can be generally intended as an increases in the quality of life, both equitable and durable. In this sense "[the human development approach] applies …to the freedom to lead lives that people today and in the future value" (Anand and Sen, 1994b: 6). Accordingly Sen himself defines sustainable development "as development that promotes the capabilities of present generation without compromising capabilities of future generations" (Sen, 2000: 5). It is in fact a point of view strictly consistent with the extension from the fulfilment of needs to the enhancement of human freedoms on a sustainability basis.

At the same time sustainable development as intended by Sen owes very much to the Bruntland's notion: the latter too, in fact, includes consideration on the quality of life of each future generation, combined with concerns of intragenerational equity, and pays attention to the ability of meeting ones' own goals. The very difference between the two approaches lies in the evaluative conception. The Bruntland's approach views human beings only in terms of needs and fulfilment, Sen's one underlines the importance of freedom to enhance human capabilities: "[So. That is,] if you broaden sustainable development as sustaining the freedoms that people have, expanding freedoms and sustaining the freedoms that we have, I think we can get an adequately broad view of it. And that is the direction I would like to push the sustainable development literature to go. And it is an important distinction because quite often on the ground that ends justify the means - a very bewildering sentiment - people do things, recommend policies in the name of sustainable development, that begin by obliterating something very worth sustaining, namely human freedom." (Massarenti, interview with A.K. Sen, 2000).

To sum up, Sen suggest that human development coincide with the expansion of capabilities ("..[a] development that promotes the capabilities of present people…", Sen, 2000: 5). If this enlargement of the space of choices is expected to hold in the future ("…without compromising capabilities of future generations", ibid: 5) it is possible to refer to it as sustainable (human) development. Finally, in a practical perspective, Sen recommends that "In detailed application, a general idea of this kind

[ie sustainable development] can, of course, be combined with more precise articulation (taking contingent note of the availability of data and information", ibid: 3). On this ground, therefore, in the following sections we outline a possible model for measuring through system dynamics analysis sustainable human development as intended in the capability approach.

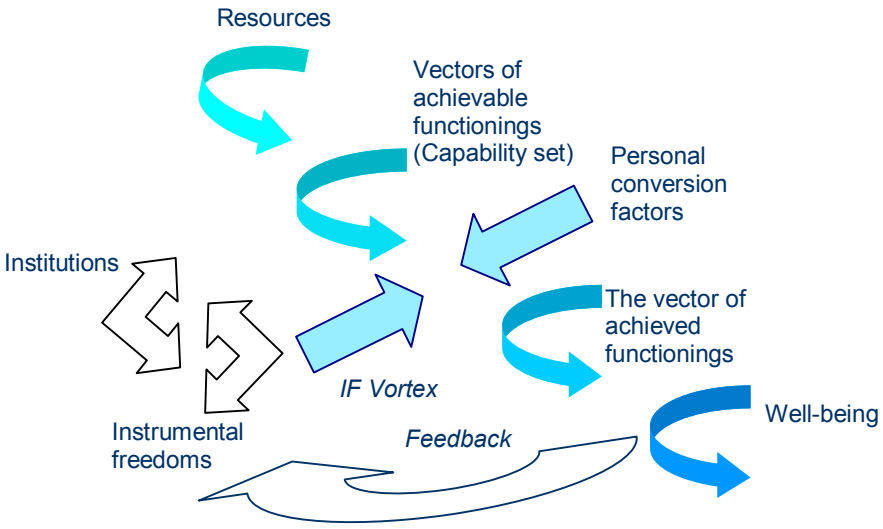
2 The operationalization of the capability approach

The process of operationalization relies on the translation of theoretical concepts into empirical ones, which eventually become empirical variables usable in quantitative and non-quantitative analysis.

We consider the capability approach primarily as a method for making interpersonal comparison of well-being. Indeed, in Sen's intention it has far wider implications: it is first of all a framework of thought, which aims to highlight the drawbacks of other approaches in identifying and defining well-being and human development. Since Sen's interest seems to be mainly concerned with this foundational level, he has never provided a formula or path to carry out welfare and development measurements and comparisons[4]. Actually, vagueness is a distinctive character of the capability approach, for it depends on the context, which is as ambiguous and complex as human life and values are.

In general, Sen's approach requires the translation of resources into valuable beings and doings (i.e. functionings), from which the various combinations of achievable functionings may be chosen (this possibility of choice forms the space of capabilities). In other words, resources, sifted by personal and social conversion factors, allow the attainment of a number of beings and doings, which may be represented by the vectors of achieved functionings[5] (or the capability set). Moreover, the conversion of resources into functionings is supported by a set of instrumental freedoms, which promote and enhance institutional efficiency and effectiveness and thus uphold the success of the translation process (we call this complex connection 'the Institutions-Freedoms – or IF – vortex[6]'). Finally, the choice of a specific subset (a vector) of functionings generates a given level of well-being, which in turn can eventually 'tune-back' institutions and their responses.

Figure 1 - The capability approach: a general view



We consider this schematic, and intrinsically dynamic representation as the capability approach itself, quite consistent with Sen's view of well-being: "We use incomes and commodities as the material basis of our well-being. But what use we can respectively make of a given bundle of commodities, or more generally of a given level of income, depends crucially on a number of

[4] With great disappointment of those who have looked into Sen's writings for these 'recipes'.
[5] Achieved functionings could be alternatively seen as an elementary valuation of the capability set. In this sense – only in this sense – functionings and capabilities coincide.
[6] The expression 'Institutions-Freedoms vortex' is taken from Chopra, Duraiappah (2001).

contingent circumstances, both personal and social" (Sen, 1999: 70). These different contingent circumstances "make opulence ……a limited guide to welfare and the quality of life" (ibid: 71).
In order to operationalise the capability approach we must introduce a major simplification[7]: we restrict the model to the space of the chosen vector of functionings. In doing so we avoid the issue of the measurement of capabilities, and bypass the problem of their unobservability[8]. Therefore, we too stick to Basu's suggestion – reported in Brandolini and D'Alessio (1998:15) –: "…to go along with Sen and evaluate well-being on the basis of functionings, but be content with achievements, instead of capabilities". Sen himself suggests that at a practical level the most appropriate focus of attention should not always lie in the measure of capabilities: "Some capabilities are harder to measure than others and attempts to putting them on a 'metric' may sometimes hide more than they reveal" (Sen, 1999: 81). Furthermore, the chosen vector of functionings could be seen as an elementary valuation of the capability set, which depending on the appropriate choice of the elements of the vector (eg assuming a maximizing behaviour), can in turn be considered as the maximally valued one[9]: "the focusing on a *chosen functioning vector* coincides with concentration on the *capability set*, since the latter is judged, ultimately, by the former." (Sen, 1999: 76 – emphasis in the original). In fact, although Sen claims the necessity of specifying deprivation or achievements in terms of capability, he provides no definitive argument for this point. So we can say that a universal need for A can be a proxy for a universal capability to A, considering A sufficiently general in order to permit different specifications in different contexts (as we try to do in our model).
From a theoretical point of view the reference unit of the capability approach is the individual, functionings and capabilities being in fact properties of individuals. More specifically, Sen moves in the space of moral individualism and considers the individual as the only unit that counts when evaluating social states, avoiding at the same time to reduce society to the mere sum of individuals and their properties, as set by ontological individualism. In other words, the use of different units of analysis (groups based on age, gender, administrative boundaries or other elements) in the empirical work points out intergroup variations, but according to Sen (1992: 117, n.1) the focal point of the analysis remains the individual, since the interest in group is only derivative (ie regarding the differences among individuals placed in different groups) and not intrinsic (ie regarding the differences between groups seen as unique bodies). Nonetheless, Sen's moral individualism does not forget that the human being is a *zoon politikon*, insofar her evaluative process is shaped by a number of social elements, such as the social conversion factors and, mainly, the IF vortex. Indeed in Sen's words, as pointed out by some observers, there is a deep interest for the institutional basis of human life, and his concern for the individual seems rather formal, or at least instrumental, insofar individuals are member of a community (Comim 2001: 9). For these reasons it is possible to use the capability approach to assess social well-being, that is some form of aggregation of individuals' well-being[10]. In other words, focusing the capability approach at a macro level indeed implies the loosing of the keener in-depth perspective of individual analysis. But this is the price we have to pay to obtain a policy tool, which hopefully could be useful for a keener comprehension of sustainability dynamics over time.
Sen himself in applying the capability approach refers to regional, national, sub-national, or group data. For instance, when examining poverty and deprivation in India and Sub-Saharan Africa (Sen, 1999: 99-104), he draws on national and sub-national level data. Or, when dealing with gender inequality, he works both with different territorial level and group data (Sen, ibid: 104-107).

[7] We are aware of other areas of incompleteness with respect to the foundational theory. For thorough and yet synthetic analysis of the capability approach, see for instance Gasper (2002), Robeyns (2000), Saith (2001).
[8] In fact their potential nature can become actual only after an individual's process of choice.
[9] In this perspective the value of the capability set is that of a single element of the set itself, the maximally valued one. But this view holds if freedom is considered mainly in its instrumental meaning, and not in its substantive one. In this latter case we inevitably should have pushed our analysis to the capability set, with all the problems deriving from unobservabilty and from the increase of information required.
[10] Sen (1991: 15-16) points out that this is a non-welfarist approach to the assessment of what standard economic theory defines social welfare.

3. The MiSS model: generalities

The model is composed of two sections:

- '*Left Side*': demand for functionings. Ideal world situation.
- '*Right Side*': supply of functionings. Real world situation.

The general model, specifically tailored for Italy, is split into a number of sub-models (6), which refer to different populations based on age and gender. As far as the age is concerned, three sets are pointed out: 0-19; 20-64; 65+. The model can be simulated over any time horizon through system dynamics analysis. System dynamics is a method for studying the world around us as a whole, allowing to model reality through the interactions between single elements (or functionings) of the system and their feedback loops. It is based on concepts of flows and stocks, dynamically connected over time. The use of system dynamics analysis surely represents a first element of consistence with Senian approach, exceeding the simple causality relationship between variables and capturing the complexity of real world through which the IF vortex operates.

For each time period, we carry out a comparison between ideal world and real world functionings. On the basis of their distances, the model simulates some responses by decision makers. These responses in turn are influenced by institutions and instrumental freedoms, and ultimately affect the dynamics of real world functionings.

3.1 Left Side: 'should be'

This side of the model refers to a normative ideal situation. Starting from a base reference year, we forecast a demographic trend for each population, including migration flows. The basic idea is that each individual within each population entails a certain amount of functionings (or, in other words, brings with her a certain demand for functionings) specifically chosen according to the priorities of the area in analysis.

As far as Italy is concerned, the most representative functionings in our opinion are: income, employment, poverty, education, environment, residences, mobility, health and security.

Some variables, such as income, are not specifically functionings in the capability approach, but instrumental variables. However, the dynamic interaction with poverty, employment and other elements of the system as a whole, and the importance of income as a mean to individual fulfilment of liberties have determined our choice.

Sen himeself states: "In many contexts, the rough and ready way of using income information may provide the most immediate approach to the study of severe deprivation" (Sen, 1999: 361). Furthermore, the use of the Solow's model that considers human capital as a determinant of growth can is in some way incorporate the influence of the IF vortex in the relationship between capabilities and functionings.

Besides, for functionings like environment and security, indicators of the 'should be' side represent, in fact, dis-functionings of the system. For the former, the level of CO_2 emissions is taken as a valid proxy; for the latter, instead, we take into consideration the number of property crimes denounced every year (in a developed country, like Italy, property crimes are, in our opinion, more proper than violent crimes in order to measure the perceived security level).

Road traffic and congestion are also considered dis-functionings, and are measured by vehicles/km divided by road network extension (in km). Transportation policies are intended to reduce this indicator switching traffic (especially passengers) from road to rail.

The other dis-functioning is related to road security and is measured by the number of accidents.

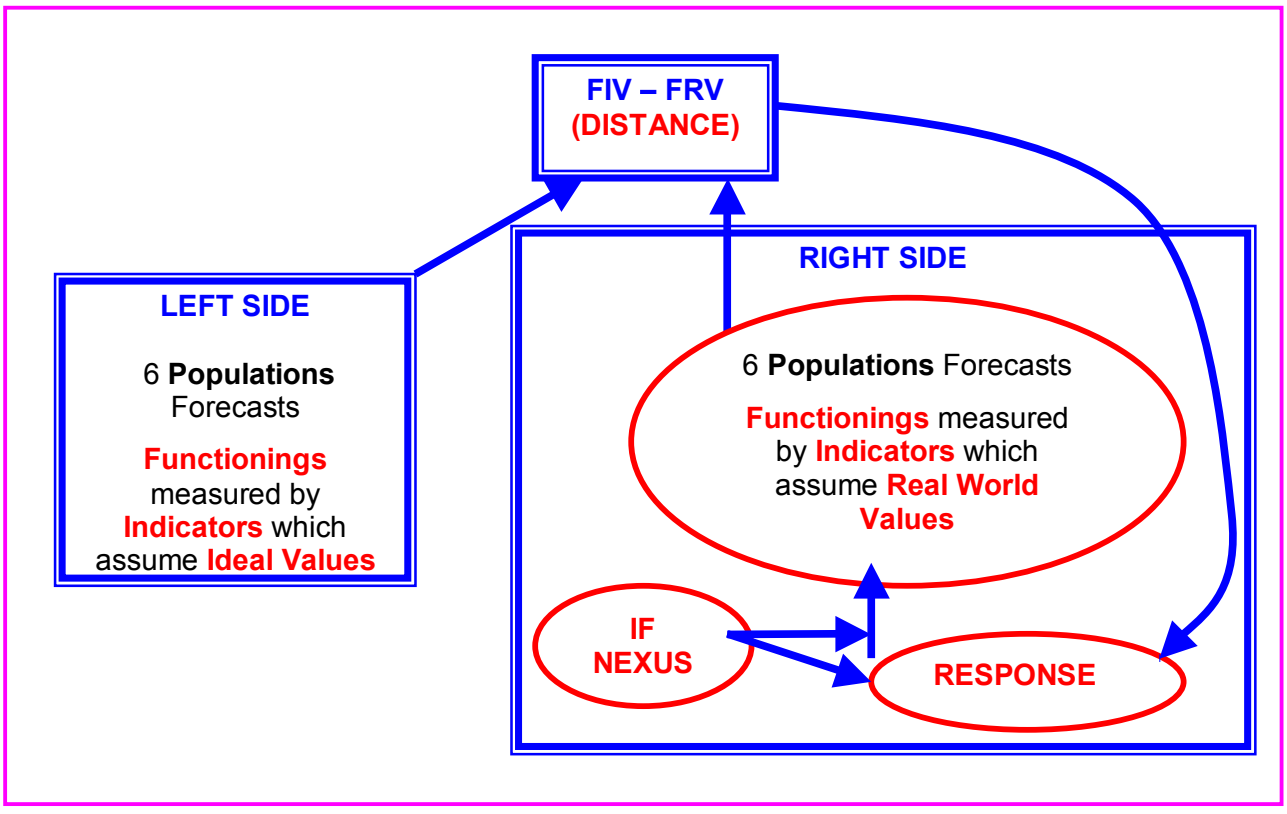
The quality of health system is calculated through the HOGA coefficient (Health Overall Goal Attainment, WHO World Report, 2000). The HOGA is an indicator that includes not only the quality of health in terms of life expectancy, but also the distributional effects of health policies regulations (considering the role of public funds or private insurances) and the non-health elements of health system (attention paid to the patient, waiting lists). Education, finally, refers to the average years of school attendance, and thus interacts with income (which is also determined by schooling variable) and health levels (which are influenced also by human capital).

3.2 Right Side: 'will be'

This side of the model refers to the 'real world' situation. It contains the same 6 sub-models of the Left Side with the same population forecasts, and it is based on the same functionings measured by the same indicators. In this context, indicators show the latest available real world figures in

Italy. On the base year the value of the indicators points out the supply of functionings that the Italian socio-economic system is able to provide individuals with. The Right Side differs from the Left one in that its indicators are: i) linked one each other through a web of relationships which reflect driving forces, one way connections and feedbacks; ii) linked to response indicators which reflect policy responses generated in order to fill the gap between the real world situation (Right Side) and the ideal one (Left Side); iii) influenced by institutional and instrumental freedom forces (IF Vortex) expressing a web of mutual relationships among these two elements. All the above mentioned relationships are taken from the literature or expressly calculated. An example of i) could be portrayed in the following chain: per-capita income drives passenger-km and per-capita energy consumption, which determine per-capita CO_2 emissions, which eventually has an effect on health. An example of ii) is: an increase in income taxation in order to meet the increased health needs and reduce the distance with the ideal value (Left Side). Finally, an example of iii) is: the efficiency of institutions in raising and managing fiscal revenues.
The following figure describes the general framework of the model.

Figure 2 – An overview of the MiSS Model



4. The MiSS model: from theory to practice

4.1 The MISS Model consistence with the Senian Approach

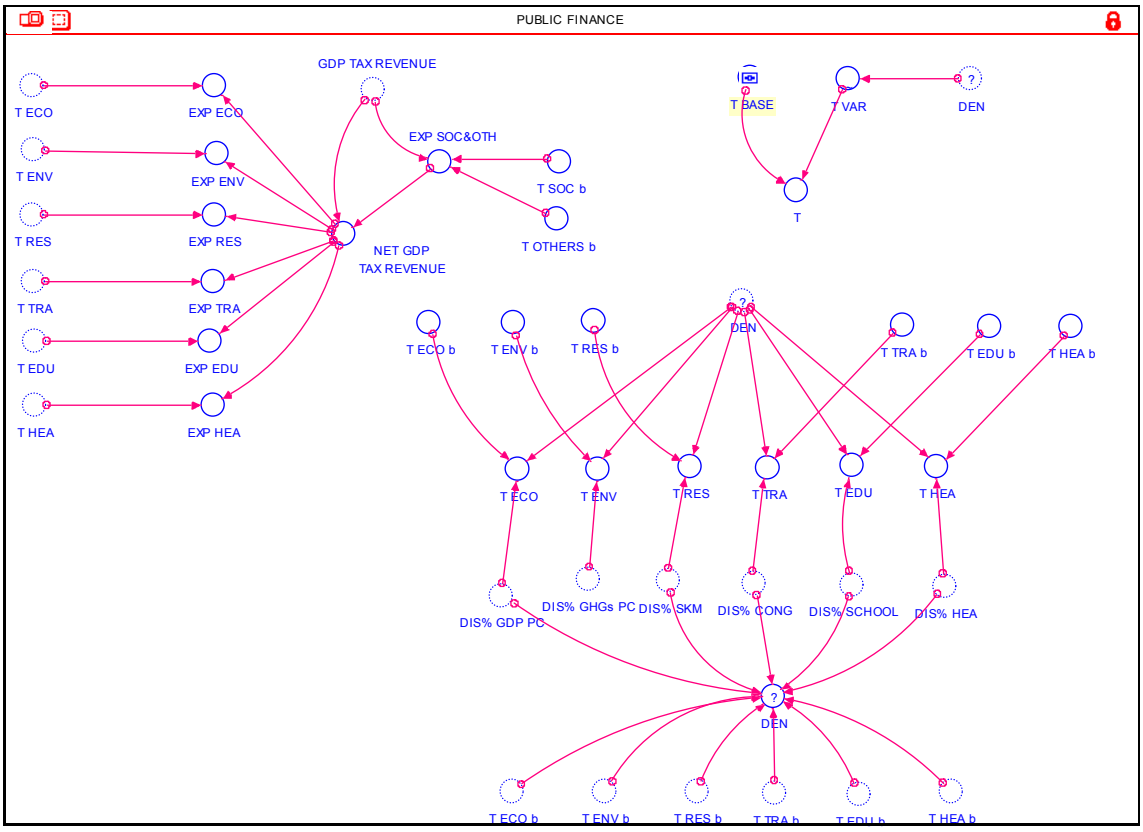
Economic literature has often focused its attention on the difficulties of operationalising Senian approach. Sen too says: “I am not under any illusion that the capability approach to the standard of living would be very easy to use. It is particularly difficult to get an idea of a person’s positive freedom of choice – what he or she could not have done or been. What we observe are the actual choices and realizations. But the case for using the capability approach is not, of course, logistic convenience but relevance” (Sen, 1984: 87).
The MISS project structure, briefly outlined in the previous section, is based on the definition of a set of functionings used as proxies for capabilities.
On the left side (‘should be’) achievable functionings are measured by an ideal value that people could try to achieve. This choice could seem problematic: is not the case of a Basic Need

Approach operationalisation? This section tries to answer this all important question, focusing primarily on the MiSS strenght points and on their consistence with the Senian theory.
First of all, the measurement of distances between ideal and real values of considered functionings that determine the institutional response, reproduces the mechanism through which instrumental freedoms turn into achieved functionings.
The dynamic interaction between each single part of the model is another peculiarity of the MiSS model. According to a systemic approach, each functioning is not an island, rather it is a constellation of interdependent elements continually interacting over time through feedback loops. This feature reminds to the Senian 'social interdependence' and justifies the choice of considering income as a functioning, while generally in the capability approach it is used only as an instrumental variable, a mean to reach a certain level of well-being.
As a matter of fact, GDP is here derived according to the Solow's model. It is a long run model with only structural unemployment, i.e. not related to economic cycles. It is dependent on: physical capital, human capital, technical progress, and labour. The three first factors are aggregated on the basis of the Cobb-Douglas production function, while labour is modelled in a different box and it is determined by physical capital growth rate and technical progress (exogenous variables). The choice of the Solow's approach reflects the ambition of drawing system connections (for example, human capital is directly linked to the educational box) and of highlighting the all important role of the IF vortex.
The use of a systemic, aggregate, perspective could be somehow considered conflicting with the capability framework, which is basically individualistic. Nonetheless, as mentioned before, the MiSS model is run for six different populations. It considers gender differences and three age cohorts (0-18, 18-64, over 64 years), allowing the choice of the population for which the simulations are run. In doing this, we can grasp how the IF vortex actually works and include in a scenario analysis those variations that, to stay with Sen, "give us unequal powers to build freedom in our lives even when we have the same bundle of goods" (Sen, 1990: 121).

4.2 Public Finance Modelling

In the MiSS Model the Public Finance box (see Fig. 3) plays a crucial role, insofar it describes the mechanism through which institutional response tries to reduce the distances between ideal and real values for each functioning.

Figure 3 - The Public Finance box



The logic of the box is straightforward: GDP Tax revenue (not including social security expenditures) is divided between all achievable functionings so that, for each of them, it is possible to calculate a specific tax rate. This tax rate is made of two components: a base value (controlled by a slider in order to make it possible to conduct a sensitivity analysis) and a variable component linked to 'DEN' (a synthetic index of distances). As distances grow, the tax rate increases in order to provide more revenue for political actions.
The variable labelled DEN is the strategic key of the model: it is the synthetic index of all the distances between left and right side functionings.
An example can prove useful to explain how it works.
In the Environment functioning the variable named 'DIS% GHG PC' represents the distance between the target level (should be side) of *per capita* greenhouse gases emissions (GHG) and the real level (will be side), of *per capita* GHG expressed in percentage (a number between 0 and 1). The variable 'T ENV b' calculates, instead, the weight of public expenditures on environment in the base year with respect to total public expenditures.
'DIS %' and 'T base' values are derived in the same way for each functioning of the system, so that the final DEN index is the weighted average of the distances expressed in relative terms (e.g. DIS% GHG's PC) and the weight of each public expenditure component in the base year (e.g. T ENV b).
If we still consider environment functioning (but the mechanism is the same for the other ones) the real expenditures in different subsequent years are derived as follows:

(DIS% GHG's PC * T ENV b)/ DEN index (1)

The variable expressed in (1) is labelled T ENV. In other words, given the weight in terms of expenditures, the more the distance of the environmental real functioning from the ideal one, the larger T ENV.
DEN index construction catches a particular aspect of the policy making process. Matter-of-factly institutional response does not automatically take place when a particular need emerges in one or

more elements of the system, rather it is a process in which past trends and traditions in the political regulation of a particular issue have to be taken in consideration.
For instance, if in the environmental box there is a great distance between the ideal CO_2 emissions value and the measured one, it is not reasonable to foresee an adequate level of public expenditure to reduce the gap. In Italy, in fact, environmental issues have traditionally been neglected in favour of other aspects of the socioeconomic system, more politically rewarding. Moreover, given the absence of a deep-rooted ecologist consciousness, we can understand the reasons why public expenditure on environmental issues has never been larger than 3% of total public expenditure. So our expectations on tax revenue distribution must pay attention to this features, and the use of DEN index in the MISS model accomplishes this task.
In other words, DEN index can point out the cultural dimension of political systems and its capacity of implementing specific reforms, according to the relative weight attributed to each issue in the control room, that is surely an element of consistence with the Senian approach in its effort of considering conversion factors and their impact on substantive freedoms.

4.3 Governance Box

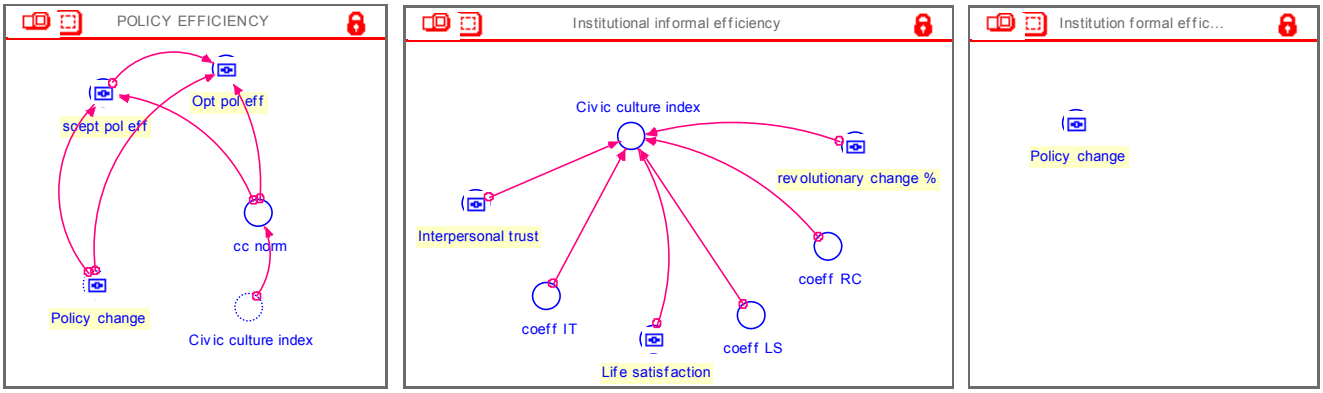
The MiSS framework intends also to model the policy level, reproducing the context in which policy making takes place and describing the impact of institutional activity on the socio-economic system. This feature certainly represents one of the most important and challenging elements of consistence with the Senian approach. In fact it aimed to include in the resulting simulations the role played by the IF Vortex, specifically the transformation of instrumental freedoms in achieved functioning, and in the end the possibility for individuals to effectively define their project of life.
The governance box is based on the distinction between formal and informal institutional efficiency: the latter includes public opinion impact on the social environment, while the former depicts governmental action. Actually, both dimensions have a considerable impact on policy efficiency.
Formal institutions efficiency is proxied in the MiSS model by the variable POLICY CHANGE, a sort of legislative productivity index, based on the results of George Tsebelis' 'veto players' theory (Tsebelis, 1999), according to which policy change (the political opportunity of abandoning the *status quo*) is a function of the number of veto players acting in the political system and can be represented by the number of significant laws passed in a political system.
A problem could rise in the definition of the significance of a law: Tsebelis considers significant only laws that lie at the intersection of two international sources[11]. Taking Tsebelis' dataset as a reference, we have built an index, labelled POLICY CHANGE.
For instance, if we want to calculate the value of this index for country A, the formula to be used is:

> POLICY CHANGE A = (Country A's number of laws x years – min value of the sample/max value of the sample – min of the sample)

Where country A's number of laws per years, min and max values of the sample are taken from Tsebelis' dataset.
The numerator highlights the distance, in terms of number of laws per year, between country A and the minimum value of the sample, while denominator expresses the maximum possible measurable distance.
POLICY CHANGE A represents the relative position of country A in the entire sample: it ranges from 0 to 1. The closer to 1, the more it is probable to foresee a policy change in country A. In the end, we can consider POLICY CHANGE as the probability of a policy change to take place in a specific context[12].

Figure 4 - Governance box

[11] Specifically, NATLEX, an ILO database of legislative systems, and Encyclopedia of Labour Law, edited by Blanpain and written for those lawyers from a country who want to practice law in another.
[12] This value is modifiable by the final user through a slider that takes the base value as a reference in order to conduct a scenario analysis.



Informal institutional efficiency refers, on the other hand, to a Ronald Inglehart's work (Inglehart, 1988: 1203-1230) which is in turn based on Almond and Verba classical study (Almond and Verba, 1963) and on Putnam survey on the impact of Italian regional reform (Putnam, 1983: 55-74).
'Civic Culture' (CC) index is a variable whose value is always positive and determined by three elements: interpersonal trust, life satisfaction and will of revolutionary change expressed in percentage values.
Interpersonal trust is measured by three Eurobarometers surveys (Eurobarometers Surveys, 1976-86) and refers to the specific question: "Now I would like to ask about how much you would trust people from various countries. For each country please say whether, in your opinion they are generally trustworthy, fairly trustworthy or not at all trustworthy".
'Life satisfaction' (LS) refers again to Eurobarometers Surveys (Eurobarometers Surveys, 1973-1987) and to the specific question: "Generally speaking, how satisfied are you with your life as a whole? Would you say you are very satisfied, fairly satisfied, not very satisfied, or not at all satisfied?".
Finally, 'will of revolutionary change' (RC) value is taken from World Values Surveys (World Values Surveys, 1981) and refers to the following question: "Please choose, between the following attitudes, the one which best describes your own opinion: a) the entire way our society is organized must be radically changed by revolutionary action; b) our society must be gradually improved by reforms; c) our present society must be valiantly defended against all subversive forces".
The values of these three dimensions are all modifiable in a sensitivity analysis through the use of specific slider instruments.
In order to build an average weight between formal institutions efficiency and informal one, CC INDEX has to be normalised and divided by its maximum achievable value, so that the final variable, labelled as 'CC NORM', spans from 0 to 1.
CC NORM can be interpreted as the probability of a positive social environment, defined as an ideal context to implement specific political reforms.
To sum up, the governance box is based on two indexes that measure formal and informal institutional efficiency. We have already noticed that both POLICY CHANGE and CIVIC CULTURE NORM values can be thought as probability values, so that final 'POLICY EFFICIENCY' gives the joint probability of the two factors. More specifically, POLICY EFFICIENCY value is a number between 0 and 1 and is the product of POLICY CHANGE and CIVIC CULTURE NORM: the final value is then linked to each functioning of the system as a multiplier coefficient having an impact on the effective response stimulated by the distance between ideal and real measured values.
We have also introduced another element of complexity in order to give the final user a great degree of autonomy in the simulations. As a matter of fact, it is possible to choose between two options: an optimistic and a sceptical one. In the former situation, political efficiency is assumed to occur when at least one of the two dimensions (formal or informal) exists in the socio-economic

environment. In the latter, instead, political efficiency requires the simultaneous action of both formal and informal efficiency. In the control panel, through the use of apposite switches, the final user can choose whether to conduce the simulations in the optimistic or in the sceptical scenario.
The inclusion of governance dimension has a remarkable important role because, like in the public finance domain, political response to a specific problem does not arise automatically as a certain distance between target value and real functioning is experimented. Rather, factors such as Senian 'social interdependence' and governments failures may cause time lags between political decisions and their implementations. In order to be consistent with Senian approach, we have necessarily to catch these dimensions and this is the very scope of the governance box.

5. The architecture of the MiSS model

5.1 Income Box

As it is remarked in the General Introduction, the economic system as it is commonly meant is just one of the subsystems which compose the society as a whole. This does not amount to saying that the economic system (and its representation) are unimportant. On the contrary, within the MiSS model, the economic system represents one of the most important "blocks" of what we called the right-hand side or the "will be" side, the other being the political-institutional block. The (bad or smooth) operation of the economic system results, at the end of the day, in the size and structure of the flow of goods (consumption/investment, durable/non-durable, material/immaterial, public/ private goods) which are , to say the least, complements to the functionings (and the ill-functionings) on which the MISS model focuses.
As a consequence, the issue of how to represent the economic system in the model can be hardly regarded as a trivial one. Let us begin by stating two desirable properties which this representation should have:

1. Long –run: the general setting of the MISS model is a long-run one, so that the economic "side" also should allow for growth and accumulation.
2. Policy-sensitiveness: a policy-insensitive economic system would imply that public policies just redistribute resources to different uses, rather than also affecting the production of resources.

Obviously, economics has a well-established and comprehensive tool for representing the economic system, namely, the model of General Economic Equilibrium (GEE) in its many variants. Then one should expect the MISS model to embody some sort of (computable) general equilibrium "box". However, here a number of sensitive theoretical and practical issues arise. Starting from theory, it is well known that GEE represents the economic system as the place of the interaction among optimizing agents (households , firms and in some versions governments and other agencies) on (more or less) competitive and complete markets. The the question is: how consistent is this view with the general approach of the MISS project, which builds (to a large extent) on Sen's refusal of the homo oeconomicus assumption? I am not that sure that inconsistency is that full (it seems to me that Sen does not refuse the idea of preference and choice , but a narrow specification of preferences as those of a self-interested individual). Nor I think that a general equilibrium approach per se implies any a priori faith in the optimality of market outcomes as long as completeness of markets is not assumed. Then a general equilibrium approach is a possibility, provided a richer specification of preferences and a proper treatment of externalities are taken care of.
Practical considerations however come soon to the fore. Since the focus of the MISS project is on the relationships among subsystems (economic-institutional-social) rather than on the interactions among agents within the economic subsystem, a full general equilibrium modelling would add too much complexity to an already complex setting. Even a static, certain, standard-preference and complete-market general equilibrium model would do so, let alone a slightly extended one.
This is why we resorted to a very simple minded, but flexible and manageable tool like Solow's model.

Solow's one-sector model rests on the representation of the technology by means of a constant-returns-to-scale, decreasing-marginal-returns production function and on a the simple behavioural assumption that individuals devote a fixed share of their income to savings, which are entirely transformed into new physical capital.
The production function then is

$$Y_t = A_t F(K_t, L_t A_t, H_t)$$

where K is physical capital, L is raw labour, H is human capital and A is the level of technology. K, H, and A are stocks and the suffix t means their levels at the beginning of the period from t to $t+\Delta$, where Δ is the unit of measurement of time (1 year in our model). L_t is a the average flow of raw labour during the period between t and $t+\Delta$. More precisely, we adopt a Cobb-Douglas form for the production function:

$$Y_t = A_t K_t^{1-\alpha} L_t^{1-\alpha-\beta} H_t^{\beta}$$

Capital changes over time according to the equation:

$$K_{t+1} - K_t = s(1-\tau)Y_t - \delta K_t$$

where: s is the marginal propensity to save out of disposable income, τ is the average tax rate on income, δ is the rate of depreciation of physical capital. We adopt a Cobb-Douglas production function. The expression for the rate of growth of GDP becomes:

$$\frac{Y_{t+1} - Y_t}{Y_t} = \frac{A_{t+1}}{A_t}\left[(1-\delta)(1+n)^{1-\alpha-\beta} + s(1-\tau)\left(\frac{K_t}{L_t(1+n)}\right)^{\alpha-1}\left(\frac{H_t}{L_t(1+n)}\right)^{\beta}\right](1+g_H)^{\beta} - 1$$

where $n \equiv \frac{L_{t+1} - L_t}{L_t}$ and $g_H \equiv \frac{H_{t+1} - H_t}{H_t}$

Let us for the moment leave aside the rate of growth of labour and concentrate on the growth rate of human capital. The model embeds the idea that the accumulation of human capital by an individual depends on his/her family background. Checchi and … () find, in large cross section of individuals, that one additional year of schooling of parents translates into one-half additional year of education for the sons. More precisely, if we take two individuals, the difference between their numbers of years in school is estimated to be half the difference between the numbers of school years of their parents. If we take son s and son s', with parents p and p', we have:

$$H^S - H^{s'} = 0{,}5\left(H^p - H^{p'}\right)$$

Since we work in time and not with a cross-section, we translated the above result as follows. The stock of individuals living at time t are supposed to have parents who, on the average, had the same age of theirs 25 years ago (the conventional length of a 'generation'). Then the difference in schooling between individuals living at time $t+1$ and individuals living at time t is deemed to be half the difference between the school-years of the individuals living at time $t-24$ and individuals living at time $t-25$:

$$H_{t+1} - H_t = 0{,}5\left(H_{t-24} - H_{t-25}\right)$$
$$H_{t+1} - H_t = 0{,}5\left(H_{t-24} - H_{t-25}\right)$$

and

$$g_H = \frac{H_{t+1} - H_t}{H_t} = 0{,}5\left(\frac{H_{t-24} - H_{t-25}}{H_{t-25}}\right)\frac{H_{t-25}}{H_t}$$

A substantial stock of applied work in the literature on the economics of growth provided most of the numerical values used in the model simulation. Barro and Sala-I-Martin (2004) summarize them. Here are the values

δ	0,05
α	0,33
β	0,42
$\frac{A_{t+1}}{A_t}$	0,02

The marginal propensity to save was set at a conventional $s = 0{,}2$. n and τ are, in principle) endogenous to the model (see below). An initial value for A was obtained as follows. Given the initial (2001 – Istat National Accounts) values for Y, K and H and setting $L = 1$, we computed:

$$A = \frac{Y_{2001}}{K_{2001}^{\alpha} H_{2001}^{\beta}}$$

How does unemployment fit into this framework ? Consistently with the equilibrium, long-run approach adopted here, unemployment is just structural (and not cyclical or lack-of-effective-demand unemployment). In a sense, unemployment does not depend on output (GDP) but the latter depends on the former. More precisely, if L is the number of employed workers , N is the labour force and P is population, the following identity holds:

$$L = (1-u)arP$$

where r is the share of total population of working age, a is the activity rate and u is the unemployment rate. Then

$$n \equiv \frac{L_{t+1} - L_t}{L_t} = \frac{u_{t+1}}{u_t}\frac{a_{t+1}}{a_t}\frac{r_{t+1}}{r_t}\frac{P_{t+1}}{P_t} - 1$$

"Structural unemployment" has, in our perspective, three possible meanings:

a) unemployment due to malfunction of the labour market
b) technological unemployment
c) 'complementarity' unemployment: to the extent that coefficients are fixed, the system might be unable to employ all workers due to lack of capital.

Different routes can be followed in the modelling of this kind of unemployment.

5.2 Environmental Box

In the context of sustainable human development, environment plays a great role, in so far it affects both intra-generational and inter-generational equity. There are several indicators that could be used for exploring this dimension and each of them could be referred to a specific context: for instance, water, soil air, green areas, waste, pressure on territory and so on. The need for a

synthesis induced us to refer to a single 'dis-functioning' and use per capita Greenhouse Gases (GHGs) as an indicator of the pressure on environment. Even if a partial representation of the environmental dimension, per capita GHGs is characterized by some advantages: firstly, it captures the connection between energy, economy and environment and, thus, allows to take into account one of the main stresses for environment: energy consumptions. In fact, GHGs are related to the combustion of fossil fuels (coal, oil, gas) which still represent more than 80% of the world total primary energy supply. In Italy, the economy heavily depends on fossil fuels, their weigh being about 93% of the total primary energy supply. Another reason which enlights the importance of GHGs is their increased relevance since the Kyoto Protocol signature in December 1997. This international agreement obliges Italy to reduce its GHGs emissions by 6.5% under the 1990 level. This target is very ambitious since, due to the electricity and transportation sectors, emissions are growing and in 2010 they are forecasted to be about 20% over the Kyoto target level. This means that if Italy will choose to meet its Kyoto target by means of domestic policies, a wide impact on the energy system and environment will emerge. On the contrary, the higher the dependence either on the purchase of carbon credits in the international emissions trading market or the generation of carbon credits thorough projects abroad, the weaker the reshaping of the Italian energy-environmental system. Due to such an uncertainty, and taking into consideration the national energy and environmental policy guidelines, we decided that the value X is the target of the GHGs per capita emissions (left side of the model). X emissions depends on the hypothesis that emissions are reduced by 50% through domestic policies and measures and by 50% through foreign action. Naturally, this value is just an indication and any model's user can change it or make sensitivity analysis by assuming other values. Having said this, the dynamics of environment is quite simple: we start from GHGs intensity, that is the ratio between national GHGs emissions and GDP. On the basis of statistical analyses of past data, which are characterized by a decreasing trend, we derive a "de-growth" rate for GHGs intensity. Basically, this rate reflects the decoupling between GDP and GHGs emissions emerged in Italy in the last thirty years, that is the fact that GDP increased more than GHGs emissions. In particular, since 1990 to 2001, GDP increased by about 1.6% a year while emissions increased by about 0.6% a year. This means that the ratio GHGS/GDP decreased by about 0.9% a year. We pass to GHGs emissions by multiplying GHGs intensity by GDP. In this way we derive a business as usual trend. The difference between such a trend and the effect of climate change policies gives rise to a new variable. By dividing it by population, we pass to per capita GHGs emissions: this latter variable represents our right side indicator. It is worth stressing that, since the business as usual trend is driven by GDP, this indicator captures the relationship between environment and economy. As far as climate change policies are concerned, they are originated by the distance between the right and the left side values. Two kinds of policies are implemented: expenditure and administrative policies. Subject to the mechanisms and constraints described in the public finance and governance paragraphs, the former are climate change policies which need funds, e.g. incentives to renewable energy and energy efficiencies interventions. The basic idea is that technically it is possible to transform 1 Euro spent on GHGs in a reduction of GHGs equal to X, but such a technical potential is reduced by institutional efficiency. Administrative policies, even if constrained by the degree of institutional efficiency, do not require funds but simply good laws which could improve the share of renewables in the energy system, energy efficiency and the capture of carbon emissions by forests. As the distance between the right and the left side approaches zero, policies slow down.

5.3 Transportation box

The relevance of the 'mobility' functioning induced us to dedicate a model box also to the transportation sector. As already said, due to its growth, transports are one of the main contributors to GHGs emissions. While in 1990 the total traffic (road, railway, shipping, aviation) was equal to 235.702 millions of passenger kilometers, in 2000 it reached 281.951 millions of passenger kilometers, that is there was an increase of about 20% in 10 years. In the same period, the increase in energy consumption associated to the transportation sector was equal to about 52%: this confirms the relevant role played by this sector within the energy and environmental systems. However, even if transports strongly affects environment, we focused on the mobility functioning.

Being Italy an industrialised country in which people travel a lot on a wide net of roads, highways and railways, we decided not to explore the degree of mobility, but the quality of mobility. In fact, like many other developed countries, Italy's transports are affected by a typical problem: congestion. We modeled it in the following way: as an indicator of road traffic and congestion (a 'dis-functioning'), both for passengers and for freight, we chose the ratio between vehicle kilometers and road kilometers. Among developed country, Italy is characterised by one of the highest value, about three times above the average. Relying on historical data, we derived a growth rate for such an indicator. In the left side of the model, as a target, we chose the average value for OECD countries. Again, we have to stress that these values are entirely in the user's hands and, thus, can be easily changed. The wider the distance between the right and the left side, the stronger the policies to improve the situation. Since in Italy the road network is quite developed and its extension does not solve the problem of congestion, in so far the kilometers travelled by vehicles tend to increase and adapt to the road network, it is not possible to propose policies that lower our indicator acting on its denominator by increasing it. For this reason, we thought of policies which affect the numerator (kilometers traveled by vehicles) and reduce it through a shift of mobility from road to railways. This shift is encouraged by public expenditure: money should be invested in increasing railway network to easy the shift from road to rail, both for passengers and freight. As the distance between the right and the left side approaches zero, policies slow down. We also considered road accidents per traffic as a 'dis-functioning' related to safety, even if this distance is not relevant in our model.

5.4 Shelter Box

We thought that a dimension that must be considered within the context of sustainable human development is shelter. As an indicator we chose the residential square meters per capita. Even if such an indicator cannot encompass the quality of living, we think that it gives a quite good representation of the residential standard. In Italy, data show that progresses occurred in the last thirty years: per capita squared meters increased as per capita GDP grew. On the basis of statistical analyses of past data, we start from 'squared kilometers intensity' and multiply it by GDP. This is what we call the private driver for per capita squared kilometers. Then we add what we call public driver, which depends on public expenditure, a price index and parameters for political efficiency.

5.4 Education Box

In a Senian perspective, educational issues perform a key role in the empowerment of human instrumental freedoms and in the transformation of capabilities in achieved functionings: for this reason the importance of such a box in the MiSS model is straightforward.
As a proxy for education quality, in the left side, we use an indicator taken from a study of Brunello and Checchi (2001): the average years of school attended by population.
The relevant literature on the matter often uses other indicators for human capital, such as enrolment rates or ISCED (level of education and training), specific for different educational programmes: the use of 'average years' of school in this model, instead, has the advantage of catching distributional effects of educational attainment among population.
In the regression cited above (Brunello and Checchi, 2001), the dependent variable (average years of school) is explained by two different factors: school quality, proxyed by the pupil/teacher ratio (the lower is the indicator, the higher is school quality) and family background, that measures the impact of parents' level of education on their children one. One assumption is made about the length of a generation, that is thought to be 25 years.
To estimate the impact of family background and school quality on returns to education, we use a two-steps model. In the first step we use the following equation:

$$Y = \alpha + \beta X + \gamma E + \varepsilon$$

where Y is log annual earnings, α represents region of birth, X is a vector of individual controls, E the years of education and γ the returns to education.
In the second step, we retrieve the estimated values of γ and estimate the relation:

$$\gamma = \lambda + \phi Q + \psi W + \sigma QW + \varepsilon$$

where λ catches the control variables, Q represents school quality calculated through the pupil-teacher ratio W represents family background.
The data used in the MiSS model are taken from the 'Survey on the Income and Wealth of Italian Households' (SHIW – Banca d'Italia) and from OECD online database.
Pupil-teacher ratio is then computed endogenously as follows: the number of pupils attending different educational programmes is considered as a decreasing function of Italian Population (with a decrease rate calculated on the basis of hystorical series) while teachers number is obtained dividing the total amount of public expenditures on education for the average wage level taken from OECD (on which the policy efficiency switches have their impacts).
The empirical study (Brunello and Checchi, 2001), gives also the values of regressions coefficient used in the MiSS simulations. Here are the values:

β_1 (family background coefficient)	0,5
β_2 (pupil teacher ratio coefficient)	0,06

The relevance of family background is captured by the β_1 coefficient, which is 0.5. This means that the increase in years of school of the present generation is equal to 0.5 times the increase in the years of school of the past generation.
Another important feature of the education box is represented by the existence of a connection with the security box, that we will describe in the specific subsection: we assume that part of the disposable public budget on security issue is addressed to finance educational programmes, because educational attainment is assumed to be the most important element capable of reducing crime ratio.

5.5 Health box

Again as in the previous subsection we have to stress the importance of those elements, in the capability approach, capable of enhancing human freedoms: health level is certainly one of the most important, so that, within the MiSS model, the health box is crucial.
We have already stressed in the previous sections the strong interdependence connecting the functionings described in the model: the level of health plays an important role in the income box (healthy people are supposed to earn more than unhealthy ones) but it is strictly linked also with educational attainment.
Literature on health policy is really extensive but we focused our attention on the analysis of health policy efficiency.
In particular, we refer to WHO World Report, because WHO is the organization with the most precise studies about health issues, with datasets covering 191 countries.
It is not simple to define in what sense an health system can be considered efficient: the WHO Report of 2000 introduced an indicator, the overall goal attainment, trying to capture five dimensions: health level and its distribution among population; responsiveness of health system (the non-health components of a health system, such as waiting lists and other elements) and its distribution among population; the way of financing a health system.
The overall goal attainment is then measured by an index ranging from 0 to 1 (Italy is one of the most efficient countries with 0,991) and comprehending all the above variables. WHO the same underlines the risk of overestimating efficiency. The fact that the countries ranked in the first positions have efficiency index above 0.97 does not mean that they could only improve their systems by 3%. It means that, compared to the most efficient country in the sample, they could improve by 3%.

According to these reasons, in the MiSS model we use the results of an empirical study (Evans, 1999) in which the efficiency of health system is compared throughout 191 countries for the period 1993-1997.
In terms of output, it is generally agreed that one important goal of the health system is to improve population health. We measure health taking into account both mortality and ill health rather than using an indicator such as life expectancy at birth which relates solely to mortality. Our approach is based on an indicator of healthy life expectancy (DALE), whose measured are constantly updated by WHO.
The choice of indipendent variables, instead, is based on operative reasons. The first one is represented by total health expenditure per capita (public and private) in 1997 international dollars (using purchasing power parities to convert from local currency units), as a summary measure of physical inputs to the health system.
It is well recognised that health is not solely a function of services provided by the health system, however broadly the system is defined. Identifying relevant variables that are available for all countries, but which are not highly correlated with health expenditure per capita, is difficult. For example, income per capita – one of the most obvious indicators of general development – is highly collinear with health expenditure per capita. While it would be possible to add income per capita directly into the estimated equations, income is not a direct determinant of the production of health. It works through other inputs such as education and housing, and it is better to capture these inputs directly. The most widely available information on non-health-system inputs to production is for education, and the most sensitive indicator of the relevant kind of educational attainment is average years of schooling in the adult population, the same variable used in the education box, making it possible to exploiting a feedback loop.
Thus, three data series are used in our model: DALE, health expenditure and average educational attainment in the adult population. Our panel covers the years from 1993 to 1997 and variables are expressed in logarithm.
With regards to the target level, we consider as an optimum for DALE 90 years of healthy life expectancy, as a desirable but feasible goal for the future.
Here is the estimated equation:

$$Y = X\beta + \varepsilon$$

where Y is DALE, X is the matrix of regressor variables, and $\varepsilon$is the coefficient vector.
The table of coefficients is the following:

β1 (health expenditures coefficient	0,008
β2 (educational attainment coefficient)	0,063

The cited study concludes saying that “efficiency is positively related to the level of health expenditure per capita. Indeed, the results suggests that it is very difficult for countries to be good performers below an expenditure per capita of approximately $60 in 1997 international dollars. This implies that there is an apparent minimum level of health expenditure below which the system simply cannot work well…There is still enough variation in efficiency at all levels of expenditure to suggest there are two critical ways of improving health outcomes. The first is to increase the efficiency of the health sector; the second is to increase health expenditures” (GPE Paper n.6).
This feature stresses the importance of public intervention in a delicate issue such as health and focuses on one of the strenght point of MISS: public finance box and the public response determined by distance between target value and real one represents for sure an element of consistence with Senian approach in describing the way of transforming capabilities in achieved functionings.

5.6 Security and Crime Prevention Box

Another important block in the MiSS model is represented by the security box, in which, as in the environment section, an ‘dis-functioning’ is measured.

The choice of an indicator is particularly difficult here, because the security functioning is characterised by a lot of dimensions: the prevalent typologies of crime, the efficiency of judiciary system, the nature of security public policies.
Within the MiSS model, we have chosen as a proxy for security level the property crimes ratio, due to the following reasons:

1- **conceptual reason**: being Italy an industrialized country, it is probably more effective in representing the incidence of crime the reference to property crimes, which are the most diffused in a rich developed nation;
2- **operative reason**: we can refer to a very precise dataset taken from International Crime Victims Survey (1996), containing crimes statistics of 19 industrialized countries

Another point to be discussed, before describing the equations of the box, is the choice of a target value: who can point out objectively which is the optimum for the number of property crimes?
Referring again to International Crime Victim Survey (1996), we have calculated throughout the dataset the best score, i.e. the country with the lowest crime rate in the sample. So, in the "will be" side, the Finnish property crimes ratio (11.59% on the total population) is set and the model calculates the level of public expenditures on security according to the distance between this target value and the real one.
On the right side, instead, the theoretical model is an individual's choice model between education, work and crime and is taken from an econometric study based on CREnOS (Center for North South Economic Research) Dataset (Buonanno, 2003).
This study tries to test the relationship between the number of property crimes and the level of education (defined as the number of high school and university students normalised by regional population), adding also a set of control variables through which it focuses the attention on the influence of population activity rate on the same dependent variable. The equation so derived is very simple and relates crime to education:

$$crim_i = \alpha + \beta_1 edu_i + \sum_{j=2}^{5} \beta_j x_{ji} + \varepsilon_i$$

where edu_i represents the level of education in region i as defined above; $crim_i$ is the number of recorded crimes in region i and x is the rate of employment.
The empirical study provides also the numerical values used in the MiSS simulation. Here are the values:

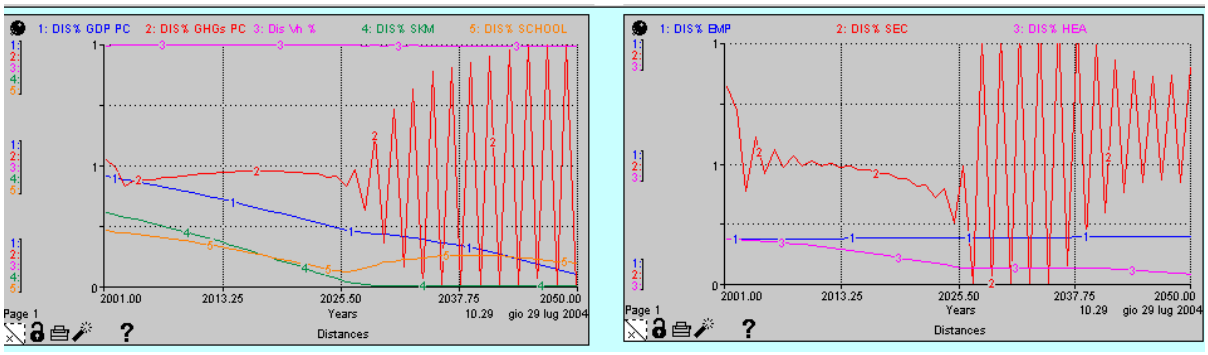
β_1 (coeff EDU)	-0,454
β_2 (coeff EMP)	2,357

In the Public Finance box, exactly as in the other functionings, the level of public expenditures on security, calculated as a response of the distance between target value and real one, is multiplied for the institutional coefficients that measure the efficiency of formal and informal institutions.
Some observations have to be added in this section. First, security box is the only one in the MiSS model in which public expenditures and political interventions have not an immediate effect on the measured indicator. This feature can be explained referring to Buonanno study, in which a control variable, denoted as POL, measures police force incidence on population and can be so considered as a proxy for public expenditures on security. Contrary to what one would expect this variable is positively correlated with the number of crimes (although with insignificant values). This result, at first sight contradictory and counterintuitive, can be justified observing that it may exist a relationship of reverse causality between the level of crime and policy force. In other words, government spends more for police force where the number of crimes is higher.
But the particular nature of security box makes it possible to enlighten the strict connection existent between this issue and education one: thanks to system dynamics approach, then, a feedback mechanism can be exploited. The basic idea is that public expenditures on security are made

essentially of two components: a first one referring to the functions of criminality control and repression (that, as we have already said, react to the crime ratio value and do not perform a preventive role) and a second one that contributes to support education programmes, because education is thought to be the most importance deterrence variable against criminality. So the model tries to calculate the additional number of pupils attending high schools and universities thanks to educational programmes financed by public security budget.
Another important aspect to notice is, finally, the ambiguous relationship existent between crime and unemployment: although the coefficient in the regression is, as a matter of fact, strongly positive and significant, there are two opposite effects of unemployment on crime that go in opposite direction: on one hand, it is reasonable to expect that an increase in activity rate will lead to a lower level of increased crime opportunity cost; on the other hand, it is likely that the number of crimes will be higher where people are richer. In conclusion, as literature seems to confirm (see Marselli and Vannini, 1997), there is not a clear relationship between unemployment and crime: this relationship appears to be very sensitive to econometric specification.

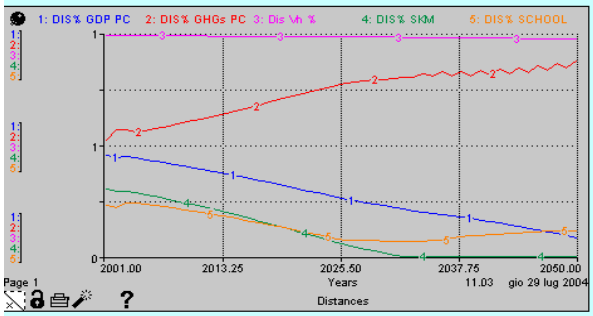
Concluding remarks

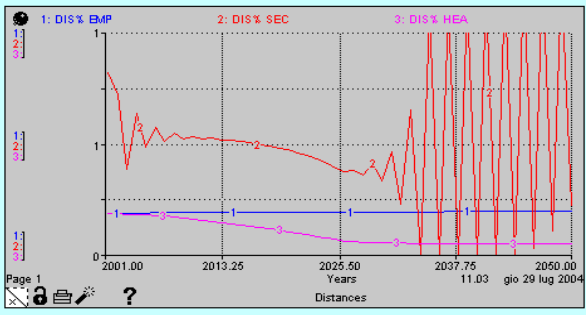
In this paper we have verified the consistence of the Senian capability approach with human sustainable development by modelling the most important human functionings through system dynamics approach, focusing our attention on the Italian case. The basic idea is to implement an institutional response mechanism reacting to the effective distance, for each functioning, measured between the real level of it and a target value chosen as the desirable one. It is a sort of distance between the real and ideal world that stimulates the policy maker to reduce it over time. The MiSS model is an interconnected dynamic system in which all elements vary in time: interdependence and the existence of the political institution degree of efficiency can simulate the mechanism thanks to which, in the Senian theory, IF vortex is able to transform human capabilities in achieved functionings.
We have verified the internal coherence of the model and, after the first simulations, some observations can be made that the following graphs can illustrate:



In the graphs, the syntetic indicators of distances are shown in an optimistic scenario (high institutional efficiency): as we can notice, the distances between target values and real ones, among time, present the expected decreasing trend. That is to say that, in the world we have modelled, policy action is really effective in the achievement of its goals. The swinging trend of some of the distances (i.e. environment box) does not represent an element of weakness of the system: rather it indicates that some functionings are more sensitive then others, in our specification, in moving towards their goals The faster real values reach target ones, the more the graphs of the distance become erratic over time.

But if we move from the optimistic political scenario of the previous graphs to the pessimistic one, in which we assume that some kind of institutional inefficiency intervenes to slow down policy response, the graphs change as we can see:





The trend of the curves is smoother and this feature demonstrates that the introduction of institutional dynamics has a great impact on the effectiveness of policies, causing a delay in the implementation of policies. The Environment distance (red line in first graph), besides, increases over time, while the erratic trend of security distance (red line in second graph) is due to the fact that, as we envisaged in the paper, public expenditures on security have not a direct effect on crime ratio (they are in part addressed to finance educational programmes).

In conclusion, the logic of public finance distribution and policy efficiency issue, presented in the fourth section, constitute MiSS strength points and represent a first operative attempt of operationalizing the Senian capability approach. The next step will be to introduce specification among populations, in order to catch gender, age and regional differences and their impact on model results: this will be another important element of consistence with capability approach and its methodological individualism.

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