Estimating health effects of income inequality changes caused by life cycles: a study at the subnational level

Ibrahima Bocoum[1-2], Catherine Macombe[1], Jean-Pierre Revéret[2]

[1] *IRSTEA, UMR ITAP, Montpellier (France)*
[2] *ESG UQÀM, CIRAIG Montréal (Canada)*

1. Context and scope

To compare the social impacts of different life cycles providing the same service, several alternatives are available. One can ask experts or different groups of actors involved, their opinion regarding the social impacts of different scenarios. One can also gather information from actors of the life cycle about how they feel and what they attribute to the life cycle they are involved in. However, due to the way these approaches are developed, the nature of the social impacts assessed is difficult to generalize.

Building on the generic solution developed in environmental LCA, we propose another approach, which consists in using formalized relationships that allow anticipating social impacts under certain conditions. The literature on social LCA (for example Parent et al., 2010) calls this the impact pathways approach.

Social outcomes that we consider are those that affect human well-being, health in particular. Epidemiologists agree that the determinants of collective health are first socio-economic (McCartney et al. 2013). The level of economic activity measured through the GDP of a country is one of the major determinants first showed by the American demographer Samuel H. Preston (Preston, 1975). Using the relation of Preston, Feschet et al. (2012) proposed the "Preston pathway" highlighting for poor countries, the long-term impacts on average life expectancy of an increase in average incomes resulting from a variation in the production stage of a life cycle.

The work described here, refers to another pathway, the "Wilkinson pathway" in reference to the work of the British epidemiologist Richard G. Wilkinson and his colleagues on the relationship between income inequality and health (Wilkinson and Pickett, 2010). This pathway proves to be particularly relevant to social LCA, since income inequality has significantly increased in many developed countries (as a result of the stagnation of economic growth: Genevey et al., 2013) and forces decision makers to try to restrain it in order to limit its social drawbacks.

The "Wilkinson pathway" allows quantifying the consequences of changes in a life cycle on income inequality and infant mortality. We first used this pathway to quantify the consequences at a country level arguing that there are life cycles that can generate important socioeconomic changes at a nation scale (article forthcoming in the International Journal of Life Cycle Assessment). However, in the interest of countries and companies, the real stake of calculating the effects of changes in a life cycle on income inequality and health is mainly at a more local scale. Indeed, the effects of an ordinarysize life cycle will in proportion be more important in a region than in the country where this region is located.

Income inequality affects health through various materialistic and psychosocial mechanisms (Biggs et al., 2010; Yang et al., 2012; Qi, 2012). Based on these theoretical thoughts, many researchers have attempted to measure income inequality – health relationship at various scales (national and subnational). Recent studies at municipalities, provinces and other local communities scales showed a negative correlation between income inequality and individuals' self-rated health (Rajan et al., 2013; Rostila et al., 2012; Edvinsson et al., 2013; Chiavegatto Filho et al., 2012; Feng et al., 2012; Franzini and Giannoni, 2010; Ichida et al., 2009).

However, the above studies are often limited by the lack or insufficiency of data. Hopefully, the possibilities expand as more data becomes available and econometric models improve.

Drawing on the recent works of Rostila et al. (2012) on the municipalities of Stockholm (Sweden), our ongoing work aims to retest the above relationship in other regions using the most recent and longitudinal data as well as the most appropriate models. We will thereafter explicit how the relationship is used to build an impact pathway for social LCA.

2. The income inequality – health relationship at the subnational level: main findings

At the subnational level, population health is most of the time measured through self-reporting questionnaires, which can be used as a proxy of mortality within a population as demonstrated by Burström and Fredlund (2001).

The first main finding which is consistent among recent studies is that in areas with political autonomy in the implementation of public goods, more income inequality is associated with more self-reported health problems (Rajan et al., 2013; Rostila et al., 2012; Edvinsson et al., 2013; Chiavegatto Filho et al., 2012; Feng et al., 2012; Franzini and Giannoni, 2010; Ichida et al., 2009). This result has been found in different countries at scales as various as municipalities, regions, districts and provinces, after controlling for multilevel socioeconomic characteristics such as demographic characteristics,

individual income, average community income, etc. The relationship is significant even within the most egalitarian societies as showed by the recent studies of Rostila et al. (2012) in Sweden. It might however be stronger in more unequal societies as reported by Kondo et al. (2012).

Moreover, like at the country level where it has been shown that health system variables attenuate the effect of income inequality on infant mortality (Macinko et al., 2004), it has also been shown that at the subnational level the correlation between income inequality and self-rated health tends to disappear after adjusting for spending on social goods. At the subnational level, Rostila et al. (2012) tested for example the effect of spending per capita on infrastructure, leisure, education, eldercare, family and work whereas Franzini and Giannoni (2010) tested the effect of living conditions, healthcare and social isolation. Both studies found that the effect of income inequality on self rated heath ceases when the endowments in social goods are taken into account (controlled for) . Franzini and Giannoni (2010) explain the mechanisms through which poor living conditions affect self-rated health as follows: "*The stress of daily life is increased by hassles such as difficulty parking, traffic, living away from family and poor public services… Poor quality housing and poor conditions of public places can impact both physical health as well as mental wellbeing. For example, individuals living in small, overcrowded, and damp homes are more likely to get sick. So are those living on dirty streets, where trash collection may be infrequent. Pollution and poor water quality also have the potential for impacting physical health directly*" (Franzini and Giannoni, 2010).

The second main finding concerns small administrative entities, such as neighborhoods, which do not have the so-called political autonomy. Rostila et al. (2012) and Wong et al. (2009) for example, found respectively in the municipalities of Stockholm and in Hong Kong, no association between self-rated health and neighborhood income inequality after adjusting for various contextual factors (average local level income and other individual and household level predicators such as gender, age, marital status and income).

The contrasting findings between neighborhoods and other bigger administrative entities reveal the importance of paying attention to the level of aggregation when studying the effects of income inequality on health.

Despite the thorough research accomplished on the subject, authors draw attention to several limitations of their work. Obtaining more robust measures of the income inequality – heath relationship that will be useful for social LCA, thus requires further work.

The first thing that needs to be improved is the type of datasets used for the analyses. The vast majority of the recent results are based on cross-sectional data, which prevents any causal inference. We therefore need to redo the estimations using time series data and applying the best econometric models available. Longitudinal data are indeed available in several developed countries. McLeod et al. (2003) for example used longitudinal health and socio-demographic data coming from several national surveys undertaken in Canada, but they combined these data with a static measure

of income inequality derived from the 1991 Canadian census. Yet, it is very likely that the Gini coefficient, which is the most common and comparable income inequality measure, is calculated for different geographic levels, in most developed countries.

Our idea is to retest the relationship at various subnational scales, using both longitudinal health and income inequality data from Canada. Retesting the relationship at different subnational scales will help defining the area sizes for which a significant effect is observed. Indeed, whether a geographic area has or not a political autonomy, as mentioned above, may be an insufficient criterion for the existence of a significant effect of inequality on health. A Norwegian study (Elstad et al., 2006) for example showed that when income inequality is considered with respect to small municipalities (population below 6000), no detrimental effect on mortality is observed, whereas this effect increases significantly at larger area scales (over 20,000 inhabitants).

Using longitudinal data will allow testing different time lags of the effect of income inequality on health in order to take into account the complex psychosocial and materialistic mechanisms underlying the relationship. Feng et al. (2012) found for example 3 to 6 years lagged effect of province level income inequality on self-rated health in China.

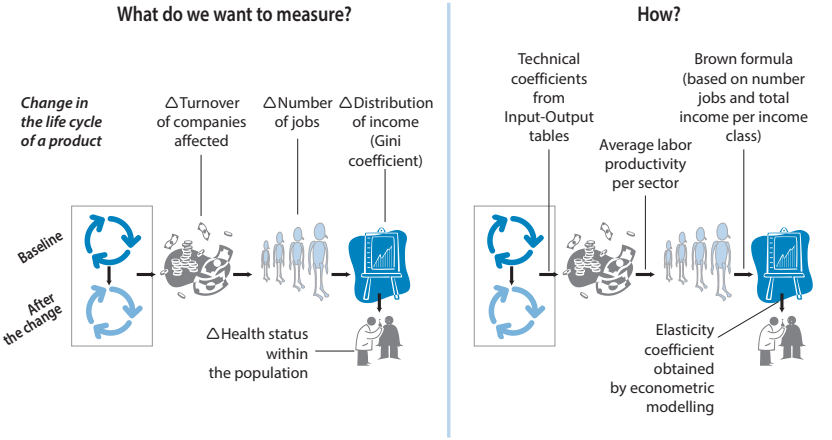
Also, as it has been shown that spending on social goods is an important determinant of the effect of income inequality on health in several countries (e.g. Sweden and Italy), it is important to check the robustness of this finding by testing in depth the role of each social good individually (health, education, housing, etc.) for which proxies are available in the current datasets. We would in particular, like to characterize the amount and nature of the social goods that compensate the adverse effect of income inequality on health.

Furthermore, because self-rated health is subjective and its assessment may vary according to cultural differences, it is important to study how it relates to other objective measures of health in different cultural contexts.

Finally, particular attention should be paid to the conditions of use of the income inequality – health relationship. In particular, it is important to keep in mind that the coefficient estimated econometrically from past data helps assessing only the likely effects (within a confidence interval), of actions that are undertaken today or will be undertaken in the future. Due to the data imperfections and the numerous assumptions made during the modeling – for instance the standard assumption in economics that all else remains equal (ceteris paribus) – we reasonably cannot expect interpreting the results in absolute terms. By comparing two alternatives with the same hypotheses, imperfect models and uncertainties, it is hoped that the difference between the two will have more meaning.

3. Building an impact pathway in social LCA using the above relationship

Once the income inequality – health relationship estimated and the conditions of use well defined, it becomes possible to use it to assess the likely effects on health of different scenarios of change in a life cycle. A complete pathway could be the one represented in the figure below. Already tested at country level, this pathway could also work for certain subnational levels such as regions or provinces where similar tools, such as input-output tables (IOT), and indicators are available.



Estimating the values of the different indicators involved in the pathway requires following four major steps: (i) estimate the flows of turnover created or destroyed by the change in the life cycle in the different subsectors of the economy using the technical coefficients derived from the IOT (one may here suppose a constant return to scale or choose a different assumption); (ii) deduce from that, the number of jobs created or destroyed in the different subsectors using average labor productivity per sector; (iii) estimate the new Gini coefficient following the change and calculate the variation compared to the baseline; (iv) use the elasticity coefficient estimated econometrically to calculate the repercussion on the health variable (one must first ensure that the conditions of use accompanying the elasticity coefficient are met).

It might be some cases where IOT are not available at a disaggregated level. The immediate alternative described by Garrabé (2008) is to empirically identify and quantify the effects of an action (for example a new expenditure) from the various iterations of the process within the production chains. The second alternative is to use the multipliers method. These multipliers could be either of demand (effects of

households' expenditures), supply (effects of local production of companies), or public spending. They should be articulated to help provide meaningful information about the consequences in terms of total activity created by an autonomous expenditure.

4. Conclusion

Social LCA is in the very early steps of its construction and despite the thorough work that has already been accomplished, further work is needed in order to be able to measure social impacts with a good deal of precision. The impact pathways approach contributes to this objective.

Much effort is needed especially to ensure the robustness of relevant socioeconomic relationships. This requires getting back a little bit to research as we cannot just build on reports of international organizations and presume the existence and robustness of relationships that have not been systematically tested.

References

Biggs, B., King, L., Basu, S., & Stuckler, D. (2010). Is wealthier always healthier? The impact of national income level, inequality, and poverty on public health in Latin America. Social Science & Medicine, 71(2), 266–273. doi:10.1016/j.socscimed.2010.04.002

Burström B., Fredlund P. (2001). Self-rated health: is it a good predictor of subsequent mortality among adults in lower as well in higher social classes? J Epidemiol Community health, 55(11), 836-840. doi:10.1136/jech.55.11.836

Chiavegatto Filho, A. D. P., Lebrão, M. L., & Kawachi, I. (2012). Income inequality and elderly self-rated health in São Paulo, Brazil. Annals of Epidemiology, 22(12), 863–7. doi:10.1016/j.annepidem.2012.09.009

Edvinsson, S., Lundevaller, E. H., & Malmberg, G. (2013). Do unequal societies cause death among the elderly? A study of the health effects of inequality in Swedish municipalities in 2006. Global Health Action, 6, 1–9. doi:10.3402/gha.v6i0.19116

Elstad, J. I., Dahl, E., & Hofoss, D. (2006). Associations between relative income and mortality in Norway: a register-based study. European Journal of Public Health, 16(6), 640–4. doi:10.1093/eurpub/ckl018

Feng, Z., Wang, W. W., Jones, K., & Li, Y. (2012). An exploratory multilevel analysis of income, income inequality and self-rated health of the elderly in China. Social Science & Medicine, 75(12), 2481–92. doi:10.1016/j.socscimed.2012.09.028

Feschet, P., Macombe, C., Garrabé, M., Loeillet, D., Rolo-Saez, A., & Benhmad, F. (2012). Social impact assessment in LCA using the Preston pathway. International Journal of Life Cycle Assessment, 16(9), 940–943. doi:10.1007/s11367-012-0490-z

Franzini, L., & Giannoni, M. (2010). Determinants of health disparities between Italian regions. BMC Public Health, 10(296), 1–10. doi:10.1186/1471-2458-10-296

Garrabé, M. (2008). La valeur d'activité totale d'une opération de développement local. Les multiplicateurs territoriaux : Théorie et application. Université Montpellier 1, Centre d'Etudes de Projets.

Genevey, R., Pachauri, R. K., & Tubiana, L. (2013). Regards sur la Terre 2013. Réduire les inégalités : un enjeu de développement durable. Paris: Armand Colin.

Ichida, Y., Kondo, K., Hirai, H., Hanibuchi, T., Yoshikawa, G., & Murata, C. (2009). Social capital, income inequality and self-rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. Social Science & Medicine, 69(4), 489–99. doi:10.1016/j.socscimed.2009.05.006

Kondo, N., Van Dam, R. M., Sembajwe, G., Subramanian, S. V, Kawachi, I., & Yamagata, Z. (2012). Income inequality and health : the role of population size, inequality threshold, period effects and lag effects. Journal of Epidemiology and Community Health, 66(11), 1–6. doi:10.1136/jech-2011-200321

Macinko, J. A., Shi, L., & Starfield, B. (2004). Wage inequality, the health system, and infant mortality in wealthy industrialized countries, 1970–1996. Social Science & Medicine, 58(2), 279–292. doi:10.1016/S0277-9536(03)00200-4

McCartney G, Collins C, Mackenzie M (2013). What (or who) causes health inequalities: theories, evidence and implications? Health Policy 113(3):221–227. doi: 10.1016/j.healthpol.2013.05.021

McLeod, C. B., Lavis, J. N., Mustard, C. A., & Stoddart, G. L. (2003). Income Inequality, Household Income, and Health Status in Canada: A Prospective Cohort Study. American Journal of Public Health, 93(8), 1287–1293. doi:10.2105/AJPH.93.8.1287

Parent, J., Cucuzzella, C., & Revéret, J.-P. (2010). Impact assessment in SLCA: sorting the sLCIA methods according to their outcomes. The International Journal of Life Cycle Assessment, 15(2), 164–171. doi:10.1007/s11367-009-0146-9

Preston, S. (1975). The changing relation between mortality and level of economic development. Population Studies, 29(2), 231–248. doi:10.1080/00324728.1975.10410201

Qi, Y. (2012). The impact of income inequality on self-rated general health: Evidence from a cross-national study. Research in Social Stratification and Mobility, 30(4), 451–471. doi:10.1016/j.rssm.2012.07.002

Rajan, K., Kennedy, J., & King, L. (2013). Is wealthier always healthier in poor countries? The health implications of income, inequality, poverty, and literacy in India. Social Science & Medicine, 88, 98–107. doi:10.1016/j.socscimed.2013.04.004

Rostila, M., Kölegard, M. L., & Fritzell, J. (2012). Income Inequality and self-rated health in Stockolm, Sweden: A test of the "income inequality hypothesis" on two levels of aggregation. Social Science & Medecine, 74, 1091–1098. doi:10.1016/j.socscimed.2011.11.027

Wilkinson, R., & Pickett, K. (2010). The spirit level: Why Equality is Better for Everyone. London: Penguin Books.

Wong, I. O. L., Cowling, B. J., Lo, S.-V., & Leung, G. M. (2009). A multilevel analysis of the effects of neighbourhood income inequality on individual self-rated health in Hong Kong. Social Science & Medicine (1982), 68(1), 124–32. doi:10.1016/j.socscimed.2008.09.064

Yang, T.-C., Chen, V. Y., Shoff, C., & Matthews, S. A. (2012). Using quantile regression to examine the effects of inequality across the mortality distribution in the U.S. counties. Social Science & Medicine, 74(12), 1900–1910. doi:10.1016/j.socscimed.2012.02.029