Concessional lending and SDGs: dealing with social and environmental externalities in imperfect markets[1]

Massimo Cingolani (*)

(*) The author works at the European Investment Bank. Opinions expressed are personal.

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[1] Second draft dated 08.09.2019, please do not quote without permission.

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Summary:

The paper discusses the issue of concessionality lending to the private sector to achieve the SDGs in a context where markets are imperfect, and rates of returns are not equalized across regions, sectors or assets.

In this context, a simple way to consider the sharing of the necessary incentives across a range of potentially very different public institutions with different policy mandates and structures is suggested.

Introduction

The Stern report (2006), summarized in Stern (2008), reviewed the scientific information available on climate change in a logic of socio-economic cost and benefits and argued in favour of an international coordination for fighting climate change. Taking a prudent stance and with all precautions, the report pleaded that, compared to a Business As Usual (BAU) scenario, it is reasonable to expect that, at a cost of some 1% of world GDP, one could avoid likely damages well in excess of 10% of GDP (Stern 2008, p. 21). Later, Stern (2015a p. 5) estimated that the cost of fighting against climate change would probably be "no more than 2% of global GDP" until 2050 (see also Stern, 2015b, p. 75)[3].

More recently the attention of the international community was drawn on the Sustainable Development Goals, a concept that includes "climate action" as its goal n. 13.

The 17 overarching Sustainable Development Goals are part of the UN 2030 Agenda for Sustainable Development defined in Addis Ababa (UN 2015), further adopted by world leaders in 2015 and entered into force on 1st January 2016.

Figure 1 below shows that the 17 goals cover: i) no poverty; ii) zero hunger; iii) good health and well-being; iv) quality education; v) gender equality; vi) clean water and sanitation; vii) affordable and clean energy; viii) decent work and economic growth; ix) industry innovation and infrastructure; x) reduced inequalities; xi) sustainable cities and communities; xii) responsible consumption and production; xiii) climate action; xiv) life below water; xv) Life and Land; xvi) peace justice and strong institutions; xvii) partnerships for the goals. The 17 goals are broken down into some 169 targets and 230 indicators.

[2] Second draft dated 07.09.2019, please do not quote without permission.

[3] As noted in Florio (2014 p. 184) the assumptions retained by the Stern report (2006) imply a relatively low social discount rate of 1.4% in real terms, which tends to give a relatively higher weight to a climate catastrophe in the distant future. However, at times of negative interest rates, one could argue that "market impatience" has gone down, although interest rates are in fact policy determined.

Table 1: the 17 SDGs

The estimates of the investment costs of achieving the Social Development Goals are higher than those for climate change only, as the latter are included in them. Various estimates of investment costs are reviewed in section 1 below. In the second section, the fact that there are different long-term rates of return for capital and for financial variables is discussed in terms of its implications for assessing the amount of support necessary to achieve a certain level of environmental investment. Finally, in the last section, a simple proposal is made for agreeing upon and sharing the necessary incentives to promote climate change across a range of potentially very different public institutions with different policy mandates and structures based for a given investment project.

1. SDGs and their estimated costs

Different figures are quoted in the relevant literature concerning the investment needs related to the realisation of the SDGs

1.1 UNCTAD (2014)

In 2014 the UN estimated that at world global level, total investment needs for the realization of the SDGs are of the order of $5 to $7 trillion per year. Of these, total investment needs in developing countries in key SDG sectors are estimated at $3.3 to $4.5 trillion per year over the proposed SDG delivery period up to 2030, with a midpoint at $3.9 trillion (UNCTAD 2014, p. 140 and table 2 below). Current investment in these sectors in

developing countries is around $1.4 trillion per year, implying an annual investment gap of between $1.9 and $3.1 trillion, with a midpoint at USD 2.5 bn.

Table 2: Table 4.2 of UNCTAD (2014): Investment needs and private sector coverage

Table IV.2. Current investment, investment needs and gaps and private sector participation in key SDG sectors in developing countries[a]

Sector	Description	Estimated current investment (latest available year) $ billion	2015-2030 Total investment required (Annualized $ billion (constant price))	2015-2030 Investment Gap (Annualized $ billion (constant price))	Average private sector participation in current investment[b] Developing countries (Per cent)	Average private sector participation in current investment[b] Developed countries (Per cent)
		A	B	C = B - A		
Power[c]	Investment in generation, transmission and distribution of electricity	~260	630–950	370–690	40–50	80–100
Transport[c]	Investment in roads, airports, ports and rail	~300	350–770	50–470	30–40	60–80
Telecommunications[c]	Investment in infrastructure (fixed lines, mobile and internet)	~160	230–400	70–240	40–80	60–100
Water and sanitation[c]	Provision of water and sanitation to industry and households	~150	~410	~260	0–20	20–80
Food security and agriculture	Investment in agriculture, research, rural development, safety nets, etc.	~220	~480	~260	~75	~90
Climate change mitigation	Investment in relevant infrastructure, renewable energy generation, research and deployment of climate-friendly technologies, etc.	170	550–850	380–680	~40	~90
Climate change adaptation	Investment to cope with impact of climate change in agriculture, infrastructure, water management, coastal zones, etc.	~20	80–120	60–100	0–20	0–20
Eco-systems/ biodiversity	Investment in conservation and safeguarding ecosystems, marine resource management, sustainable forestry, etc.		70–210[d]			
Health	Infrastructural investment, e.g. new hospitals	~70	~210	~140	~20	~40
Education	Infrastructural investment, e.g. new schools	~80	~330	~250	~15	0–20

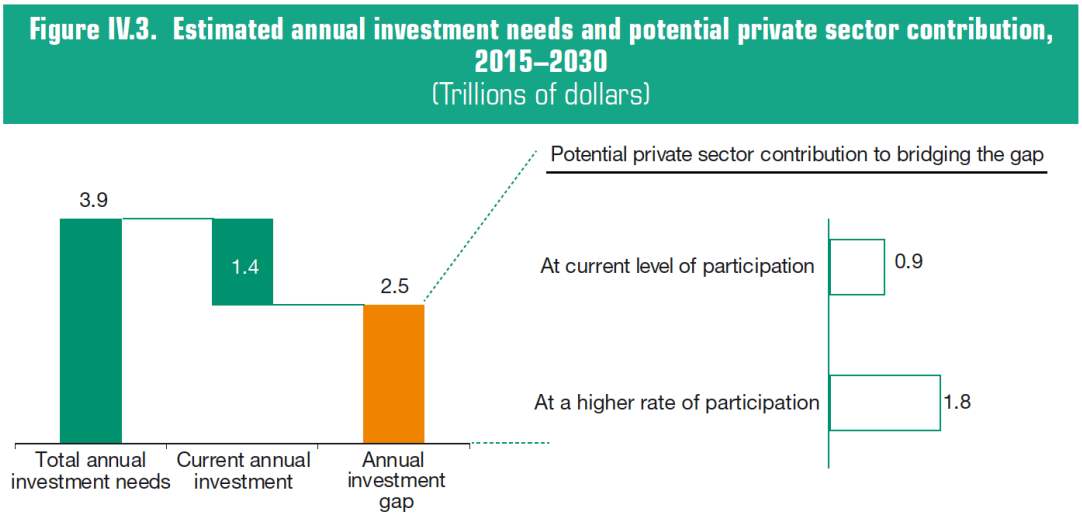
Source: UNCTAD.

[a] Investment refers to capital expenditure. Operating expenditure, though sometimes referred to as 'investment' is not included. The main sources used, in addition to those in box IV.2, include, by sector:
Infrastructure: ABDI (2009); Australia, Bureau of Infrastructure, Transport and Regional Economics (2012); Banerjee (2006); Bhattacharyay (2012); Australia, Reserve Bank (2013); Doshi et al. (2007); Calderon and Serven (2010); Cato Institute (2013); US Congress (2008); Copeland and Tiemann (2010); Edwards (2013); EPSU (2012); Estache (2010); ETNO (2013); Foster and Briceno-Garmendia (2010); Goldman Sachs (2013); G-30 (2013); Gunatilake and Carangal-San Jose (2008); Hall and Lobina (2010); UK H.M. Treasury (2011, 2013); Inderst (2013); Indonesia, Ministry of National Development Planning (2011); Izaguirre and Kulkarni (2011); Lloyd-Owen (2009); McKinsey (2011b); Perrotti and Sánchez (2011); Pezon (2009); Pisu (2010); India, Planning Commission (2011, 2012); Rhodes (2013); Rodriguez et al. (2012); Wagenvoort et al. (2010); World Bank (2013a) and Yepes (2008);
Climate Change: AfDB et al. (2012); Buchner et al. (2011, 2012) and Helm et al.(2010).
Social sectors: Baker (2010); High Level Task Force on Innovative International Financing for Health Systems (2009); Institute for Health Metrics and Evaluation (2010, 2012); Leading Group on Innovative Financing to Fund Development (2010); McCoy et al. (2009); The Lancet (2011, 2013); WHO (2012) and UNESCO (2012, 2013).
[b] The private sector share for each sector shows large variability between countries.
[c] Excluding investment required for climate change, which is included in the totals for climate change mitigation and adaptation.
[d] Investment requirements in ecosystems/biodiversity are not included in the totals used in the analysis in this section, as they overlap with other sectors.

Source: UNCTAD (2014, p. 142)

Figure 1 below shows the calculation of the investment gap retained by UNCTAD as the mid-point for developing countries, i.e. the figure of USD 2.5 trillion per year.

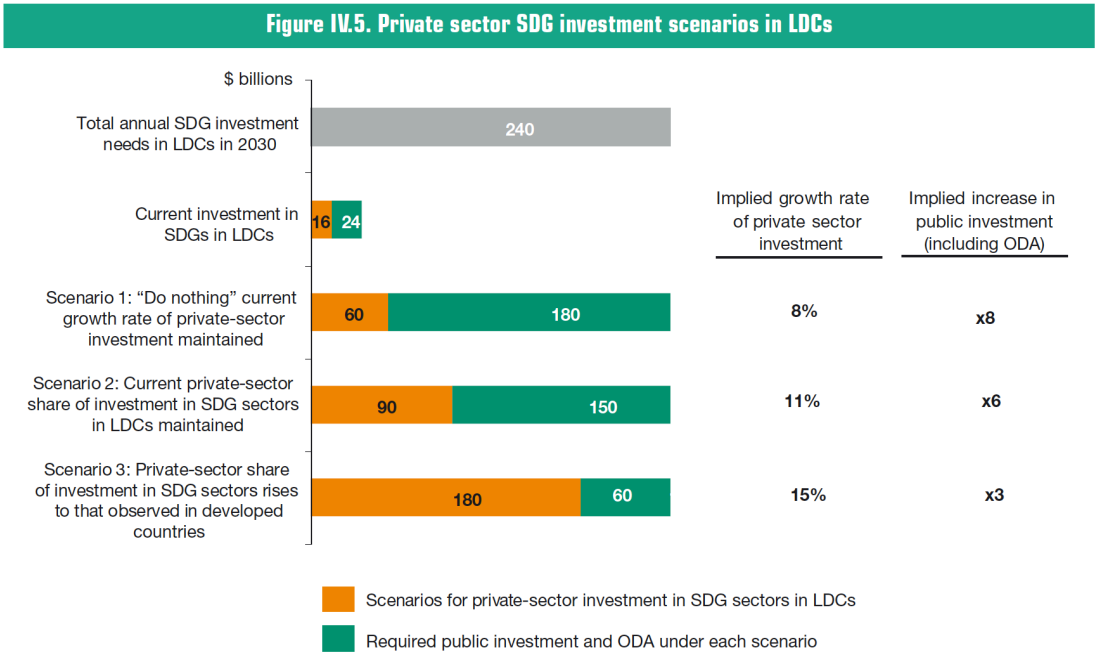
Figure 1: Investment gap for SDGs in developing countries



Source: UNCTAD (2014) p. 145

In the Less Developed Countries, which are the poorest group of developing countries, UNCTAD estimates that the gap in investment for SDGs is of the order of USD 200 bn per year, to be compared to current level of investment of the order of 40 bn USD.

Figure 2: Investment gap for Less Developed Countries



Source: UNCTAD (20014) p. 147

In a "do nothing scenario", i.e. assuming a growth of 8% per year of private investment, most of this gap, or USD 180 bn per year, would have to be covered by public investment and Official Development Aid (ODA), implying a multiplication of current public support flows by 8. In an intermediate scenario, where the private sector would support a "proportional" share of SDG investment of 40% (equal to the share of LDC in SGD total investment) the growth of private sector of investment should run at 11% per year and the balancing gap to be supported by public investment and ODA would be EUR 150 bn, or 6 times the current level. Finally, in a positive scenario in which the private sector share of investment in SDG would reach 75%, i.e. a level similar to the developed countries, it would grow at an annual rate of 15%. In this case the balance to be covered by public investment and ODA would be EUR 60 bn per year, still 3 times the current level. UNCTAD concludes that: "Public sector funds, and especially ODA, will therefore remain important for SDG investments in LDCs, including for leveraging further private sector participation." (p. 147).

1.2 *Sustainable Development Solutions Network (SDSN* 2015)

Also Schmitt-Traub (2015) attempted to quantify the investment implications of the SDGs. He translated the 17 SDGs into eight "SDG investment areas" which are: (1) health, (2) education, (3) social protection, (4) food security and sustainable agriculture, (5) infrastructure – including (a) energy access and low-carbon energy infrastructure, (b) water and sanitation, (c) transport infrastructure, and (d) telecommunications infrastructure – (6) ecosystem services and biodiversity, (7) data for the SDGs, and (8) emergency response and humanitarian work. He found that low- and lower-middle-income countries may need to increase public and private expenditure by some $\$_{2013}$ 1.4 trillion per year ($343-360 billion for LICs and $900-944 billion for LMICs) in order to reach the SDGs. Contrary to the millennium goals that shaped the development agenda in the period 2000-15, the SDG concern not only the development world but also developed countries. The Schmitt-Traub's study considers that at global level 1.5-2.5% of world GDP may be required to finance the achievement of the SDGs in all countries. With world GDP at USD 84,740.3 bn in 2018 (IMF database online), the realization of the SDGs would require some additional USD 1,271 bn – US 2,119 bn at 2018 prices if there was no growth of income. Schmidt-Traub actually made the calculation taking assumptions on the growth of income during the period of application of the SDGs, which is 2015-30. Taking an average world GDP for the period of 103,288 bn USD_{2013} he calculated a need to invest additional USD 2.2-2.5 trillion USD_{2013} per year over the period 2015-2030.

Table 3: Investment needs for SDGs: SDSN (2015)

Incremental investment needs as a percentage of world GDP (at market exchange rates and PPP), by income group						
Country groups	Incremental investment needs ($2013 billion)		Incremental investment needs (% of world GDP)		Incremental investment needs (% of world GDP, PPP)	
	low	high	low	high	low	high
LICs	343	360	0.3%	0.3%	0.2%	0.2%
LMICs	900	944	0.9%	0.9%	0.6%	0.6%
LICs+LMICs	1 251	1 327	1.2%	1.3%	0.8%	0.9%
World	2 261	2 562	2.2%	2.5%	1.5%	1.7%

Source: Schmitt-Traub (2015, p.)

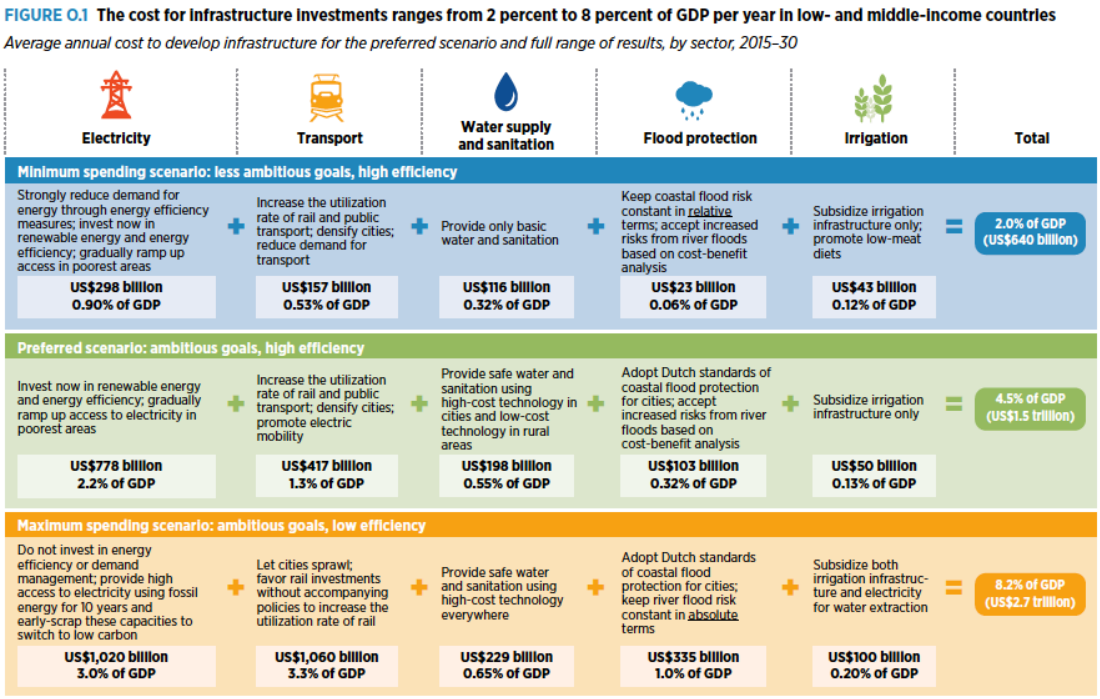
As mentioned, for what concerns the investment to be realized in the LICs+LMICs, the figures are in the range 1.2-1.3 trillion per year, of which some 39-45% (or 525-560 bn)

could come from the private sector. The public sector would provide the balance, i.e. some 726-767 billion USD per year.

1.3 World Bank (2019)

Finally, recently the World Bank estimated that: "[…] new infrastructure related to the achievement of SDGs could cost low- and middle-income countries (LMICs) anywhere between 2 percent and 8 percent of gross domestic product (GDP) per year to 2030, depending on the quality and quantity of service targeted and the spending efficiency achieved in reaching this goal. […] With the right policies, investments of 4.5 percent of GDP will enable LMICs to achieve the infrastructure-related Sustainable Development Goals and stay on track to limit climate change to 2°C." (Rozenberg &, 2019 pp. xiii-ivx).

Figure 3: Estimates investment needs: World Bank (2019)



Source: Rozenberg & Fay (2009)

1.4 Conclusion

According to the IMF, world GDP was of the order of 80 trillion USD in 2017, hence a figure in the range of 1.6 trillion dollars per year, corresponding to 2% of World GDP can be retained as a lower bound for the cost of fighting climate change in absolute terms. Under the middle of the way scenario this figure could increase to 3.6 trillion per year and would get to 6.4 trillion in the most favourable scenario for the fast realisation of the SDGs.

Most of this investment, up to 80% would have to be realised by the private sector, which would therefore have to scale up its investments substantially, for instance doubling in LDC from USD 900 m per year to USD 1.8 bn per year according to UNCTAD.

2. The required level of concessionality to the private sector when markets are imperfect

"Concessionality" could be defined as the public support element in an investment of the private sector, a concept that is generally measured by so-called grant equivalent. But if concessionality measurement should exploit market evidence, it should also take due account that markets are imperfect and inefficient and that, notably, the law of one price does not hold. Hence there is no single and objective benchmark against which one could firmly establish the calculation of the concessionality element. In the absence of an absolute single reference, such as that would be provided by (given) market prices in a situation of perfect competition, the assessment of concessionality cannot but be related to the policy objective pursued. This approach would give something reasonably close to an objective meaning to the otherwise arbitrary expression "minimizing concessionality" and suggests implementable ways to calculate it meaningfully.

Before discussing such a framework in the next section, the evidence that markets are imperfect and thus "inefficient" because they fail to bring to a single rate of return could be briefly discussed. In a perfect market with no barriers to entry, free entry would guarantee that a single rate of return would prevail, adjusted for risk, as capital would move from low return activities to high return ones. Different ways, equally imperfect, have been devised to translate the theoretical concept of "convergence to a single rate of return in the capital markets" into empirically testable propositions. Despite empirical difficulties, it does not seem that long-run time series support the view that this convergence occurs. Without entering into a technical debate[4], one can check quickly by looking at the long-term time price series available for the UK for various assets. These allow to compare the long-term evolution of some key financial indexes during the last decades and thus get a feeling for the kind of magnitudes involved. Figure 4 below shows that, between 1980 and 2016, total financial assets of UK financial intermediaries were multiplied by a factor of 47[5]. This corresponds to a rate of growth of 11% per year.

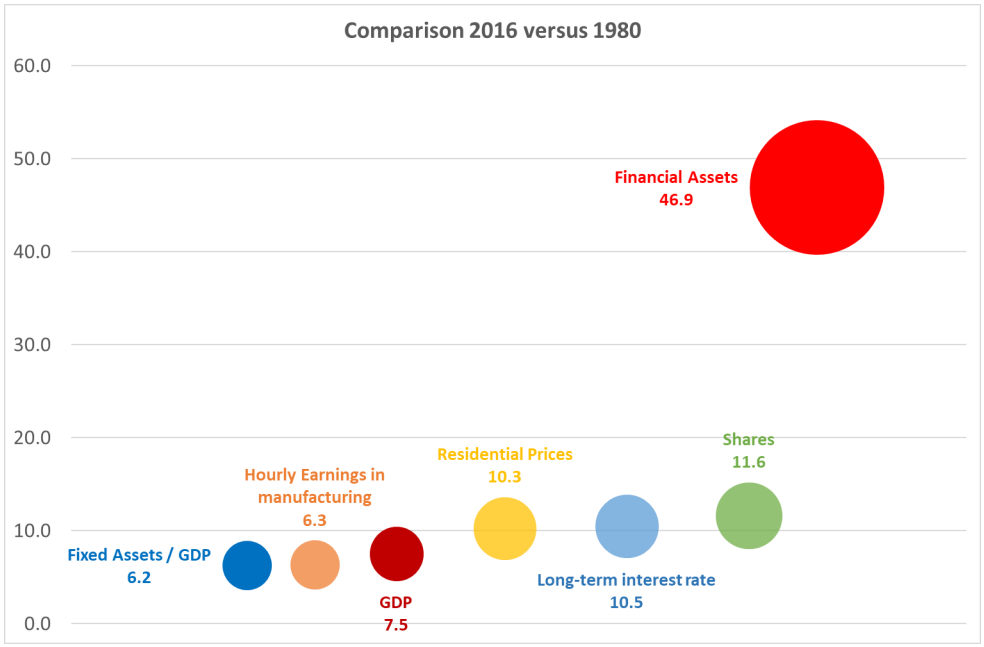
During the same period, an index of UK shares was multiplied by 12, implying an increase of 7% per year on average. An index of the long-term interest rate on Government bonds has increased 10.5 times (6.7% per year). Residential prices have been multiplied by 10.3 (6.7% p.a.), nominal GDP by 7.5 (5.7%), hourly earnings in manufacturing by 6.3 (5.2% p.a.) and fixed assets over GDP by 6.2 (5.1%). Since all these indicators are measured in current UK pounds, they are indicators of the "relative own rate of interest" of the assets they represent compared to the own rate of interest of the UK pound. Save for the measurement units, they thus represent the relative gross profitability of the relevant assets or flows

[4] For evidence in the corporate sector one can quote Mueller (1986) and (1990), references for which the author is indebted to Fabio Petri. In the case of financial assets, the problem is complicated by the difficulty to assess the social discount rate and the fact that the assessment of risks is necessarily subjective and it is far from guaranteed that subjective risk assessments converge. However, if as shown by Mueller, the "monopoly power" of supply in extracting higher returns in the long-term is documented for the corporate sector, there is no reason to think that in the financial markets the "monopoly power" (or price manipulation capacity) of supply should be lower. In other words, the "market evaluation of risk" could divert from the actuarial neutral one and not only for reasons of asymmetric risk-aversion between the parties to the transaction.

[5] Figures are in nominal terms, but to the extent that to get them in real terms one would use the same deflator (say GDP deflator) this does not affect the comparison between indicators, which include also nominal GDP.

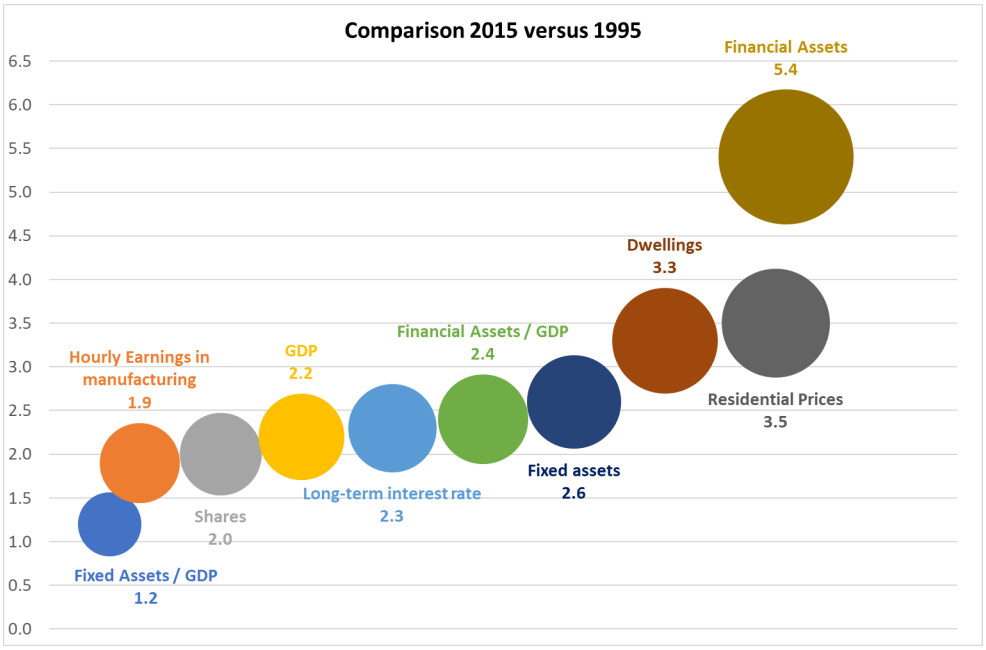
(inclusive of inflation, which should be the same for all assets). One cannot but observe that these gross profitabilities are different for different classes of assets.

Figure 4: Ratio of the value of some assets in the UK compared between 2016 and 1980



Taking a shorter time span, for the period 1995-2015, one sees that financial assets were multiplied by 5.4, residential prices by 3.5, the price of dwellings by 3.3, fixed assets have been multiplied by 2.6, financial assets over GDP by 2.4, long-term interest rate by 2.3, GDP by 2.2, shares by 2, hourly earnings in manufacturing by 1.9 and fixed assets over GDP by 1.2.

Figure 5: Ratio of the value of some assets in the UK compared between 2015 and 1995



Overall these figures imply that the dynamic of the “real economy” activities captured by GDP, investment and wages, which corresponds to the real wealth creation that is distributed to the factors of production, has been slower than that of the financial variables included as assets of the UK financial intermediaries. In short the price dynamics of income related variables is of the order of half of those of financial activities[6].

The convergence to a single rate of return is a way to define a competitive market that is common to both the classical and neo-classical traditions. For the former one can quote Kurz & Salvadori (2003, ch. 1), while for the latter a classic reference is Malinvaud (1966). When there is no equalisation between the rates of return of different assets, the “no arbitrage assumptions”, which is one of the building blocks of market efficiency hypothesis, appears difficult to retain. There is therefore no single benchmark reference price but several different prices reflecting market power and other factors. This simple empirical argument can be complemented by other more theoretical arguments, some of which are reviewed in Annex 2.

In Stern 2008 (p. 13), the economics of climate change are clearly set in a “non-perfect competition” conceptual framework, where:

Private Discount Rate (PDR) ≠ Social Discount Rate (SDR) ≠
≠Social Return on Investment (SRI) ≠Private Return on Investment (PRI)

i.e. in a situation where there are pervasive externalities, which is distant from a competitive equilibrium, where all these rates would converge to a common value.

Most of the subsequent policy recommendations in the field of climate change and SDGs, assume explicitly or implicitly that the economy in which one fights against climate change is not a perfectly competitive one, starting from Stern (2015b). They conclude however that, thanks to appropriate policies and regulations, the investment to achieve climate change objectives and SDGs can be realized mainly by the private sector. This means that it is assumed that, thanks to regulation and other policy measures, market prices would converge towards normative “desired” carbon prices and could thus direct the private sector in the achievement climate change objectives without additional incentives.

However, it is not realistic to assume that the "other policy conditions” will quickly enforce equality between effective and normative prices in implementing the climate change policies and SDGs. One should take into account that, by definition, reality departs substantially from “Pareto optimality”. Precisely because the starting situation when dealing with climate change and SDGs is one where PDR ≠ SDR ≠SRI ≠PRI, if no additional incentive is provided, the only signal for private investment will be given by market prices, which do not embed any convergence towards common rates of return. In other words, the least cost technology that the market would spontaneously adopt in maximising profits would not be consistent with the achievement of SDGs.

[6] Similar developments could be documented for the other large industrial countries.

It thus appears obvious that some incentives will be needed in order to push the private sector to realize the investment that until now it has not realized and that, under the most reasonable expectations, it will not realise in the so-called BAU scenario.

Depending on the level of concessionality that is necessary to incentivize the private sector in case the market profitability of SDG projects is insufficient, a certain portion of this investment would need to be supported by public budgets. Let's retain conservatively the figure of USD 2.5 trillion for total investment needs related to SDGs for LDCs at world level and assume 80% is to be financed by the private sector. Then this corresponds to 2 trillion additional investment per year. Say, for the sake of the argument, just to fix ideas on the magnitudes involved, that one retains the totally arbitrary assumption that the incentive sufficient to mobilise such investment is equivalent to a 2% enhancement in the required rate of return in grant equivalent terms[7], this means that some 2%*2 trillion = 40 billion USD per year of subsidies equivalents should be distributed and channeled to the right private sector projects at world level, something which will require substantial coordination efforts by the international donor community, be they financed through carbon tax or by other means.

For the purpose of the definition of concessionality, the recognition that markets are imperfect and inefficient thus implies that the law of single price does not hold and that there cannot be a single market benchmark valid for all borrowers and projects. Hence the framework of reference must define in a way as objective as possible the different prices obtained by different borrowers, so at to tackle what is an objective subjectivity. In the following paragraph a framework is proposed to reason about the level of concessionality to be planned for allocation by the public authorities of the world, potentially with the support of public banks, to achieve the targets of private investment for climate change.

3. Defining concessionality when the law of one price does not hold

If one looks at the work of a non-monetary financial intermediary with development or investment objectives (IFIs) as that of putting in relation supply of lending or finance and demand of capital for investment, the intermediation of the IFIs consists in getting funds from the market to lend them to investors. Let's call the financial rate of return required by the capital supplier as r_S. Let's call the financial rate or return that the investors require to realize a capital investment as r*[8]. On the basis of r*, the investor is ready to pay r_D to the supplier of funds. A project i where:

$$r_i^* \geq r_{iD} \geq r_{iS}$$

can be financed directly by the market without intermediation of an IFI. An IFI can intervene when:

[7] Experience suggest that the required incentive could go as far as 50% in some cases.

[8] To simplify, the argument is developed in terms of returns on assets. Obviously it applies to a defined project and borrower/investor, but it is not inconsistent with and could be a step in a roadmap approach to SDG such as that proposed by Miedzinski, Mazzucato & Ekins (2019).

$$r_i^* > r_{iD} \leq r_{iS}$$

if it can collect finance at a rate r_{IFIc} such that the remuneration for the supplier of capital must be competitive with respect to his or her alternatives:

$$r^* \geq r_{IFIc} \geq r_{iS}$$

and it can lend it to the investor at a rate r_{IFIf} that allows him to obtain his target rate of return:

$$r_{iS} \leq r_{IFIf} \leq r_{iD} \leq r^*$$

where $r_{IFIf} = r_{IFIc} + Markup_{IFI}$. Therefore:

$$r_{iS} \leq r_{IFIc} + Markup_{IFI} \leq r_{iD} \leq r^*$$

where: $r_{IFIc} = r_{iS} + Markup_{iS}$, which assumes that the IFI pays a premium noted $Markup_{iS} \geq 0$ to attract the supplier of capital.

In a logic of "going from billions to trillions" and of Sustainable Development Goals, one may assume that there is a large number of climate change projects or other social and development projects that have financial returns providing a remuneration below that of the alternative investments available to the private sector. As shown in the previous section above, real activities have generated returns below those of financial investments. Moreover, within real activities, it is well known that in the absence of government intervention, environmental investments have generally lower financial returns than other activities. One may assume that they have a financial return of the order of one fourth of that of other investments. This is for instance confirmed by the experience of all IFIs with public sector projects, whereby Governments prefer to invest in motorways rather than in environmental (water) projects because this is financially more interesting for them in revenue (tax collection) terms. Similarly, social and development projects, which have an important redistribution element, can be expected to have relatively low levels of financial return.

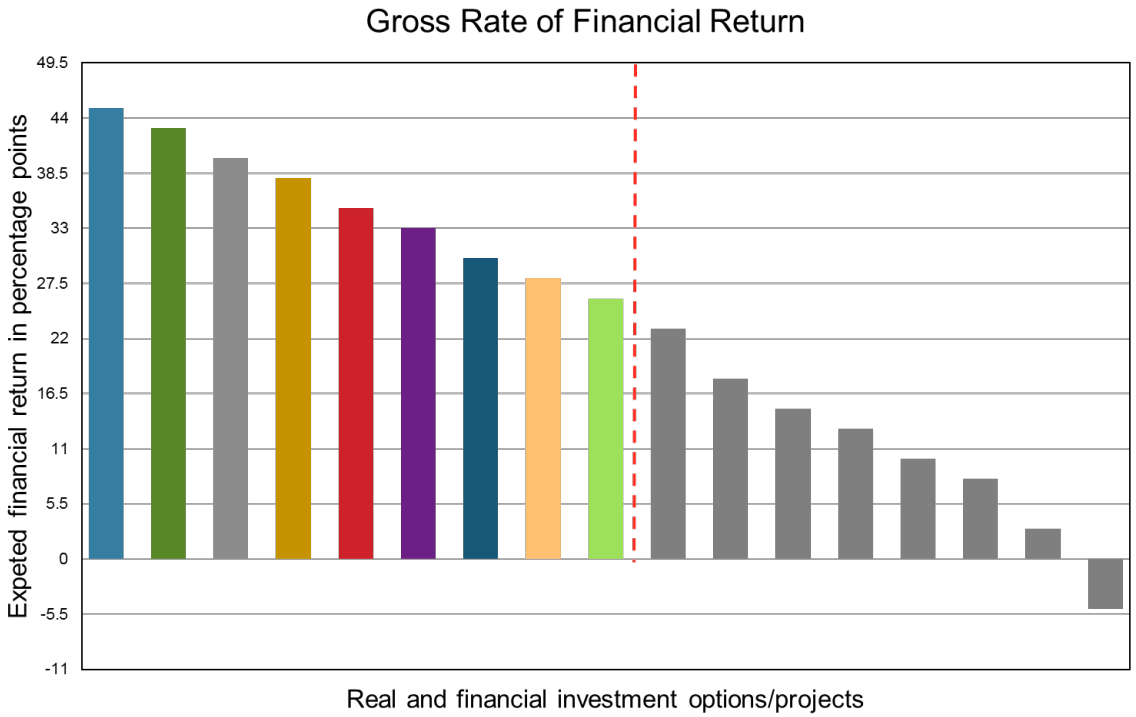
Assume that it is possible to rank all investment options open to an investor at a certain time and place by decreasing level of financial return in cash terms, as shown in Figure 6 below.

The investor having a certain target rate of return, he/she will invest in all projects and or activities up to its target return, say 25% in the chart. In the chart, activities represented by coloured columns, which have a return above 25%, will be financed by the market, whereas activities coloured in grey will not be financed.

With reference to the previous discussion, one may assume that in reality $r^* \approx 15\%$. In a perfect market, one should have that $r_{iS} = r^* \approx 15\%$ as well, since a condition for maximum

efficiency is that the rate of profit equals the rate of interest[9], but acknowledging that markets are imperfect and (extra-) profits and rents positive, say that r_{iS}=7%. Let's assume an environmental project with a rate of financial return of r_{Ei}= 2%. 0

Figure 6: Hypothetical cash rate of returns of different investments



Then, to obtain its target rate or return the investor must in one way or another obtain an incentive I* such that:

$$r^*=r_{Ei} - r_{IFIf} + I^*= r_{Ei} - r_{IFIc} - Markup_{IFI} + I^*= r_{Ei} - r_{iS} - Markup_{IFI} - Markup_{iS}+ I^*$$

With the previous figures and assuming to simplify that $Markup_{IFI}=Markup_{iS}=0$, one has:

$$15\%=2\%-7\%+I^*$$

hence the "minimum incentive" for the project to take place is I*= 15%-2%+7%=20%.

In this example the incentive is very high and one would like to be sure that it is minimized to all extent possible. One would thus like to define unambiguously what is the element of incentive that is needed to be given to the private sector in order to realize the investment only when the socio-economic benefits of the project r_{SOECi} have otherwise been calculated to exceed the level of the target rate of return r* so that it is sure that the incentive itself is equal or lower than the socio-economic benefit of the project.

$r_{SOECi} > r_i^*= r_{Ei} - r_{iS} - Markup_{IFI} - Markup_{iS}+ I^*$, with $r_{SOEC} \geq I^*$ when $r_{Ei} - r_{iS} - Markup_{IFI} - Markup_{iS} \geq 0$.

[9] This is the essence of the golden rule of capital accumulation, which was originally developed by Desrousseaux and Allais, before Phelps. Strictly speaking, it is only valid making abstraction of technical progress. Pasinetti treated the dynamic case with technical progress.

The best of the economic literature on cost-benefit analysis shows that the socio-economic rate of return must be calculated based on accounting prices that reflect policy objectives (Drèze and Stern, 1987 & 1988; as well as Florio, 2014. See also Guesnerie (1980) for a general formulation in terms of second best)[10]. Then the difference between the socio-economic and the financial rate of return is a first indication of the maximum subsidy element required by the project to achieve its policy targets[11]. When measuring the concessionality element, one should not abstract from this policy objective.

The above calculation depends inevitably on the rate r_{IFIf} at which each IFI provides finance, itself a function of its capital structure, size, portfolio diversification, technology, efficiency and other factors that influence the rate r_{IFIc} at which it can collect funds on the market. Although this rate may differ amongst IFIs[12], it is nonetheless objectively measurable, at least in principle. Also, despite the difficulties and arbitrariness of some of the assumptions required in the estimation of the socio-economic return of the project, one can admit that this rate can be estimated in a convergent manner amongst IFIs, as evidenced by the fact that they often finance the same projects together[13]. Hence, the "objective elements" that can reasonably enter into the calculation of concessionality in situations where market inefficiency prevails are the rates at which IFI lend to investors, themselves a function of the rate at which they can collect funds on the market, as well as the socio-economic rate of return and the financial rates of return of the projects they finance.

Hence it makes sense to suggest as a first approximation that whatever amount of subsidies world governments have to deploy to reach climate change objectives, incentives which could logically be put at the disposal of the IFIs to incentivize private and public sector investment, this should be shared according a key that considers their different cost structure and policy objectives. For instance, it can be stated as a target that external subsidies should allow each IFI to achieve the same percentage reduction in their cost, or other similar arrangements simply to apply.

Indeed, it does not make sense to require that all IFIs should have the same cost structure and Darwinian competition should eliminate the least competitive ones. If a public institution is required to intervene for policy purposes, it is precisely because "competitive" market prices are not maximising social welfare. Each institution having a different policy mandate[14], by definition it would have a different cost structure. If for example an institution, because of its mandate, provides a mix of 50% technical assistance from its own

[10] By acknowledging the prevalence of "second best" situations when markets are inefficient, these formulations do not necessarily fall under the criticism raised by Rudra (1972) against shadow prices. In fact, in the logic of SDGs , shadow prices do not need to reflect an impossible formalised optimisation programme, but can be taken as reference values dictated by policy-makers (*valeurs tutélaires* in the French CBA tradition).

[11] This is essentially the approach followed in DG REGIO's CBA manual (see also Mairate & Angelini, 2007). The argument does not need to be understood as carried out in terms of Pigouvian taxes (Stern), as the financing of the grant falls outside the scope of the present discussion.

[12] There is in principle no reason why, under market inefficiency conditions, in the financial sector "Salter structures" of supply should not prevail as well, i.e. the co-existence of different firms being each on a different cost curve, co-existence that was documented for the English industrial sector in the sixties by Salter and, although rarely acknowledged, should be reasonably thought to prevail in any oligopolistic market.

[13] In fact, it would be sufficient to agree upon a "minimal" level of the socio-economic rate of return of a project, from which the financial rate of return would be subtracted to a higher bound for the concessionality element.

[14] This would imply that each institution would have in fact different shadow or accounting prices for assessing the socio-economic rate of return of its projects. Here it must be assumed that it is possible to agree at interinstitutional level on a set of shadow prices to be used for climate change projects at world level.

costs and 50% financing, it cannot have the same cost structure and pricing as one that provides 10% technical assistance and 90% financing. In addition, the size and the risk composition of the balance sheet of each institution, which also depends on its mandate, obviously condition its cost structure and pricing.

Because each institution has its own cost structure and, apart from possible inefficiencies, should keep it as it derives essentially from its mandate, the discussion on concessionality in the private sector should be based on arguments different from inter-institutional cost comparisons, which are meaningless when abstraction is made of their different mandates.

Conclusion

A fair judgment on the concessionality element of the public financing that covers a certain portion of a private project's (investment) cost, should be based (at least) on the following five parameters:

1. Economic and social return of the project, intended as a synthetic measure of the cash flow stream of the economic and financial flows generated by the project evaluated from a policy perspective (i.e. including externalities).
2. Financial return of the project, intended as a synthetic measure of the cash flow stream of the cash flows generated by the project (so called "financial return").
3. Cost of funding of the borrower or investor, intended as a synthetic measure of the cost at which a borrower can finance its project on the market (if any).
4. Target rate of return of the investor intended as the minimum return that he expect from the project cash flows in order for him to undertake the project.
5. Price at which an IFI provides finance for the project.

Provided that (4) remains reasonable[15], it is only for projects for which (1) exceeds (2) that, (5) could and should be lower than (3) and part of the difference can be covered by public funding. The fact that (5) is different between IFIs should be taken as a fact and be tackled accordingly, for example by giving each IFI the same incentive as a proportion of its costs, or other reasonable mechanisms.

Legend:

r_i* = financial rate or return that the investors require to realize a capital investment i

r_{iD} = financial rate or return that the investor is ready to pay to the supplier of funds

r_{iS} = the financial rate of return required by the capital supplier

r_{IFIc} = the rate at which an IFI collects funds on the market

r_{IFIf} = the rate at which an IFI finances an investor for project i

$Markup_{IFI}$ = "Markup" of the IFI: $r_{IFIf} = r_{IFIc} + Markup_{IFI}$

$Markup_{iS}$ = "Markup" to be paid to the supplier y the IFI: $r_{IFIc} = r_{iS} + Markup_{iS}$

r_{Ei} = rate of financial return of an environmental project

r_{SOECi} = socio-economic rate of return of project i

[15] Its level could be "revealed" through auction mechanisms such as those proposed by Milgrom (2004).

Annex 1: Concessionality assessment as part of the overall appraisal of the project

The proposed approach is a combination of requiring $r_{SOECOi} \geq r_{SOECO}$*, generally different per sector and achieving $r_{IFIfi} \leq$ Cost of funds for borrower i.

It is suggested that the alternative cost of funding for the borrower/investor is the main objective element entering in the assessment of the minimum concessionality and can in principle be calculated separately for the investor, the supplier of funds and the IFI. This cost of funding would be different in principle for each borrower and in developed markets, it can be derived from the price of its debt on the secondary markets, whenever these are sufficiently liquid. In principle, the "market" cost of alternative funds of a borrower could be decomposed into the following elements:

$$r_i = r_0 + r_C + r_S + r_B$$

Where:

$$r_i = alternative\ cost\ of\ funds\ for\ investor\ i$$
$$r_0 = rate\ of\ time\ preference\ or\ base\ rate$$
$$r_C = risk\ premium\ relevant\ to\ space\ (country\ or\ region)$$
$$r_S = risk\ premium\ relating\ to\ sector$$
$$r_B = risk\ premium\ specific\ to\ investor\ i$$

The incentive element g_i could be defined with respect to r_i, which could be estimated based on actual or assumed values for each component. Based on experience, possible ways to define r_i could consider of the following.

The Financial Value Added (FVA) estimates the extent to which the pricing of a loan is below the alternative funding cost of the borrower for a comparable financing.

The FVA can be calculated based on the following methodology:

FVA = Alternative Funding Cost – (Actual Pricing + Structural Adjustments)

The Alternative Funding Cost (AFC) is determined by direct reference to a liquid bond or recently signed loan of the same borrower and for a duration similar to that of a loan.

Alternatively, if such reference instrument does not exist, a bond/loan issued by a comparable entity can be employed as a proxy. A comparable entity ideally should have the same rating, sector and similar size, and the reference funding should be in the same currency as the proposed loan. If the comparable entity meets only some of the mentioned criteria, respective adjustments to the AFC calculation to account for the differences between the borrower and the comparable entity have to be made. In case there is no comparable issuer, the closest applicable generic spread curves as provided by Bloomberg can be used.

In case of capital market references, to limit volatility of results, the latest three-month average of secondary trading levels is to be used (based on mid-price).

Annex 2: Some literature references on market inefficiency

In reality, economic and financial uncertainty goes much beyond insurable risk and is non-ergotic (Davidson 1982-83). Intrinsic uncertainty does not generally allow the coordination of expectations to converge towards rational expectations equilibria, which is de facto a necessary condition for market efficiency (Malinvaud, 1953; Arrow, 1953; Radner, 1972; Guesnerie-Jaffray, 1974; Magill and Quinzii, 2002). When agents learn from the environment, stability of equilibrium can be expected only in good cases (Evans and Honkapohja, 2001; Guesnerie). In general, the stability of general economic equilibrium, which is the *pendant* of the no-arbitrage assumption, is not guaranteed (Sonnenschein-Mantel-Debreu –SMD- theorem: Shafer & Sonnenschein, 1987). Empirically, these theoretical results are confirmed by the various "market anomalies" detected in the literature (Keim) such as the equity premium (Mehra and Prescott, 1985) and the excess volatility puzzle (Shiller, 2003; LeRoy, 2008). Some top mathematicians and statisticians look with condescendence at the applicability of Brownian motion and Markov processes to the analysis of risk in finance (Mandelbrot and Hudson, 2004; Wiener, quoted by Bouleau, 2013). From the viewpoint of the development of mathematics in the second half of the XXth century, they thus don't believe in the practical applicability of a theory that still remains the core of modern finance and which was proposed at the very beginning of the century by Bachelier in his doctoral thesis, supervised at the time by Poincaré. Finally, one can note that if markets were efficient, the 2008 financial crisis would not have occurred (nor the 1987 crash, cf. Mandelbrot and Hudson, 2004). For a recent contribution in the ecological literature proposing a macro-financial approach to deal with market imperfections see Stolbova, Monasterolo & Battiston (2018), this would be complementary to the more micro-economic proposed here at project level.

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