

Sustainability Rediscovered: Development, Freedom and Environmental Issues

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Abstract

Pursuing sustainable development requires sharing a common view about what to consider as improvements or regressions, leading the debate towards development indexes. Despite provided efforts by the scientific community, the subject remains controversial, therefore showing the existence of an underlying conflict about what has to be considered as a priority: environmental, social or economic dimension. The Development Space Value/Creation (DSV/DSC) approach suggests appreciating development by weighting the financial resources available on a territory by its degree of development freedom, concept which steps further from Berlin's two liberties and Sen's capabilities and might be seen as a fundamental 'capability to be capable'. After describing DSV/DSC indexes and their characteristics, the paper presents how the indicators react to environmental issues and climate change outcomes. As a consequence, it also shows how DSV/DSC might allow catching the relationship between development and sustainability. Finally, some considerations about the concept of sustainability itself are introduced, and so are the consequences of freedom perspective on responsibility and compensation systems.

1 Introduction

In the last years, awareness about the value of ecosystem services has considerably stepped up, and some consensus exists on the fact that market assessments of goods and services should take account of it. On the contrary, discussions still exist about establishing consistent methods to achieve this goal. This article's aim is to put forward a novel approach to the subject.

In a world ruled by economic beliefs and economic conventional wisdom (Galbraith 1958), it appeared logical to try to estimate the value of natural services and natural capital by money units. If successful, this approach would have resulted in both a more accurate economic model and a set of arguments written in the economic language, more decision-maker friendly than a biological or envi-

ronmental one. Regrettably, establishing consistent methodologies of assessment, for instance in order to calculate a « green » GDP, seems to be harder than expected (e.g. Alfsen et al. 2006).

As a matter of facts, the evaluation problem is an ancient one. Since the 20's, Pigou had been trying to integrate the hidden pollution cost in market value of goods and services by using taxation. Nevertheless, he had later to admit the existence of a “knowledge problem” (Pigou 1954) and the practical impossibility to fix the tax at the appropriate level and to make it rely on a fair base.

Trying to find a valuable solution to this issue, Coase later suggested that, in a neoclassic-like universe, a well-defined system of property rights would lead to an efficient market of externalities. Nonetheless, he was also the first to notice that, if transaction costs exist, the original distribution of property rights will affect “the efficiency with which the economic system operates” (Coase 1960). Therefore, if the way in which rights are distributed from the beginning does matter, and transaction costs can't easily slashed down, then property rights should be assigned to the actors gaining largest utility from them. Unfortunately, this would require perfect knowledge, as it is in the perfect competition framework adopted by Coase to treat the externalities market, which implies absence of transaction costs. As a consequence, if Coase's “counterintuitive insight” is extremely interesting as a theoretical speculation, the vicious circle of knowledge makes the approach less reliable in real conditions (Hahnel & Sheeran 2009).

In more recent times, many methods have been rising up in order to estimate the value of ecosystem services and of natural capital variations. Any of these methods can be seen as a “theory” (Popper 1934). Indeed, building up them requires establishing rules and relationships in order to tie physical phenomena and economic representations. The nature of these rules and relationships is similar to axioms, what leads the measures to be somehow conventional. As a consequence, if consensus is lacking about underlying assumptions, the same will happen with conclusions. To set an example, the large debate about uncertainty biases in contingent valuation, to which we humbly participate (Voltaire et al. 2012) can be recalled.

It seems clear that, despite the strong efforts provided by the scientific community at least since the 70's to reach a consensus on such indicators, the limits of appraisal methods of “estimated money” still affect, in decision-makers views, the comparability with “real money”. As a consequence, economic actors do not feel they can rely on a comprehensive and consistent index which would take account of interrelationships between environmental, social and economic dimensions, despite a clear demand for it (Stiglitz et al. 2009). Therefore, the lack of such a general consensus fuels use of partial indexes, so boosting the implicit and fundamentally ideological quarrel about

which dimension has to be considered as a priority¹.

Thus, if sustainability concept was intended to be about mutual coherence of the “pillars” (UN 2005, 48), it sometimes seems to have become a battlefield where it is more question of domination rather than “reconciling” (Dasgupta 2007), as attested by Boutaud (2005). Some examples of this conflict might be claims for “Green Economy” (eg. Cato 2009), “degrowth” (eg. Latouche 2006), or the idea that market-based GDP growth is inherently sustainable (eg. Lomborg 2001).

On the other side of the quarrel, “much of the literature” (K. J. Arrow et al. 2012, p.318) focused on the idea of “well-being”, as the quantity that should be not decreasing over times. To the best of our knowledge, the very recent “Inclusive Wealth Report” (IWR) is on this wake the latest and more comprehensive trial to assess the evolution of sustainability in the development of different countries. In the vein of Solow (1974) and Hartwick (1977), it adopts the shadow prices technique in order to measure “the society’s productive base” (UNU-IHDP & UNEP 2012, p.15). This leads towards interesting results as, for instance, the ability to conciliate positions about strong and weak substitutability across the different forms of capital. However, despite its economic elegance and intellectual interest, this approach seems to us relying on too optimistic assumptions. Indeed, to correctly assess the “inclusive wealth” requires to estimate changes in total factor productivity (Dasgupta 2007, p.9), which in his turn demands to know with sufficient certainty today the needs of future societies and individuals, as well as the future aptitude of the actual productive base to provide valuable future responses. Thus, it seems that the “knowledge problem” remains unsolved.

Facing this state of the art, we esteem that dealing with sustainable development requires coming back to the fundamentals. In particular, three different questions have to be answered: what has to be considered as ‘development’; which approach of sustainability is the more appropriate relating to development concerns; how environmental issues affect development and have therefore to be acknowledged in a simple, easy to be used, indicator. The first two questions were partially discussed in former papers (Pirrone & Charles 2011; Pirrone & Thouément 2011), illustrating Development Space Value (DSV) and Creation (DSC) indexes and their sensibility to attractiveness policies. That is why these topics will be treated as briefly as possible, in order to share the framework.

Subsequently, the paper focuses on the third aspect, illustrating how DSV and DSC may react to environmental and climatic issues. To achieve this goal, we first illustrate a simple, fictive situation in which DSV is calculated. Hence, we adapt the simulation for taking account of climatic change (CC),

¹For an overlook upon the great variety of sustainable development indicators, we refer to (Ayong Le Kama et al. 2004). However, it has to be acknowledged that this issue is common to multidimensional measurement approaches. See, for instance, the analysis of Human Development Index developed by Ravallion (2010).

firstly considered as a natural phenomenon. Finally, we refine the analysis considering CC as a human-driven process and introducing some considerations about responsibility, compensation and rules. A short conclusion will sketch needed improvements to step further from the conceptual insight detailed in the paper and fix a modelled framework able to deal with empirical data.

2 Defining ‘Development’: a territory-based approach

Recent literature has clearly shown ‘development’ is an unclear, evolutionary word², especially in times when the basic identification of development with economic growth is more and more contested. Sustainability approach, despite its ambiguities, largely contributes to this evolution but, as depicted in the previous pages, it does not provide a sufficiently clear and accepted framework.

Similarly, in the wake of Sen’s works (Sen 1980; 1985; 1989; 1992; 1999), ‘capability approach’ (CA) has strongly improved the way ‘development’ could be looked at. Thus, even if popular HDI has probably still to be refined (Herrero et al. 2012), CA allowed “an astonishingly extensive – and intensive – interdisciplinary debate” (Chiappero Martinetti 2009) to take place in order to redefine the concept of development. Nonetheless, CA cannot yet be considered as a ‘development paradigm’, as Alkire (2009) clearly stated, and it is still today implicitly witnessed by the subject of the HDCA 2012 conference: “Revisiting Development: Do We Assess It Correctly?”

Having to cope with such contingency, try to question again what development “is” seemed to be necessary. The only restrictions imposed to our reflection were: a) a concept of development (what it is) should not force adopting a single model (how it is pursued); b) this concept should allow economic development to be considered as a specific approach in a more general concept. In this conceptualisation, we chose to adopt a territorial perspective.

2.1 Territory as a social construct

Available literature (Antheaume & Giraut 2005; Pecqueur 2001) suggests that a ‘territory’ can be defined following a large variety of criteria, as geography, history, culture and so on. Of course, defining the concept of territory will result in different outcomes, as a consequence of adopting specific points of view.

For development purposes, regarding the territory as a “social construct” (Leloup et al. 2005), both lasting and continuously regenerating, is fertile and consistent with recent sources. Indeed, even if ‘territory’ is a still ambiguous word (Faure 2004), some consensus appears in academic writings to consider it as a human fact. Namely, it can be seen as the unstable outcome of a social process by which a specific community established on a specific area endlessly reinterprets a wide range

² For instance, see (Cartier-Bresson et al. 2009).

of objective and symbolic elements (Ternaux & Pecqueur 2005), (Ritchot 1992; 1999), (Ritchot & Desmarais 1991), (Blais et al. 2007), (Talandier & Davezies 2009). Thus, the concept of territory tends to include a dimension of 'project' and even of 'ideology', according to Lussault (2007).

This point of view can be corroborated by simulating the emergence of the territory from an 'original state' where only exist local populated areas marked by the absence of well identified social bodies and organizations, any person thus being a stand-alone dot juxtaposed to the others.

In this circumstances, 'territory' can arise only when there are emerging reasons and willingness to 'live together' which give evidence of the pre-existing actors' freedom to recognize oneself and each other in a vision of what they are, of what they aim to be and how to they could achieve the goal. Therefore territory as a project is defined by three elements: the initial state, the expected one and the chosen path of evolution. As a consequence, the universe of territorial projects options is threefold infinite. In fact, from an infinite variety of early situations it is possible to set an infinite variety of goal circumstances and, once these two points established, they can be relied by an infinite range of lanes.

It has to be acknowledged that none of these elements is strictly objective. The initial state comes under the territorial self perception, thus including a significant subjectivity; the expected one constitutes the idealized, and often implicit, modelling of unknown conditions; and the chosen path necessarily encompasses the ethic dimension, side to more objective cogitations as well.

A "profound dissatisfaction" (Hayek 1933) is felt, "another world" (Fisher & Ponniah 2003) is pictured and people try to construct it, involving the means which seem to be effective and morally acceptable by the community. As a matter of facts, the word 'project', recurring in sources about development and territory, does not only concern wishes about what to do but it blends them with a deeper feeling about what people would like to be. The hope expressed by Germans to recognise themselves as one people, ending in the reunification, or the wish to make the European Union to be "the more competitive and dynamic knowledge economy all over the world" (Kok 2004), are two examples of such a complex mix.

The analytical framework just drafted applies well both to the territories choosing to adopt a trajectory of change and to the ones pursuing conservative finalities. Indeed, as it was shown by Heraclitus of Ephesus, everything in the world is continuously changing, despite of appearances. And, even if we would suppose that the territory can reproduce itself identically over times, the unstable nature of the 'social construct' implies the existence of countless ways of achieving such a goal.

Let us state the hypothesis that difference is perceived as a threat, as the territory want to stay the same. In this case, it is possible trying to integrate the diversity, which ends in a dialectical equi-

librium à la Hegel. Similarly, the territory might elect the assimilation path, as in the old Roman Empire, and even choose to protect itself by segregating the heterogeneity, as in totalitarian countries. Clearly, any choice will end in different territorial projects and trajectories. As the universe of projects is unbounded, it is necessary to avoid superposing, even by inadvertence, the observer's own vision, to the territorial one. Operationally, this requires that no hypothesis about the substance of the territorial project is integrated into the analysis, neither explicitly or in an implicit manner.

In order to respect the constraint reminded before, we theoretically identify the territory with its project, which is a useful simplification. Indeed, even if assuming such an identity could drive forgetting the dialectical and dynamics elements which animates real territories, it allows finding a general relationship between territory and development.

If 'territory' is a project, then 'development' measures the progressive fulfilment. Of course, this statement inherits the axiomatic nature of representing territories as projects, even if supported by some arguments, with all what comes together (Gödel 1931).

2.2 Enlarging Freedom as a proxy of Development

On this wise, the analogy with the CA is evident. Indeed, if the territory was assimilated to a person, we could affirm that development is a functioning (Alkire 2005), as it represents a way to be which is valued by the territory. This similarity calls an important consequence. Directly referring to Sen's works, we know that a functioning needs and implies an existing capability, a space of possibilities including real achievements.

However, development freedom of a territory differs from capabilities on some issues. First, the territory is not a person. Thus, its freedom, will, and preferences, all depend upon the actors which recognize themselves as a territory, in an endless dynamic process on reciprocal influence. As a consequence, the border between freedom as opportunity and as procedure (Sen 2009) tend to become confused. In fact, the territorial will to follow a specific trajectory of development, which is a signal of opportunity freedom, requires the existence of some kind of procedure allowing the will to be established, before that it could be expressed. On the other hand, the functioning 'development' is inhomogeneous with standard ones which could be adapted to fit a territorial area, as to be safe and secure, enjoying a fair environment, a high life quality and so on.

Actually, it could be said that, if standard capabilities and functionings refer to 'doings' or 'beings', a hypothetical capability of development should embrace simultaneously the two aspects. This comes straight from the assumption of territory as project, because the 'ultimate goal' of the development process, and the reason why the territory exists, overlap. Thus, if 'territory' is a project and 'development' measures the progressive fulfilment of it, then any development requires the exis-

tence of a space of development possibilities (DS), conjointly defined by the freedoms to be (FB) and to do (FB) which characterize the specific territory. If the territory is not free to exist, development cannot exist no more. In the same way, if the territory is not free to do, engaging a trajectory of development would be unfeasible.

From these statements, it is intuitive that development, as intended here, shows two characteristics: it cannot be evaluated directly, by any indicator of result, and it is positively correlated with the DS wideness variation. Indeed, from a static perspective, fulfilling the 'ultimate goal' of the territory implies to progressively making achievable the goals that were not so at the beginning, what is equal to seek for a DS enlargement.

On the other hand, from a more realistic dynamic perspective, a developed territory should become more and more capable to refine his project over times, and even to modify it in order to adapt itself to a continuously changing world, as well as his 'identity' might have shifted. Once again, enhancing possibilities of choice is identical to induce DS improvement and it stimulates a form of resilience (Folke et al. 2002).

As a consequence two statements can be fixed: a) development and freedom enlargement are two different objects of observation; b) freedom enlargement can be used as proxy in order to evaluate development performances of different territories, regardless of specific development models adopted by them.

3 DSV, DSC and Sustainability

Passing from conceptual analysis to calculable indexes requires adopting some conventions. Of course, this implies adopting definitions and simplifying hypothesis which cannot be perfectly neutral. In this paper they are just reminded for clarity, while for deeper analysis it would be better to refer to bibliography.

First, the chosen definition lies in the stream flowing from Berlin and his negative/positive dichotomy (Berlin 1958) to Amartya Sen's capabilities. Nonetheless, the concept adopted here is different from its precursors: the real and effective possibility for any individual to freely define his own objectives, to pursue them in freely chosen ways and to accomplish them. Specifically, if referring to previous considerations about relationship between capabilities and freedom, it is probably possible to see the second as a fundamental "capability to be capable"³.

As freedom is strictly tied with will expression, a particular definition is adopted: any bearer of autonomous will is considered as an 'individual'. Thus, the category recovers persons, organisations

³ This interpretation was submitted to Pr. Sen in 2011 and he encouraged further research on the topic. A paper specifically dealing with this question is in progress.

and social bodies. Indeed, as far as we accept the impossibility issue (K. Arrow 1951) in aggregating elementary wills in complex ones, we have consequently to accept some degree of autonomy in collective will determination.

However, the analysis showed that freedom aggregation does not suffer of impossibility. As a consequence, territorial freedom is evaluated by assembly at this level the estimations of FB and FD assessed at the individual one. Chosen aggregation formulas give *all individuals* forming a territory the same weight, finding the fundamental “equality” (Sen 1980) of the approach in the equal dignity accorded to any “individual” freedom. Of course this is not neutral as, from a mass effect, equality at individual level implies to consider freedom of people, as a whole, superior to the others, if freedom maximisation is an objective.

Finally, an economic parameter directly measured at aggregate level is taken into account, as the wealth of territory contributes defining DS by possibility of allocating means to finance development-oriented initiatives. It is called Monetary Capability (MC) and it can be measured in local currency or PPP, in order to allow comparing different territories.

3.1 Freedom to Be (FB), Freedom to Do (FD) and Territorial Freedom (TF)

All freedom parameters are assessed by a qualitative evaluation which aims to catch to what degree any individual, or homogeneous stratification of individuals, enjoys freedom. As in any qualitative approach, methodological cautions are essential to secure the consistency of results. We suggested four tools (question, parameters, grid, and procedure) to avoid as possible the excess of subjectivity in assessment. Still, we are aware that lot of operational work is required before being able to establish a real guide to fix the process.

Table 1 : The evaluation grid

Degree	Keyword	Description
1.0	Absolute	Fully free. Using this value needs explicit justification.
0.9	Very Large	Positive situation, unclearly improvable. Equal to unjustified 1.
0.7	Large	Positive situation, clearly improvable.
0.5	Acceptable	Impossible to discriminate between positive or negative assessment.
0.3	Narrow	Negative situation, with clear leeway.
0.1	Very Narrow	Negative situation, hardly detectable leeway. Equal to unjustified 0.
0.0	Null	Fully constraint. Using this value needs explicit justification.

This grid grants that $FB, FD \in [0,1]$ and allows a sufficiently clear discrimination of different situations. However, we tried to better secure the process, by adopting a two-step procedure.

To fit this procedure, the grid is first transformed in a nine items one, with estimated freedom degree $E \in \{0.0, 0.1, 0.3, 0.3, 0.5, 0.7, 0.7, 0.9, 1.0\}$. In reality, the two grids are identical, but from the appearance of doubles for 0.3 and 0.7 values. The nine values are used to fill a two entry table which will be used to guide the evaluator in his or her choice.

Table 2 : Procedural scheme

Situation is :	Q1: positive	Q1: undetermined	Q1: negative
Q2: positive	1,0	0,7	0,3
Q2: undetermined	0,9	0,5	0,1
Q2: negative	0,7	0,3	0,0

Operationally, evaluator will be request first if, regarding the specific parameter which is assessed, the degree of freedom enjoyed by the individual marks a rather positive/negative situation or a “too close to call” one. Once this rough evaluation stated, a second question, identical to the former but applied to different vectors, is expected to refine the first-sight judgement. If, for example, Q1 answer indicates a positive situation, Q2 will focus on relative judgment inside the subgroup of “positives”. Thus, if situation is rather negative on the subgroup of positives, it will be affected by a freedom estimation of 0.7.

More concretely, **FB** it is intended to assess the wideness of the real possibilities for individuals to see their permanency not threatened by others’ behaviour. “Permanency” is evaluated in two dimensions: *surviving* and *projection*, the second aspect being about self-fulfilments relying on transferring legacies both in time, to “future” generations, and in space, as for solidarities. How the availability of drinkable water, fair credit or governance and criminality do affect individuals’ permanency are some samples of elements evaluated in FB. In formulas, stated TFB_x as the aggregation of surviv-

ing aspects of FB for any i to n individuals existing on the territory, TFB_y as the aggregation concern-

ing projection, and TFB as the global indicator of territorial FB, we have:

$$(1) TFB_x = \frac{\sum_{i=1}^n TFB_{xi}}{n}$$

$$(2) TFB_y = \frac{\sum_{i=1}^n TFB_{yi}}{n}$$

$$(3) TFB = \sqrt{TFB_x * TFB_y}$$

FD is estimated in the same way, the only differences concerning the specific parameters to look at. FD is intended to show the wideness of real possibility for individuals to freely make individual choices and influence collective decision. Four categories of freedoms are taken in account separately: to conceive projects, to make free choices, to possess and freely allocate individual resources and to participate effectively in collective decision process.

Such elements like political systems, relative poverty and richness at individual level, fair information and education systems, are some of the parameters requiring to be paid attention to. In

formulas, stated TFD_x as the aggregation of FD as for category x, with x going from 1 to 4, for any i

to n individuals existing on the territory, and TFD as indicator of territorial FD, we have:

$$(4) TFD_x = \frac{\sum_{i=1}^n TFD_{xi}}{n};$$

$$(5) TFD = \sqrt[4]{\prod_{x=1}^4 TFD_x}$$

Finally, TFB and TFD are integrated in TF by simple multiplication, so TF is always a number ranging from 0 to 1, extremes included:

$$(6) TF = TFB * TFD$$

The reason of this simple formula relies on the idea that even if only one freedom falls to zero, than whole “Freedom” is zero. We could have obtained the same result by using geometrical mean to aggregate TFB and TFD in TF, and this would probably have been mathematically more elegant (Herrero et al. 2012). However, linear function was chosen for two reasons.

The first is logical: while TFB and TFD are intended to show mean values about categorized phenomena, and so they are calculated as means of means, TF is a *combination* of different things. Some people can easily be assured about their surviving while any choice is denied to them: political prisoners in some modern dictatorships are good examples. A reverse situation is also theoretically conceivable, even if practically more difficult to find.

The second reason is technical. As it is easy to verify, using a squared function instead a linear one would result in an ever higher evaluation, marked by a more moderate slope when TF is high and a lack of very low values. Two both could lead to underestimate progressions and regressions in territorial freedom when comparing two different periods.

3.2 Monetary capability (MC) and Development Space Value (DSV)

The last element defining freedom is territorial richness. It could seem weird to treat again about “money”, as individual richness was yet considered in TFD. However, it is necessary in order to recognize that becoming richer or less poor, gives to the territory more wiggle room and thus it enlarges freedom besides individual distribution.

In an ideal situation, with consistent statistical data available, MC should include only net territorial richness. Therefore, it should be question of disposable incomes of families, reduced by income production costs and transfers to outside beneficiaries, companies self-financing and the net values of non-market services. In its turn, this category should include public sector activities, services provided by associations and similar organisations, as well as the auto-production of goods and services.

Unfortunately, regardless of hard work from researchers, data about non-market services value still are unfit to allow quantitative treatment. A good example is the recent work on public services value in Canada (Mackenzie & Shillington 2009). Value is there still identified with costs, which implies that no added value is created or destructed in the production process, which is a very strong hypothesis. Thus MC is reduced to the global amount of disposal income and self-financing as described above. Non-market sector and public sector are not considered, so taxes and contributions appear as parts of incomes. In formula, with $M(i)$ the available means for individual (i):

$$(7) \quad MC = \sum_{i=1}^n M_i$$

Means are expressed in current money, for instance in euro. In a second step, MC will be standardized by PPP, available on OECD website, so that:

$$(8) \quad SMC = MC / PPP$$

However, non-market productions and services value is not forgotten, as using freedom criteria provides an indirect solution. If we focus on public sector it is clear that its existence makes taxes and contributions to exist too. If taxes do not alter SMC, nonetheless they reduce individual availability of means. By that effect, taxes reduce freedom. On the contrary, services as health, drinkable water, non partisan education, buses, waste collection and treatment and so on, will give back some freedom, both to be and to do. If TFB and TFD are correctly evaluated, both effects are taken ac-

count of. So, application of freedom criteria includes an at least implicit estimation of *net value of any non-market activity*.

Combining SMC with TF gives an estimation of the *Development Space Value (DSV)*, which varies between 0 and SMC. In formula:

$$(9) \ DSV = SMC * TF$$

or, in a more general and comprehensive shape:

$$(10) \ DSV = \frac{\sum_{i=1}^n M_i}{PPP} * \left(\sqrt[kb]{\prod_{x=1}^{kb} \left(\frac{\sum_{i=1}^n TFB_{xi}}{n} \right)} * \sqrt[kd]{\prod_{x=1}^{kd} \left(\frac{\sum_{i=1}^n TFD_{xi}}{n} \right)} \right)$$

3.3 Development Space Creation (DSC) and Sustainability

The DSV index allows catching a static image of development possibilities of a given territory. However, it inherits of approximations and subjective judgements which cannot be forgotten. Indeed, called *D* the ‘real’ value of the development space, DSV has to be considered as an arbitrary function of it $f(D)$ which only gives a value index, what reminds the paretian approach to ophelimity (Pareto 1906). And as in Pareto works, if cardinal measure is almost conventional⁴, its variation does make sense, under the conditions of stability in methodology and of correct correlation between *D* and $f(D)$.

Concerning development assessment, what really matters is exactly to understand if DSV grows or shrinks. That is why we adopted a variation index, in order to assess the creation, positive or negative, of DS. A useful representation of DSC is to show it as percentage variation:

$$(11) \ DSC_t^{\%} = \left(\frac{SMC_t * PPP_t}{SMC_{t-1} * PPP_{t-1}} \right) * \frac{TFB_t * TFD_t}{TFB_{t-1} * TFD_{t-1}}$$

The factor in parenthesis shows changes in territorial richness, adjusted to avoid illusions induced by PPP fluctuations. The two others represent variation in FB and FD. As a matter of facts, any progress on the development path will imply $DSV_{t+1} > DSV_t \Leftrightarrow CED_t^{\%} > 1$.

This condition has an important corollary: a development detected by DSV/DSC is necessarily sustainable, at least if the Brundtland Report perspective is adopted (WCED-UN 1987). Indeed, a “development (which) seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future” is, by definition a development which does not reduce future

⁴ The same critics might be addressed to GDP (e.g. Chiappero Martinetti & Pareglio 2009, p.21-22), whose variation, the growth rate, is still so broadly used (Gadrey & Jany-Catrice 2005), as well as to the “Inclusive Wealth Index” (e.g. Solow 2012; Smulders 2012).

possibilities, that is a development producing a $CED_t^{\%} \geq 1$ over times, which is a less restrictive condition than requirements of the presented approach.

4 Environmental issues and Climate Change (CC)

The natural complement of the conceptual contributions sketched in previous pages would be to empirically investigate a real territory, thus facing its complexity and gaining useful experience to improve and secure both concepts and methodology. It is a goal we aim to achieve in the very next future. However, a three-year testing period would be necessary, which brings some financial and organisational issues on the table.

Nevertheless, it was important to test the general validity and the range of applicability of DSC/DSV indexes, at least by running a simulation. That is the reasons why verifying the sensibility of suggested indicators to environmental issues retained the attention. In particular, we tried to integrate CC effects as for the controversial nature of the subject, which adds to complexity.

Indeed, to discuss about CC is rather difficult, as the debate is often perturbed by implicit judgements, no matter whether they come from political, moral or ideological origin. Face to such a threat, the only answer was to adopt an as neutral as possible posture.

4.1 The starting point: Fictivia's DSV

First step of simulation was intended to establish estimation of DSV at t_0 . Application referred to a fictive territory, Fictivia, marked by the existence of 100 persons, 10 organizations and two social bodies, namely two opposite clans, a dominant one the other representing a minority. According to the methodology, there are 112 individuals living in Fictivia. In simulation, it was accepted that only two conditions induce some differences in enjoyed freedom: individual wealth and clan belonging. Of course, in real applications, stratification hypothesis should previously be tested by appropriate econometric models.

Resulting stratification is summarised in Table 3. As for surviving aspects, available information regarding Fictivia, indicates the existence of paternalistic solidarity, so that no people or organisation experience a really wrong situation. On the contrary, the dominant clan uses its power to wipe out the social organisation of the minority, by a policy of assimilation. Thus, freedom to survive of Clan B as a social body is lesser than any other.

Table 3: Fictivia's TFB

Individuals	number	FB(x) surviving	FB(y) projection
Social Body A (dominant clan)	1	0.9	0.9

Social Body B (minority clan)	1	0.3	0.3
Organizations related to A	7	0.7	0.3
Organizations related to B	3	0.5	0.1
People group Aa (A and rich)	20	1.0	1.0
People group Ab (A and poor)	40	0.5	0.9
People group Ba (B and rich)	10	0.9	0.3
People group Bb (B and poor)	30	0.5	0.1
Totals	112	71.6	65.6
TFB; TFB(x); TFB(y)	0.611914	0.639286	0.585714

As a consequence, the freedom of projection of elements tied to Clan B is very poor, because assimilation policy reduces the possibility to choose who to be. And even if wealthier people can partially escape this constraint, its effect is somehow limited.

Even if in this simple exercise we supposed to know how to fill the boxes, it is of clear evidence that for a real evaluation a deep knowledge of territory is very useful, and rather required, in order to establish solid estimations.

With the same methodology Fictivia's TFD is assessed, as it is shown in Table 4. Available information on Fictivia points a critical situation of poor and minority people. Indeed, as they are both dependent from paternalistic solidarity and suffering by assimilation policy, this population seems to enjoy rather no freedom to do. Indeed, the incentive to quit minority clan is strong but no insurance does exist to be accepted between the dominants.

Interesting, freedom of choice is reduced for rather anyone. In facts, position in the society being dependent from the clan people and organizations belong to, real choice freedom exists only for the Clan A, as a social body.

Table 4: Fictivia's TFD

Individuals	number	FD(1) project	FD(2) choice	FD(3) resources	FD(4) participation
Social Body A (dominant clan)	1	0.9	0.9	0.9	1.0
Social Body B (other clan)	1	0.5	0.3	0.3	0.3
Organizations related to A	7	0.5	0.3	0.9	0.9
Organizations related to B	3	0.3	0.3	0.3	0.3
People group Aa (A and rich)	20	0.9	0.3	1.0	1.0
People group Ab (A and poor)	40	0.5	0.1	0.5	0.5
People group Ba (B and rich)	10	0.7	0.3	0.7	0.3
People group Bb (B and poor)	30	0.1	0.1	0.1	0.1
Totals	112	53.8	20.2	58.4	54.5
TFD; TFD (x)	0.385051	0.480357	0.180357	0.521429	0.486607

Indeed, the sketched situation recovers realities where belonging to the dominants is both an opportunity and a constraint, the social body imposing his weight and priorities to others individuals. Giving simulated data, **TF = 0.23561782**.

Table 5: Fictivia's SMC

Individuals	consistency	Average means (€)	Means (€)
Social Body A (dominant clan)	1	0	0
Social Body B (other clan)	1	0	0
Organizations related to A	7	30,000	210,000
Organizations related to B	3	3,000	9,000
People group Aa (A and rich)	20	100,000	2,000,000
People group Ab (A and poor)	40	20,000	800,000
People group Ba (B and rich)	10	70,000	700,000
People group Bb (B and poor)	30	5,000	150,000
MC; SMC			3,869,000

Finally, last step to establish DSV is to collect data about MC. For ease, we suppose PPP=1 so that MC and SMC will be identical, and that Clans do not possess anything in their own name. In our example, under the hypothesis than average means are available or calculable for each stratification category, we can suppose to have the figures indicated in Table 5. Once again, information availability will be a critical factor when going on the empirical field.

In our example, **SMC = 3,869,000** PPP units. However, **DSV = 985,039.15** PPP only, relating to a low level of territorial freedom. This shift is coherent with preliminary simulations we made by merging GDP data with “freedom index” provided by Freedom House (Puddington et al. 2008). Indeed showed that usual representation of developed, developing and undeveloped countries changes dramatically when freedom is included into the analysis. And this even when the freedom index used refers to the “negative” side of freedom (Berlin 1958), as it is the case for the Freedom House one, which is probably less discriminating than the one implied in DSV approach.

4.2 CC as a natural phenomenon

Great emphasis was given in the press, at least in France, to uncertainty about human origin of CC. As I am not titled to enter the debate, I wondered if the question was really relevant. And obviously it is, at a determined level.

However, the human or natural origins do not modify the evidence that climate is actually changing. Thus, a neutral analysis has to start hence here, before focusing on responsibilities and hypothesis of compensations. Also, even if we were conscious that climate change could even benefit some territories, the simulation was ran following to the more shared opinion that CC is mostly a threat, and so it is for Fictivia.

4.2.1 Climate Change and Freedom to Be

As described in §3.1, FB take account of two dimensions: actual existence and projecting. If we focus on the first side, it is clear that any change affecting food production or fresh water availability (UNEP 2010), hits freedom sphere. No food or no water, it's equal to no survival. And no survival is equal to no freedom. In a similar way, catastrophic climate events, as flooding or hurricanes, cause deaths with a spectacular regularity even in so-called developed countries. Again, a “warming atmosphere (which) aids the pole-ward spread of pests and diseases once limited to the tropic”⁵ can't be without consequences on physical conditions of surviving.

“Projecting” dimension of FB is sensible to CC too. Essentially, it is about real possibility of creating and handing an increasing DSV (a “better world”) down to future generations. Now, if CC causes a DSV reduction, and if such a shrink cannot be countered or at least controlled, then projecting side of FB will equally shift down in a kind of cumulative effect. For instance, think about the submersion risk faced by some isles as a consequence of actual and expected sea-level rise. Beside of outcomes on surviving side of FB, projection aspect will be also affected by the loss of a strong symbolic element, the isle, integrated to the social construction of the territory.

Coming back to Fictivia, we can consider that CC induces a generalised reduction of FB, which was former relatively high, by a single step in evaluation grid. An exception is the minority clan, whose freedom was yet low and which might use of the contingency to earn consensus and strengthen its positions.

Table 6: Changes in Fictivia's TFB induced by CC

Individuals	number	FB(x) surviving	FB(y) projection
Social Body A (dominant clan)	1	- 0.2	- 0.2
Social Body B (minority clan)	1	0	0
Organizations related to A	7	- 0.2	0
Organizations related to B	3	- 0.2	0
People group Aa (A and rich)	20	- 0.1	- 0.1
People group Ab (A and poor)	40	- 0.2	- 0.2
People group Ba (B and rich)	10	- 0.2	0
People group Bb (B and poor)	30	- 0.2	0
TFB; TFB(x); TFB(y)	0,476451	0,458929	0.494643
Ancient values	0.611914	0.639286	0.585714
Variations	-0.135463	-0,180357	-0,091071

⁵ From UNEP's website, <http://www.unep.org>

In the same way, projection freedom enjoyed by minority, yet very poor, is not affected, contrarily to Clan A and people belonging to it. Organisations, less strictly tied to physical location, are not affected.

As a consequence of CC, TFB would reduce and, even if any other parameter will stay the same DSV will decrease by 22 %, uniquely as an outcome of natural threats tied to CC.

4.2.2 Climate Change and Freedom to Do

If FB alone gives a dark picture where nothing can be done to counter CC effects, FD parameter helps to show that getting result in keeping FB unchanged is not a sufficient condition to say CC effects on development are reduced to negligible quantity.

To show such effects it is useful to focus again on food/water shortage, catastrophes and disease spreading, as characteristic threats. Even if they represent a big struggle, the territory can imagine some reactions. For example, food and water scarcity can be hindered by exterior commerce, investment in infrastructures can reduce catastrophes impact, and a proficient health system may perfectly face new threats. Indeed, as Heal (2009) nicely summarized, there is wide room for the economics of climate change. But still, freedom might be decreasing.

Indeed, a naive vision of economic growth, leads sometimes to consider as positive the improvement of services whose aim is simply to repair damages and to recover disutility emergence. And there is no need to adopt references as Bastiat (1850), to consider that any rational human being will prefer not to need security systems because no criminals are around, rather than paying for the police service, by tax system or market price. Nonetheless, if no criminals were around, GDP will probably fall in the short term.

Health care system is another example of the same principle: no illness, no hospital and no pharmaceutical industry. The final situation would be nice, population living in good health but GDP will again decrease at least in short term, so providing the illusionary image of something going wrong. Using freedom criteria allows sticking more tightly to reality.

Improving the health system of territory to face new diseases will demand, at least, some resources. In a first time it is useful to adopt the simplifying hypothesis that such resources are easily available. If their allocation is driven by *the need* to preserve health conditions on territory, the model will consider it as a *constrained* allocation and consider it as a reduction of real possibilities to make choices. In the end, a FD downsize will be detected.

Indeed, whether a quite economical approach will see no difference between a **freely chosen** action and a **constrained** one, freedom allows discriminating them correctly.

If the availability hypothesis is relaxed, which is undoubtedly more realistic in contemporary economies, facing new health threats will need either to abandon other spending choices or to demand to people to pay for the service, by tax or market prices. In other word, a form of opportunity cost of capital will appear and it should be included in the analysis.

It is interesting to notice that any of possible cases has consequences on freedom:

- Taxes reduce individual availability of means, so reducing FD
- Need to pay for health will make constrained allocations of means to rise, so reducing FD, if the individual availability of means allows the financial effort. If not, health problem is not treated and we have a reduction in FB instead⁶
- Reallocation in spending will lead to abandon a formerly freely chosen action for a constrained one. FD is reduced but a complete analysis should take account of inducted losses. In fact, if former choice was rational, it was intended to produce more DSV than consumed by money effect (cf. §3.3). So, abandoning it will result in a mirror greater loss of DSV than money made available for health spending.

Similar considerations can be made for catastrophes. To move a city 20 kilometres back from coastal line, in order to prevent flooding disaster, is conceivable. But, of course, there are fees to pay, monetary and freedom ones.

Finally, it is worth spending a word on food/water issue. Dealing with ecosystem services, earth ability to provide natural drinkable water and natural soil fertility are of priceless value. If these planet abilities disappear, Earth existence would not be in danger but human's life would be rather impossible.

Even on a smaller scale, the problem remains critical. Let set the hypothesis that our fictive territory have to face seawaters infiltration in water table. By this event, the resource which was once simply exploited free of charge has now to be bought back. That can be done either from planet itself, paying for technical installation to make water drinkable, or from an outside territory which is provided in resources ad wish to export it.

As a consequence, the same service now requires using more means, which results in a negative DSC, as yet seen for health system. More, lack in soil fertility and drinkable waters, does affect food auto-production. This is a particularly important issue for territories marked by strong poverty situations, as it is attested by recent literature (e.g. D. Simatele et al. 2012). As matter of facts, if food auto-production is a real possibility, even people with low FD can secure their FB thanks to earth free

⁶ Referring to that, it is of common experience that people in weak economic situations actually tend to renounce to be treated.

of charge services. On the contrary, when these services become costly, the loss in FD will couple with strong FB reduction.

4.2.3 Climate Change and Monetary Capability

CC effects on CM are harder to forecast than ones on FB and FD. Really, positive and negative effects can arise, especially relating to employment/unemployment dynamics.

For instance, having a larger health care industry could lead to a higher employment, henceforth to a growth in disposal income, and finally to CM improvement.

At the same time, reduced availability of usable water as well as its market counterpart, the price raise, could affect installed industries, leading the economic system towards employment reduction and, in the end, to a lesser CM.

For these reasons, forecasting the CC effects on MC would actually require to establish a more complex model of interrelations and test it by focusing on a plurality of real territories. Nonetheless, difficulty in predetermining the sign of the effects is a clue of average probable compensation between positive and negative consequence, even if, from a territory perspective, it is not sufficient to conclude for their negligibility.

4.3 CC as a human induced phenomenon

The progress of science tends to indicate that the CC we are experiencing is mainly due to human behaviours (UNEP 2010). In a freedom perspective, it is positive news.

Indeed, if CC was a natural phenomenon, the only choice humans would have is to try adapting to modified environmental conditions. On the contrary, as it seems to be essentially human driven, it is also possible to be proactive. In such process, freedom approach may be helpful as it allows taking simultaneously into account economic and non economic, actual and expected impacts on DSV.

On the other hand, if we accept human origin of CC, we can also study specific doings in order to suggest modifications and help establishing responsibilities, if they exist, and compensations.

4.3.1 Constrained Behaviours

Unlike merely economic or ecological approaches and similarly to Sen's one based on capabilities, DSV/DSC analysis is intended to make possible discriminating between free choices and constrained behaviours.

By observation, it seems clear enough that car use contributes to carbon emission and, in the end, to CC. At the same time, rather all of us use a more or less carbon emitting car. Should we all be

considered as accountable? A standard economic or ecological approach will consider all car drivers as responsible, so suggesting a general form of compensation, for instance by a carbon tax.

On the contrary, freedom approach will try to understand if to drive a car is a “mere” **pleasure** or if it can be considered as a **need**. If this is the case we face again constrained behaviour, else it is a choice. In particular a need is observed *if no behaviour change is possible without negating freedom at individual level*. So the question is about reasons why people drive cars and, as cars are not identical, why they use a more or less carbon emitting engine.

A four-wheel engine could be necessary if you live in mountain or desert regions. Lot of kilometres could have to be driven just in order to cover house to work distance. Of course, in theory, it is possible to change address, but this negative liberty forgets two important things.

First is that, in practice, it is rarely possible to set own residence in order to minimize distance from work. Elements as houses prices and rents, financial markets, company localization strategy, multiple employers in life, family constraints, life surroundings, and so on could limit residence choice. Also, the possibility to freely choose where to live, or where to set if talking about organizations, is an important constituent of freedom to do. If risky behaviours are constrained, to sanction them would result only in more freedom shrink, so aggravating the problem. On the contrary, efforts should concentrate on enlarging possibilities, and make climate compatible doings accessible for the greater number of individuals.

4.3.2 Free Choices

Nonetheless, not all conducts are constrained. The free choice to act regardless of consequences suffered by the environment, and even to deliberately deteriorate it, exists too. In such cases, the individuals who put climatic equilibrium in danger, and so the freedom of territories, act as intentional or negligent polluters, by following a behaviour scheme which can be assimilated to microeconomic free decision under the influence of preferences⁷.

To know precisely how high is the freedom cost of toxic waste polluting rivers, acid rains, bees' mortality, as well as the ones related to CC outcomes, requires strong and reliable biophysical models which are outside of our limited field of competence. Thus, we rely on science increasing ability in understanding phenomena and their mutual connection.

However, DSV/DSC approach clearly shows that:

⁷ For a dynamic analysis of such decisions, under uncertainty on future preferences, see Ayong Le Kama & Schubert (2006).

- Responsibility needs the real possibility to act in a differently without experiencing significant reductions in individual FB/FD. In a dramatic phrase, it can be said that none can be asked to suicide.
- Environment deterioration affects territorial development in monetary and non monetary way, by hitting TFB and TFD⁸. So, fixing compensations which would be quite monetary could be inappropriate in order to restore the original situation.
- As freedom is hard to restore and that the transferability of freedom space to future generations is a constitutive element of projecting side of TFB, *prevention is a strategic investment* in development.
- In choosing instruments of prevention, territories should give higher priority to measures demanding low costs and providing strong and long lasting effects, protecting individual freedom, in the sense adopted in this paper. Suasion, negotiation, regulation, controls, and repression give an example of such a prioritized list of measures.

5 Conclusions

DSV/DSC approach contributes to the debate about development and sustainability at different points. Some of them, expressed in the paper or remaining implicit in the reasoning, are the ability: a) to deal with any development model avoiding ideological a priori; b) to include resilience aspects as constitutive of development; c) to rediscover sustainability and d) to fully integrate such dimension while escaping from the trap of prejudgments struggle. Also, different simulations ran to test the approach, including the one presented in these pages, seem to indicate promising perspectives of actual application.

Referring to environmental issues, and more specifically to CC, DSC/DSV allows using a non monetary unit in order to assess the value of non market and ecosystem services, thus suggesting a relatively easy solution to the evaluation problem. Also, it offers a new perspective to the debate about strong or weak sustainability, as well as about responsibility and compensations by integrating the freedom dimension, in the wake of capability approach and its developments.

However, much remains to be done in order to make DSV/DSC fully operational. Indeed, even if the approach is productive, accepting to proceed in a qualitative manner can be considered as an implicit cost. Indeed, even if the more quantitative approaches include lots of rather arbitrary conventions, our option bears a specific source of uncertainty which adds to more common difficulties about passing from ecological to economic analysis.

⁸ By this aspect, DSV/DSC approach support the vision of partial, non-free, freedom substitutability of different capitals. Therefore, it tends to corroborate “strong sustainability” approaches, yet with caution.

Testing, securing, and certainly enhancing the whole methodology will demand to empirically run the model on an actual territory. This application should last, we estimate, three years at least. This period will be reasonably sufficient to verify data availability, as well as possible biases referring to the evaluator. In the same vein, more research is needed in order to catch relevant stratification parameters, which is essential to transform a promising intuition into a useful model.

BIBLIOGRAPY

- Alfsen, K.H. et al., 2006. *International experiences with « green GDP »*, Oslo: Statistics Norway.
- Alkire, S., 2005. Capability and Functionings: Definition & Justification. Available at: http://www.capabilityapproach.com/pubs/HDCA_Briefing_Concepts.pdf.
- Alkire, S., 2009. The Capability Approach as a Development Paradigm? In E. Chiappero Martinetti, éd. *Debating global society : reach and limits of the capability approach*. Milan: Fondazione Giangiacomo Feltrinelli, p. 31-59.
- Antheaume, B. & Giraut, F., 2005. *Le territoire est mort, vive les territoires! Une (re)fabrication au nom du développement*, Paris: IRD éditions.
- Arrow, K., 1951. *Social choice and individual values*, New York: John Wiley & Sons.
- Arrow, K.J. et al., 2012. Sustainability and the measurement of wealth. *Environment and Development Economics*, 17(03), p.317-353.
- Ayong Le Kama, A.D., Lagarenne, C. & Le Lourd, P., 2004. *Indicateurs nationaux du développement durable : lesquels retenir ?* La Documentation Française., Paris: la Documentation française.
- Ayong Le Kama, A.D. & Schubert, K., 2006. Ressources renouvelables et incertitude sur les préférences des générations futures. *Revue d'Economie Politique*, 116(2), p.229-250.
- Bastiat, F., 1850. *Ce qu'on voit et ce qu'on ne voit pas, ou l'économie politique en une leçon*, Paris: Guillaumin.
- Berlin, I., 1958. *Two concepts of liberty*, Oxford: Clarendon Press.
- Blais, J.-P., Ingallina, P. & Vernier, M., 2007. *L'attractivité des territoires : regards croisés*, Paris: PUCA.
- Boutaud, A., 2005. *Le développement durable : penser le changement ou changer le pansement ?* Saint Etienne: Ecole Nationale Supérieure des Mines.
- Cartier-Bresson, J., Destremeau, B. & Lautier, B., 2009. Les mots du développement : trajectoires et pouvoirs. *Revue Tiers Monde*, (200), p.725-734.
- Cato, M.S., 2009. *Green economics : an introduction to theory, policy, and practice*, London: Earthscan.
- Chiappero Martinetti, E. éd., 2009. *Debating global society : reach and limits of the capability approach* 1st ed., Milan: Fondazione Giangiacomo Feltrinelli.
- Chiappero Martinetti, E. & Pareglio, S., 2009. *Sviluppo umano sostenibile e qualità della vita : modelli economici e politiche pubbliche* 1a ed., Roma: Carocci.
- Coase, R.H., 1960. The problem of social cost. *Journal of law and economics*, p.1-44.

- Dasgupta, P., 2007. The idea of sustainable development. *Sustainability Science*, 2(1), p.5-11.
- Faure, A., 2004. Territoire/territorialisation. In L. Boussaguet, S. Jacquot, & P. Ravinet, éd. *Dictionnaire des politiques publiques*. Paris: Presses de Sciences Po.
- Fisher, W.F. & Ponniah, T., 2003. *Another world is possible: popular alternatives to globalization at the World Social Forum*, Zed Books.
- Folke, C. et al., 2002. Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *AMBIO: A Journal of the Human Environment*, 31(5), p.437-440.
- Gadrey, J. & Jany-Catrice, F., 2005. *Les nouveaux indicateurs de richesse*, Paris: La découverte.
- Galbraith, J.K., 1958. *The affluent society*, Harmondsworth: Penguin Books.
- Gödel, K., 1931. *On formally undecidable propositions of Principia mathematica and related systems*, New York: Basic Books.
- Hahnel, R. & Sheeran, K.A., 2009. Misinterpreting the coase theorem. *Journal of Economic Issues*, 43(1), p.215-237.
- Hartwick, J.M., 1977. Intergenerational Equity and the Investing of Rents from Exhaustible Resources. *The American Economic Review*, 67(5), p.972-974.
- Hayek, F., 1933. The Trend of Economic Thinking. *Economica*, (40), p.121-137.
- Heal, G., 2009. Climate Change Economics: A Meta-Review and Some Suggestions for future research. *Review of Environmental Economics and Policy*, 3(1), p.4-21.
- Herrero, C., Martínez, R. & Villar, A., 2012. A Newer Human Development Index. *Journal of Human Development and Capabilities*, 13(2), p.247-268.
- Kok, W., 2004. *Relever le défi : La stratégie de Lisbonne pour la croissance et l'emploi*, Luxembourg: Office des publications officielles des Communautés européennes.
- Latouche, S., 2006. *Le pari de la décroissance*, Paris: Fayard.
- Leloup, F., Moyart, L. & Pecqueur, B., 2005. La gouvernance territoriale comme nouveau mode de coordination territoriale ? *Géographie, économie, société*, Vol. 7(4), p.321-332.
- Lomborg, B., 2001. *The skeptical environmentalist : measuring the real state of the world*, Cambridge: Cambridge University Press.
- Lussault, M., 2007. *L'homme spatial : la construction sociale de l'espace humain*, Paris: Le Seuil.
- Mackenzie, H. & Shillington, R.E., 2009. *Canada's quiet bargain : the benefits of public spending*, Toronto: Canadian Centre for Policy Alternatives.

- Pareto, V., 1906. *Manuel d'économie politique*. 5e éd. (1981)., Genève: Droz.
- Pecqueur, B., 2001. Gouvernance et régulation : un retour sur la nature du territoire. *Géographie, économie, société*, 3(2), p.229-245.
- Pigou, A.C., 1954. Some Aspects of the Welfare State. *Diogenes*, 2(7), p.1-11.
- Pirrone, C. & Charles, E., 2011. L'espace de liberté comme mesure synthétique du développement territorial durable. *Revue Tiers Monde*, (207), p.61-77.
- Pirrone, C. & Thouément, H., 2011. Développement territorial soutenable : l'approche des libertés et ses conséquences pour les politiques d'attractivité. In *Sustainable Development, Territories and Firms Location Decisions: toward a Sustainable Attractivity?* Bordeaux.
- Popper, K., 1934. *La logique de la découverte scientifique*, [Paris]: Payot.
- Puddington, A. et al., 2008. *Freedom in the world 2008: the annual survey of political rights & civil liberties*, New York: Freedom House.
- Ravallion, M., 2010. *Troubling tradeoffs in the Human Development Index*, Washington, D.C.: World Bank.
- Ritchot, G., 1992. *La valorisation économique de l'espace géographique.*,
- Ritchot, G., 1999. *Québec, forme d'établissement : étude de géographie régionale structurale*, Paris: L'Harmattan.
- Ritchot, G. & Desmarais, G., 1991. *Études de géographie structurale*, Sainte-Foy Québec: Université Laval Centre de recherches en aménagement et en développement.
- Sen, A., 1980. Equality of What? In *Tanner Lecture on Human Values*. Cambridge, p. 194-220.
- Sen, A., 1985. *Commodities and capabilities*, Amsterdam: North-Holland.
- Sen, A., 1989. Development as Capability Expansion. In K. Griffin & J. Knight, éd. *Human development in the 1980's and beyond*. Journal of development planning. New York: United Nations, p. 41-58.
- Sen, A., 1992. *Inequality reexamined*, New York: Russell Sage Foundation.
- Sen, A., 1999. *Development as freedom*, Oxford: Oxford University Press.
- Sen, A., 2009. Capability: Reach and Limits. In E. Chiappero Martinetti, éd. *Debating global society : reach and limits of the capability approach*. Milan: Fondazione Giangiacomo Feltrinelli, p. 15-28.
- Simatele, D., Binns, T. & Simatele, M., 2012. Urban Livelihoods under a Changing Climate*: Perspectives on Urban Agriculture and Planning in Lusaka, Zambia. *Journal of Human Development and Capabilities*, 13(2), p.269-293.

- Smulders, S.A., 2012. An arrow in the Achilles heel of sustainability and wealth accounting. *Environment and Development Economics*, 17(3), p.368-372.
- Solow, R., 1974. Intergenerational Equity and Exhaustible Resources. *The Review of Economic Studies*, 41, p.29-45.
- Solow, R., 2012. A few comments on « Sustainability and the measurement of wealth ». *Environment and Development Economics*, 17(3), p.354-355.
- Stiglitz, J.E., Sen, A. & Fitoussi, J.-P., 2009. *Rapport de la Commission sur la mesure des performances économiques et du progrès social*, Commission sur la Mesure de la Performance Économique et du Progrès Social. Available at: www.stiglitz-sen-fitoussi.fr.
- Talandier, M. & Davezies, L., 2009. *Repenser le développement territorial? : confrontation des modèles d'analyse et des tendances observées dans les pays développés*, Paris: Lavoisier.
- Ternaux, P. & Pecqueur, B., 2005. Mondialisation, restructuration et gouvernance territoriale. *Géographie, économie, société*, Vol. 7(4), p.315-320.
- UN, 2005. *2005 World Summit Outcome*, New York: UN.
- UNEP, 2010. *UNEP year book 2010 : new science and developments in our changing environment.*, Nairobi: United Nations Environment Programme.
- UNU-IHDP & UNEP, 2012. *Inclusive Wealth Report 2012 Measuring Progress Toward Sustainability.*, Cambridge: Cambridge University Press.
- Voltaire, L., Pirrone, C. & Bailly, D., 2012. Dealing with Preference Uncertainty in Contingent Willingness to pay for a Nature Protection Program: A New Approach. In XXI-Xèmes Journées de Microéconomie Appliquée. Brest.
- WCED-UN, 1987. *Our common future*, Oxford: Oxford University Press. Available at: <http://www.un-documents.net/wced-ocf.htm>.