The Little Book of NATURAL CAPITAL ACCOUNTING AND FINANCE

Raul Martinez-Oviedo and Francesca Medda

Editors of the Little Books series:

Dr Christopher T. Boyko and Dr Claire Coulton,
ImaginationLancaster, Lancaster University

With design by Roger Whitham, Rachael Hill and Michael Stead,
ImaginationLancaster, Lancaster University

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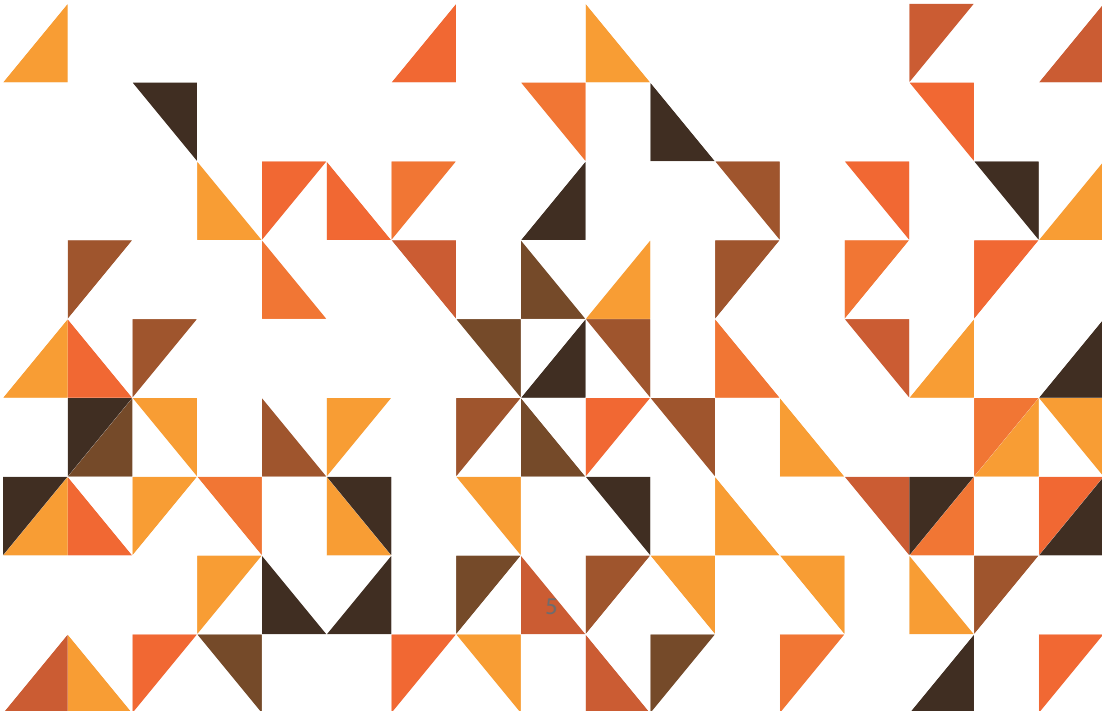
Contents

What this little book tells you

This little book tells you about the research that we did on accounting and financing natural capital as part of the Liveable Cities project. The research conducted focused on studying three relevant aspects of natural capital: natural capital accounts, natural capital investment performance and the use of Sovereign Wealth Funds (SWF) to invest in natural capital.

Based on our investigation, we have concluded that:

This book therefore not only presents our understanding of natural capital accounting and finance, but it also illustrates how accounting and financing natural capital can be beneficial for preserving the value of our natural resources.



Introduction

The value of natural capital in countries around the world has been consistently declining over the past decades. In the UK, for instance, the Office for National Statistics (ONS) initial estimates suggest that natural capital losses in this country were as high as $183 billion (in constant 2014 US$) between 2009 and 2014, indicating a drop of 32.3% in only five years (ONS, 2016c). These trends have also been found in many other countries. Figure 1 shows the trends of natural capital value between 1990 and 2010 in 19 different countries across the Americas, Europe, Asia and Africa, using the most recent estimations provided by the UN University International Human Dimension Programme (UNU-IHDP) and the UN Environmental Programme (UNEP) in the Inclusive Wealth Report (UNEP&UNU-IHDP, 2014). From the figure, we can conclude that, with the exception of France, the value of natural capital in the rest of the countries is declining. When we examined the Inclusive Wealth Report data in detail, we found that this situation is actually shared by the vast majority of countries worldwide.

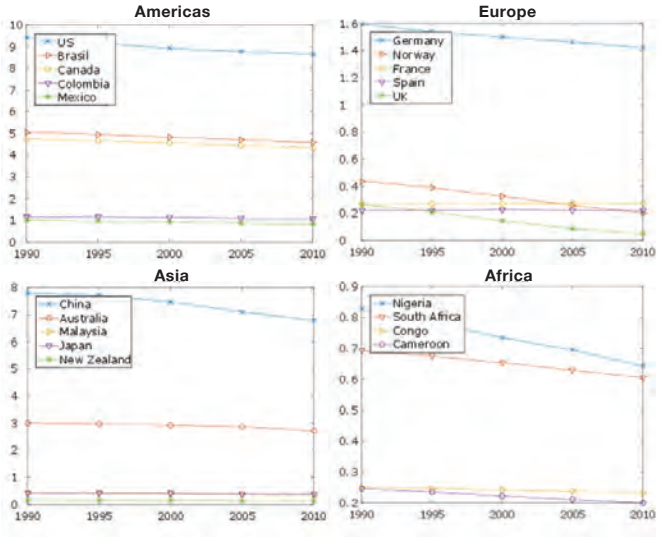


Figure 1. Natural capital value in countries around the world (in USD 2005 trillion)

Many scholars agree that the generalised loss of natural capital value is mainly the result of human-induced factors, such as, overexploitation of natural resources, soil erosion, water pollution, loss of biodiversity, and increasing population. However, it is also widely accepted that the lack of accounting and financial mechanisms dedicated to the measurement and recovery of the value of natural capital has contributed to this decline).[1] In the absence of robust natural capital accounting systems and support investment mechanisms, the valuation of nature stays outside the realm of economic activity and decision-making, and also prevents private enterprise and public authorities from developing strategies to reverse the declining trends witnessed today (Zhang et al., 2010; Jones, 2010). Therefore, if the value of natural capital is to be recovered, actions must be taken to develop and implement natural capital accounts that provide information on the condition of natural resources. Similarly, novel financial mechanisms able to dedicate significant investments in natural capital assets should be introduced in order to maintain and recover the value of natural capital (NCC, 2014a). Recovering natural capital value and reversing decreasing trajectories are essential to national and regional authorities in their aim to achieve sustainable development goals, they are important for the society to secure levels of well-being, and they are integral to the long-term decision-making strategies of businesses.

Many international organisations, national governments, private sector entities, and academics have nevertheless focused strongly in recent years on creating natural capital accounts and furthering the development of financial mechanism for natural capital. Examples of efforts by international organisations include the introduction of ecosystem assessments, such as the Millennium Ecosystem Assessment (MEA, 2005) and The Economics and Ecosystems and Biodiversity report (TEEB, 2010), for identifying and classifying the range of economic benefits derived from nature. In addition, the UN Statistical Commission has introduced the System for Environmental-Economic Accounting (SEEA-CF, 2012) as an international framework to provide guidance on how to quantify natural capital value. Similarly, institutions such as The World Bank (2001) and the UNEP&UNU-IHDP (2014) have presented some of the first valuations of natural capital in multiple countries as part of their work to account for the wealth of nations.

[1] See Smith et al., 2017; MEA, 2005 for further details.

A number of national authorities worldwide have also developed and implemented their own national natural capital accounting systems. Prominent examples include the national governments of Norway, the UK, Australia, Sweden and Canada, leading countries in the practical implementation of natural capital accounts. Contributions from the private sector include the Natural Capital Coalition's creation of the Natural Capital Protocol, a set of natural capital accounting principles specifically designed for private corporations and businesses. Despite the significant progress achieved to date in the study of natural capital, only scant research is dedicated to the specific study of the use of natural capital accounts to assess changes in the value of natural capital over time. Moreover, investments in natural capital continue to be regarded as alternative investments of secondary importance for private investors when compared to traditional asset classes (i.e., equities, bond instrument or real estate); and this is likely due to the lack of consensus on their financial benefits. By examining the financial performance of natural capital investments and contrasting their outcomes with those of other financial instruments, we will have demonstrated in this little book the attractiveness of natural capital investments to private investors.

What is natural capital, and why it is important?

Before we go any further with our discussion, we will clarify our terms and why we think this research is important to our future cities. Natural capital refers to the stock of natural assets and ecosystem services that provide value, directly or indirectly, to people and the economy (NCC, 2014b). The concept of natural capital is relevant to cities as it helps to increase the understanding of the services and benefits that citizens enjoy from aspects such as green spaces, public parks, clean air, or secured water provision. Moreover, the concept of natural capital also contributes to improving the future management of these benefits. The enormous economic value of the benefits provided by nature in cities brings into discussion the importance of maintaining, or even increasing, the value of natural capital; and prompt policy-makers to explore new ways of financing the provision and maintenance of natural capital benefits. Figure 2 below shows the different forms of natural capital that contribute to the economy of our cities and to the wellbeing of our citizens.

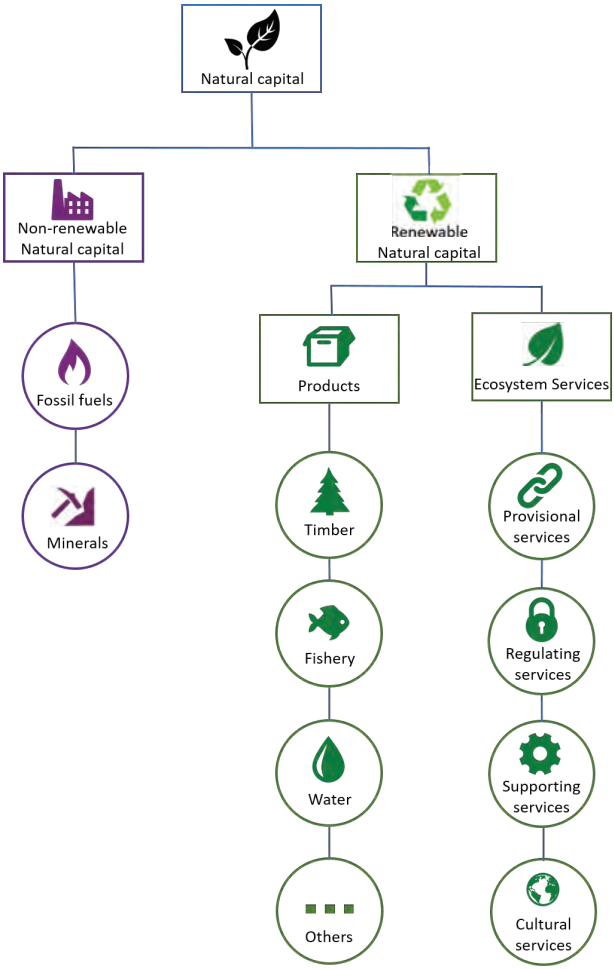


Figure 2. Natural capital forms

The current issue with natural capital is that, unlike other capital forms such as human or produced capital, its value has been steadily decreasing over the years. Poorly managed natural capital not only results in ecological damage but also causes social and economic liabilities. At present, the over-exploitation of natural capital is reducing the flow of benefits that stems from nature; this has a severe impact on economies and jeopardises the ability to deliver sustainable development.

For instance, the Truscost-TEEB (2013) report estimates that the global top 10 environmental externalities, including carbon emissions, soil degradation, and water scarcity are costing the global economy nearly US$ 4.7 trillion a year in term of degradation of natural capital. The same source estimates that, in Europe alone, the economic cost of natural capital depletion due to Greenhouse Gas emissions, land use degradation, and water supply scarcity, has been in the order of approximately US$ 337 billion per year. Figure 3 illustrates the ecosystem services most affected by environmental externalities.

Figure 3. Natural capital and its ecosystem services

In order to reverse the declining trends of natural capital and save the associated costs, the situation requires the development and implementation of accounting mechanisms and financial approaches dedicated to natural capital. Natural capital accounts are not only essential for capturing the value of natural capital in financial terms, but they are also crucial for tracking changes in the value of natural capital

assets over time, and identifying the major factors driving the changes. Likewise, financial approaches aiming to allocate significant investments in natural capital are fundamental to the recovery of downward-moving values of natural assets.

In the next section we will discuss the relationship between natural capital and the capital approach to assess sustainability in development. Achieving economic sustainability means creating the conditions that are necessary to allow economic production to continue into the future. One of the most basic conditions for delivering sustainability is preserving enough natural capital for future generations to be able to maintain their levels of production. By accounting for the value of nature as an asset, the concept of natural capital therefore integrates with other capital forms to provide a criteria to assess sustainability.

Natural capital and the capital approach to sustainability

The concept of natural capital has been endorsed by the 'capital approach' for assessing sustainability in development. The capital approach emerged during the search for robust ways of assessing sustainability, and at a time when traditional indicators such as GDP could not provide useful information on sustainable asset management, as illustrated in Figure 4. This approach focuses on measuring the condition of the capital assets that compose the wealth of a region, including human, produced, and natural capital, and that are used as an input factor for production. GDP specifically measures current economic activity in the form of input and out flows, but does not address the condition of the capital stock necessary to maintain levels of production and consumption. The capital approach explicitly measures the condition of capital assets by estimating the monetary value of each capital component. The criteria for sustainability set by the capital approach establishes that sustainable development is a development that ensures non-declining per capita wealth over time where wealth is defined as the aggregate values of the stock of human, produced, and natural capital. Thus, the capital approach for sustainability analysis highlights two types of activity in relation to capital assets: (i) estimating the monetary value of the available capital stock, and (ii) tracking changes of the per capita value of capital assets in time.

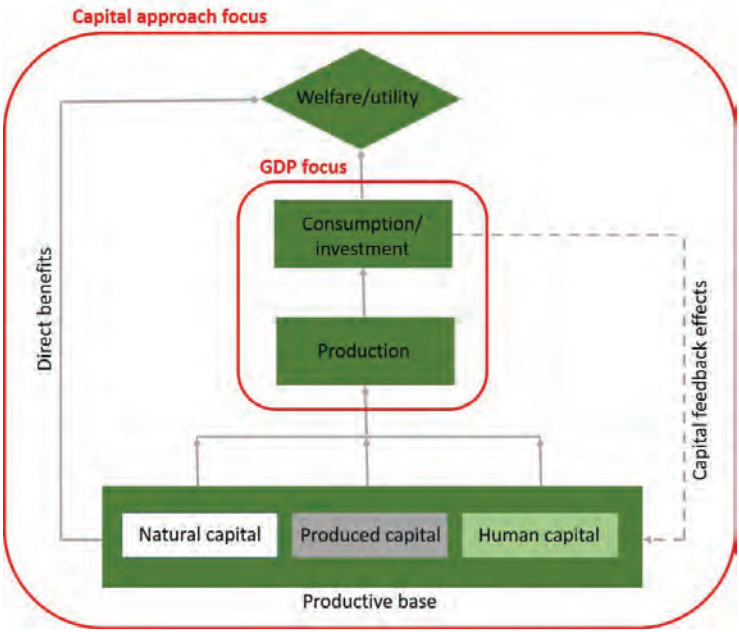


Figure 4. The capital approach vs GDP focus

The major strengths of the capital approach, different from GDP, are that it provides quantifiable criteria for sustainability and also incorporates the value of natural resources, aspects commonly neglected by the GDP approach. But despite the strengths offered by the capital approach, this approach also encounters several limitations in terms of valuation (i.e. practical issues found when valuing the capital stock) and critical capital appraisal (i.e. the degree of substitutability among capital assets). Capital accounting requires us to measure shadow prices, and the capital approach assumes that shadow prices can always be measured. However, this assumption is not realistic, given that the valuation of all capital assets is not always feasible. Several scholars point out that the capital approach assumption on shadow prices does not hold true in many cases. Moreover, the measure of sustainable development provided by the capital approach works under the condition of a high degree of substitutability among capital assets. In reality, the degree to which various capital stocks, and in particular the stock of natural capital, can be substituted, is

limited. Thus, it would be inadequate to aggregate values of non-critical capital with those of critical capital because information for sustainable development would be lost. Despite the aforementioned criticism and limitations, the capital approach to sustainability continues to be the most viable mean of addressing sustainability issues in development. This approach has been broadly adopted by many international organisations and national authorities around the world for measuring wealth. Therefore, we can assert that the capital approach has motivated the development of natural capital accounting systems for incorporating the value of nature into national wealth accounts and therefore also tracking variations in the condition of natural capital over time. Furthermore, the capital approach prompts the necessity for investment mechanisms capable of maintaining per capita levels of natural capital in order to achieve sustainability.

Natural capital in the UK

The UK has positioned itself as a leading country in the discussion and implementation of natural capital accounting and financing mechanisms for sustainability (ONS, 2015). The initial strategy for addressing the natural capital accounting challenge in this country was set out in the UK Natural Capital Roadmap 2012, and later extended in the 2015 Natural Capital Roadmap Review. The UK roadmap defines the policies and actions to be taken, over the time span 2012-2020 in order to create and implement a natural capital accounting system that can be fully integrated into the SNA of this country by 2020. To date, UK authorities have produced the first estimates of natural capital value, first introduced in 2012 and since then reported by the Office for National Statistics (ONS). The UK national government also established in 2012 the Natural Capital Committee (NCC) as an independent advisory body to government on the subject of natural capital management (NCC, 2014b). In addition, the Department for Environment, Food & Rural Affairs (DEFRA) has contributed to the development of the UK National Ecosystem Assessment (UKNEA, 2014), the UK land cover and land use accounts (Miles et al., 2014), and the UK carbon emission by land use category (Buys et al., 2014) in order to support the work of accounting for natural capital value.

The initial UK natural capital accounting system is in accordance with the UN's System for Environmental-Economic Accounting (SEEA), a central framework developed as guidance to measure the value of natural capital, and provides partial estimates of UK natural assets using methodologies still under revision (Khan et al., 2014). Natural assets currently accounted in the UK system include: the non-renewable natural capital of fossil fuel reserves (i.e. oil & gas), mineral reserves and coal; the renewable natural capital of timber resources, fisheries and water supply; and the non-provisioning ecosystem services of outdoor recreation and net greenhouse gas sequestration. These are more natural assets than have been considered in other natural capital accounting systems, including the The World Bank (2006) and

UNEP&UNU-IHDP (2014). However, many other important natural assets for which valuing methodologies do not yet exist remain excluded from the accounts. To name a few, for instance there is biodiversity, cultural heritage, and aesthetic experience, but there are many others. Although partial, the initial estimates in the UK confirm that natural capital value in this country has been consistently declining since it was first measured in 2009. Figure 5 presents the trajectory of the UK's natural capital value between 2009 and 2014, as reported by the Office for National Statistics. From the figure, we can see that natural capital passed from an approximate total estimate of $566 billion (in 2009 constant price) in 2009, to less than $383 billion in 2014, representing a 32.3% decline over a period of five years. The rapidly declining rate of natural capital has motivated UK authorities to increase their understanding of the factors driving changes in the value of natural assets. Analyses using natural capital accounting systems have allowed for the extraction of information about the condition and factors influencing the values of natural capital.

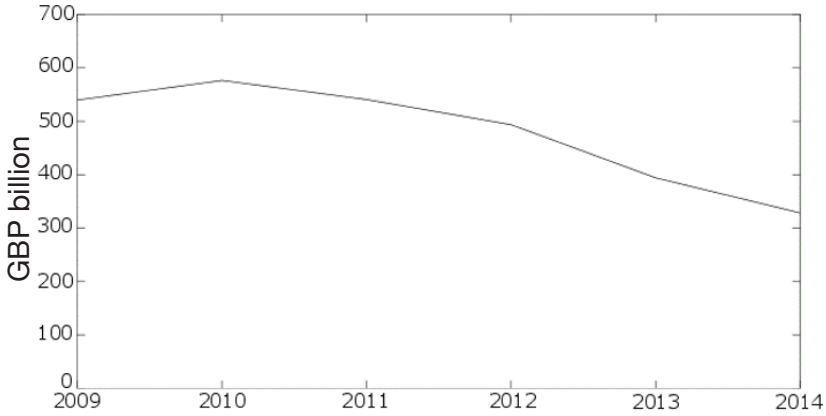


Figure 5. Natural capital value in the UK, 2009-2014

In so far as natural capital financial approaches are concerned, environmental taxes have been traditionally implemented in the UK mainly in energy, transport, pollution and resource production, each having different results on environmental benefits and the economy. Only in 2014, revenues from environmentally related taxes stood at $44.6 billion (ONS, 2014). The traditional tax approach is also being complemented by more innovative approaches emerging in recent years. At the national level, for example, the UK Government has committed to a 25-year plan of `targeted investments' to restore the UK's natural capital. Moreover, the UK has already developed the Green Investment Bank as a financial initiative to fund green infrastructure projects with minimum environmental impact across the UK (GIB, 2016). Furthermore, the possibility of creating a Sovereign Wealth Fund (SWF) to manage the rent from the potential exploitation of shale gas resources has been debated in the House of Commons. At regional level, local authorities have begun to formulate their own natural capital investment strategies for the future. Examples include the investment strategy developed by authorities in Surrey (Surrey Nature Partnership, 2015) and Dorset (Dorset Local Nature Partnership, 2016) for the recovery of their renewable natural capital, and the green infrastructure investment plan designed for London to improve the condition of non-provisioning ecosystem services.

The information on the UK natural capital condition, combined with research efforts of the NCC and DEFRA, have allowed these institutions to identify three relevant areas where research is imperative on the topic of UK natural capital accounting and financing. First is the impact that natural capital accounting has on understanding the main drivers of natural capital decline. Second is the assessment of how investments in natural capital assets offer attractive financial benefits for investors. Finally, the third is the study of the use of new financial mechanisms that can be adapted to manage and fund natural capital.

Natural capital accounts to track change in value

The value of natural capital is a fundamental component of the wealth of a nation, which is the result of aggregating the value of the stock of produced, human, and natural capital assets. A necessary condition for delivering sustainability is the preservation of enough per capita wealth, including its natural capital component, for future generations. Nevertheless, natural capital normally represents a very small fraction of national wealth compared to other capital forms and the value of natural capital has been declining steadily in the last decades. A wealth composition that is largely composed of elements of produced and human capital, under conditions of financial shock, exposes per capita wealth trajectories to the risk of decline. The 2008 financial crisis, for instance, severely impacted the levels of human and produced capital in developed and developing economies, and in doing so, dragged down aggregate values of wealth. The 2008 financial crisis yielded a high default rate in the United States subprime home mortgage sector, precipitating an international banking crisis that collapsed a number of the world's largest investment banks. Natural capital, on the contrary, is an element of wealth which is less exposed to economic fluctuations since its value is less dependent on economic stability. Nevertheless, different forms of natural capital including non-renewable and renewable natural assets and ecosystem services, as already mentioned, continue to decline due to the persistent depletion and degradation of natural capital stock.

The research we conducted for the Liveable Cities project on natural capital accounting addressed the objective of evaluating changes in natural capital value within the framework of total wealth for the specific case of the UK. The results obtained from this analysis show that the UK's national wealth is predominantly comprised by its human and produced capital that, when taken together, accounts for more than 94% of total wealth. Whereas the value of natural capital, on the contrary, represents only a small fraction of 6% of wealth. A wealth composition of this type is standard in most developed economies and makes the major drivers of wealth changes contingent upon variations in the values of human and produced capital, i.e., factors such as employment and unemployment rate, average wages, and levels of investment in infrastructure largely shape the aggregate wealth trajectories. Given that the majority of these factors may be significantly affected by changes in GDP, changes in wealth value are also positively associated with changes in GDP. A financial shock in the form of an economic crisis can therefore have a detrimental effect on wealth trajectories, turning upward trends into downward ones. Conversely, we found that the value of natural capital is less associated to GDP changes when compared with human or produced capital. Nevertheless, given the current low share of natural capital in terms of total wealth, it is unlikely at present that changes in the value of this capital form can have a direct influence on the risk of declining per capita wealth. Our analysis of the UK wealth composition has revealed that recovering the value of natural capital and increasing its contribution to wealth is fundamental in order to introduce resilience in levels of aggregate wealth against the threat of financial shocks.

The value of non-renewable natural capital in the UK decreased from £5,641 in 2003 to £1,634 in 2013, declining at an average annual rate of -11.5%. The major driver for this loss is a fall in the monetary value of the UK's oil & gas reserves. Oil & gas showed a net change in value of -£3,930 (-78% value loss) between 2003 and 2013, being by far the largest among all non-renewable natural capital assets. UK's oil & gas reserves have been declining consistently over the past two decades, nearly halving from 2,286 MM tonnes in 1999 to just 1,164 MM tonnes in 2013. Oil & gas production has also decreased too, reducing from 137.1 MM tonnes in 1999 to 49.9MM tonnes in 2013 for oil, and from 37.5 to 15.9 billion therms over the same period for gas. In addition, the monetary values of mineral and coal reserves declined as well, registering a net change of -£16 (-4.7%) and -£60 (-23%), respectively, on their per capita value between 2003 and 2013. Similar to the case of oil & gas, the values of minerals and coal have largely been affected by a reduction in overall levels

of productions during the examined period. Figure 6 shows the changes in value experienced by UK's non-renewable natural capital between 2003 and 2013.

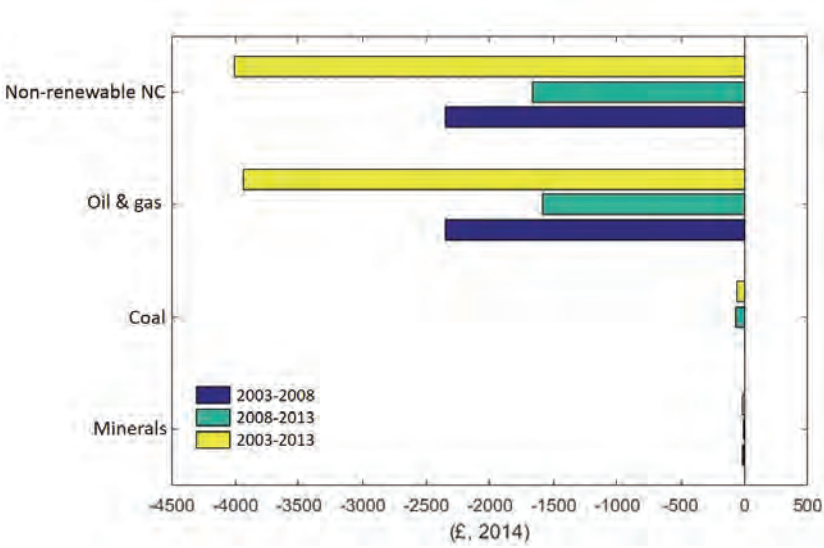


Figure 6. Changes in value for UK's non-renewable natural capital, 2003-2013

In the case of UK's renewable natural capital, its value per capita decreased from £867 in 2003 to £665 in 2013, at an average rate of -2.5% per year. The declining rate for non-renewable natural capital is over four times slower compared with that of non-renewable natural capital. Figure 7 shows the changes in value experienced by UK's renewable natural capital between 2003 and 2013. The fall in renewable natural capital value during that period was mainly due to the loss of per capita value of agriculture and water supply assets, which exhibited a negative net change of -£231 (-37.6%) and -£57 (-55.3%), respectively, between 2003 and 2017. In reality, the total non-per capita value of the agricultural natural asset has been increasing slightly over the examined period at an average annual rate of 0.5%, as the output from the Agriculture industry in the UK has incremented as well. However, the

rate of increase of the value of this particular asset has been slower than the rate of population growth (0.7%) over the same period, resulting in decreasing per capita values. On the other side in renewables, timber and fishery are the only natural capital assets in all categories to have registered a net positive change in value of £78 (+102.6%) and £7 (+9.3%) respectively. Nevertheless, the increase in per capita value of these assets was not sufficient to overcome the losses introduced by the other non-renewable assets.

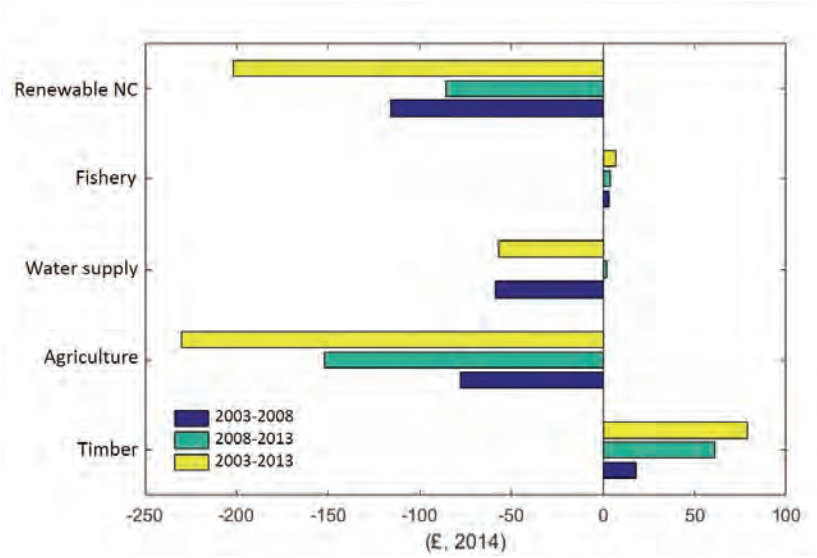


Figure 7. Changes in value for UK's renewable natural capital, 2003-2013

As illustrated in Figure 8, the per capita value of ecosystem services also declined from £27,381 in 2003 to £22,601 in 2013. The average annual decline rate for ecosystem services was -1.9%, the slowest among all of the natural capital forms. The value decline, in this case, has been primarily driven by a significant loss in value of outdoor recreation, which registered a net change in value of -£4,780 (-17.5%) between 2003 and 2013. Although the other ecosystem service of GHG sequestration

registered a positive net change of £114 (+122%) over the same period, this increase in value was too small to compensate for the losses registered for outdoor recreation. The decline of the outdoor recreation value is mainly associated with fluctuations in the total number of people visiting the natural environment in the UK during the last five years. Recreational visits to the environment were largely affected by the economic crisis and a reduction in GDP per capita as reported in the Outdoor Recreation Economy Report. On the contrary, the increasing value of GHG sequestration (i.e., capturing GHG from the atmosphere) is linked to the increase of timberland resources that has resulted from an increasing afforestation rate.

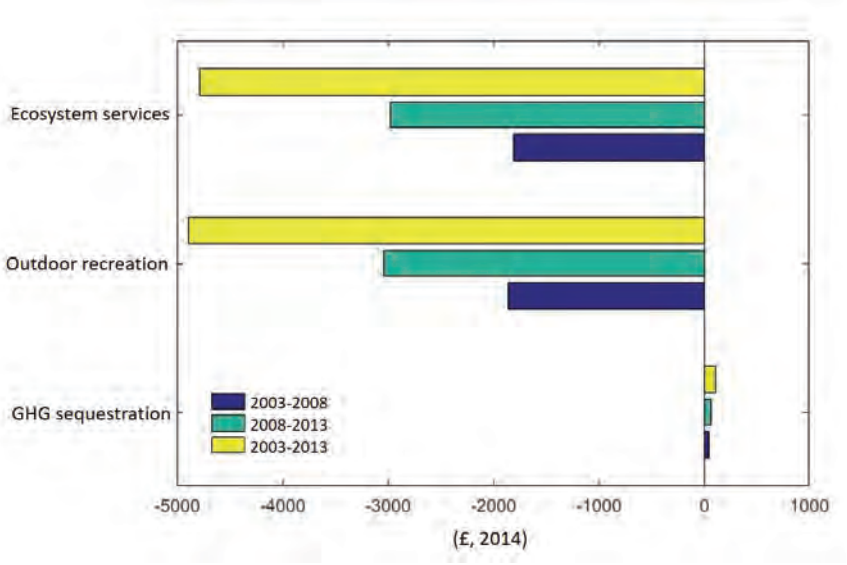


Figure 8. Changes in value for UK's ecosystem services, 2003-2013

In the analysis of the condition of the UK's natural capital, we found that most of the natural capital value (in the considered set of natural assets measured) is concentrated in ecosystem services. The ecosystem services of outdoor recreation and GHG sequestration represent nearly 90% of the value of all the natural assets

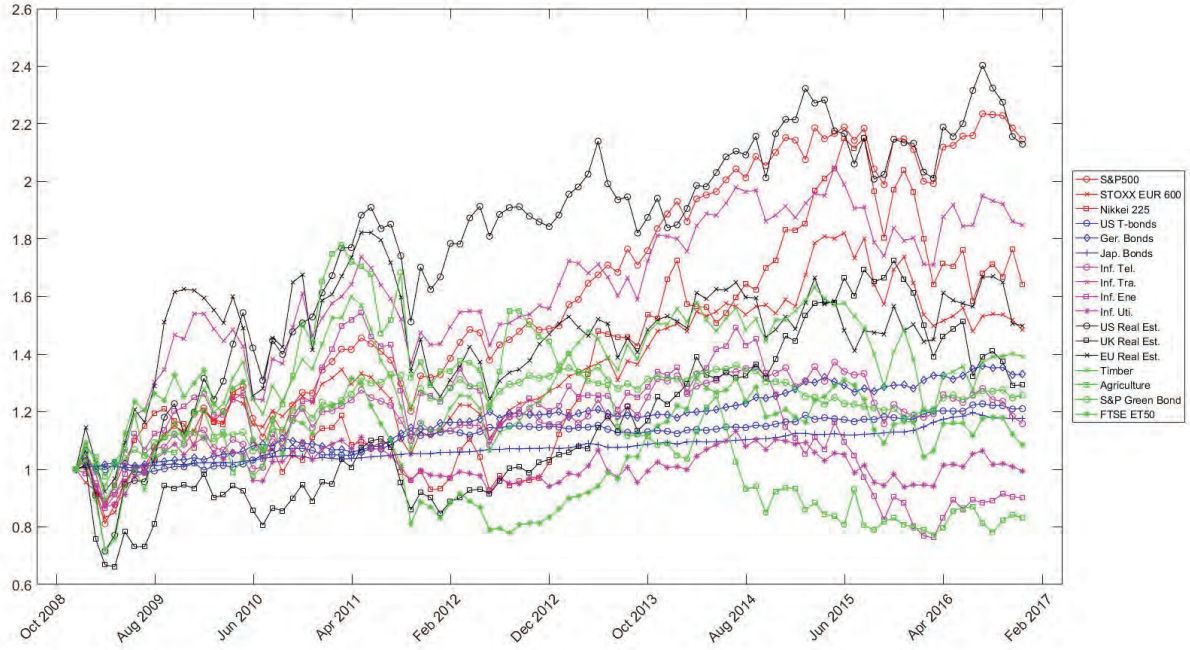
quantified in the UK. This is followed by the value of non-renewable natural capital, which accounts for nearly 6%, and renewable natural capital with the remaining 4%. Moreover, results from our analysis also indicate that the value of all the forms of natural capital, i.e., non-renewable, renewable and ecosystem services, have been in steady decline in the last 10 years. It is noteworthy that the rate of decline has been faster for non-renewable natural capital in particular, over the period 2003-2013, due to depleting oil and gas reserves. Thus, variations in the value of outdoor recreation, determined by the number of people visiting recreational sites, as well as reductions in oil, gas and coal production rates, represent the major drivers of aggregate natural capital value losses since approximately the year 2000. Nevertheless, as oil and gas reserves continue to deplete to exhaustion levels, and coal production progressively slows, the drivers of resources over the period 2015-2020 are expected to change. Factors from renewable natural capital, such as the outputs from the agriculture and water supply industry, will begin to take precedence over the factors from non-renewable natural capital, such as oil, gas and mineral production in affecting the risk of losing natural capital value. This finding provides a hint about the specific natural assets to which attention should be paid in the coming years in order to reverse the declining trajectory traditionally followed by natural capital value. That is, to increase the value of natural capital in the UK, priority should be given to investments and decisions that enhance the value of renewable natural capital and ecosystem services, with particular focus on outdoor recreation, agricultural production and water supply.

Natural capital investment performance

Investments in natural capital, in the form of green investments, are gaining increasing attention among governments and private investors seeking to deliver green economies and support the recovery of natural capital. However, despite growing interest in green investments, institutional investors' direct allocations in green assets remain low. Some of the main barriers preventing institutional investors from dedicating major investments into green or natural assets include lack of performance information, credible standards, little transparency, and low financial incentives. Whereas the incentives for investors to dedicate allocations in green assets can range widely from ethical considerations, image and reputation, response to legal and regulatory constraints, or ultimately the search for risk mitigation and higher financial returns. Nevertheless, green investments have traditionally been perceived by many investors as relatively poor performers as shown in Figure 9. If, however, institutional investors are to consider major green investments, it is fundamental that we determine whether the financial performance of green assets is verifiably advantageous.

Significantly increasing investments in renewable forms of natural capital will require private investor involvement. Private investors have traditionally regarded investments in natural capital as poor performers, and as a consequence given relatively little importance to these investments. In the aim to increase awareness of their benefits for investors, our research in this area investigates the performance of investments in natural capital assets and compared it with the performance of other traditional asset classes (e.g., equity, real estate and fixed income) as well as non-traditional assets, e.g., infrastructure. The results obtained from this

Figure 9. Monthly returns for equities, bonds, real estate, infrastructure and natural capital assets, 2008-2016



analysis demonstrate that direct investments in real natural capital may certainly be attractive to both private and institutional investors due to their financial benefits. Real natural assets, in the form of timberland and farmland properties, have exhibited higher average expected returns during the period 2004-2016, in addition to lower volatility and greater diversification potential, than those exhibited by traditional assets, such as equities, bonds and real estate. The differences in performance were more notorious, particularly after the 2008 financial crisis, i.e., we demonstrated that real natural assets can provide private investors with protection against unexpected inflation and hedging against the risk of liquidity shocks in stock markets. Nevertheless, all of the aforementioned benefits were absent in non-real forms of natural capital assets, which were shown to underperform when compared to the rest of the assets.

The differences in performance comparisons between real and non-real forms of natural capital assets were also confirmed in our investigation of the effects of their inclusion in investment portfolios composed of traditional asset classes and infrastructure. By modelling investment portfolios using out-of-sample simulation techniques with Markowitz portfolio optimisation, we showed that portfolios containing real natural assets outperform those excluding them in all the metrics tested (i.e., mean return, volatility, Sharpe ratio, and maximum drawdown). Conversely, the portfolios with investments in non-real natural assets tended to underperform the portfolios that excluded them. Therefore, the primary conclusion drawn from our analysis is that private investors seeking financial benefits in natural capital investments should focus on direct investments in real natural assets rather than indirect investments in non-real natural assets. Nevertheless, the lack of liquidity and long holding periods associated with real natural asset investments calls for investors with large amounts of capital under management, low liquidity constraints, and long investment horizons. These requirements still pose a significant challenge for many private and institutional investors in seeking their support for higher allocations in natural capital.

Sovereign Wealth Funds to invest in natural capital

The emergence of Sovereign Wealth Funds (SWF) as major global investments in the last decade now allows private investors to remove some of the aforementioned barriers to natural capital investment. Unlike other types of investors, SWFs meet the requirements set by real natural assets due to their large size and commitment to long-term investment. Moreover, since the majority of SWFs worldwide are funded by rents received from non-renewable natural capital exploitation, these funds have the opportunity to compensate for the depletion of non-renewable resources by investing their rents in renewable forms of natural capital, as depicted in Figure 10. When evaluating the performance of an SWF portfolio that dedicates major allocations in real forms of natural capital assets, the obtained results were robust. Results show that, when real natural assets were included in an SWF portfolio, the fund's performance improved significantly in terms of a better return-risk characteristic, greater market value growth, saved losses, and less exposure to commodity risk. Importantly, our results also revealed that the benefits of natural capital investments for an SWF are more apparent during times of financial hardship when equity investments tended to underperform. Furthermore, results also showed that levels of asset allocations by SWFs in natural capital, which are presently in the range of 2-5%, can be raised further to 15-20% with these funds still benefitting. Hence, overall results allow us to conclude that SWFs can, in fact, dedicate significant investments in natural capital

assets, and thus have the potential to become a credible financial mechanism in the recovery of natural capital value.

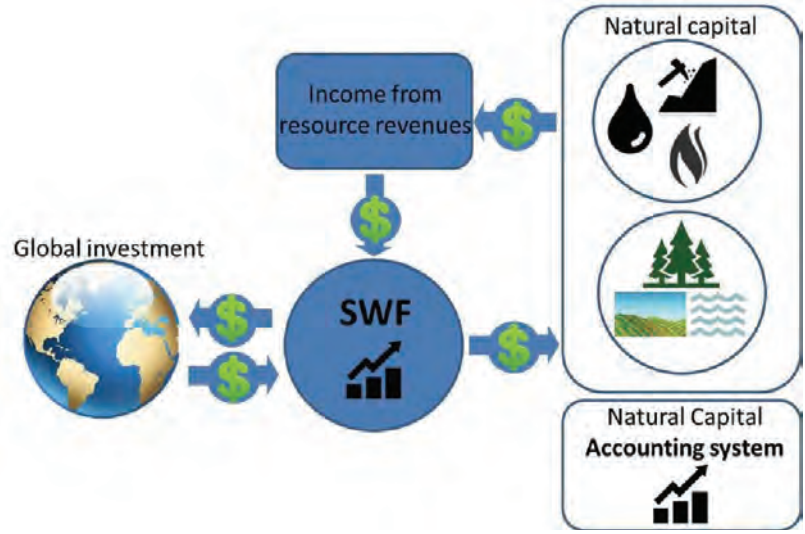


Figure 10. Sovereign Wealth Funds to finance natural capital

The characteristics of SWFs make them particularly suitable to preserve the value of different forms of natural capital. On one side, when used as saving mechanisms, SWFs can receive revenues realized from the liquidation of non-renewable natural resources (i.e. oil, gas, minerals) converting the value of this type of natural capital into a financial capital form that can be reinvested in a more diversified portfolio to preserve its wealth for the future. On the other side, as investment vehicles with a long horizon, SWFs can allocate part of their portfolio to directly invest in renewable natural capital and contribute to recovering their value. Given their large size, SWFs have the ability to invest for much longer time horizon compared with other financial instruments, which convert them in suitable investors for natural capital assets. Despite their attributes, SWFs are not exempt of limitations and challenges. The

main concerns associated to SWFs regard possible economic distortion, since some SWFs may find difficult to coordinate the fund's operations with fiscal policy; how to cope the lack of transparency, which can allow others to copy their investment strategy; effectiveness in achieving its goals; and the risk of acquiring proprietary knowledge, patented technology or trade secrets.

Despite their attributes, SWF investments have mainly focused on equities driven by short-term investments strategy goals. The high preference towards equity can be due to the absence of incentives to commit to other long-term alternatives. There are, however, two major factors that are currently influencing the investment strategy of SWFs. First, the growth of equity markets has shrunk considerably after the financial crisis experienced in 2008. As a consequence, equity markets are no longer as attractive as they used to be. The second major factor is that oil and gas markets have become more competitive with the introduction of the shale oil and gas revolution in the US. The arrival of shale oil and gas have impacted global energy markets, resulting in significantly lower oil prices in recent years, and thus reducing income for SWFs. Encouraged by the situation, these funds are taking a more active role in the direct management of their assets, and new trends are emerging in their SAA as a result.

The current context seems to be providing incentives for SWFs to seek long-term returns in more illiquid investments instruments. Among illiquid instruments, investments in natural assets such as timber and farmland have called the attention of some of the biggest SWFs, including both commodity and non-commodity sourced funds. As an example of this, China Investment Corp. - the world's third largest SWF – has announced their interest in including agricultural assets as part of their new investment strategy. Similarly, Angola's US$5 billion SWF is seeking investments in timber and agriculture to diversify it asset allocations and increase returns. Investments in natural assets are not new to SWFs. The New Zealand Superannuation Fund and Canada's Alberta Heritage Fund are SWFs that have been investing in timber assets since 2005. Other SWFs have followed this trend too. The Sovereign Wealth Fund Center reported in 2015 that 14 different SWFs have executed 51 deals into land, farm, forestry and agricultural businesses over the last 10 years, valued over US$ 11.1 billion. These include the Abu Dhabi Investment Council, Singapore's GIC and Temasek Holdings. The reasons for SWFs to invest in these assets are motivated by the potential of increasing returns, stabilizing volatility, providing portfolio diversification and protection against inflation. Yet, only a small portion of SWF portfolios is allocated in natural assets due to liquidity concerns.

Timberland and farmland are very illiquid assets compared to bonds or stocks. They take a long time to sell and their returns are driven in many cases by a slow biological growth process. This raises the concern of how to re-balance a portfolio with a significant weight on natural assets, making timberland and farmland unsuitable for many investors with horizons shorter than 10 years. Most institutional investors limit allocations in timberland and farmland to 1-5% of their portfolio, with only exceptional investors allocating up to 10%. Nevertheless, more recent commercial manager's research has started to project that institutional investors may well begin to increase the percentages of portfolio allocation in real assets (which include natural assets) to the range of 15-25% over the next several years.

Summary

This little book has shown that the value of natural capital in countries around the world, including the UK, has been continuously decreasing due to the degradation of natural resources. The lack of accounting and financial mechanisms dedicated to measure and recover the value of natural capital, combined with low investment allocations from private investors, have been a determinant factor contributing to this decline. Given this consideration, the present research defines three objectives in relation to natural capital accounting and finance. First, to investigate the use of natural capital accounts to study changes in natural capital value and identify the major factors impacting the risk of declining natural capital and wealth using the case study of the UK. Second, to analyse the performance of investments in natural capital assets. Finally, to examine the use of Sovereign Wealth Funds as a financial mechanism to dedicate major investments in natural capital.

In relation to the first objective, a stochastic model for risk analysis is developed to estimate changes in UK's wealth using data on produced, human, and natural capital asset values reported by UK authorities between 1992 and 2012. Results show that natural capital losses in the UK have been mainly driven by a decrease in value of non-renewable natural capital, together with variations in the value of ecosystem services. Nevertheless, as non-renewable natural capital reach depletion, focus shall be given over coming years to recover renewable natural capital. As part of the second objective, the present work evaluates the performance of investments in real and non-real natural assets and compare it with those of traditional asset classes using time series analysis of historical returns. The obtained results indicate that, when investing in natural capital, investors should focus on real natural assets as their financial benefits are higher than those from equities, bonds, real estate or even some infrastructure assets. Regarding the final objective, this work models the investment portfolio of an oil-based SWF using Norway's Pension Fund Global as a case study and employs out-of-sample simulation technique to estimate global efficient portfolios while considering their relationship with oil prices. In this regard, the final results demonstrate that SWFs are able to challenge their current allocation range in natural assets (2-5%) to a higher range (15-20%) while still benefiting from those investments.

Based on our investigation, we have concluded that:

On UK's natural capital

- UK's national wealth is mainly constituted by human and produced capital (94%), whereas natural capital represents only a minor share (6%).
- Natural capital is unlikely to have a direct effect on the risk of declining per capita wealth.
- Most of UK's natural capital is found in the ecosystem services, particularly outdoor recreation.
- Therefore, the aggregated value of UK's natural capital is mainly driven by changes in the value of ecosystem services.
- Given the depletion of non-renewable natural resources in the UK such as oil and gas, increasing importance will be gained by renewable forms of natural capital in coming years.

On natural assets investment performance

- Real natural assets outperform investments in traditional asset classes such as equities, bonds, real estate, and non-traditional ones, namely infrastructure.
- Investments in real natural assets provide hedging against unexpected inflation, reduce downside risk and lower the exposure to liquidity shocks in financial markets.
- Major challenges of natural capital investments include their long investment horizon and low liquidity, as compared with equities or bonds.
- Investments in real natural assets require investors with long investment horizons, long holding periods and low liquidity constraints.

On the use of Sovereign Wealth Funds

- Including natural asset investments in an oil-sourced SWF portfolio have a positive effect on its performance.

- Benefits are manifested in the form of higher expected returns, lower volatility, greater savings, and hedging against oil price risk.
- The benefits of natural asset investments are more evident during time of crisis when equities perform poorly.

The research summarized in this little book shows that combining the importance of effective natural capital accounts, the financial benefits of natural capital investments, and the role of financial mechanisms such as SWFs is essential to increase the value of natural capital.

Resources

This is a small section containing websites about sharing initiatives and further readings. As with any of these digital resources, they grow and change rapidly, but we thought we'd give you some of the websites and readings we liked.

Natural capital initiatives:

UK's Natural Capital Committee (NCC): https://www.gov.uk/government/groups/natural-capital-committee

Natural Capital Coalition: http://naturalcapitalcoalition.org/protocol/

World Forum on Natural Capital: https://naturalcapitalforum.com/about/

Natural Capital Initiative: http://www.naturalcapitalinitiative.org.uk/

Sovereign Wealth Fund Institute: https://www.swfinstitute.org/

Sovereign Wealth Fund Center: http://www.sovereignwealthcenter.com/

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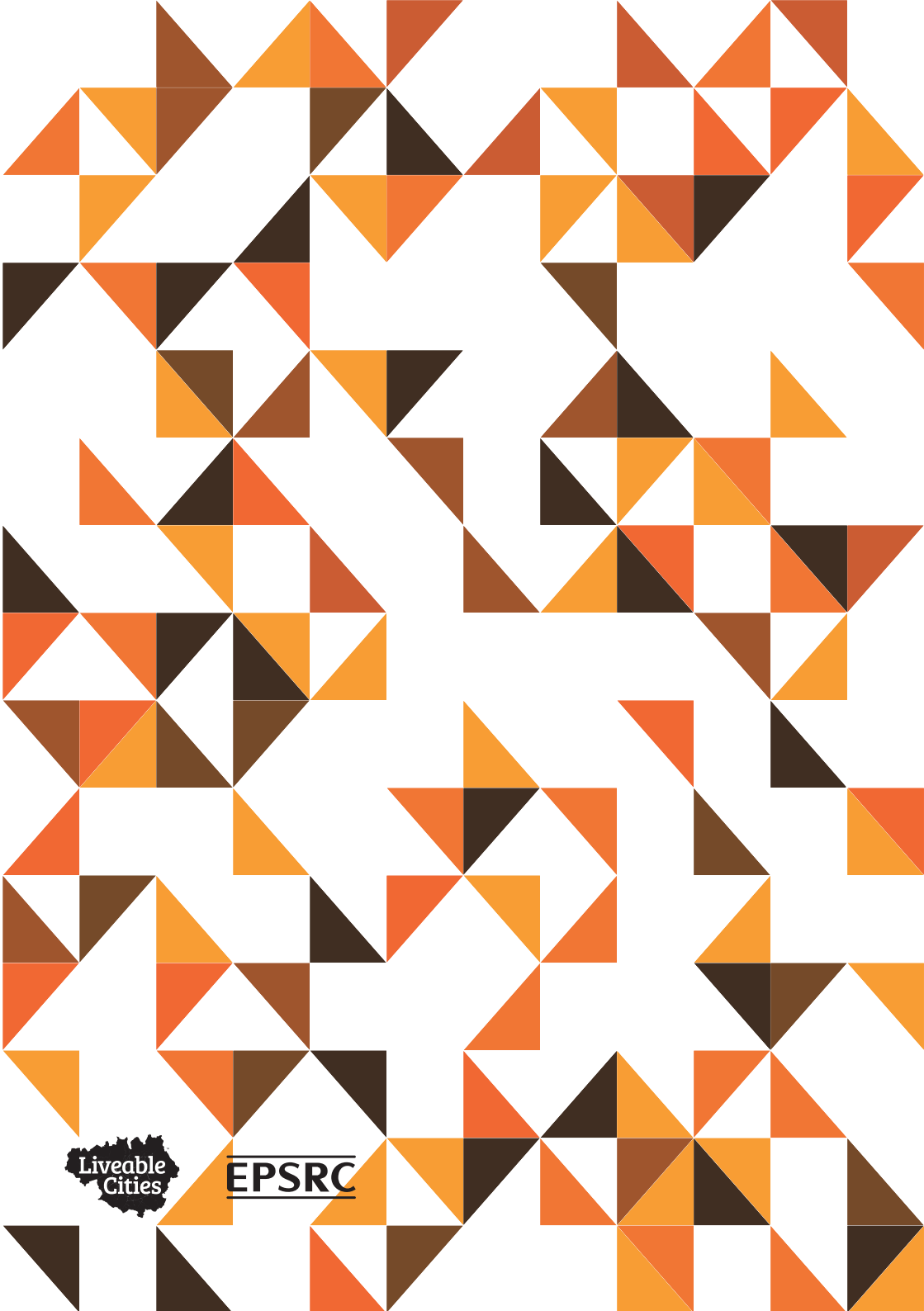
Liveable
Cities
EPSRC