Some Methodological Issues in GPI Work:

Illustrations From the Calculation of a GPI for Quebec

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ABSTRACT: The Quebec GPI presents its results via three sections covering (i) the development of its territory, (ii) economic activities not directly based on territorial inputs and (iii) the social objectives of the overall process of development. The results indicate upward trends in the GPI for the period 1970-2009 which follow closely those of the GDP; the importance of the Consumption element of the GDP seems to govern this parallelism. Nonetheless, the GPI reduces the GDP by two-thirds, before adding the contribution of un-paid work, for a final GPI approximately half the GDP. Calculations for improvements in life expectancy in good health and in diplomation provide insights into the contribution of these phenomena, assumed to be reflected in personal consumption figures. The calculation of a GPI for the province of Quebec continues a process where the lack of data requires variants in the basic methodology of this important indicator. In spite of recourse to proxies and indirect approaches, the GPI is judged a useful tool in confronting the abuse of the GDP as an indicator of progress, particularly in the light of the long period that will be required to develop the data series necessary for attaining methodological consistency.

GRAPHICAL ABSTRACT

Quebec GDP, GPI and GPI without un-paid work, 1970-2009
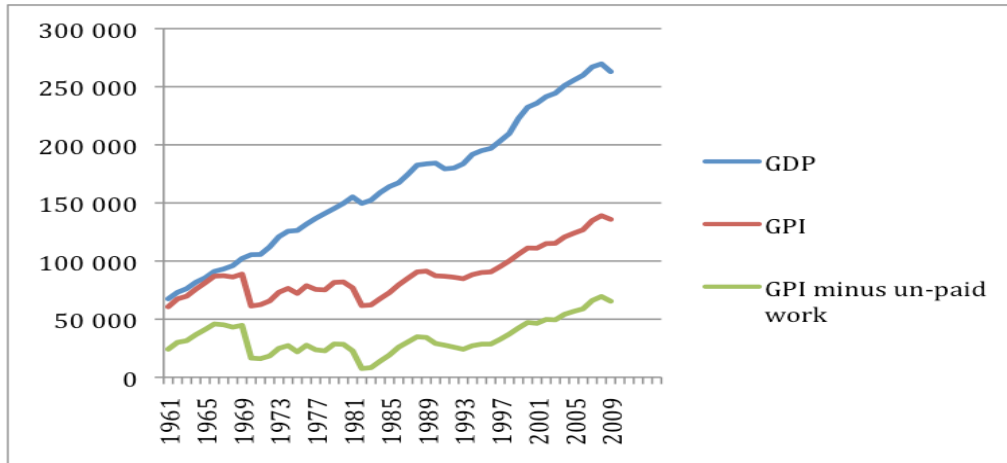
Keywords: GPI; GDP; proxy; externality; social costs; statistical value of human life

1. Introduction

A recent article (Posner and Costanza, 2011) in this journal describes several efforts to calculate a GPI at the state, county and municipal levels in the USA. At the same time, the article emphasizes the need for GPI practioners to establish a common methodology, while itself introducing variants to the methodology, due to lack of data or in recognition of specific problematics associated with sub-national calculations. In the context of the call for a common methodology, it is important to recognize that this objective must take second place before the need for the production of reasonable estimates of GPIs to counter the continued and misguided insistence on the GDP as the only indicator of development worth following.

The purpose of this paper is to present certain methodological aspects of the recent calculation of a Quebec GPI (Mead, collab. Marin, 2011). The presentation will follow the order of the book, where the occupation of the territory is placed first, followed by economic activity not directly involving territorial considerations and concluding with a look at aspects of social life constituting, finally, the objective of economic activity and of development more broadly. As with Posner and Costanza, variations with respect to the standard methodology are necessary, but the importance of an indicator "correcting" the GDP outweighs the divergence from a desired consistency.

2. The calculation and the methodology involved

2.1. Territorial development in the GPI

The occupation of the territory along the St. Lawrence River over several centuries has marked Quebec's development. Agriculture and forestry transformed the countryside and the terrestrial and aquatic ecosystems present at the beginning of European colonization. Mining for

asbestos in the region south of the river has also left its toll, as have mining activities north of the river in the Abitibi area. The growth of the population has resulted in the creation of major urban centers throughout the river basin, but primarily in areas originally clearer for agriculture, concentrated along the St. Lawrence. Infrastructure links among these centers have progressively placed on emphasis on automobile and truck transportation, following the trend throughout North America. Along the lower reaches of the St. Lawrence, and especially in the Gulf of St. Lawrence, fisheries dominated social life and economic activity for centuries, before the collapse of the 1990s. A first step in determining the cost of all this "development" is consequently one that looks at its direct impacts on the environment. Nine components of the calculation address these issues.

2.1.1   Protected areas

The role of protected areas in development has rarely been recognized in the calculation of a GPI; Pembina Institute's work on an Alberta GPI (Taylor, 2006) includes such a recognition, but in an approach different from that proposed in the Quebec GPI. In view of their importance in providing a reference and benchmark for comparison with areas under management, the Quebec GPI introduces a process whereby a subtraction is made for missing protected areas, on the basis of the province's map of ecological regions and using conservatively the value (Ingraham and Foster, 2008) of forests for all missing areas, even if many are either aquatic or wetlands having a greater value.

Explicit government commitments, first to protect 8 % of the territory, then (for 2015) to protect 15 % of the territory, mark the importance of this component of development practice and the role of quantified objectives in ensuring that the commitment is met. Challenges remain in the

St. Lawrence basin and in the southern part of the province, where most of the population resides and where most of past development has occurred.

This is the only component of the GPI that uses a value for ecosystems and biodiversity in calculating the costs of development.

2.1.2   Forestry

The Quebec GPI makes no attempt to introduce a subtraction for the earlier loss of most of its old-growth deciduous forest in the south (a major economic loss, in terms of present commercial value); this constitutes one element among several which make the calculation quite conservative. The GPI uses government data to establish the costs of contemporary forestry operations in the public forest, and compares the results to those in the private forest (about 10 % of all forests but providing about 20 % of forest products). The result is the discovery that Quebec obtains almost no rent for the public resource provided for harvest to private industry; the costs of operations are more or less equivalent to revenues, and the entire industry seems based on a decision by government authorities to maintain employment "at all costs". The subtraction for the GPI is made by adding the loss of rent to the costs of lower productivity (by comparison with an independent operation by Laval University in the same forest) and to the degradation of the (flow of revenue from the) forest itself. The subtractions are equivalent to the value-added GDP.

This "degradation", associated both with a loss of ecosystem vitality and with a loss of productivity as sought by forestry operations, is behind the zero-sum operation that is presently the standard. The loss of revenue involved arises in large part from the increasing distance of operations from mills and markets, and the decreasing size of the trees as recourse is had to virgin

forests further and further north. This harvesting approach presents several similarities to the exploitation of non-renewable resources.

In principle, the GPI methodology for the harvest of a renewable resource would focus primarily on the environmental and social externalities resulting from the forestry activities. However, no data are available for calculating the monetary costs of numerous externalities. These include the loss of biodiversity, the loss of regenerative capacity, perturbations to drainage and to the aquatic ecosystems, changes to fire and insect regimes and instability in communities threated with closures. The methodological approach to the calculation of a forest GPI, made possible by the existence of data developed to support market requirements, allows for an indirect estimate of the loss of revenue flows resulting from these impacts.

2.1.3   Agriculture

For agricultural activities, absence of data is again a major difficulty. There is nothing to provide a value for the monetary costs of surface water and aquifer pollution, soil erosion and compaction, nor even for the loss of wetlands, a continuing and important process in Quebec over the years; social instability associated with declining populations in agricultural communities is also involved. The method used to evaluate the costs of environmental externalities for the GPI is to take the inputs for crops and livestock as the basis for most of the degradation caused by these activities. The GPI subtracts the expenditures for these inputs, whose value represents approximately one-third of the total output. The hypothesis behind this approach is that it is precisely these inputs of contemporary industrial agriculture that have caused the impacts and created the externalities. A comparison with the USA GPI of 2006 (Talberth, 2006) indicates that

this recourse to a proxy arrives at a result extremely close to the latter, based on limited but formal data.

A further subtraction is made for the social impacts of industrialized agriculture, using research which indicates that the great majority of government subsidies – the subtraction - end up destructuring rural communities (by encouraging the largest producers and reducing the number of farmers) and encouraging a rural exodus. An attempt to determine directly these monetary costs would require numerous hypotheses in its own right, whereas the proxy here subtracts what is a positive element of the agricultural GDP.

The calculation indicates that agriculture is not an "economic" activity any more than forestry; the subtractions are again the equivalent of the value-added GDP. The analysis provides an opportunity for reassessing government policy in the area, with the suggestion that smaller-scale farming, and a renewed interest in rural communities, could drive initiatives in the future.

2.1.4   Point-source water pollution

Non-point-source water pollution is taken as covered by the subtraction for agricultural activities, and a separate subtraction is made for point-source water pollution. There is the same absence of data for the monetary costs of diffuse pollution, but the GPI takes the costs of a provincial program to build sewers and treatment plants for municipal sewage, beginning in 1980, as a proxy for these direct costs, and adding the costs of a later federal-provincial program to deal partially with industrial waste water. The hypothesis is that these infrastructure investments would not be made if there were not a political judgement to the effect that the costs of the infrastructures are less than the externalities that they are designed to remediate. The

subtraction for the GPI is conservative, in that the political decisions are made primarily with a view to human welfare and do not take into account ecosystem impacts.

2.1.5   Urbanisation

The calculation of the costs of urbanisation, and in particular of urban sprawl, was confronted with several difficulties. On the one hand, many GPIs calculate the cost of congestion, of noise pollution and of other factors associated with contemporary urban life; we were not satisfied that the data for such subtractions were available. On the other hand, several approaches to the lands lost to urban sprawl made it possible to establish an estimate for the loss of agricultural land, a major concern, and one of the most important impacts of Quebec's urban sprawl, mostly in the Montreal area. Working from data available on the commercial value of Quebec's five major crops, the GPI substracts the value of the loss of production on the lands converted to urban uses. This loss of production is covered by the GDP, which then adds the value of the new economic activity on the converted land base, and the deduction for the GPI (a second counting of the loss of agricultural land) serves, finally, as a proxy for the cost of urbanization independent of the loss of production itself, That is, the ultimate cost of the permanent loss of agricultural land as a fundamental condition for the development of most human settlements represents partially the loss not only of the agricultural ecosystems but of the already reduced biodiversity which the original clearing of the land entailed.

Ultimately, an alternative approach is desirable, one that would directly evaluate the positive and negative elements of urbanization itself; the calculation of the loss of farmland is inadequate to properly quantify what are quite clearly important costs. A second set of subtractions should be made in such an approach for the costs of congestion, noise and other

negatives impacts of urban life itself; implicitly, such an approach assumes that the GDP adequately covers its social benefits.

2.1.6 Transportation infrastructure

Following Daly (Daly and Cobb, 1989) and others, we judge the municipal network of roads an essential infrastructure. The costs of construction and maintenance of this network are reasonably well known, and we take these expenses as a positive contribution to the well-being of urban populations. The addition of the value of these municipal allocations thus added to the GPI does not take into account the costs incurred to the extent that the network of intramunicipal roads has gone beyond what is really needed and desirable, and our calculation is thus conservative.

2.1.7 Air pollution

One of the costs of urban life not dealt with in the calculation of that component is that relating to air pollution in (primarily) urban areas. The Quebec GPI approaches this issue separately, as one element of the social impacts not covered by the proxy used to assess the costs of urban sprawl. The USA GPI for 2006 uses the research by Myrick Freeman (Freeman, 1982) going back more than two decades to make a first decision to the effect that the principal impact of urban air pollution is on the health of the population. Data for the health impacts of air pollution for Quebec exist, resulting from a study conducted in 2002 (Bouchard and Smargiassi, 2007) and placing an important emphasis on particulates ($PM_{2.5}$). Using the statistical value of a human life developed for the GPI, an important substraction for the costs associated with the loss of life due to air pollution is calculated; this is complemented by an indirect evaluation of the non-health impacts, using Freeman's results.

To our knowledge, this is the first calculation of a GPI that makes use of an explicit calculation of the statistical value of a human life (cf. section 2.4). To the extent that attempts are made in different GPIs to evaluate the costs of the stress caused by noise, congestion and other urban irritants, it seems more than reasonable to introduce this alternative methodological element. Premature loss of life reduces the benefits associated with the economic activity that is directly estimated by the GDP. It is thus clearly a human cost, in terms of the hypotheses underpinning the GPI.

2.1.8   Mining

The elaboration of the Quebec GPI follows the argument of Daly and Cobb (Daly and Cobb, 1989, p. 405-411) while looking at those for the Australian GPI and others for the mining sector, subtracting the total value of production as the social cost of the extraction of non-renewable resources. All studies with which we are familiar have dealt with energy resources, primarily oil; in Quebec's case, the non-renewable resources in question are metals and industrial minerals, Quebec having no active exploitation of fossil fuel resources (although plans are in the works for these latter). No attempt is made to deduct the costs of operations from the production, for lack of publicly available data, but also respecting the decision of Daly and Cobb not to do this in any case (they consider these costs as regrettable necessities, akin to defensive expenditures).

An additional subtraction is made for the costs of deaths incurred in the asbestos mining sector, for which data are available and to which we apply the statistical value of a human life already mentioned. Therre are also deductions for the rehabilitation costs for abandoned mines now the responsibility of the government.

2.1.9   Fisheries

Canada was in the headlines for many years in the 1980s and 1990s with the total collapse

of its cod fishery, after being recognized for centuries for the enormous value of that fishery on

the arrival of the first Europeans. Data are available for the loss of revenue incurred in Quebec in

regard to the collapse. While here again the annual losses were included in the GDP (although

some of these were actually positive contributions), the Quebec GPI takes these losses as a

conservative proxy for the costs to the communities of the loss of their centuries-long livelihoods.

The loss of revenue is taken as having a direct (if not one-to-one) relationship with the enormous

social suffering caused by the unsustainable use of this renewable ressource, mined to oblivion.

Further, the GPI cumulates the annual losses to reflect the ongoing loss of the stocks. This study

is more conservative than the work of GPI Atlantic, where the entire fishery is examined to

establish the costs involved (Charles, Boyd, Lavers, Benjamin, 2002; Charles, Burbidge, Boyd,

Lavers, 2009).

2.1.10 Invisible collapse and apparent progress

The fisheries component of the Quebec GPI is the smallest in terms of its monetary value.

At the same time, the figure which maps the collapse of the stocks and the economic value of the

fishery followed by the GDP is striking: the collapse occurs several years before that of the

economy dependent on them. We believe that this quite possibly represents the present global

situation, where every effort is being made to maintain at least the appearance of economic

normality while ecosystems are in dire straights just about everywhere, even if this does not show

up in an immediately observable manner.

Figure 1: The unseen crisis
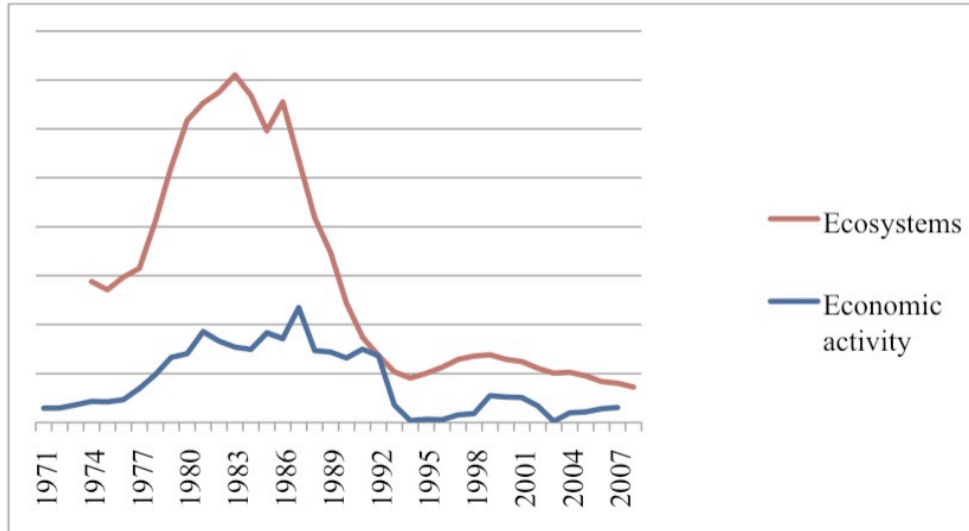
2.2   Non-territorial economic activities in the GPI

"Normal" economic activity

Much economic activity today takes place independent of its particular surroundings, even more so than in earlier times when a nearby watercourse or proximity to resources might be essential. Infrastructures for energy distribution and for transportation services are themselves human artifacts, and while they have important impacts on the surrounding area, these are strictly that, impacts or externalities, rather than the transformation of the territory itself. These externalities have for the most part been covered by different components of the first section dealing with territorial development, these being primarily air and water pollution along with the transformation of whole regions for agricultural, forestry and mining operations.

A second section of the Quebec GPI involves the evaluation of the costs of externalities specific to economic activity not grounded in the territory, and we have limited them to three.

2.2.1 Non-remunerated work

All GPIs include a calculation of the contribution of non-remunerated work (normally work in the home), and including volunteer work. Standard GPI methodology considers this to be economic activity, but outside the markets providing the inputs for the GDP. Statistics Canada has followed this issue for decades, underscoring its direct relation to the GDP itself, but still not proposing to include it in the calculation of the latter. Data are abundantly available for evaluation of the time consecrated to domestic work (without separating out volunteer work, indicated as approximately 10% of the total). This component of the GPI, following the standard methodological considerations, provides the largest single contribution to the indicator, and is positive, in contrast to the subtractions for the costs of the social and environmental externalities.

2.2.2 Unemployment

Unemployment or underemployment (Talberth) is sometimes included in the list of components of GPIs. The economic costs of unemployment are already included in the GDP and, in large part, in the personal consumption base of the GPI that is less than it would be if there were full employment. It remains that a high rate of unemployment is structurally involved in the present economic system (Victor, 2009), and this generates social costs as well as economic costs. We have calculed these costs, first following a procedure to establish them as economic costs, and then transforming these into social costs. The basic hypothesis is that the loss of revenue covered by the personal consumption element of the GDP can be considered a conservatively calculated proxy for loss of stature, increased stress and a multitude of other social costs that are not simply economic. This approach replaces attempts to deal with certain

important social costs of development used in other GPIs, such as crime, divorce and suicide, for which partial data are probably available but not very robust.

2.2.3 Greenhouse gas emissions

Climate change is ultimately a question of greenhouse gas emissions resulting from a multitude of activities, those involved in our occupation of the territory as well as in specifically economic activities; in Quebec, these include emissions from several important aluminum smelters and paper mills as well as emissions from transportation and agricultural activities and from residential and institutional establishments. The Quebec GPI uses a conservative value of $22 per ton developed by the Canadian government (Transport Canada, 2007) for the cost of eliminating, correcting the impacts of or adapting to the consequences of these emissions. Emissions themselves are calculated using data available from the Quebec government. Following Talberth, the subtraction is made on the basis of the accumulation of gases in the atmosphere, but reduced to take into account the capacity of sequestration of Quebec's forests and of the earth's ecosystems.

Again following Talberth, we assume that the "marginal damage arising from carbon emissions are cumulative, so that costs incurred in one year continue to be incurred the next year" (Talberth et al, p. 17). This subtraction is the largest of all those in the GPI, in spite of using a value for the cost of carbon much lower than that used by Talberth. Projections are made following Quebec government commitments for 2020, to indicate the enormous ecological debt incurred and continuing to be incurred, which is causing major obstacles for the development envisaged by emerging countries.

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2.3. Social aspects of development in the GPI

Ultimately, development is about social progress, and Quebec has made great strides in this regard since its Quiet Revolution that began in the 1960s. The benefits of the progress over this period are presumed to be indicated by the Consumption part of the PIB that serves as the base for the entire calculation. The hypothetical relation between monetary values and human well-being justifies the proxy used to calculate the cost of unemployment in section 2.2.2 and is again used in treating the progress in health and education in the province in this section. This progress seems clearly compromised by the society's adhesion to the consumer model and the debts incurred to attain it.

2.3.1   Indebtedness of households and government

The Quebec GPI makes only two substractions relating to the social costs of development, namely, namely that associated with the record indebtedness of households and that incurred by the government not associated with an asset (a situation which holds for almost all rich countries and many poor ones). While this indebtedness, at least that for current consumption, might well be judged as itself the subtraction appropriate for the GPI, we have subtracted only the interest on household debt, and the government debt service costs. In both cases, the current crises are underscoring the fact that the traditional approach to "management" of these debts, through continued GDP growth, is apparently reaching certain limits, not only those imposed (but not recognized) by potential ecosystem collapse, but even others arising from the economic system itself which is behind the disastrous impacts on ecosystems (Meadows, 2012; Turner, 2012).

2.3.2 Health and education in a developed society

Quebec's Quiet Revolution placed an important accent on improvements to basic public services in health and education. Over the 40 years covered by the GPI, baccalaureats increased five-fold and life expectancy in good health increased by 5 years. These improvements resulting from Quebec's recent development led to increased revenue for those with university degrees and to longer lives as consumers, generally. The GPI assumes that these effects are found in the Consumption component of the GDP with which the calculation begins, following the general approach of all GPIs. These improvements in well-being are thus associated with their monetary value, and the GPI therefore makes no further additions in their regard.

The Conclusion to our publication nevertheless underscores the fact that this type of progress does indeed have non-monetary value and provides an indication of directions for a new paradigm for development which is not consumption-based, necessary to reduce Quebec's (and humanity's) ecological footprint.

2.3.3 Demographic issues

The publication presenting the Quebec GPI also includes a chapter on the negative impacts of population growth, particularly that experienced by almost all nations since World War II. Theoretical calculations are provided for a hypothetical development based on stable populations, as well as others subtracting the important contribution to the GDP of demographic growth, on the view that it is ultimately negative rather than positive, contrary to the almost universal approach of economists. To our knowledge, no GPI work has introduced this topic formally, and indeed, it leads to no changes in our own calculation.

2.4.   The statistical value of human life

An appendix to the Quebec GPI provides the calculation for this value, following an evaluation made and approved by the Canadian government. This value is 6,4 M$ CA in 2007. The calculation of the value is an attempt to evalute the loss of productive work associated with premature death. The fundamental hypothesis of the GPI is that the Consumption component of the GDP represents to a reasonable degree the benefits of such productive work. We use this value in making subtractions in sections 2.1.7 on urban air pollution and 2.1.8 on mining. This value is also used in the chapters of the publication covering health and education benefits, as mentioned in section 2.3.2.

2.5   Following development's inequalities: the Gini Index

Use of the Gini Index is universal in calculating the GPI elsewhere, reducing the Consumption base of the calculation to take into account social inequalities. Several interesting criticisms of preliminary work on the Quebec GPI underscored the fact that this operation, correcting the monetary base of all other GPIs, constitutes a non-monetary ponderation that is found nowhere else in the calculation. Taking these criticisms into account, the Quebec GPI does not include a correction of the GPI's base for what is in fact rising inequality in Quebec, but provides the calculation as an appendix. It remains the case that the same economists who were ready to criticize the use of a ponderation are almost certain to criticize the use of proxies (as indicated above) and, ultimately, to reject the GPI in any case, as has been the experience elsewhere.

3. Results

Contrary to almost all other GPIs, the Quebec GPI shows a constant increase over the forty-year period covered, the curve following that of the GDP itself. There is reason to think that this is due to the important increase in the personal consumption element of the GDP, the base of the GPI calculation, and, leaving aside the fundamental critique required of that of all the rich countries of the world, reflects Quebec's remarkable progress over the past half century. We believe that our calculation of the benefits of improved health and education services provides part of the explanation of this increase, and our analysis of demographic issues provides another part, this one explicit in the standard economic model.

With its subtractions for environmental and social externalities, the Quebec GPI reduces the GDP by two-thirds, before adding the contribution of un-paid work, for a final GPI approximately half the GDP.

Figure 2 : Quebec GDP, GPI and GPI without un-paid work, 1970-2009
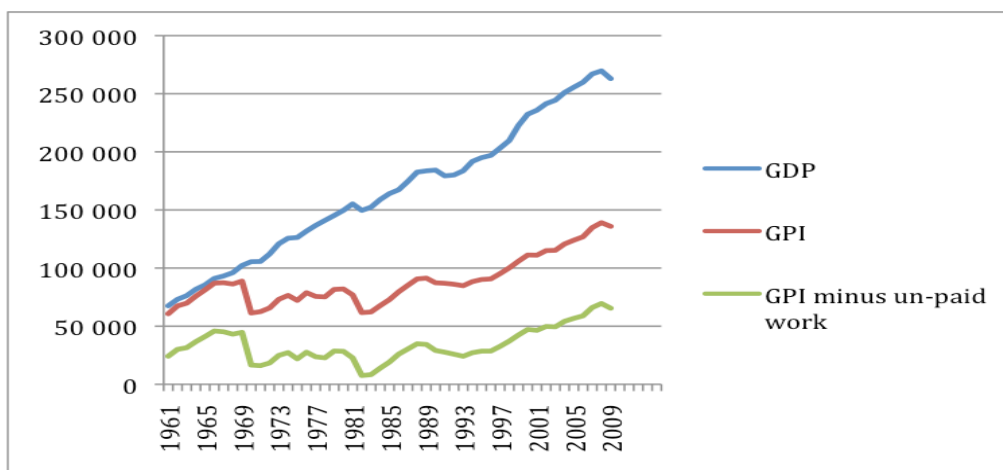
The curves are almost identical for the per capita versions of these indicators. No adjustment is made to the Consumption component of the GDP, the basis of the GPI calculation, for the inequalities introduced by the Gini Index. This adjustment is made in an appendix.

Our work on the Quebec GPI provides insights into the role of improvements in health and education, which are implicit in the Consumption part of the GDP, but made explicit in separate calculations. The same is true for the extent to which population growth has influenced the trends.

4. Discussion

The recourse to proxies in our calculation of the Québec GPI turns out in several cases to suggest other ways to measure certain externalities. Our use of direct expenditures for water pollution control and treatment as a proxy for the costs of point-source impacts of development on water bodies would seem to reflect an intuitive evaluation of the importance of these costs by decision-makers, whereas the costs of loss of biodiversity, and of other ecosystem impacts, remain difficult to quantify. The same can be said for the use of a proxy – the value of inputs in our agricultural systems – in attempting to estimate the costs of the complementary non-point-source impacts on these water bodies.

In addition, our use of the statistical value of a human life to calculate subtractions associated with loss of life due to urban air pollution seems to be an interesting alternative to attempts to deal with the health effects of noise and traffic congestion in other GPIs; its application to worker loss of life in asbestos mining is presumably applicable to similar situations in industrial activity elsewhere in the system, but not always taken into account. The use of this factor in our estimate of the increased life expectancy in good health in the Quebec population

provides a way to interpret more explicitly the use of the Consumption part of the GDP as the starting point for the calculation of GPIs.

Our use of double counting in making subtractions for the social costs of the economic impacts of the cod fishery collapse provides a way to separate a social factor from the omnipresent economic data. This is even more the case in our calculation of the costs of unemployment, a component not always used in GPI calculations, but very important in ours. Not only does this social impact of the present economic system seem endemic, but it constitutes a widespread phenomenon in the present global unrest that calls for greater recognition. Here again, our proxy using the economic costs of unemployment to estimate the social costs returns to the implicit assumption of all GPIs, that consumption is at least a useful beginning point in the attempt to identify the benefits of "progress".

Finally, the Quebec GPI seems to be one of the first attempts to incorporate a subtraction for the costs associated with metal mining, in contrast to the widespread calculation of the cost of the loss of fossil fuel reserves, especially oil. In a world where minerals are becoming less and less available, following the pattern which marked the run-up to peak oil, it would seem worthwhile to include such a component in future GPIs, where rising prices for minerals will probably provide results somewhat similar to what has been experienced with fossil fuels, in terms of costs to be deducted.

5. Conclusion

Numerous reports of a diverse and wide-ranging nature are coming out almost monthly to underscore the culmination of decades of failure to integrate environmental and social constraints into our development model. The projections of *Limits to Growth*, published in 1972, have been

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shown to coincide with the actual data for the period 1972-2012; these projections suggest that the collapse of the systems marking our civilisation is likely to occur within the next twenty years, with the inertia associated with the present economic model providing little indication of decisions that might permit us to avoid the situation.

Efforts to call into question the economic model founded on exponential growth would seem most likely to have some impact if they continue to insist on the weaknesses of the GDP as our main measure of progress. Calculation of the GPI for different juridictions represents a major contribution in this sense. At the same time, the lack of data for such a calculation, which marked our work, is in fact omnipresent. Our recourse to indirect approaches to the calculation, as needed, would seem to be inevitable, and to be encouraged, since the formal collection of the data presently missing will take years, probably decades, once a decision is made to go in that direction in the different jurisdictions. We do not have the time to allow ourselves to insist on formally impeccable approaches to the calculation, given the imminence of possible collapse and the urgent need to change direction.

The current financial and economic crises being experienced in wealthy ("déveloped") nations may well represent indications that the economic system itself is finally confronting its inherent limits, based as it is on continued, materials-based growth of economic activity. This activity is clearly responsible for numerous ecosystem crises that seem to be reaching the limits of their resilience as well. Work on indicators such as GPIs is urgently required to help decision-makers work out alternatives to their present orientations, which seem closer and closer to absurdity in their call for growth as the fundamental reponse to almost all our present problems, and crises, when it is in many ways their cause.

Results of the Quebec GPI provide indications for important new policy initiatives in forestry, in agriculture and in mining, as well as of the overwhelming importance of initiatives to reduce the ecological debt of the province's greenhouse-gas emissions. A general rethinking of both rural and urban development seems in order. The results also suggest the need for reflection on the weaknesses of the GDP in dealing with issues of unemployment and the non-market components of the economic and social fabric of the province, especially un-paid (domestic) work.

By the time we get to the point where data will be available to allow practitioners to become more coherent in their work, and avoid proxies and other approaches which continue to prevent a consistent methodology in the elaboration of various GPIs, it will be too late for our major objectives, a reorientation of development policies to avoid overshoot and collapse.

The GPI, in this context, is a tool which, in spite of its deficiencies, should hopefully force mainstream economists to respond by changing their abuse of the GDP as an indicator of well-being, providing alternatives to what they perhaps disagree with in the GPIs which concern them, but not just carrying on with business as usual faced with the criticism. The GPI is of most interest as a tool for opposing this continued recourse to the GDP for policy decisions, at whatever level.

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Appendix: Table of results, in three pages (available on line as Appendix I on the site of the editor, MultiMondes, at http://multim.com//titre/?ID=343)

I – The territory

Year	Protected areas	Forestry	Agriculture	Point-source water pollution	Urbanization	Municipal roads	Environmental impacts of air pollution	Maintenance deficit for provincial roads	Mining activity	Fisheries
1961										
1962										

Year									
1963									
1964						45			
1965						66			
1966						77			
1967					207	70			
1968					399	71			
1969					573	52			
1970	9 505				742	52	4 587		
1971	9 505				902	44	4 569		
1972	9 504				1 069	48	4 514		0
1973	9 504				1 179	51	4 543		0
1974	9 504				1 232	65	4 544		1
1975	9 504				1 268	68	4 476		1
1976	9 504				1 325	76	4 486		1
1977	9 504				1 370	68	4 457		2
1978	9 504				1 390	75	4 462		3
1979	9 499				1 411	82	4 483		5
1980	9 496			389	1 391	97	4 487		6
1981	9 579		592	410	1 332	114	4 429	1 275	10
1982	9 484		617	429	1 285	116	4 383	1 243	10
1983	9 484		649	450	1 309	144	4 366	1 260	10
1984	9 467		639	580	1 344	138	4 364	1 387	11
1985	9 449		711	723	1 366	190	4 343	1 571	13
1986	9 443		710	770	1 375	189	4 343	1 482	13
1987	9 442		742	985	1 394	211	4 358	1 853	18
1988	9 432		867	785	1 421	234	4 307	1 900	24
1989	9 432	549	894	815	1 435	249	4 330	2 006	25
1990	9 431	524	1 005	940	1 442	269	4 299	2 220	25
1991	9 418	482	920	911	1 406	281	4 294	2 249	27
1992	9 347	523	978	936	1 444	288	4 322	2 024	28

1993	9 344	623	877	1 047	1 491	359	4 256		2 083	36
1994	8 919	832	1 175	1 146	1 576	370	4 260		2 358	39
1995	8 905	1 266	1 285	1 233	1 622	361	4 231		2 822	39
1996	8 905	1 474	1 565	1 198	1 664	368	4 214		2 911	39
1997	8 893	1 607	1 578	1 143	1 712	366	4 231		3 042	40
1998	8 893	1 557	1 816	1 049	1 752	363	4 246		3 166	41
1999	8 866	1 689	1 634	1 005	1 788	400	4 237		3 240	44
2000	8 866	1 700	1 736	972	1 807	438	4 206		3 276	44
2001	8 845	1 713	1 940	1 070	1 832	492	4 215		3 151	44
2002	8 844	1 643	2 268	843	1 868	515	4 235		3 134	46
2003	7 964	1 560	2 521	1 219	1 891	515	4 219		3 215	49
2004	6 951	1 692	2 608	1 308	1 917	554	4 212		3 460	51
2005	6 830	1 471	2 455	1 471	1 935	596	4 225		3 390	51
2006	6 433	1 247	2 566	1 578	1 969	646	4 194		4 162	52
2007	5 556	981	2 965	1 595	2 012	630	4 200	1 700	5 204	52
2008	5 478	795	3 200	1 782	2 044	536	4 193	1 578	6 113	51
2009	3 319	552	3 455	1 870	2 065	592	4 185	1 839	6 306	52

II – Economic activity   III – Life in society

Non-market work	Unemployment	Social impacts of air pollution	Climate change – emissions	Personal expenses	Household indebtedness	Gouvernment debt service	Health and well-being	Diplomation
36 503	11 538			35 702				14
37 390	8 770			38 809			206	42
38 276	9 152			40 646			418	84
39 190	7 117			43 756			638	141
40 150	4 878			45 937			809	210
41 163	3 280			49 083			1 038	298
42 205	5 031			50 369			1 277	403
43 141	8 641			52 092			1 531	517

44 065	10 426			55 655			1 781	600
44 794	13 927	12 402		57 646			1 912	715
46 434	14 898	12 352	-653	57 934		355	2 167	875
47 311	16 148	12 205	-443	61 701		391	2 442	1 048
48 218	14 149	12 284	-178	66 770		433	2 720	1 195
49 233	14 328	12 286	138	69 636		403	2 798	1 405
50 238	20 082	12 101	481	70 219		454	3 133	1 658
51 218	17 133	12 129	881	73 524		526	3 354	1 919
51 927	23 585	12 050	1 317	76 537		648	3 398	2 204
52 410	26 442	12 065	1 820	79 216		804	3 831	2 533
53 001	22 511	12 122	2 367	81 858		886	4 178	2 851
53 654	24 314	12 131	2 963	84 620		1 144	4 521	3 192
54 190	27 162	11 974	3 594	86 606	2 151	1 437	4 513	3 537
54 132	39 273	11 851	4 291	83 531	1 739	1 520	4 930	3 899
53 939	40 767	11 804	5 011	86 192	1 354	1 572	5 359	4 251
53 775	38 153	11 800	5 772	90 498	1 370	1 812	5 289	4 594
53 676	36 100	11 742	6 573	94 968	1 471	1 933	5 614	4 946
53 631	31 797	11 742	7 429	98 409	1 588	1 955	5 975	5 324
54 797	29 243	11 783	8 330	102 038	1 765	1 937	6 537	5 701
55 791	27 382	11 645	9 323	105 665	2 025	1 932	7 073	6 094
57 070	28 005	11 708	10 419	108 263	2 643	1 957	7 386	6 490
58 212	31 791	11 622	11 547	108 745	2 989	2 073	7 278	6 895
59 305	30 844	11 611	12 713	106 760	2 509	2 031	7 859	7 309
60 182	33 133	11 685	13 939	108 282	2 284	2 032	8 362	7 749
60 684	35 630	11 507	15 235	110 082	1 940	2 243	8 087	8 202
61 154	33 752	11 519	16 613	113 503	1 988	2 513	9 024	8 664
61 621	31 201	11 439	18 056	115 384	2 557	2 534	8 728	9 124
62 075	33 085	11 393	19 572	118 956	2 287	2 421	8 927	9 597
62 575	32 114	11 439	21 170	123 914	1 691	2 992	9 488	10 057
62 988	28 521	11 479	22 858	126 813	1 765	2 887	9 878	10 491

63 500	25 835	11 456	24 618	131 252	1 898	2 918	10 913	10 941
64 061	23 238	11 372	26 456	135 632	2 274	2 938	11 894	11 383
64 678	24 998	11 395	28 355	138 491	2 269	2 741	11 488	11 810
65 263	24 628	11 449	30 363	143 093	1 864	2 639	12 474	12 258
65 850	27 375	11 408	32 518	147 513	2 023	2 614	12 878	12 712
66 520	25 103	11 387	34 513	151 587	2 072	2 637	12 429	13 184
67 230	24 534	11 424	37 047	155 867	2 284	2 616	13 114	13 653
67 996	23 387	11 339	39 680	160 326	2 499	2 969	13 847	14 125
68 765	19 760	11 357	40 799	167 279	2 746	2 933	13 478	14 586
69 573	19 955	11 335	41 863	172 868	2 853	2 669	13 914	15 056
70 418	26 296	11 317	44 558	176 286	3 026	2 587	14 187	15 514

IV - Synthesis   V – GPI per capita

GPI	GDP	Population of Quebec (,000)	GPI per capita	GDP per capita	GPI per capita without non-market contribution
60 667	67 473	5,235	11 330	12 601	24 164
67 429	73 080	5,355	12 330	13 363	30 039
69 770	76 263	5,469	12 503	13 667	31 494
75 874	81 805	5,58	13 346	14 389	36 684
81 275	85 575	5,685	14 041	14 784	41 125
87 043	91 111	5,788	14 789	15 480	45 880
87 406	93 167	5,886	14 640	15 605	45 201
86 263	96 012	5,971	14 292	15 907	43 122
88 773	102 219	6,036	14 568	16 774	44 708
61 329	105 505	6,094	10 017	17 233	16 535
62 484	105 660	6,122	10 181	17 216	16 050
65 672	112 139	6,137	10 636	18 162	18 361
73 124	120 931	6,174	11 769	19 464	24 906
76 498	125 686	6,213	12 203	20 050	27 265

72 159	126 300	6,269	11 399	19 952	21 921
78 833	131 792	6,33	12 324	20 603	27 615
75 599	136 722	6,397	11 752	21 253	23 672
75 210	141 024	6,433	11 678	21 897	22 800
81 657	145 234	6,44	12 629	22 461	28 656
82 050	149 624	6,466	12 611	22 998	28 396
76 965	155 209	6,506	11 755	23 706	22 775
61 654	149 611	6,547	9 369	22 735	7 522
62 239	152 399	6,581	9 426	23 080	8 300
67 714	158 970	6,603	10 211	23 973	13 939
72 838	164 089	6,631	10 927	24 617	19 162
79 581	167 354	6,666	11 863	24 948	25 950
85 197	174 585	6,708	12 562	25 742	30 400
90 646	182 548	6,782	13 258	26 700	34 855
91 364	183 638	6,837	13 193	26 518	34 294
87 317	184 297	6,925	12 479	26 339	29 105
86 931	179 324	6,997	12 300	25 373	27 626
86 078	180 068	7,067	12 107	25 326	25 896
84 814	183 659	7,11	11 851	25 663	24 130
88 337	191 774	7,157	12 282	26 663	27 183
90 175	195 009	7,192	12 491	27 012	28 554
90 670	196 932	7,219	12 512	27 175	28 595
95 203	203 253	7,247	13 087	27 940	32 628
100 134	209 715	7,275	13 725	28 744	37 146
105 925	222 716	7,296	14 464	30 412	42 425
111 245	232 378	7,323	15 121	31 586	47 184
111 093	235 832	7,357	15 020	31 885	46 415
115 047	241 448	7,396	15 461	32 448	49 784
115 302	244 422	7,441	15 403	32 651	49 452
120 750	251 028	7,486	16 023	33 311	54 230

123 959	255 559	7,536	16 349	33 706	56 729
126 892	259 853	7,582	16 627	34 050	58 896
134 814	267 033	7,632	17 538	34 738	66 049
139 069	269 665	7,687	17 936	34 780	69 496
135 867	262 965	7,753	17 355	33 589	65 449