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Measuring sustainability and well-being

INCLUSIVE WEALTH REPORT 2018

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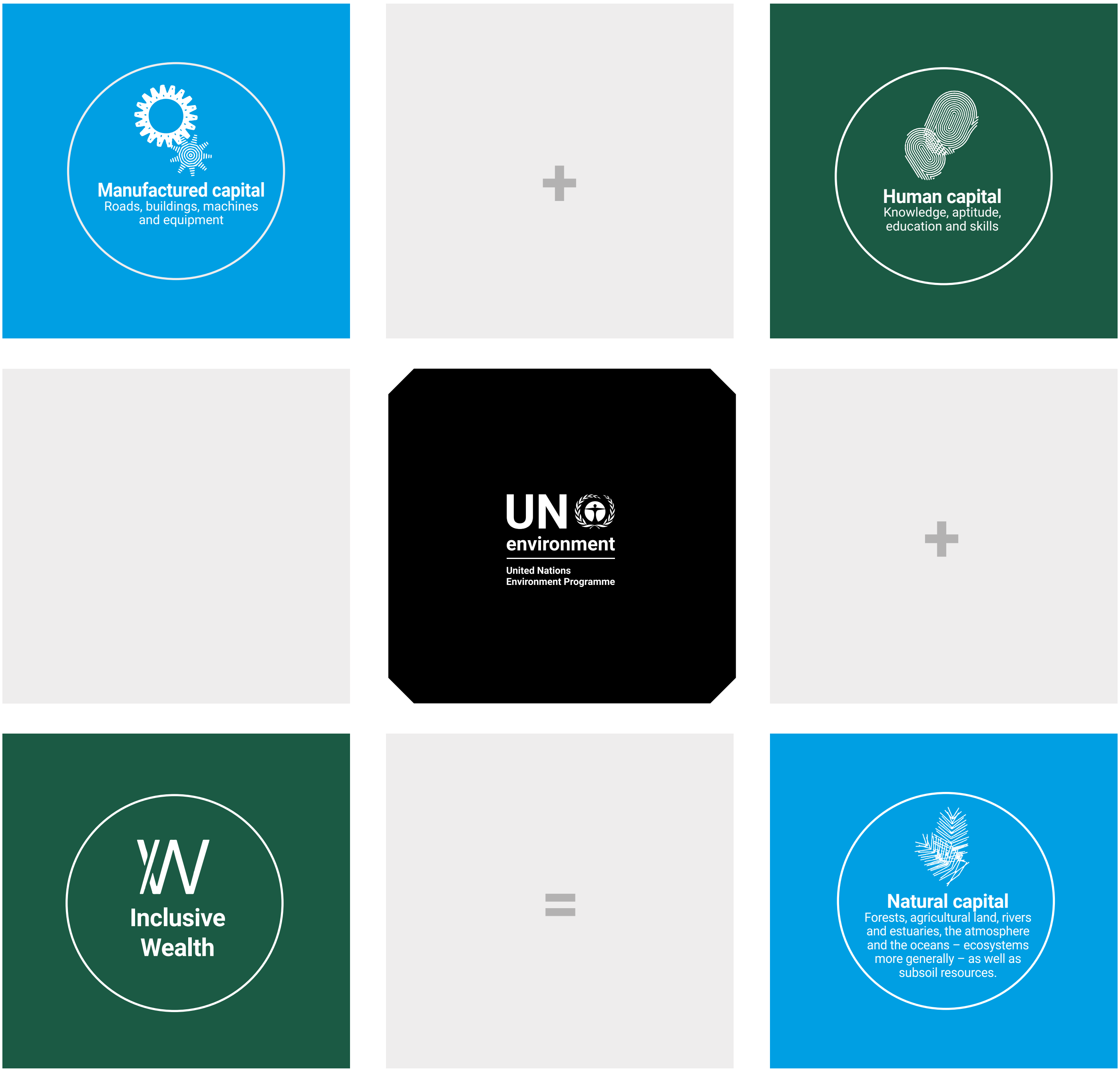
WHAT IS INCLUSIVE WEALTH?

The Inclusive Wealth Report (IWR) is a biennial effort led by UN Environment to evaluate national capacities and performance in terms of measuring economic sustainability and well-being. Existing national statistical systems use Systems of Environmental and Economic Accounts, which are geared towards measuring the flow of income. These flows critically depend upon the health and resilience of capital assets like manufactured capital, human capital and natural capital.



CHAPTER 7: THE IWR AND POLICY LESSONS

Shunsuke Managi

7.1. Introduction

The purpose of genuine savings and IW clearly lies in sustainability analysis. The analysis can indicate whether the national productive base is on the increase or decrease, in accordance with intergenerational well-being. As such, proceeding from sustainability analysis to policy implication is not straightforward. Specifically, even if the shadow price of a given asset is known to be high, it does not necessarily mean the given asset should be the focus of investment. A cost-benefit analysis, using the same set of shadow prices, should be performed to determine what kind of policy should be the means to increase social well-being (Dasgupta, 2009).

However, inclusive wealth figures on their own are not silent about policy implications. For example, if a particular component class of IW is on a rapid decline within a relatively short period of time, the necessity for policy intervention should be reflected, perhaps even in the absence of cost-benefit analysis.

In this chapter, we first discuss those implications that may arise from certain classes of capital assets. Investing in human capital, which has not been the focus of previous chapters, is important, but the questions remain regarding how and to what extent this investment should be made. As our previous edition (UNU-IHDP and UNEP, 2014) elaborated, there are many critical aspects not captured by the current exercise of human capital measurement. Health status of mothers, early childhood education, home environment, vocational training, and non-cognitive development are all examples of these aspects. Among others, we highlight vocational training and child labour.

We also examine fishery resources, which is another area of contentious debate in natural capital management. Globally, it is a growing industry that is under threat from overfishing, but there are many positive sides to the industry, such as aquaculture and recent experiences of sustainable fishery and green labelling.

We next address an important area of negative capital stock, which is not previously addressed in inclusive wealth accounting (aside from carbon damage). As long as a capital-like source of pollution causes direct disutility or damage to capital stock (health capital), this source should be one of the capital assets relevant to social well-being. The World Bank has plausibly included particulate matter emission in their account of genuine savings, which we will review in our context.

Certain policy implications can also be derived for investing in technological advancements. TFP measures all the residual contributions to social well-being, after accounting for all the relevant capital assets (Arrow *et al*., 2012). It is known to affect the bottom line figure of IWI adjusted (UNU-IHDP and UNEP, 2014).

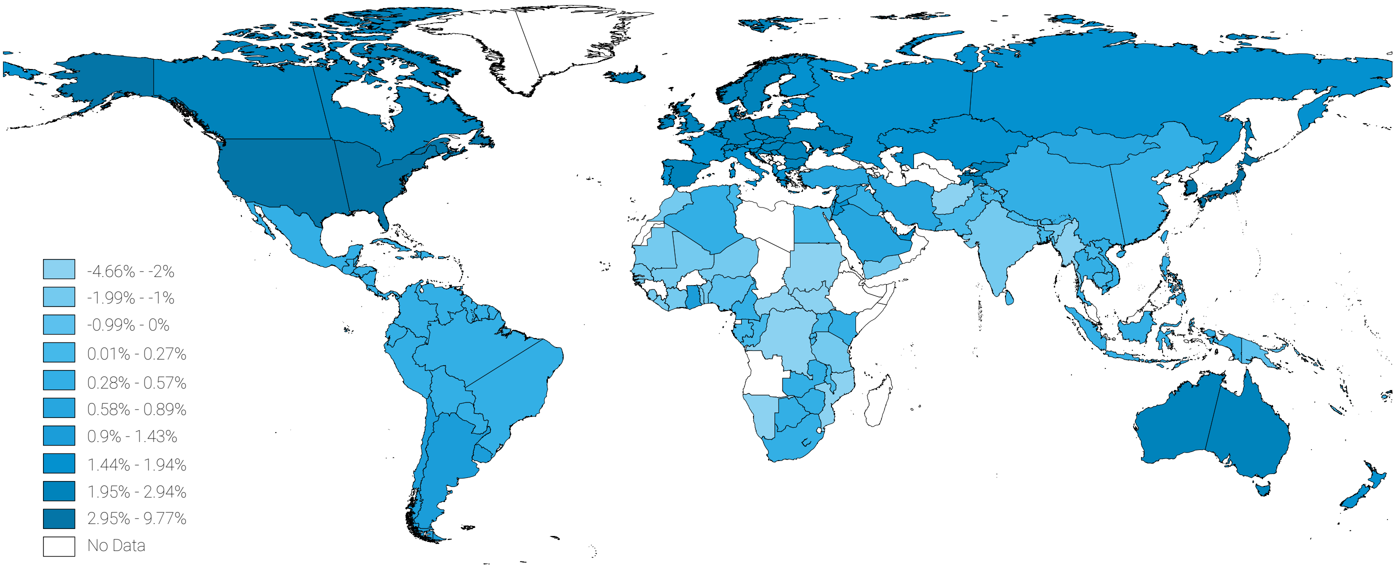
Finally, we note how to translate concepts and measurement into policy action. In this chapter, we address this issue from a different perspective. In particular, we suggest a new financial policy tool, where national or local governments may consider issuing financial bonds that are linked with the IWI of their sovereignty. As the asset side of the national balance sheet has now been expanded to include human and natural capital, the liability side can also increase, analogous to the corporate finance structure. Not only is this idea inspired by the proposal and recent practice of GDP-linked bonds, but it also appears to be more plausible than the original argument, in that the capital asset we assume is wider and more comprehensive from a well-being perspective.

7.2. Policy Lessons for Education

Education is an important contributor to human capital, and countries can increase their productivity by increasing their investment in education. Thus, investment in education provides a high rate of return to the IW of countries, both directly through accumulating human capital and through enhancing TFP adjustment.

But how can we boost investment in education? Many factors come to mind; from physical infrastructure (school buildings, toilets), to consumables (textbooks, uniforms, nutritious meals), and human capital (quantity and quality of teachers, class size). All of these can potentially be reasons behind the low average years of schooling shown in Fig 7.1.

Fig 7.1 : Average years of schooling from 1990 to 2014



Source: Author, using Barro and Lee (2016)

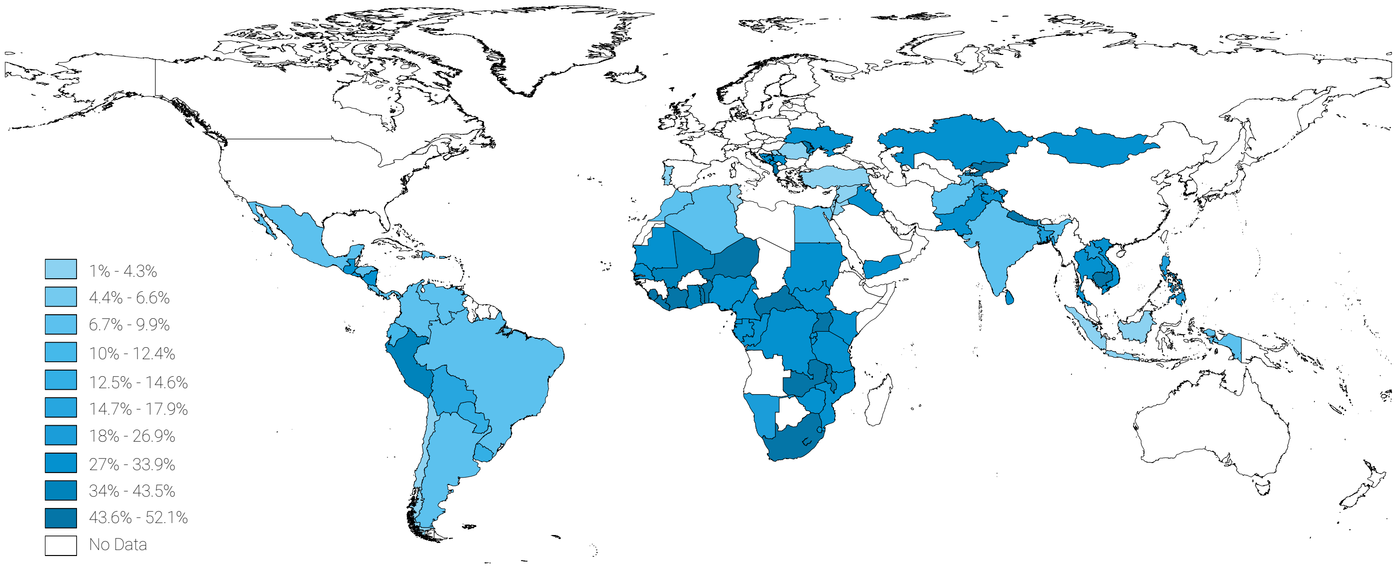
The educational portion of human capital is explained in inclusive wealth accounting. However, this accounts for only a small portion of human capital. It does not mean that the other factors are irrelevant, only that we should start from the most measurable chunk. For example, missing components could include parenting, on-the-job training, informal education/learning, adult education, health care, migration, and others (Boarini *et al.*, 2012).

Vocational training is an important means of education, to increase human capital in developing countries. Vocational training generally benefits low-income students, enabling them to become earners and contribute to the economy quicker than regular schooling. It is also effective in reducing child labour in many developing countries and assists in human capital performance. The vocational school should benefit a special group of students, and they should have specific skills in the sector of their own interest.

Investments in the education infrastructure can lead to improvements in both current welfare and future well-being by accumulating human capital. The majority of low-income countries have a child labour problem, which is widespread in the developing world. In particular, child labour has been known to suppress educational attainment (Psacharopoulos, 1997). Of course, poverty is one of the driving forces leading children to perform physical labour; it is easy to see why children give up schooling when given the opportunity of paid employment.

Care should be taken, however. Many factors contribute to creating this problem and thus abolishing child labour altogether may not be a solution (Basu and Tzannatos, 2003). Ranjan (1999, 2001) showed child labour might arise in poor households with credit constraints. In reality, child labour may provide the only way to finance school attendance, as agreed in a mining case study by Maconachie and Hilson (2016). Moreover, the majority of child labour exists in the agricultural sector, typically operated by family-run farms (Bhalotra and Heady, 2003).

Fig 7.2: Percentage of children (7–14 years) employed in labour



Source: Author, using Barro and Lee (2016)

Fig 7.2 shows the percentage of children (7–14 years) employed in the labour market; apparently, most of the African nations and certain Asian and Latin American countries have alarming levels of child labour. Understanding the reasons for low years of schooling and the economics of child labour can improve the education condition in low-income countries. These problems should be examined in light of poverty and credit constraints in rural households. The most obvious policy lesson for those countries, therefore, is to resolve poverty, human capital investment, child labour, and other market imperfection problems simultaneously.[49]

7.3. Regulating Pollution and Inclusion in Inclusive Wealth

It is important to include regulating ecosystem services in the inclusive wealth measure. These range from flood prevention at local scale, to climate control at global scale. IWR 2012 and 2014 have employed carbon damage to account for climate change damage. As a global public problem, climate change needs to be assessed based on the global aggregate. A flow damage cost of a nation, regardless of how much it emits, is subtracted from IWI, to reflect true social well-being. This is a plausible move to account for negative pressure on social well-being.

However, at the other end of the spatial spectrum lies local air pollution, which is yet unaddressed in inclusive wealth accounting. Local air pollution is especially relevant to policymakers at national and local scales. Regulating air pollution will benefit human health by improving the mortality rate and reducing health care expenses.

Among many potential sources of air pollution, anthropogenic sources of solid particles that are less than 2.5 micrometres across, called particulate matter 2.5 (PM2.5), are growing rapdily. The release of PM2.5 has a chronic effect on human health. PM in ambient air is considered to be related to an increased risk of premature death, as well as other less severe health end-points such as respiratory and cardiac emergencies (WHO, 2006), although some mechanisms remain uncertain (Harrison and Yin, 2000). Many sources of PM2.5 are noted: for instance, transportation, energy resource usage, construction, agriculture, and international trade are major emitting industries. In addition, the exposure exists at the local and international levels, implying that PM2.5 primarily affects people in developing economies in Asia. For instance, China, Russia, India, Viet Nam, Thailand, Indonesia and Afghanistan are encountering significant health damage due to the adverse impact of PM2.5. Fig 7.3 reports the annual average growth rate of PM2.5 damage based on the World Bank (2017) database. At the aggregate level, the intensity of damage is also very high in the United States, Japan, Brazil, and the EU (Fig 7.4), but their environmental policies seemingly significantly reduce this growth (Fig 7.3). BRICS countries also experience major damage from PM2.5 exposure.

49 See Fors (2010) for a survey. Islam and Choe (2013) have investigated the role of microcredit in child labour and human capital formation. Shimamura and Lastarria-Cornhiel (2010) discuss the effect of credit program participation.

Fig 7.3: Growth of PM2.5 damage from 1990 to 2014 (percentage)

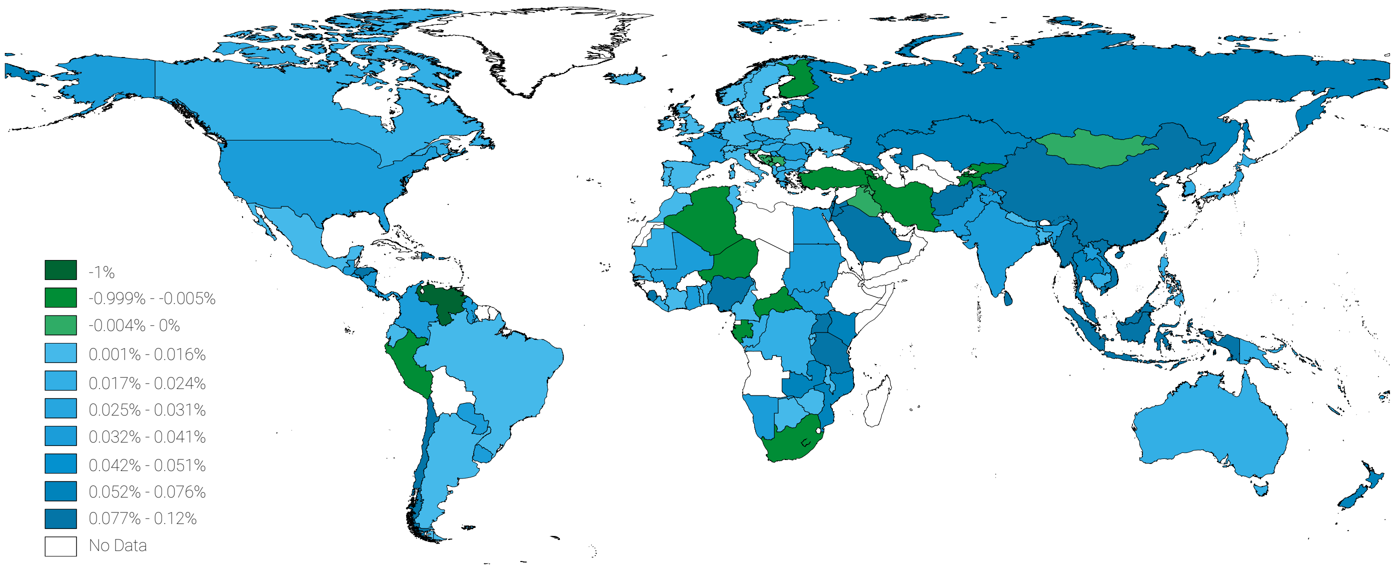


Fig 7.4: Average PM2.5 damage from 1990 to 2014 (million US dollars, 2005)

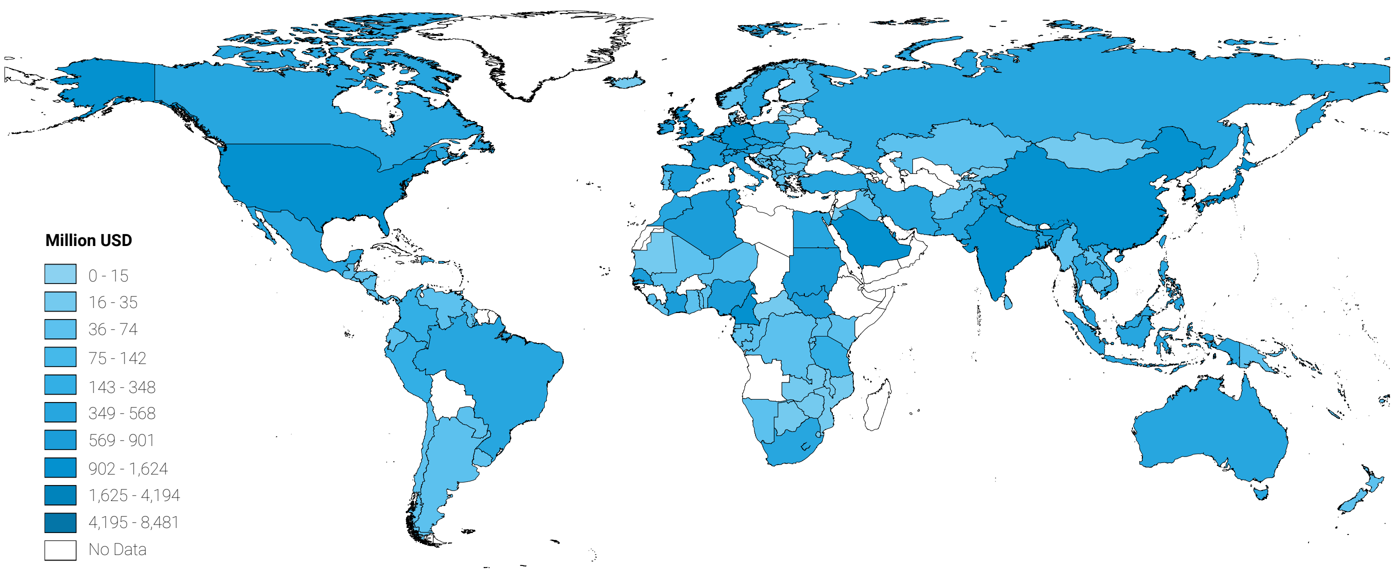


Fig 7.5 shows the growth of PM2.5 damage in per capita terms; emerging economies are increasingly vulnerable to exposure to damage. The average damage per capita over 25 years (1990 to 2014) is reported in Fig 7.6, where Saudi Arabia, South Africa, the United States, Japan, China, and EU countries show relatively high per capita damage, surpassing US$10 per person.

Fig 7.5: Growth of the PM2.5 damage per capita from 1990 to 2014 (percentage)

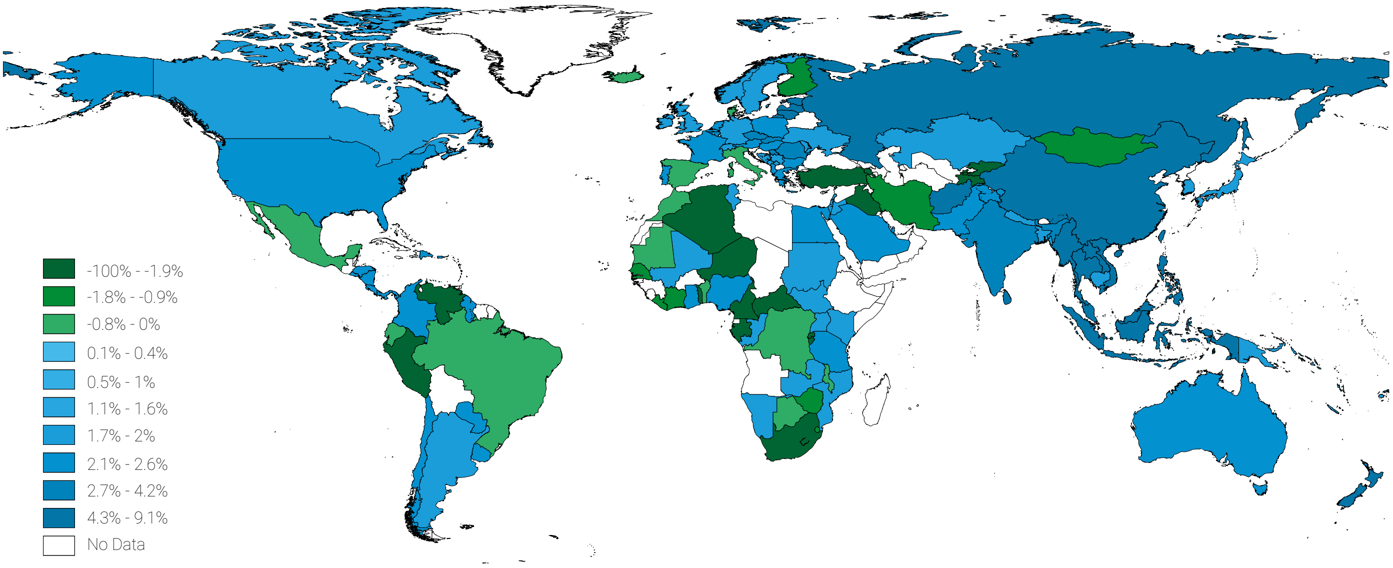
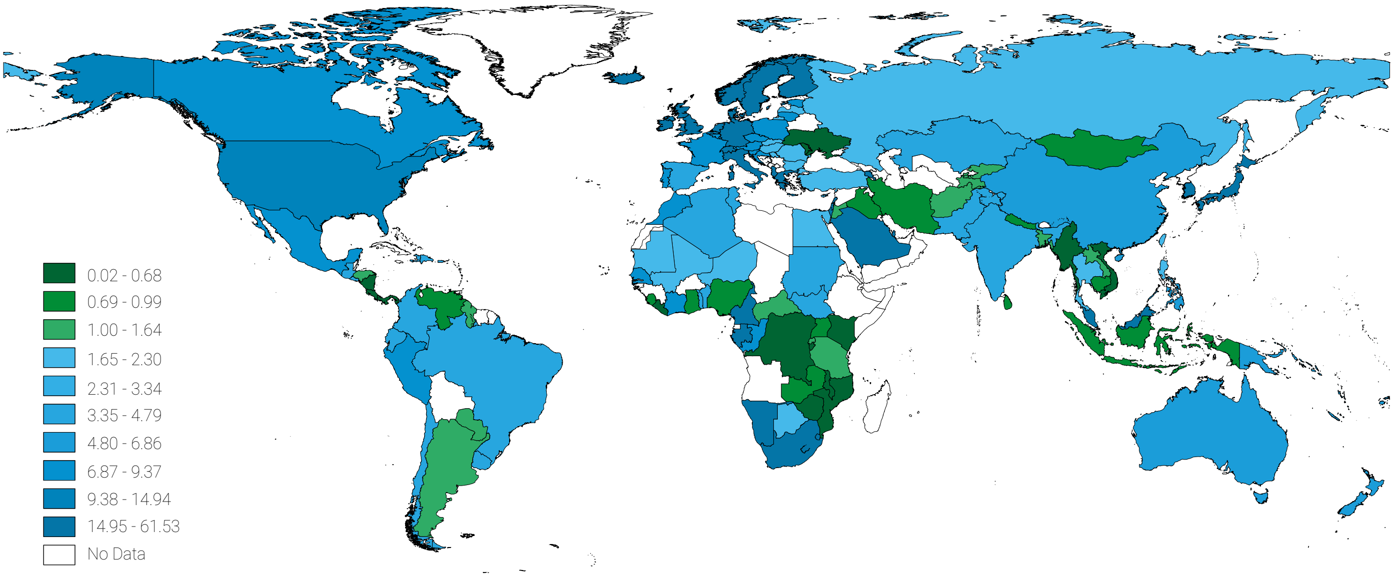


Fig 7.6: Average PM2.5 damage per capita from 1990 to 2014 (US dollars 2005)



What is distinct about ambient air pollution caused by PM is that it is transboundary (WHO, 2006; Anenberg et al., 2010). This means it should be treated as a regional public concern, if not a global one. In our inclusive wealth accounting, we adjust carbon damage as it affects human well-being globally.

We therefore might want to consider PM damage as another adjustment to IWI, while avoiding double counting with health capital accounts.

7.4. Fisheries Policy

Fisheries are an essential part of natural capital, which significantly contribute to the total wealth. However, the ability of a marine ecosystem to provide non-declined utility is limited by its regenerative capacity; this is currently being threatened by increasing human activities to satisfy food needs and to pursue higher economic development.

The growing population of the world has led to an increase in annual global fish consumption from 9 kg/capita in 1961 to 16.5 kg/capita in 2003, and this figure is expected to increase further to 17 kg/capita in 2020 (Delgado, 2003). The increasing demand for fish was followed by the industrialization of the marine fisheries sector in the first half of the 20th Century, through the mechanization of fishing fleets and the improvement of marketing systems. This improvement in techniques led to increasing productivity and employment in the fisheries sector (Coulthard *et al*., 2011). However, despite the industrialization of the marine fisheries sector and the increasing demand for consumption, the total catches of global marine fisheries eventually reached their peak in the mid-1990s (see Fig 7.7). Subsequently there has been an increasing number of overfished and collapsed stocks (Branch *et al*., 2011; Froese *et al*., 2012) and a declining mean trophic level of catch (Myers and Worm, 2003; Pauly *et al*., 1998; Pauly and Palomares, 2005). These factors have led to persistent debates regarding the sustainability of marine fisheries over the past two decades.

Sugiawan *et al.* (2017) argue that the sustainability of global marine fisheries is correlated with economic development. The researchers find a non-linear relationship between economic growth and both marine fisheries catch and estimated stock, suggesting the existence of turning points in the economy beyond which the beneficial impacts of economic growth on a marine ecosystem will be achieved. Hence, declines in resource abundance arising due to the development of the fisheries sector are only temporary. As the economy grows, the structural changes in the economy lead to more stringent environmental regulations, better fisheries management and new technologies. These changes will lead to a decline in catch levels in the short run and stock recovery in the long run. Similarly, by using the Ocean Health Index (OHI), a novel index to quantify and observe the health of human-marine ecosystem interactions, Halpern *et al.* (2012) show that, in general, developed countries have healthier oceans than developing countries. Flaaten (2013) discusses the institutional influence on the relationship between economic growth and fishing.

In terms of wealth accounting, sustainability is achieved if the capital stock of marine fisheries is non-declining over time (strong sustainability) or if the decline in marine fisheries stock can be compensated by a sufficient increase in other types of capital stock (weak sustainability). Fig 7.8 shows a comparison of capital stock of marine fisheries in 1976, 1990 and 2014 for selected countries having fish capital of more than US$25 billion. The size of the bubble indicates the size of the population.

From Fig 7.8, we can see that in general, the wealth of fisheries declines over time as a result of continuously increasing fishing efforts, which are driven by economic development and population growth. Only a few countries, such as Canada and Spain, can maintain or increase their level of stock. From Fig 7.8, we can also see different patterns of fish stock depletion between developed and developing countries.

Certain rich countries, regardless of their population, are found to have a declining rate of fish stock depletion. This finding may have resulted from the institution of better management systems and policies and the adoption of more advanced technologies. On the other hand, developing countries, which are characterized by increasing economies of scale, tend to have a steadily declining rate of fish stock depletion. In addition, we can see that the rate of stock depletion is also influenced by the size of the population.

Countries with a relatively large population, such as China, India and Indonesia, are very likely to have an increasing rate of stock depletion. However, Sugiawan *et al.* (2017) argue this rapid depletion is inevitable but only occurs temporarily. The researchers argue that as the economy grows, there will be declining pressures on the marine ecosystem that will lead to stock recovery in the long run.

Fig 7.7: Time-series data of global marine fisheries catch, population and world GDP per capita

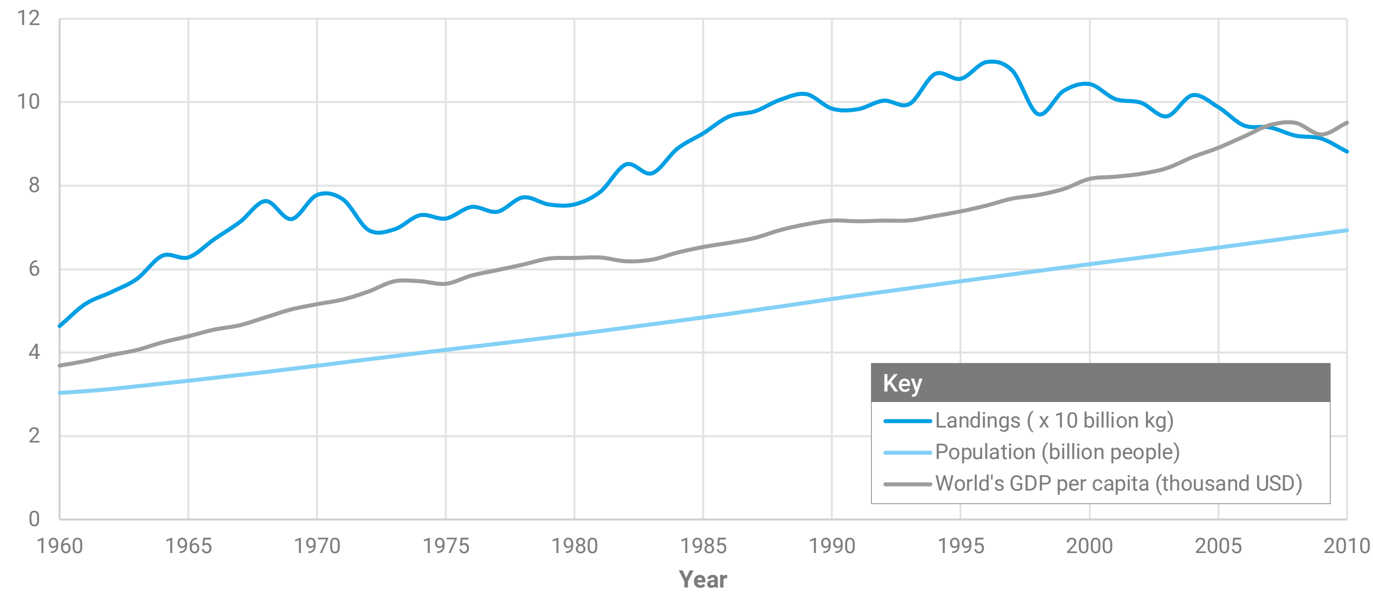
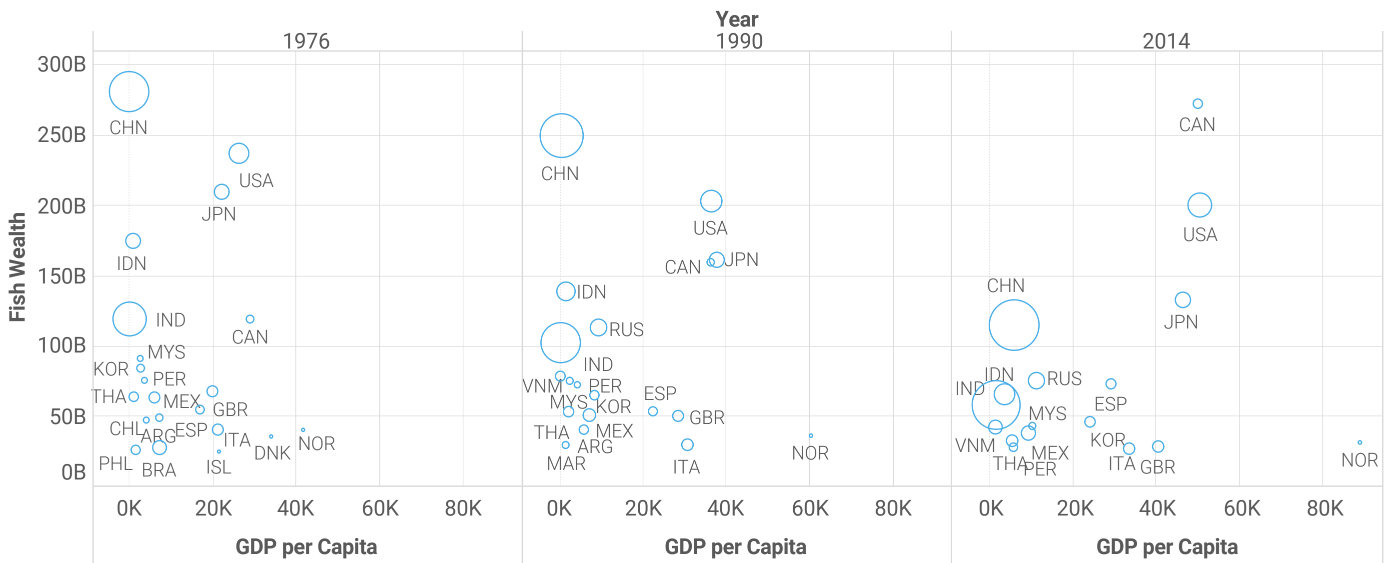


Fig 7.8: Comparison of fish stock capital for selected countries



From the discussion, we highlight certain important policy implications. First, the composition and technical effect of the economy, which are marked by the institution of better management systems and policies, investment in cleaner and more advanced technologies, and adoption of more stringent environmental regulations among others, are essential for decoupling economic growth from fish stock depletion. The immediate impact of these effects would be in reducing the volume of fish catches and discards. However, stock recovery is likely to be observed only in the long term. These findings suggest the need to implement better fishing practices and fisheries management to achieve sustainability in the fisheries sector.

Second, to maintain positive growth of total wealth, the inevitable stock depletion in the earlier stage of the economy should be compensated by a sufficient increase in other types of capital. Consequently, the constant pressure of population growth on fish stock should not only be considered a threat to sustainability but should be viewed as a potential asset, which needs to be managed to increase the productive base of an economy, that will compensate the declining level of natural capital.

7.5. Total Factor Productivity (TFP) and Social Capital

7.5.1. TFP and sustainability implications

Arrow *et al.* (2004; 2012) suggested that TFP can contribute to social well-being directly. Formally, TFP can be regarded as the shadow value of time as a capital asset (UNU-IHDP and UNEP, 2012). IWR thus includes the change in TFP as an adjustment term, based on the finding that we need merely to add TFP growth to inclusive investment (Arrow *et al.,* 2012).

A in the production function A(*t*)F(K(*t*)), where K(*t*) is the vector of capital assets and F(.) is the constant-returns-to-scale production function, can be interpreted to be an aggregate index of knowledge and the economy's institutions. In conventional growth accounting, K(*t*) include produced and human capital. In a remarkable move to include natural capital in growth accounting, however, Vouvaki and Xepapadeas (2009) observe that dismissing natural capital can mislead the analyst to interpret degradation of the environment as an improvement of knowledge and institutions. Brandt *et al.* (2013) argued that failing to account for natural capital tends to lead to a biased estimation of productivity growth. Natural capital has also remained largely hidden to policymakers due to the limitations of traditional economic indices (Fujii and Managi, 2013; Managi *et al*., 2004; Johnstone *et al*., 2017; Kurniawan & Managi, 2017).

In this report, therefore, we calculated TFP as a residual by expanding natural capital (forest, agriculture land, fish, fossil, and minerals) as an explicit factor of input into the production process. By integrating natural capital, we can understand that the same productive base of a country can lead to an increase (decrease) in aggregate output over time regarding the effective utilization of its productive resources. In particular, the frontier approach in IWR 2018 measures TFP adjustment by capturing the efficient utilization of natural capital, as well as produced and human capital, by using the Malmquist Productivity Index approach. The result shows 55 of the 140 countries – more than one third of our sample – have negative average TFP. Increasing investments in R&D tend to be focused on areas revolving around produced and human capital, but we need to shed new light on ways to efficiently employ natural capital and the environment in a modern economy. This brings us to the question of how environmental policy actually improves productivity.

7.5.2. Productivity and environmental policy

Porter and van der Linde (1995) postulated an apparent link between productivity and environmental policy. According to their hypothesis, well-designed environmental regulation can provide "a free lunch" and can trigger innovation which, in turn, can decrease and offset the costs of pollution abatement and enhance competitiveness. New evidence from the OECD countries shows that the more stringent environmental policies of recent years have had no negative effect on overall productivity growth (Ambec *et al.*, 2013). The researchers found that before tighter environmental policies came into effect, the overall productivity growth of a country slowed, possibly because firms anticipated the changes and prepared themselves for new operating conditions. However, a rebound in productivity growth soon followed, with no cumulative loss reflected in the data. Lanoie *et al.* (2008) also found a positive relationship between lagged regulatory stringency and productivity; innovations may take several years to develop, and capital expenditures are often delayed for a few years through normal budgetary cycles and building lags.

These results imply that more stringent environmental policies, when properly designed, can be introduced to benefit the environment with no loss of productivity. Well-designed market-based instruments, such as taxes on externalities or cap-and-trade schemes, score better in dynamic efficiency than environmental standards and effectively induce broadly defined innovation, providing firms more flexibility in the way they adapt to new environmental policy (De Serres *et al.*, 2010). Global society is required to innovate environmental practices based on incentives for industries to perform well in their environmental management and formulate economic and environmental policies simultaneously to achieve the sustainability of the growth process.

7.5.3. Productivity at the sectoral level

Innovations have minor importance in sustainable development issues with respect to exploiting resources for production, consumption, and disposal by a better means. Thus, it has been pivotal to work towards a more advanced technological shift and shift in the progress up to this point, through the deployment of sustainable techniques and products (Hemmelskamp, 1999). Technology innovation and efficiency catch-up are driven by productivity growth. Consequently, environmentally friendly technologies, such as waste heat to electricity conversion, may lead to an improvement in productivity regarding which resources (energy) are used. It is necessary to widely adopt energy-saving technologies, to have policy-induced impulses that help companies cope with the adoption barrier. Particularly, regarding energy efficiency, Jaffe and Stavins (1994) argued that energy-efficient technologies are not widely used without policy inducement. Contributing factors are a lack of information about available technologies, particularly when there are no incentives, principal/agent problems, low energy prices, and high implicit discount rates.

The most powerful driver to support energy efficiency is profit; if an energy efficiency project is profitable, everyone will participate in the project. Investments in energy efficiency have many positive effects, not only an economic impact through maintaining energy security and increasing competitiveness but also environmental and health impacts by reducing GHG emissions. Arvanitis *et al.* (2016) proved that there is a direct positive effect of investment spending for energy-related technologies on labour productivity and indirect positive effects of energy taxes through investments in energy-related technology. Consequently, countries need to induce more investment in the energy efficiency sector.

In the agricultural sector, public policies, such as investments in research extension, education and infrastructure, and natural resource management have been the major sources of TFP growth. Chand *et al.* (2011) found that public investment in research has enhanced a significant source of TFP growth in most crops. The variables for natural agricultural resource management and produced capital have been important sources of TFP growth for most crops. Among natural resources, a dependable supply of irrigation revealed by the proportion of groundwater in total irrigation, in addition to the balanced use of fertilizers, has played a significant role in increasing TFP. Investments in agricultural technologies, such as drought-resistant seed varieties, soil-improving technologies, and solar energy sources, are options that may increase the productivity of the agricultural sector.

These results and previous discussions provide several noteworthy contributions to policymakers. First, these findings enhance our understanding of how particular countries can measure and manage their sustainability by incorporating natural capital into TFP. Second, countries need to develop well-designed environmental regulations to trigger innovation and utilize their productive assets in a more effective manner. Third, policymakers are encouraged to support the research and development of renewable resource technologies, although their impact on social well-being is yet to be captured (but see also Chapter 3). The contribution of investment in technology is crucial to confront dwindling natural resources and to achieve the desired productivity growth in terms of social well-being.

7.6. Policy Instruments: IWI-linked Bonds

In its inaugural report, IWR 2012 proposed that inclusive wealth, rather than GDP, interest rates, unemployment or other indicators, should be "mainstreamed" for use in economic policymaking. We believe that conventional economic indices continue to play a key role in economic policymaking, as they represent how the economy, rather than social well-being, is performing overall. Conventional aspects of the economy have many ramifications. For instance, inflation and unemployment certainly affect our short-term well-being. It is well-known that job security is an important constituent of subjective well-being and a sense of dignity. Moreover, our index of IW pertains more to the question of whether a productive base is on the increase in the long run, rather than short-run fluctuations. Thus, we should be humble in what our index says about the sustainability of social well-being and the productive base in the long run. Having acknowledged these differences in focus, we also believe that IW should be emphasized in economic policymaking, if not mainstreamed. Political administrations naturally focus on increasing their reputation and can thus be short-sighted. For example, it is expected that current administrations have an incentive to prefer policies that cater to the current generation and leave the policy burden to be dealt with by future generations. Therefore, IW can be a headline index in economic, as well as social and ecological, policymaking, as a sort of commitment device for sustainable development.

There could be many alternative means to operationalize the idea of making IW a headline index, as with the interest rates of stock prices. In a recent thought experiment, Yamaguchi and Managi (2017) proposed that national governments could issue bonds that are linked to the level or the growth rate of IW. By linking bond coupons (fixed income) to IW, holders of this financial asset would be intrinsically linked with trends in IW, an indicator of sustainable well-being.

However, the main intention of this proposal is much wider than garnering focus on IW in the policy arena. In theory, this instrument would create macro-financial markets for a previously unnoted but important portion of wealth. Kamstra and Shiller (2009) refer to human capital, which accounts for a large proportion of wealth, particularly in high-income countries, but there is no reason not to extend this discussion to natural capital. Therefore, the proposed financial vehicle can be seen as a plausible extension of the recent proposals of GDP-linked bonds (Borensztein and Mauro, 2004; Kamstra and Shiller, 2009; Barr *et al.*, 2014).

By properly designing new bonds, governments could offer institutions and other investors opportunities to mobilize their financial resources into investments in the components of IW: produced, human, and natural capital. One way to accomplish this mobilization is to set aside the proceeds from the general budget and establish a bond revenue fund to be used for reinvestment in capital assets that comprise IW.

In this case, the government, with the aid of the voice of citizens, is expected to craft investment strategies in capital assets. Suppose that, the shadow price of a forest in a given country is rising, due to aggressive deforestation and rising scarcities. Then, the national government could conduct a cost-benefit analysis, using the same shadow prices as well as cost estimates, to determine whether and how investment in the forest is justified (see, e.g. Collins *et al.*, 2017). If the investment is indeed rationalized, then the government taps into the revenue from the proposed inclusive wealth-linked bonds for afforestation, reforestation or protection from illegal logging.

A bond of this kind would face some obstacles in practice. First, government budget deficits may increase, at least in the short run, in a sluggish economy. GDP-linked bonds, it is argued, have the advantage of being countercyclical, by automatically suppressing interest payments when the output is not increasing. In the current proposal of IWI-linked bonds, interest payments are linked with a long-run productive base, which may conflict with the short-run trend in output. Second, unless we have a very transparent institution for measuring the shadow prices of the list of capital assets and democratically prioritizing public investments, the government may have an incentive to report (a growth rate in) IW that is higher than the true value. This finding is particularly true of administrations facing the threat of being expelled from power. However, this mechanism may be attenuated to a certain extent due to the obligation of the government to pay IWI-linked interests.

To fix ideas, let us take India as an example. As Table 7.1 shows, produced, human, and natural capital represented 8 percent, 61 percent and 31 percent, respectively, of total capital of the nation in 1990. The relatively high position of natural capital in IW is typical of developing countries, as discussed in Chapter 1. However, this position is reduced to as low as 15 percent in the latest figure.

More fossil fuel (oil, natural gas and coal) experienced an across-the-board decline. Fisheries nearly halved, and pastureland also witnessed a decline. In contrast, forest resources somewhat increased during the period. The past quarter century has also observed massive investment in infrastructure, contributing to the elevated share of produced capital in 2014 (24 percent). Interestingly, the relative share of human capital remained at 60 percent. Apparently, we could argue that the country has invested in produced capital, at the expense of certain natural capital resources.

Table 7.1: Inclusive wealth in India, 1990–2014

	1990		2014		Annual change rate	
	$billion	Share (%)	$billion	Share (%)	%	Weighted (%)
Produced capital	867	7.5	5,049	23.5	7.62	1.36
Human capital	7,110	61.4	13,215	61.5	2.62	1.61
Natural capital	3,605	31.1	3,242	15.1	-0.44	-0.09
Total	11,582		21,505		2.61	2.88

Let us review the order of the magnitude of this financial instrument in this example. First, we study a possible bond whose interest payment is linked with the level of IW of India. Suppose the social discount rate is 5 percent per annum. Assuming, at a cost of rigour, that the NNP is the return on wealth (the latter being US$21,505 billion in monetary units in 2014), we can simply estimate that the NNP in 2014 would be US$1,075 billion (=$21,505 billion times 0.05). The interest payment would be a share of the corresponding NNP, which should be fixed before the issuance of the bond. Suppose that this constant share is 100 billionths of the current NNP. Then, the coupon payment would be US$10.75 (=$1,075 billion/100 billion).

Second, we could also consider a potential bond linked to the growth rate of wealth. Fig 7. 1 shows IW has increased at a rate of 2.6 percent annually since 1990.[50] This growth rate can be directly used as the coupon interest rate of this possible bond. As is often the case with an emerging economy, the 10-year government bond in India is higher than its peers in developed countries, with the latest figure of approximately 6.5 percent as of September 2017.

This comparison shows that a premium would be needed to compensate investors for taking risks in the growth of IW; in this case, the interest payment could be based on a benchmark rate, such as short-term government debt.

Finally, comparisons with other similar initiatives are in order. The proposal of GDP-linked bonds was innovative and provocative (Shiller, 1993), but their focus is on fiscal sustainability and the inclusion of capital assets, the income of which is revealed in the GDP boundary. This focus naturally needs to be extended to sustainable development and the inclusion of income from the non-GDP boundary (Yamaguchi and Managi, 2017).

50 If consumption does not grow, this rate should be equal to the growth in green NNP.

Another relevant trend in the financial market is the increasing issuance of green bonds. As case studies demonstrate (European Commission, 2016), green bonds are issued for specific projects in the fields of renewable energy, energy efficiency, low carbon transport, sustainable water, and waste and pollution, some of which overlap with natural capital investments. The IWI-linked bonds have an advantage of prioritizing projects on a macro scale, based on shadow prices for a wide variety of human and natural capital.

This advantage would also enable the issuer to shift investments to more needy projects when relative scarcity changes in the long run. Moreover, interest payments are linked with nationally aggregated IWI, such that the return to bond holders decreases when wealth does not increase sufficiently. This finding also demonstrates that the risk of the decreased well-being of future generations is shared with current investors.

A busy street market, Vrindavan, India. Fancycrave on Unsplash.com

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United Nations Avenue, Gigiri
PO Box 30552, 00100
Nairobi, Kenya
unenvironment.org