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RESEARCH IN ECONOMICS AND RURAL SOCIOLOGY

Discount rate and sustainable development

From their emergence to their eventual collapse, the fate of civilisations depends on their ability to reconcile concern for the future with the need to satisfy their immediate needs. A myriad of individual and collective decisions are the concrete representation of these concerns, from the accumulation of capital through long-term savings and investments to the level of education, via environmental preservation, the allocation of natural resources, the quality of public infrastructures and the intensity of the research and development (R&D) efforts. In his book "*Collapse*", Jared Diamond (2005) describes the flourishing civilisation of Easter Island up until a time shortly before it was discovered by Westerners, collapsing before their arrival because of the islander's inability to control their over-consumption of a natural resource which was absolutely essential to their survival: wood.

In 1972, the publication of the book "*Limits to Growth*" by the Club of Rome revealed the emergence of a collective consciousness of the dangers associated with non-sustainable development. Since then, citizens, politicians, businesses and investors have had to face an increasingly long list of environmental problems which include the management of nuclear wastes, the rarefaction of natural resources and the decline in biodiversity in the air, on land and in the oceans. The case of the increase in the concentration of greenhouse gases and the climate changes which result is a particularly powerful example. Ultimately, all of these environmental issues pose the same question: are we making a big deal for nothing, or are we not doing enough? This question transcends the environmental subjects. It is central to many issues of public policy, such as pension reform, agricultural policy, the appropriate level of the public debt, investments in public infrastructures and efforts in the fields of education and R&D.

Since Homo sapiens rose to become the dominant species on our planet, and until very recently, every year human beings consumed only that which they had collected, hunted or harvested during the year. Seemingly bound by Malthus' law, humankind apparently remained at subsistence level for thousands of generations. Despite recent developments on the notions of dynamic inconsistence and hyperbolic discounting, it is beyond doubt that, unlike other species, human beings are conscious of their own future, at individual, dynastic, community and anthropological levels. At individual level, the human being makes compromises between the satisfaction of his needs and his desire for a better life in the future. As a young man, he invests in his human capital. Later, he saves for his retirement. He makes efforts to preserve his health by doing some sport, brushing his teeth or eating healthily. He plans his own future and his children's, to whom he wishes to transmit the property inherited from his own parents. Once the right to individual property was clearly established and protected (gradually from the end of the Middle Ages in Europe), the individual desire for future investments was unleashed. In parallel, states slowly became aware of their role as producer of sustainable public goods, such as road infrastructures, schools or hospitals. At aggregated level, this led to a gigantic accumulation of physical and intellectual capital which generated the economic growth and prosperity, as described in the neoclassical theory of the growth. The sacrifices of the past generations made this prodigious phenomenon possible.

The observation of this dynamic puts a crucial question: are we exaggerating our problems, or do we not do enough for the future generations? Should we not consume rather than invest? To revisit a famous debate, instead of spending without limits to explore space, should we not take immediate action against malnutrition, poverty, illiteracy, malaria and AIDS?

Applied discount

In societies like ours, the concern for the future held by the myriad of economic agents is coordinated by the fixing of a single variable: the interest rate or discount rate. We can spend years debating the responsible or irresponsible behaviours of various parties, but ultimately the decisions of households, businesses, investors and governments will always be determined by the discount rate, a crucial socio-economic variable of our economic dynamic.

The importance of this question may be illustrated in the context of climate change. Nordhaus uses a 5% discount rate to assess the present value of the flow of future damages (financial and extra-financial) induced by the emission of one additional ton of CO2 (tCO2) today, assuming the lack of public intervention to reduce these emissions. He obtains a present value of 8 dollars. Stern (2007) applies a 1.4% discount rate, much lower than that retained by Nordhaus. Having, consequently a longer-term vision, he gets a much higher present value of the future damages of a tCO2, around 85 dollars. With such a value, a lot of green technologies become socially desirable, and individually profitable if an 85 dollar tax per tCO2 avoided was imposed at the planet level. But such a rate would increase the sacrifices asked of current generations. In France, traditionally, it is the State Planning Commission (superseded by the Centre of Strategic analysis a few years ago) which determines the discount rate according to the various plans implemented. That rate was 7% in the 5th plan (1966-1970, then 10% in the 6th plan (1971-1975) and 9% in the 7th and 8th plans (1976-1985). Between 1985 and 2005 an 8% rate prevailed, based on the principle of private capital yield, as in the USA in the 60's. In 1985, a drastic reduction to 4% was implemented, and even down to only 2% for flows coming into effect after more than 30 years.

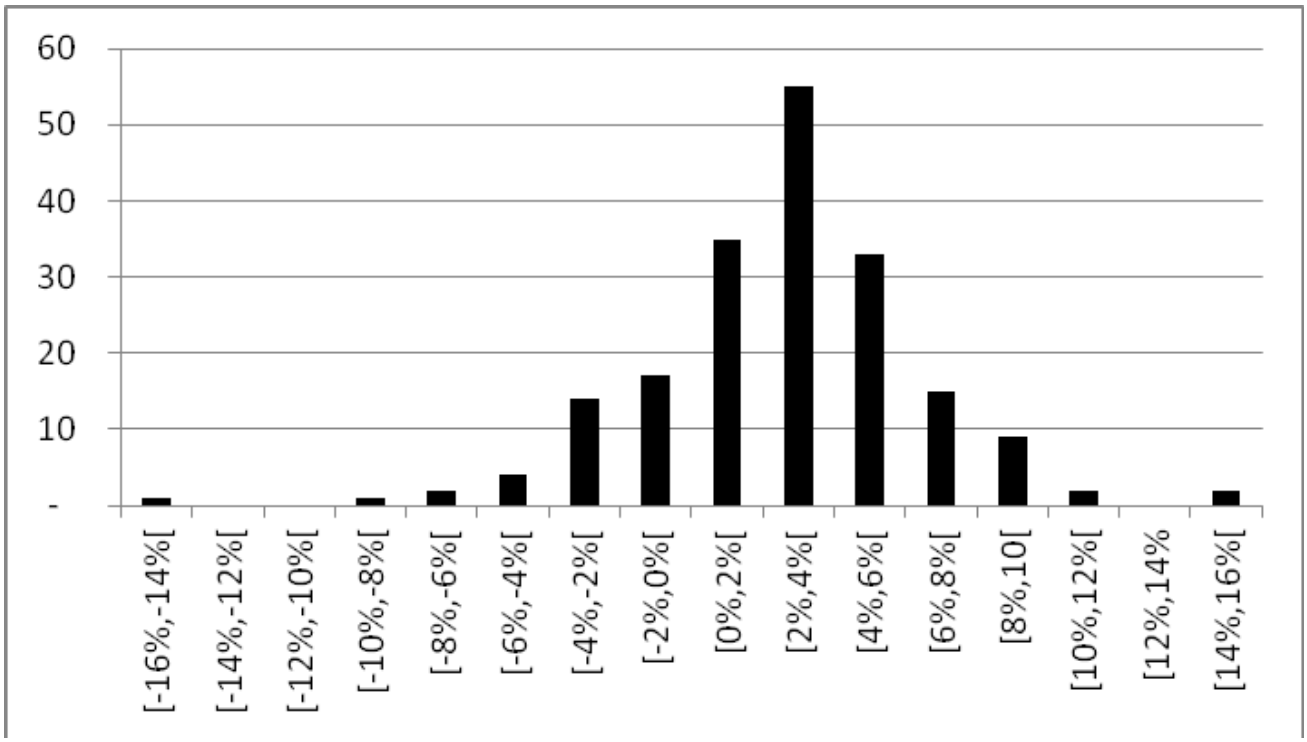
As an observer and participant in a great many working groups in ministries and businesses during the last two decades in France, I can testify to the intensity of the debates and negotiations on which these decisions are based. While the private operators who build the public infrastructures, and the ministries which manage them (transports, equipment, agriculture, ecology and health,…), are usually in favour of a cut in the discount rate because that raises the present value of their projects, the Ministry of Finance is directly opposed because a decline in the discount rate may massively increase the public financing requirements of these projects. Until now, it seems that scientists have been able to effectively arbitrate in these conflicts. If they are intense, it is because the drop in rate has a huge impact on the valuation of crucial projects for certain ministries, the reinforcement of road and rail infrastructures (TGV, Lyon-Torino tunnel,…) the investment policy in the electric sector (renewing the country's nuclear power facilities and transport network, repurchase value,…) or the exact level of any proposed tax on carbon emissions.

The economy of the discount rate

There is an clear case to be made for evaluating future at a lower rate than present profits. Let us suppose that we anticipate the continuation of positive growth. Since investing in this context is equivalent to stealing from the current poor generation to give to the future rich generation, such action serves to increase intergenerational inequalities. We should consider this action socially desirable only if the social cost of this reversed redistribution is more than compensated by high levels of profitability. This wealth effect justifies a positive discount rate, in line with the collective social ambition to redistribute wealth in favour of the poorest, even though such actions lead to economic inefficiencies. We should bear in mind that even with a true 2% growth rate of consumption; we now consume 50 times more goods and services than in the Napoleonic era. If we project this growth rate into the future, the problem of climate change means worrying about the well-being of people who in 200 years will benefit of a Gross Domestic Product per Capita (GDP/Capita) 5000 times higher than ours. From that angle, fighting against climate change is like asking homeless people to make sacrifices to enrich Bill Gates! Let us suppose that we collectively agree to sacrifice 4€ from a rich person to give one euro to a person with half as much money, then a rate of2% economic growth/year justifies a 4% discount rate.

However, there is not much sense in basing a principle of valuation and decision for future generations on the assumption of guaranteed, unlimited growth. Per nature, growth is a volatile phenomenon. Throughout the ages societies have been faced with shocks, sometimes quite violent and long-lasting, which have deeply affected the course of their history. The harbingers of inevitable decline evoke the disappearance of non-renewable resources (especially the fossil energies), the end of scientific discoveries, major health crises, and so on. Optimists defend the idea of development supported in a permanent way by the conquest of space or by technological and scientific innovations, in particular in the sectors of green energies, information technologies, biotechnologies and genetics. In any case, using the certainty of a brilliant future as a reason to ignore distant future considerations while taking present decisions with a 4 % discount rate is not acceptable. It is necessary to take into account the fact that the present and future generations are careful, meaning that they will be inclined to save more money as their future becomes more uncertain. Collectively, this is reflected in a reduction in the discount rate. The use of the Ramsey formula (1928) extrapolated to cover future uncertainty indicates that this effect of precaution reduces the discount rate by 3 times the square of volatility of the consumption growth rate. Since over the past century we have observed a 4% volatility, this reduces the discount rate by 0.5%. This method recommends a 3.5% rate. In figure 1, I ran these calculations for 190 countries using their growth data over the period 1970-2010. The average discount rate is equal to 2.54%, but the dispersion around this average is significant, with a 3.93 % standard deviation. Practically, two thirds of the discount rates are in the range 0 to 6 %.

Figure 1: Frequency table of discount rate in 190 countries using the Ramsey formula extrapolated to estimate the trend and volatility of the growth of GDP/capita over the 1969-2010 period.



We may apply this extended Ramsey formula to any temporal horizon to determine the discount rate of the corresponding flow. Intuitively, the wealth effect justifies a constant discount rate if the growth trend is constant, the exponential consumption growth justifying an exponential diminution of the present value of a future profit. We may show that the precaution effect also justifies a constant discount rate if the growth rate follows a random curve. So, in the case of a GDP/Capita growth process using a Geometric Brownian[1] Motion, the term structure of the discount rate is flat.

[1] A Brownian movement can be interpreted as a continuation of immediate shocks normally distributed, without serial correlation, thus totally unpredictable.

Weitzman (2007) and Gollier (2008) suggest acknowledging that our beliefs on growth, in the centuries to come, cannot be modelled by a geometric Brownian motion. After all, if we take the last three millennia, the average annual growth rate was infinitely lower than the 1.5 to 2% which acts as a reference to justify a 3 to 4% discount per year. I think it reasonable to include, in the economic growth modelling, a possibility of a sudden return to a low growth trend, in the same vein as the sudden change caused by the industrial revolution, a little more than two centuries ago. In the same way, growth undergoes shocks which can be persistent. A technological innovation generates an increase in growth which spreads out over numerous years, often decades. It generates stochastic dynamics involving cycles and periods where things "return to normal". The persistence of economic shocks implies a more rapid accumulation of uncertainties with regard to the future. This implies that the Brownian assumption leads to an under-estimation of the precaution effect for the long term, and so, to an over-estimation of the long term rate. In Gollier (2008), I show that some reasonable grading of growth dynamics integrating these persistent shocks allows us to maintain the discount rate at around 3.5% in the short term, but also to apply a discount rate of around 1% for more long-term forecasts.

Conclusion

Do we do enough for the generations to come? This question is of huge significance, but the current crisis means we are constantly worried about the immediate present. It threatens the (sometimes very extensive) funding provided by numerous rich countries for the development of green energies, but also education and agricultural policy, for example. As I have explained, if we believe in the perpetuity of the economic growth rate at around 2 % in the years to come, it is reasonable to use a rate around 3 % to 4 % to rate the projects without risk in the corresponding forecast periods. I have also attempted to demonstrate that there are strong arguments for using a lower discount rate - reduced to 1% - for much more distant predictions, considering the importance of the uncertainties which surround the economic environment of these remote generations. Not that this was the initial goal of our research, but this recommendation should help to reconcile the theorists of sustainable development to economic science, its method and its tools.

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For further information

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