Working paper

Inclusive, sustainable economic transformation

An analysis of trends and trade-offs

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Key findings

Among low-income and lower-middle-income countries (LICs and LMICs), increases in labour productivity are accompanied by poverty reduction. By contrast, the relationship in upper-middle-income countries (UMICs) is weak, which might relate to higher total factor productivity and capital substitution in UMICs. It might also suggest that additional factors including redistributive policies around education, social protection and other social policies may play a stronger role in driving poverty reduction in UMICs.

Increases in gross domestic product (GDP) per capita, labour productivity and diversification tend to be accompanied by increases in greenhouse gases (GHGs) and material footprints across country groups, but more so among UMICs.

Among LICs, poverty reduction and inclusion are correlated with national increases in material footprint per capita. However, starting points matter, and the increases in material footprint among this group are from very low levels.

LICs and LMICs that are doing particularly well on growth and poverty often have a higher material footprint; however, this contributes to a fair share of consumption for a more decent standard of living (if equitably distributed) and does not exceed ecological thresholds as in other income contexts. There is a mixed relationship between poverty and growth among UMICs. Countries faring better on both dimensions tend to have a higher material footprint, often exceeding ecological thresholds, though at lower levels than in high-income countries (HICs).

Certain enabling conditions support ‘Nexus’ outcomes of economic transformation, social inclusivity and environmental sustainability. In LICs, the role of government effectiveness may be relatively important. In LMICs, and particularly in South Asia, improvements in risk management might help explain some of the successes. Among UMICs, improvements in risk management and government effectiveness may be necessary but not sufficient enabling conditions, again pointing to the potential role of other social policies in these processes. In all cases, there are also likely to be other factors (e.g., norm change, diet, education of a middle class, aspects of political change) that constitute this enabling environment, an area of investigation for future research.

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Acronyms

GDP	gross domestic product
GHG	greenhouse gas emissions
EAS	East Asia and Pacific
ECS	Europe and Central Asia
HIC	high-income country
LCN	Latin America and the Caribbean
LIC	low-income country
LMIC	lower-middle-income country
MEA	Middle East & North Africa
PNG	Papua New Guinea
PPP	purchasing power parity
SAS	South Asia
SIGI	Social Institutions and Gender Index
SSF	Sub-Sharan Africa
UMIC	upper-middle-income country

Contents

1 Introduction

Although policymakers often tout economic growth and transformation as a golden goose to promote prosperity and the goals of the Sustainable Development Agenda, some countries are seeing increases in inequality and stalling or reversing poverty reduction despite increases in labour productivity or GDP per capita. In addition, climate change may affect the pace of growth and other drivers of inclusion, but growth itself may proceed in ways unsustainable for planetary boundaries.

As such, there is an urgent need to develop a joined-up understanding of and decision-making on these issues. Already, there is increasing recognition that other measures of wellbeing need to be considered alongside growth in contributing to welfare, and that these measures do not necessarily flow from economic transformation. Instead, what is needed is a more holistic prioritisation of people and planet, such that pillars of transformation, inclusivity and sustainability can go hand in hand. This in turn requires an evidence-based understanding of country progress in these domains.

The purpose of this analysis is to explore advances made in low- and middle-income countries around economic transformation, social inclusivity and environmental sustainability (see Box 1). These three pillars together are identified in this analysis as 'Nexus' outcomes. The study draws on a range of country-level data across these three dimensions to examine synergies and trade-offs between domains and the state of progress since the turn of the century (see Table 1 for data sources).

Box 1: Key definitions

- Economic transformation – moving employment to higher-productivity and higher-value activities that enable increases in human and physical capital. This may also encompass improvements in productivity within sectors through innovations and efficiencies.
- Environmental sustainability – economic and social activity happens while conserving biodiversity and ecosystem function, reducing pollution (including GHGs) and using natural resources in ways that take account of the needs of future generations.
- Social inclusion – benefits of transformation reach the bottom of the distribution, especially those facing discrimination and multiple disadvantages; and providing children with the means to be included in future transformation.

Source: Nexus Theory of Change

The analysis is organised as follows: Section 2 lays out the methods guiding the analysis presented in this paper. Sections 3 undertakes trend analysis, Section 4 presents a descriptive analysis of two-way relationships between domains, and Section 5 present the results of the cluster analysis and descriptive complements underpinning the

analysis of Nexus outcomes. Section 6 offers emerging policy recommendations and concludes.

2 Methods

This report relies on an analysis of a range of indicators of economic transformation, inclusion and environmental sustainability over the period 2000 to 2019. A rationale for the choice of indicators and further details are outlined in Annex A. While some of the indicators have been used to construct other indices (e.g., Human Development Index, Sustainable Development Index) or dashboards (e.g., the Sustainable Development Goals – SDGs), we focus on a subset that are perceived to be particularly important in nurturing transformation, inclusion and sustainability. We rely on data since the turn of the century, when the Millennium Development Goals were first implemented and the SDGs subsequently introduced. This represents the continuation of a period when issues beyond economic growth, especially around human development and capabilities, began to gain attention in international development discourse (Sen, 1992; Nussbaum, 2000; Robeyns, 2005). Most of the data we rely on is more consistently available in the post-2000 period, and so the focus is also a pragmatic one.

In addition to the three Nexus pillars, we add a focus on risks and governance, which we hypothesise as being key mediating contextual factors that can structurally affect the degree of social inclusion, environmental sustainability and economic transformation observed. There is likely to be a range of other factors (e.g., norm change, diet, education of a middle class, aspects of political change) that affect the enabling environment, but our focus on risks and governance is an initial attempt to begin to understand some of the contextual and structural conditions that can affect Nexus outcomes.

Table 1: Definition of indicators used in this analysis

Indicator	Short description	Coverage	Source
Social inclusion			
Poverty headcount ratio	The percentage of the population living on less than $1.90 a day in 2011 international prices	2000–2019 interpolation	PovcalNet (2021)
Multidimensional Poverty Index headcount	Percentage of population deprived in at least one-third of weighted indicators in health, education, living standards deprivations, with the three dimensions equally weighted	Two years (variable)	OPHI (2021)
Social Institutions and Gender Index	Laws/social norms/practices on social institutions and gender, including factors such as discrimination in the family	2014, 2019	SIGI (2021)
Inequality in the bottom half	Measure of inequality in the bottom half of the distribution – ratio of income accruing to the bottom 20% relative to the bottom 50%	2000–2019, with missing values	Constructed from PovcalNet (2021)

Environmental sustainability			
GHG emissions per capita	Includes all sectors (including agriculture, bunker fuels, energy sub-sectors, industrial processes, land-use change and forestry, and waste) and gases (Kyoto GHGs)	2000–2018, with three year lag	ClimateWatch (CAIT dataset)
Material footprint per capita	The sum of domestically produced and imported raw materials (biomass, fossil fuels, metals and non-metallic ores) divided by the population	2000–2019	materialflows.net
PM2.5 air pollution, mean annual exposure	Average level of exposure of nation's population to concentrations of suspended particles measuring <2.5 microns in aerodynamic diameter, capable of penetrating deep into respiratory tract causing severe health damage	2000, 2005, 2010-2017	WDI (2021)
Terrestrial and marine protected areas	(% of total area) Terrestrial: totally or partially protected areas of at least 1,000 hectares. Marine: intertidal or subtidal terrain – and overlying water and associated features – reserved to protect part/all of enclosed environment	2016–2018	WDI (2021)
Economic transformation			
Gross domestic product per capita	GDP per capita based on purchasing power parity (PPP). Data are in constant 2017 international dollars	2000–2020	WDI (2021)
Diversification index	Indicates whether the structure of exports or imports by product of a given country differs from the world pattern	2000–2019	UNCTAD (2021)
Labour productivity	Gross domestic product divided by total employment in the economy. GDP is converted to 2017 constant international dollars using PPP rates	2000–2020	WDI (2021)
Risk and governance context			
INFORM risk	Three dimensions to assess risk: hazard and exposure, vulnerability and lack of coping capacity-concepts related to the needs of humanitarian and resilience actors	2012–2021	INFORM (2021)
ND-GAIN Readiness	A measure to reflect countries' abilities to leverage investments and convert them to adaptation actions. Three components – economic readiness, governance readiness and social readiness	2000–2018	Notre Dame Global Adaptation Initiative
Government effectiveness	A measure to reflect perceptions of quality of public services, quality of civil service and degree of its independence from political pressures, quality of policy formulation and implementation, and credibility of government's commitment to such policies	2000–2019	WGI (2021)

Note: See Annex A for more details.

The analysis presented in this report is organised sequentially, where we first examine trends in individual indicators over time (Section 3), then investigate two-way correlations, and finally focus in on three-way comparisons across our three domains of interest (Section 4). This enables us to examine individual domains over time and how the layering of inclusion and sustainability considerations interplays with processes of economic transformation over time. It differs from conventional analyses of economic transformation, which tend to examine increases in GDP per capita or labour productivity and then

try to understand why these have occurred and their impacts. We also rely on an assessment of the risk and governance context hypothesised to be important components in the enabling environment. Even so, there are also likely to be other factors (e.g., norm change, diet, education of a middle class, aspects of political change) that constitute this enabling environment, to be explored in future research. Our focus is not on explaining key drivers of Nexus outcomes but rather examining the presence of relationships for further investigation.

In our assessment of Nexus outcomes, we rely on a pooled k-means cluster analysis to identify groups (clusters) of countries that had variable performance on the Nexus outcomes and to understand changes in countries' alignment with the clusters over time. Our process follows a constellations of fragility analysis undertaken on a different topic (to assess state fragility) by Ziaja et al. (2019). We apply this process to our analysis given our similar interest in understanding constellations of outcomes, albeit on a different set of issues. Further details on the method are presented in Annex C. Alongside this method, we examine rates of change in key indicators over time, which helps assess the sensitivity of results from the cluster analysis as well as offering additional nuance.

We distinguish different country income groups based on present-day status to recognise the different pace of economic growth that could affect degrees of transformation, inclusivity and sustainability. Our focus on aggregating by country income groups while examining certain Nexus indicators alongside recognition of structural conditions is just one way of approaching this analysis; there are other forms of aggregation that would likely yield different results. Even so, the emphasis on change also inherently draws attention to conditions that might enable change, such as the degree of human or physical risk a country faces, as well as its capacity for governance.

3 Trends by domain

As countries undergo economic transformation, we would expect employment in higher productivity, higher value activities that can enable improvements in human and physical capital. This in turn has the potential to contribute to wealth generation and poverty reduction. At the same time, there is a complexity underlying this that might make the relationship less clear. For example, diversification may contribute to higher value activities in certain cases, as well as to economic stability, which may further propel poverty reduction; on the other hand, it could limit countries' comparative advantage and thus weaken the link. In addition, certain growth processes may not be environmentally sustainable, while others may offer opportunities for greening.

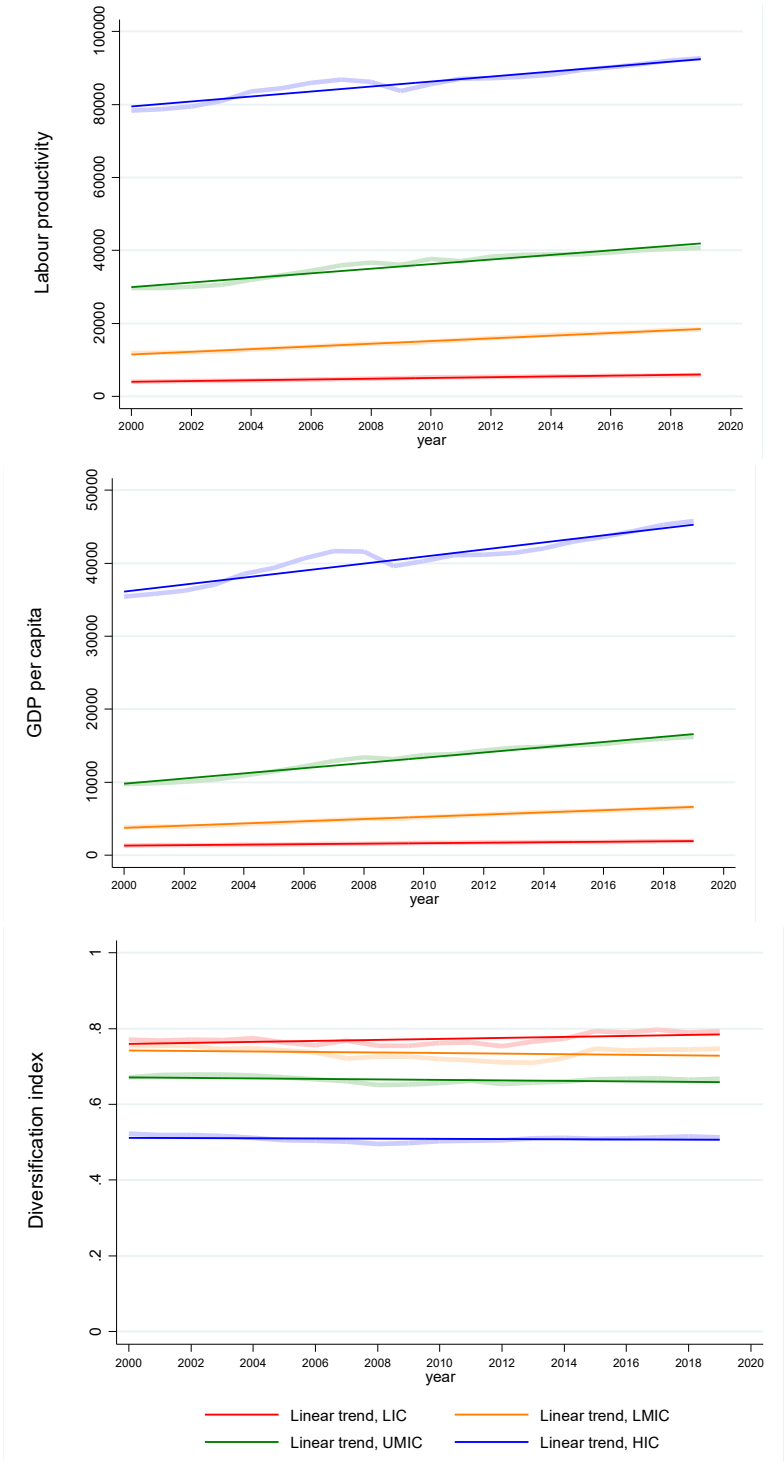
Understanding country progress along these dimensions of economic transformation, environmental sustainability and inclusion is an important first step before assessing the relationship between these dimensions. This section presents country-weighted trend analysis, categorised by country income grouping.

Economic transformation

By country income group, there is a large difference in the labour productivity levels of HICs compared to other countries (Figure 1), which partly reflects the underlying correlation between this measure and per capita GDP. This productivity is only very slightly improving in LICs, and the slow pace of improvement has contributed to divergence with other country groups. In relative terms, the annual rate of improvement in labour productivity is lower among LICs compared to MICs, though higher than in HICs on account of different baselines. However, trends need to be viewed with caution, as they also depend on the employed population, which is affected by changing demographics over the years, variably for different country groups. In addition, the relationship between labour productivity and changes in the structural composition of growth varies and could affect the degree of economic transformation (see Annex D).

LICs also have lower levels of diversification over time (values closer to 1), compared to other groups where diversification is very marginally increasing and contributing to a slight divergence in rates between the country income groups (Figure 1). This divergence between country income groups is driven by certain LICs in sub-Saharan Africa that have narrowing economic bases, particularly South Sudan over the last decade (2012–19), as well as Eritrea, Burkina Faso and Mali over the last two decades. Again, the difference in levels of diversification between HICs and other income groups is stark. This is relevant given that among LICs and MICs, increases in labour productivity are correlated with increases in diversification, with this relationship being particularly pronounced among LMICs (see Annex D3). This relationship is reversed among HICs, and together may reflect a U-shaped curve relating sectoral concentration to per capita incomes more generally (Imbs and Warcziag, 2003). As such, the low and decreasing levels of diversification among LICs do not bode well for its ability to spread risk and potentially improve welfare.

Figure 1: Trends in economic transformation



Social inclusion

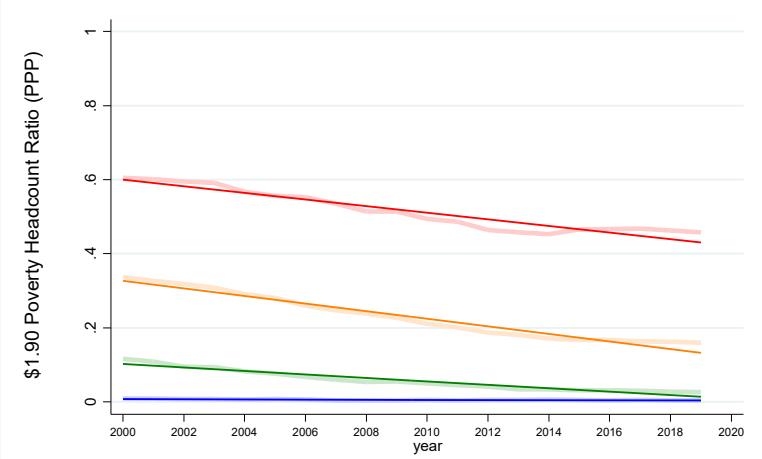
When examining inclusion trends since the turn of the century (to pre-pandemic 2019), we observe that extreme poverty rates are generally high but reducing in LICs and MICs (Figure 2). LICs saw estimated country-weighted average poverty rates of 45.8% in 2019, compared to 16.2% in LMICs and 2.7% in UMICs (author's analysis of PovcalNet, 2021). In terms of absolute numbers, though HICs had shares of people in poverty that were relatively constant between 2000 and 2009 (about 6.8–6.9 million people on average), there was in increase in LICs (207 million in 2000 to 265 million in 2019). LMICs and UMICs

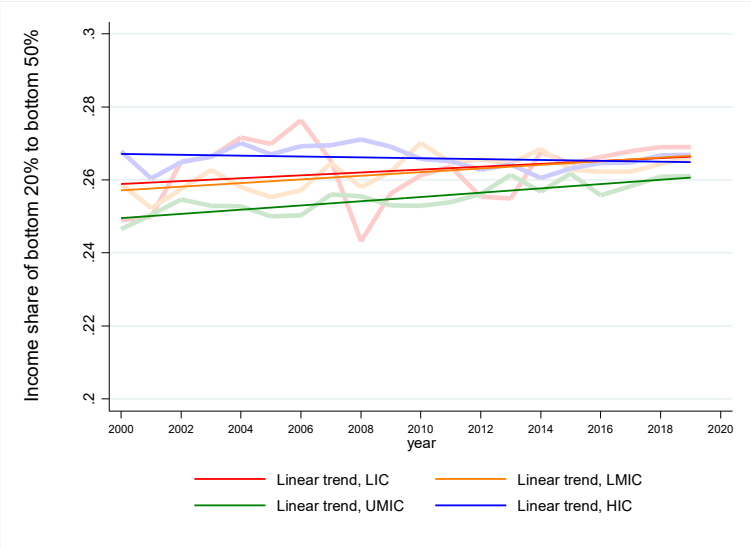
saw poverty numbers drastically reducing, from 833 million in LMICs in 2000 to 225 million in 2019, and from 616 million in UMICs in 2000 to 41 million in 2019 (author's analysis of WDI, 2021; PovcalNet, 2021). Reflecting this, poverty rates have also fallen slightly faster in LMICs than LICs, pointing to divergence over time between these sets of countries, which could partly reflect changes in income country categorisation. Instead, there is typically only a small difference between UMICs and HICs in more recent years, due to decreases in poverty among UMICs. The difference between LMICs and UMICs shows signs of convergence in poverty rates over time, though with LMICs still with higher rates of poverty on average.

These stark differences carry over to other dimensions of inclusion, such as average rates of multidimensional poverty and the Social Institutions and Gender Index (SIGI), where the difference between LICs and LMICs is large, as is the difference between LMICs and UMICs (Figure 2). In terms of the SIGI, out of countries with available data in 2019, certain countries in the Middle East and South Asia (Yemen, Pakistan, Iran, Jordan, Lebanon, Bangladesh, Iraq, and others) had some of the worst SIGI scores, brought down particularly by weak scores for discrimination in the family and civil liberties. The former captures institutions limiting women's decision-making power, such as formal and informal laws, social norms and practices in areas such as marriage, inheritance, and household responsibilities. Civil liberties reflects discriminatory laws and practices constraining women's access to public space and their political voice and participation. Outside of the Middle east and South Asia, where inequality tends to be higher, only Guinea featured in the worst 10 scores, again due to family discrimination as well as restricted physical integrity.

In terms of inequality within the bottom half of income distributions, LICs report income received by the bottom 20% to be a larger share of the total income received by the bottom 50%, when compared to MICs (Figure 2). This is mainly due to the low share of income accruing to the bottom 20% in UMICs. Though overall trends are equalising over time, this still points to the presence potentially of a Kuznets phenomenon, where inequality first increases and then decreases as an economy develops across country income groups. Interestingly, HICs are the only group where the share of income among the bottom 20% is marginally declining over time. Finally, in Latin America and the Caribbean, the bottom 20% share of income is also increasing, though from very low levels (Figure 2). We also see an increase in East Asia and Pacific, possibly linked to labour-intensive manufacturing and agricultural growth, and informal sector growth.

Figure 2: Trends in inclusion


$1.90 Poverty Headcount Ratio (PPP)
0
.2
.4
.6
.8
1
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
year


Income share of bottom 20% to bottom 50%
.2
.22
.24
.26
.28
.3
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
year
Linear trend, LIC
Linear trend, LMIC
Linear trend, UMIC
Linear trend, HIC

Environmental sustainability

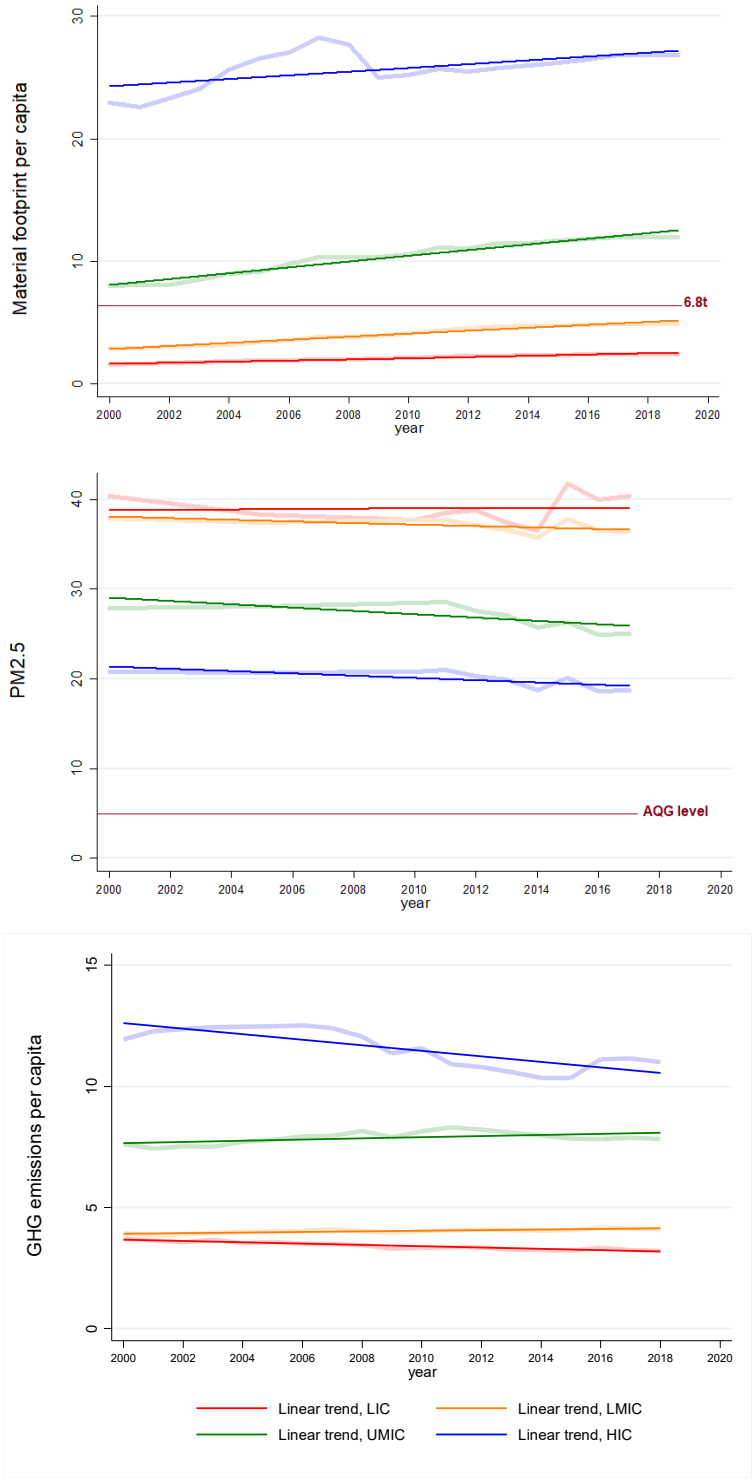
In terms of environmental sustainability, HICs tend to be very different to other income groups on all dimensions except for average protected areas (the similarity of which across income groups is possibly related to its more *de jure* nature). HICs have the highest global environmental footprints, measured here using material consumption and GHG emissions, but enjoy clean local environments, measured here by air pollution (PM2.5) and protected areas.

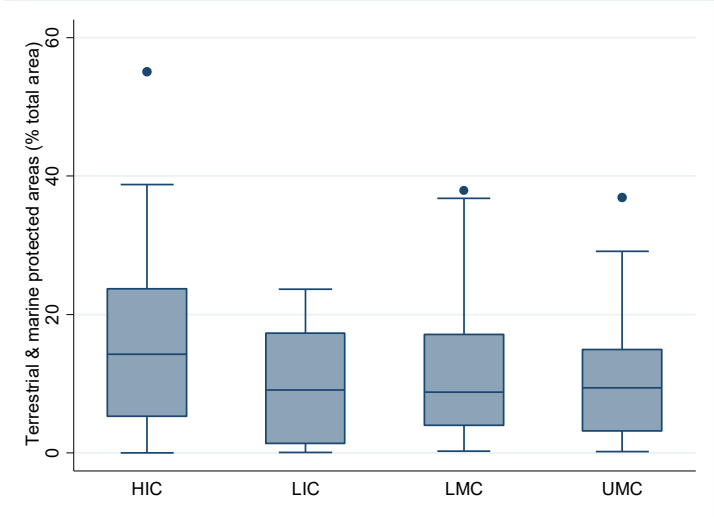
There is marked convergence between HICs and MICs with respect to per capita GHG emissions, mostly due to reductions by HICs. This differs from material consumption-based footprints, which continue to increase in HICs. Per capita GHGs in UMICs have also increased, primarily driven by Central Asian countries (Turkmenistan, Georgia and Kazakhstan) but also China. Per capita material footprints continue to increase in all regions, though there are much slower rates of increase in LICs and LMICs, and these remain below per capita sustainability thresholds.[1] In other contexts, the increase is particularly alarming given that higher rates of material consumption are necessary to eradicate poverty and boost living standards but that unsustainable levels of material consumption (and associated waste

[1] We adopt the 6.8t per person per year suggested by Hickel (2020), who derives this limit based on Bringezu et al.'s planetary boundary of 50 billion tonnes per year, which is then divided by the 2015 population.

and pollution) will lead humanity to exceed critical ecological thresholds.

Figure 3: Trends in environmental sustainability





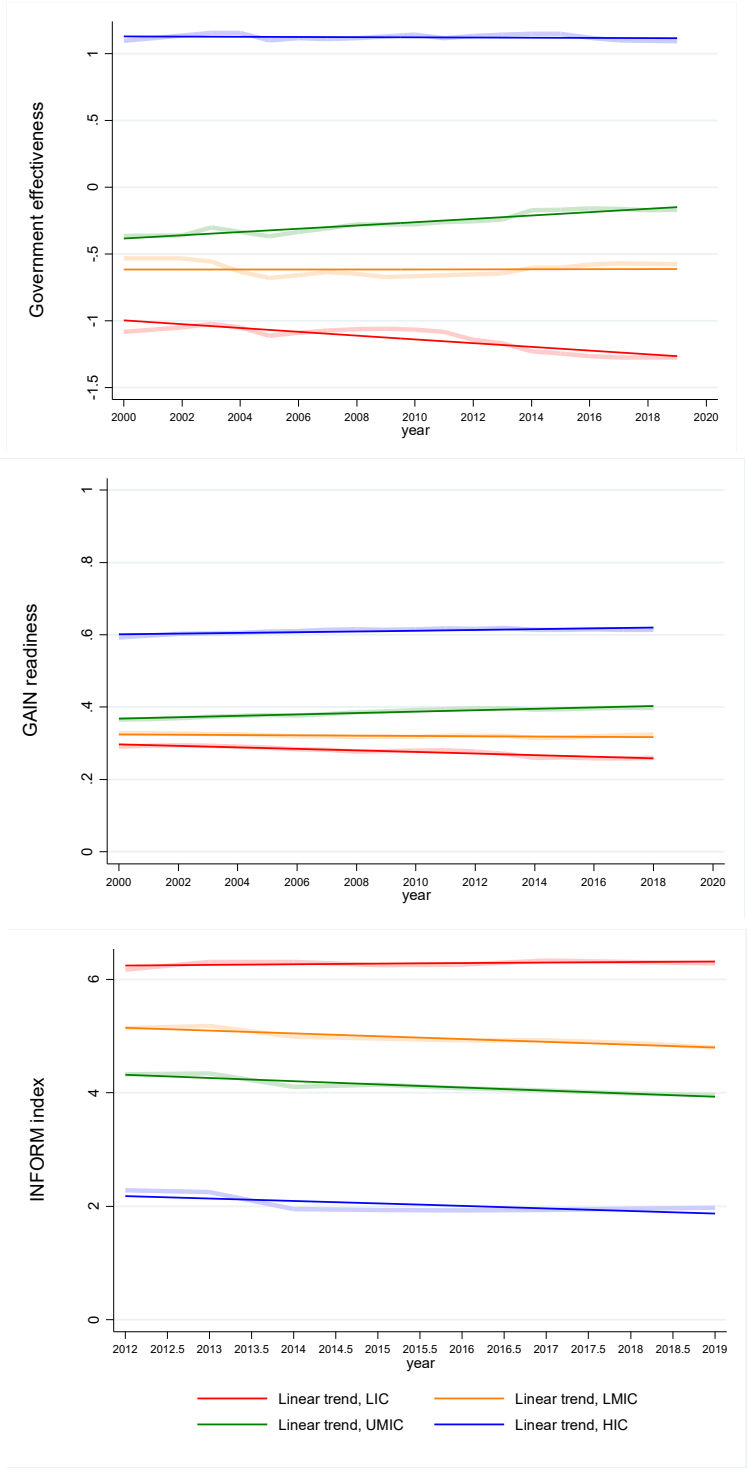
Air pollution is falling in all countries except LICs, though absolute levels continue to be very high in LMICs as well, and well beyond the 'safe' threshold recommended by the Air Quality Guideline levels (WHO-EURO, 2021). There is considerable variation within most income brackets (and often within individual countries), subject to factors such as industrial base and geophysical conditions, as well as the level of localisation in cases where the data may be based on one or two measuring sites plus satellite information. Among LICs, for example, Niger, Sudan, the Central African Republic, Uganda, and Ethiopia are all seeing higher levels of air pollution while certain LICs like Afghanistan, the Democratic People's Republic of Korea (North Korea), and Tajikistan have achieved notable reductions. However, the pace of improvement of these exemplar countries is far surpassed by Sri Lanka, the LMIC with the strongest decline in PM2.5 of almost three-fold over the same timeframe. However, the Sri Lankan case needs to be viewed with caution considering differences in data values depending on the dataset used, as noted in Section 2.

Risk and governance context

Finally, the underlying risk context (INFORM risk score, ND-GAIN readiness and WGI government effectiveness scores) that influence the outcomes above point to some interesting trends. For example, we observe deteriorating government effectiveness in the last two decades among LICs, improvements among UMICs, and relatively no progress among HICs and LMICs, though HICs begin at much higher levels of perceived effectiveness. These risk indicators also showcase large differences in HICs (much lower risk levels) compared to other income groups. Moreover, there is a divergence in government effectiveness driven by deteriorating conditions in LICs, which include a large share of fragile states. The ND-GAIN index on countries' readiness to improve resilience is also reducing in LICs as well as LMICs, though the latter at a slower pace, suggesting that

these countries are particularly susceptible to climate change and have a weaker ability to adapt. These fragile situations marked by limited state capacity are further reflected in high and increasing INFORM risk scores, pointing to the increasing vulnerability and precarity in these countries that is likely to hamper efforts at poverty reduction as well as inclusive, sustainable forms of economic growth and transformation.

Figure 4: Trends in risk context



4 Progress within and between domains

We next compare the domains of economic transformation, inclusion and sustainability. In this exploration, we: (1) focus on indicators with sufficient trend data coverage over the two decades;[2] (2) limit the economic transformation indicators to labour productivity and diversification;[3] and (3) focus on low- and middle-income countries that may not be able to mobilise domestic revenues as easily as HICs to address this Nexus. Country codes are included in Annex B, and sensitivity analysis in Annex C.

4.1 Inclusion and economic transformation

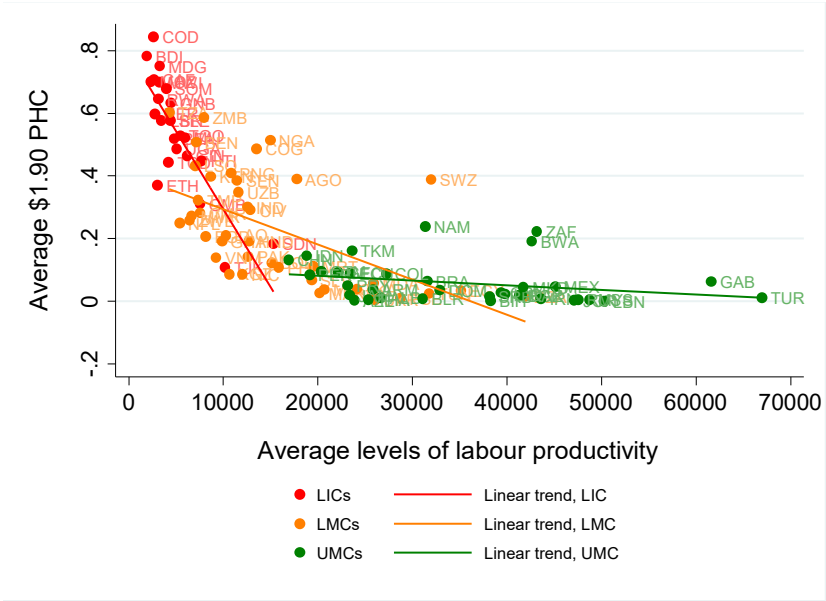
Key message: Among LICs and LMICs, increases in labour productivity accompany poverty reduction. The same relationship is weaker in UMICs, where levels of labour productivity are on average much higher. This suggests that perhaps additional factors such as education, social protection and other social policies beyond economic development may play a stronger role in driving poverty reduction in these contexts.

There are noticeable differences in the progress made in labour productivity compared to progress in poverty reduction depending on income level of countries, as displayed in Figure 5 (top). **The reductions in poverty accompanying absolute annual improvements in labour productivity appear to be highest for LICs, followed by LMICs**. Among UMICs, the correlation virtually disappears, suggesting that increasing marginal returns to productivity, even at similar magnitudes of change, may have less of a poverty-reducing effect. A similar relationship is observed in terms of the change in the share of income accruing to the bottom 20% of the population relative to the bottom half of the population, where an increase in labour productivity correlates with improvements in the share of income for the bottom 20%, particularly among LICs and LMICs.

Figure 5: Poverty reduction and labour productivity average change (top) and levels (bottom)

[2] This excludes a discussion of changes in multidimensional poverty, SIGI, and terrestrial and marine protected areas, where typically just two or three data points are available over the two decades.

[3] For the most part, this excludes GDP per capita for ease of communication due to its strong correlation with labour productivity.

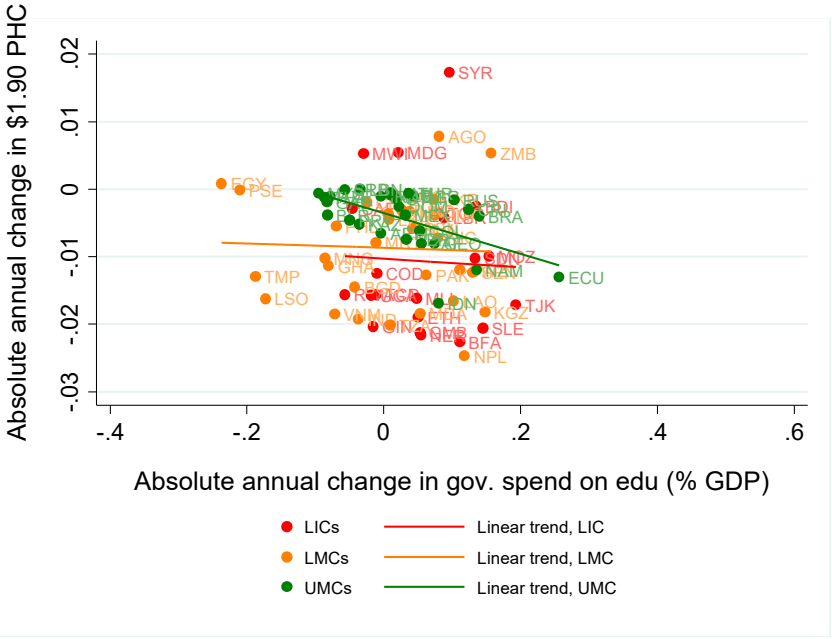


The relatively weak correlation for UMICs may stem from their higher average levels of labour productivity to begin with. Indeed, comparing changes in poverty rates with the average levels of labour productivity in Figure 5 (bottom) points to this difference by income level, reflecting diminishing returns to labour productivity improvements. After a certain point, it is likely that even if changes in poverty are not driven by changes in productivity (from a higher base), a high level of productivity itself might be enough to spur poverty reduction.

Poverty reduction in UMICs could also be driven by social policies such as around education and social protection. Depending on their distribution, these can help ensure that the gains of economic development are widely shared. Indeed, Figure 6 plots the relationship between changes in poverty headcounts and in government spending on education as a share of its GDP after removing Yemen, Zimbabwe, South Sudan, and Myanmar as LIC/LMIC outliers. The relationship appears relatively consistent

among LICs and LMICs, with a similar relationship observed when examining inequality. However, the relationship is reversed among UMICs. UMICs that have seen increased government spending on education also tend to have faster rates of poverty reduction. This suggests that UMICs could theoretically ease up on footprint and GHG-increasing growth in favour of less polluting growth, and still reduce poverty through social policies and redistribution. However, there may be perceived trade-offs between investments for greener growth and strong redistributive social policies, just as there may be perceived trade-offs with investments for labour productivity increases and social and environmental goals. Even so, this trade-off may implicitly cast human and environmental objectives as a cost or hindrance to economic development, instead of a purpose.

Figure 6: Poverty reduction and change in government education expenditures



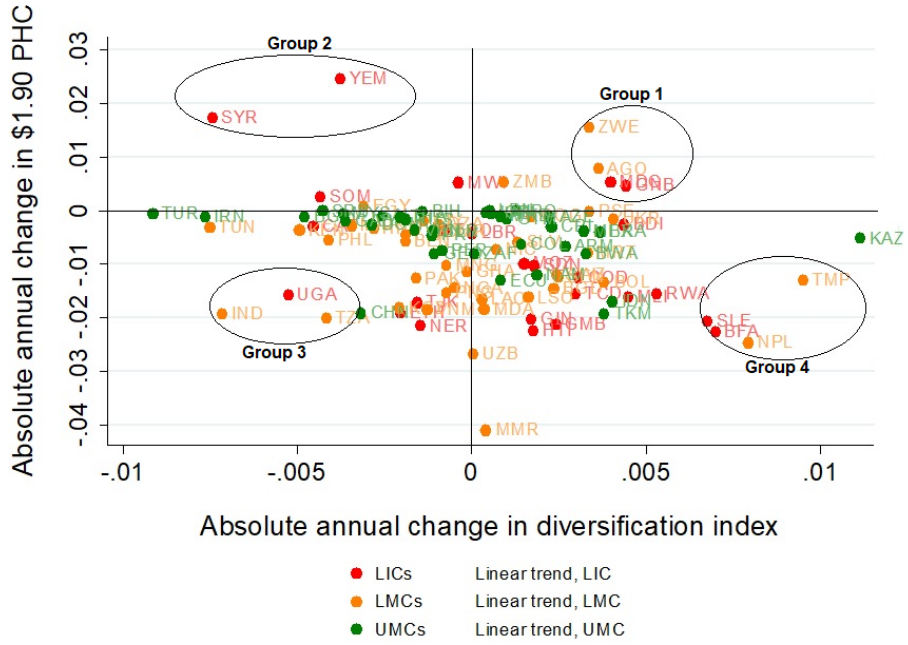
Diversification bears an unexpected relationship with poverty reduction. For LICs,[4] diversification of the export base (whether in terms of change, as in Figure 7, but also in terms of average levels) appears more frequently among countries experiencing increases in poverty reduction. However, among other income brackets, the relationship is less clear. This may be due to the importance of services and other international financial flows that may play an important role in economic activity but are not captured by the diversification index. Even so, some outliers that might be affecting these trends though are worth drawing attention to in Figure 7:

- Group 1, crises-affected LICs and LMICs: increasing poverty and less diversification (Zimbabwe, Angola, also Madagascar, Guinea-Bissau).

[4] South Sudan excluded as extreme outlier.

- Group 2, conflict-affected LICs: increasing poverty but more diversification (Syria, Yemen).
- Group 3, relatively more stable LICs and LMICs: decreasing poverty and more diversification (India, Uganda, Tanzania).
- Group 4, mix of types, some post-conflict LICs and LMICs: decreasing poverty and less diversification (Nepal, Burkina Faso, Sierra Leone). Others: Myanmar (limited change in diversification, but strong poverty reduction in spite of conflicts) versus Kazakhstan (limited change in poverty from a low base and large decrease in diversification).

Figure 7: Poverty reduction and diversification



Note: axes lines through the value 0 represent no change

This examination of outliers suggests that diversification as a conducive factor for poverty reduction within LICs and LMICs depends at least partly on the degree of risk experienced. Outliers that see increases in poverty over the last two decades (groups 1 and 2), regardless of the degree of diversification, are generally affected by conflict or other forms of insecurity (e.g., disasters, economic instability or layered crises). The same holds true for countries that experience less diversification over time (group 3). Group 4 outliers constitute a set of LICs and LMICs that experience instability but with relatively higher government effectiveness scores on average over the period compared to group 3 outliers.

It is worth noting though that there is a degree of endogeneity in these relationships, where **conflict and other forms of risk might variably influence the ability to innovate and diversify, yet economic diversification can itself be a risk mitigation measure**. Moreover, there must be caution in interpreting change in certain variables. For example, whether diversification is beneficial for poverty reduction or

growth more generally is likely to depend on the context. Even so, the discussion of risk draws attention to one contextual factor likely to influence the strength of relationships observed.

4.2 Sustainability and economic transformation

Key message: Increases in GDP per capita, labour productivity and diversification tend to be accompanied by increases in GHGs and material footprints across country groups, and improvements in air pollution. The relationship between economic growth and GHGs and material footprints is most pronounced among UMICs. The relationship between changes in GHG and changes in labour productivity is weaker among LMICs compared to LICs and UMICs.

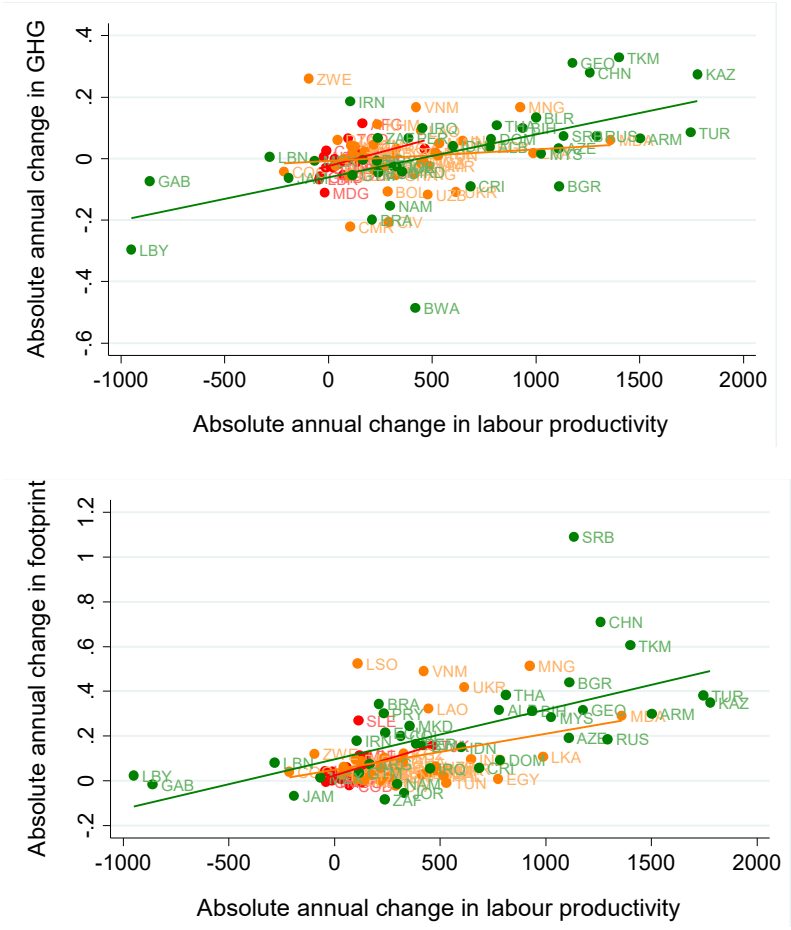
An increase in **labour productivity tends to be accompanied by an increase in per capita GHGs (Figure 8, top) and material footprint (Figure 8, middle**). A similar relationship is observed when looking at GDP per capita growth rates, which as noted earlier are closely related to changes in labour productivity. These correlations need to be interpreted carefully, not least because labour productivity is measured per employee while the environmental indicators are measured per capita, and huge demographic shifts have meant that the labour force as a share of the population has also changed considerably from different baselines. Even so, the relationship observed is unsurprising given that increased economic activity is likely to fuel the consumption of energy, which remains largely fossil fuel-based, and possibly other emission-intensive activities such as the production of cement, steel or plastics or the conversion of natural habitats to agricultural land. The relationship between labour productivity and emissions or material consumption is particularly stark for LICs, where (given existing deficits and shortfalls) higher incomes likely correlate closely with increased consumption of food and energy as well as construction of housing and infrastructure. It may also reflect the higher cost or complexity of choosing greener or more resource-efficient options that can preclude their uptake in very low-income contexts.

A handful of LMICs are achieving rapid labour productivity increases and falling per capita GHGs – a decoupling of economic activity and emissions. These include Uzbekistan, Ukraine (Europe and Central Asia), Papua New Guinea (PNG) and Myanmar (East Asia and Pacific), and Nigeria and Eswatini (Sub-Sharan Africa), though the latter three at relatively negligible reduction rates in GHGs. However, it is important to recognise that Ukraine, Uzbekistan and PNG all have per capita GHG emissions slightly above the income-group average, suggesting that these countries were taking advantage of low-hanging fruit rather than achieving low-carbon structural transformation. Other examples are discussed in Section 3.4.

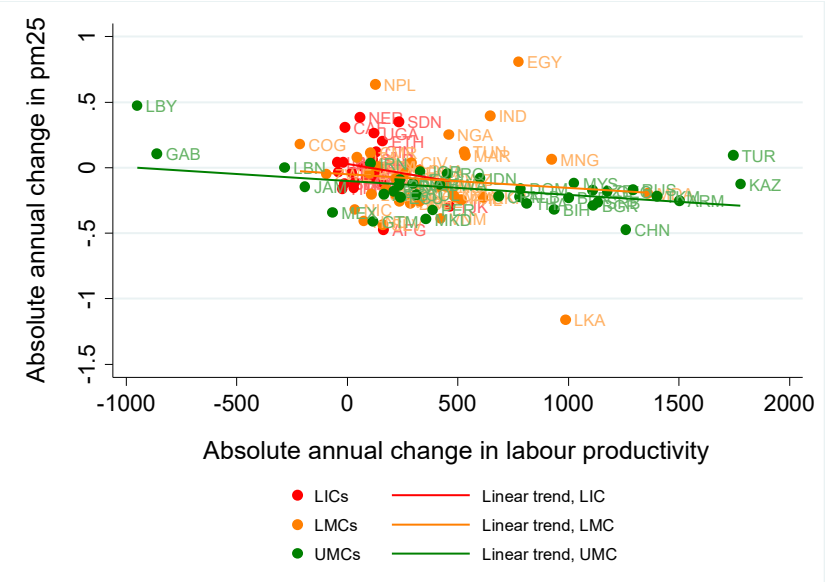
Air quality is improving on average across all income brackets, though many individual countries have seen air pollution increase (Figure 8), most notably Egypt, India, Libya, Nepal and Niger. Sri Lanka has

achieved the most dramatic improvements. Moreover, these improvements have been occurring amid average increases in labour productivity, regardless of country income group and thus often its base values.

Figure 8: Sustainability and labour productivity (GHG change (top), footprint[5] change (middle), PM2.5 change (bottom))



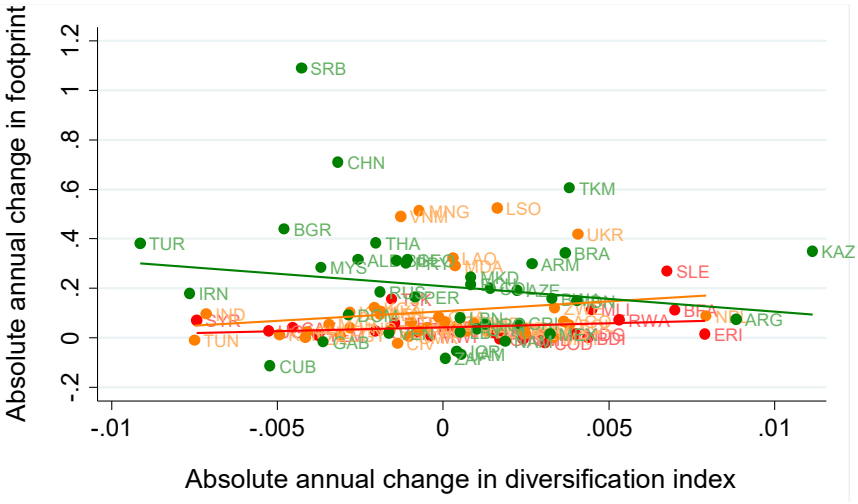
[5] A note of caution is needed in interpreting changes over time with regards to the baseline for assessing material footprints. An expanding average material footprint in a LIC may be positive but negative for a richer UMIC where the footprint may already be higher than environmental carrying capacities permit.



When focusing on other indicators of transformation, there is no clear relationship between diversification and metrics of sustainability, whether examining change (Figure 9) or levels. This is unsurprising given that economic diversification could include expansion into more emission-intensive sectors (e.g., production of cement, chemicals or paper) or less emission-intensive sectors (e.g., financial services or much low-end, labour-intensive manufacturing). Similarly, economic diversification could correspond with either more industrial activity, which would consume more materials, or be more services oriented, which would demand fewer materials. There are also independent drivers of environmental degradation beyond economic composition, for example whether a country has pursued sprawling urban development, which demands more land, materials and energy than more compacted, connected urban growth.

The weaker relationship between changes in diversification and changes in sustainabilty, including among UMICs, suggests **that a focus on diversification might provide a pathway for more sustainable growth processes, rather than an overriding focus on enhancing GDP per capita or labour productivity**. However, the weak relationship between diversification and poverty reduction observed above (Figure 9) suggests that an additional emphasis on risk mitigation may be necessary in promoting inclusive as well as sustainable outcomes through economic transformation.

Figure 9: Footprint and diversification change



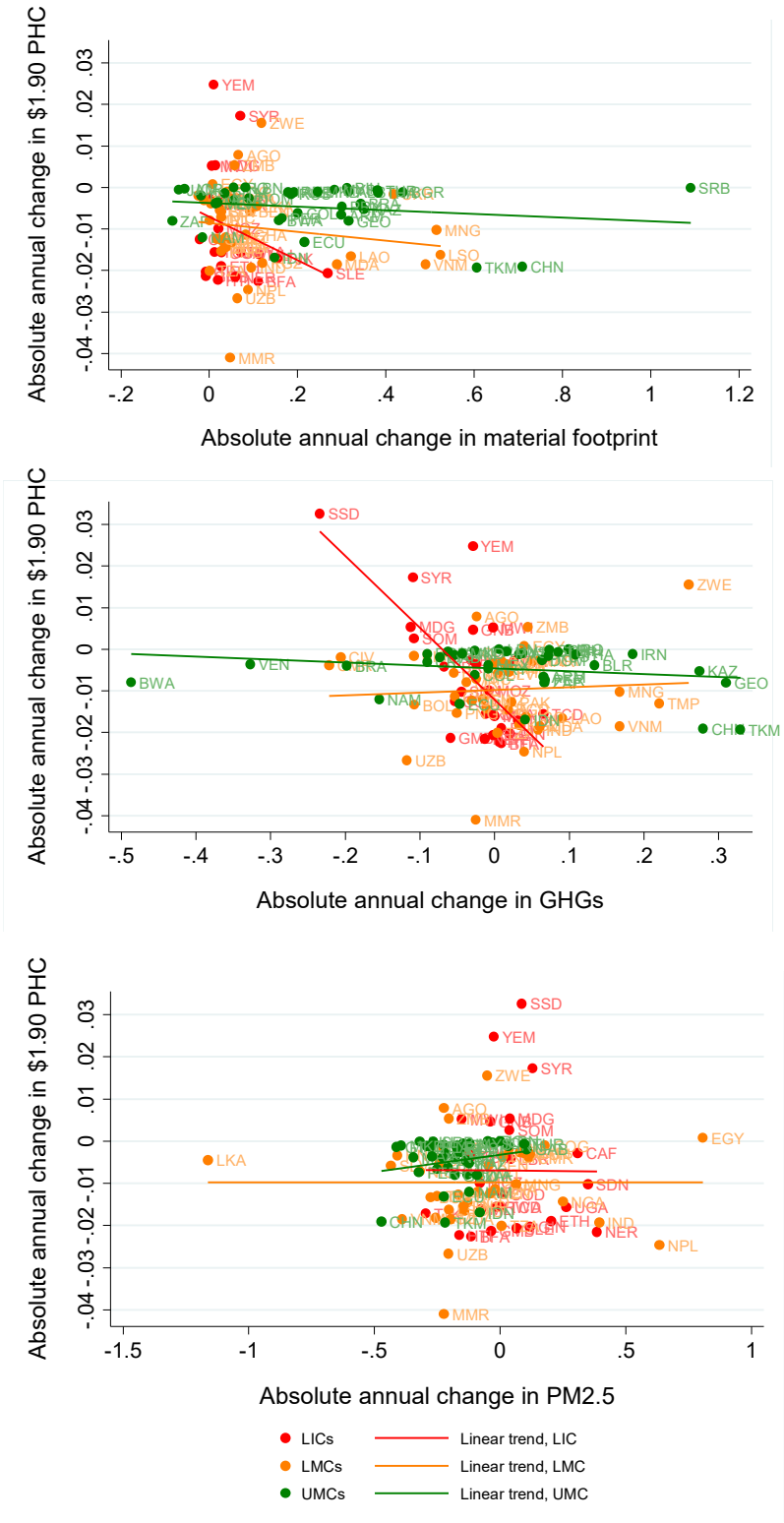
4.3 Inclusion and sustainability

Key message: Among LICs, poverty reduction and inclusion in the bottom half of the distribution is correlated with increases in material footprint. This reflects the need to improve consumption thresholds at the bottom of the welfare distribution without exceeding maximum ecological thresholds in higher-income contexts.

An increase in the rate of poverty reduction is associated with an increase in material footprint per capita and GHG emissions per capita among LICs. This largely reflects the low base values of environmental indicators from which LICs begin and remain on average, compared to other country groups. For example, on average across the two decades, the material footprint per capita among LICs stood at 2.1 tonnes, compared to almost double that (4.0) among LMICs, and over five times (10.4) among UMICs.

Examining changes in air pollution and poverty reduction, there is virtually no relationship between these for LICs or LMICs. Although there appears to be a weak relationship in the case of UMICs, this disappears when removing China, which has strong poverty reduction as well as absolute decreases in its air pollution (PM2.5) levels. Its air pollution decreases have been particularly evident since China's Air Pollution Prevention and Control Action Plan in 2013, though its average levels of air pollution remain among the highest globally, and lower only compared to Iraq and Libya among other UMICs.

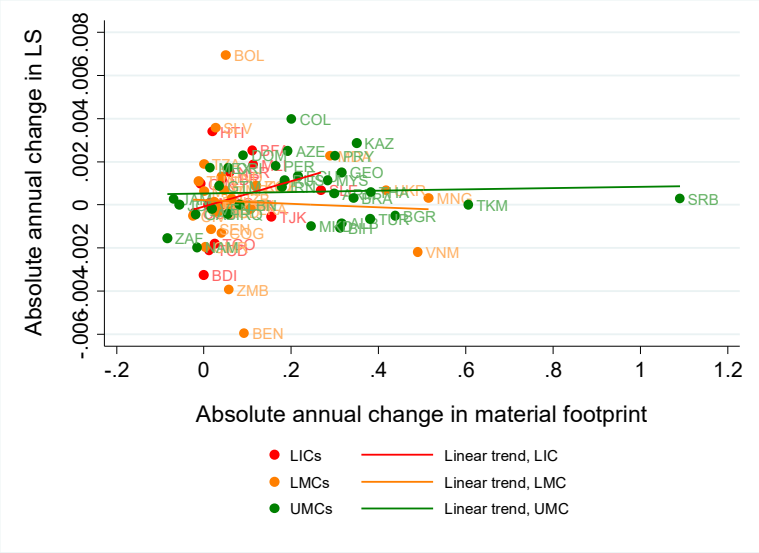
Figure 10: Poverty and footprint (top), GHGs (middle), air pollution (bottom)



In terms of inequality, a more equitable spread of income accruing to people in the poorest quintile when compared to the bottom half of the distribution is correlated with a higher material footprint per capita among LICs. Among other country income groups, this relationship disappears. This points to the need to promote a 'safe and just operating space for humanity' (Raworth, 2012), such that minimum

thresholds of consumption for a decent quality of life are met, without exceeding maximum ecological thresholds in higher-income contexts.

Figure 11: Inequality and material footprint



5 Constellations of Nexus outcomes

Key message: Countries that are doing particularly well on inclusion and productivity dimensions often have larger environmental footprints (even if they have improved local environmental quality). Outliers might offer valuable lessons. In LICs, the role of government effectiveness appears to be relatively important. In LMICs, improvements in risk management, particularly in South Asia, might help explain some successes. Among UMICs, improvements in risk management and government effectiveness appear to be necessary but not sufficient enabling conditions, again pointing to the potential role of other social and environmental policies in these processes.

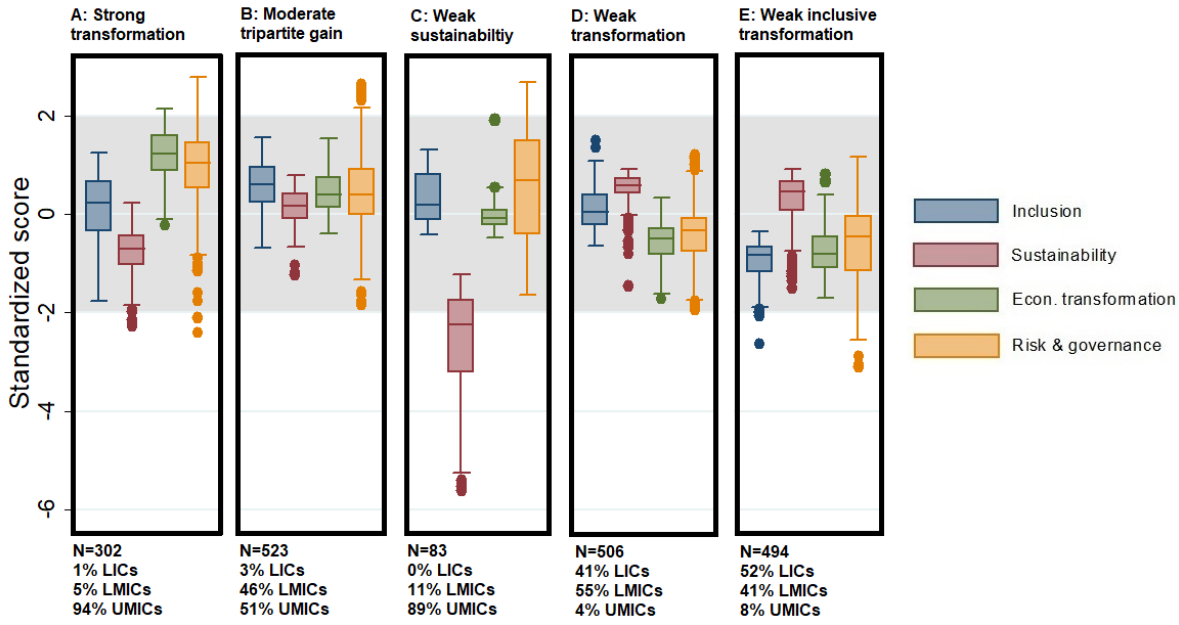
5.1 Clusters of inclusive, sustainable economic transformation

The discussion above has presented certain hypotheses on the links between two dimensions of inclusion, sustainability and/or economic transformation. In this section, we examine constellations or clusters of Nexus outcomes. We present the properties of our cluster analysis as boxplots (Figure 12). To derive cluster scores, we invert select indicators to represent best-to-worst scales, log transform labour productivity and impute certain variables with missing values as outlined in Annex C. We then standardise the indicators and derive the dimension score as the average across indicators within the

dimension. Our final pooled country-year database comprises a sample size of 1,908 observations after removing HICs and countries without adequate data from which to derive dimension scores.

The clusters are not ordinal, insofar as there is no obvious ordering of clusters based on their performance overall. It also does not capture the degree of change over time but only levels, given that the data is pooled across countries and years. Although the risk and governance dimension is not included in the determination of our clusters, we assess its cluster-based properties in Figure 12 as potential contextual variables that may influence the degree of inclusivity, environmental sustainability and economic transformation observed over time.[6] Finally, it is worth emphasising that different approaches would have resulted in different clusters, depending on the metrics employed and the selection of representative indicators, time horizons and subgroup partitions. Our analysis nevertheless offers insights into where countries fare along a spectrum of performance in the three dimensions alongside aspects of the enabling (risk and governance) context.

Figure 12: Dimension scores per cluster, 2000–2018 (N=1,908)



From the cluster analysis, we identify cluster A as predominantly UMICs exhibiting strong economic transformation among the set of countries included, though this comes with a trade-off of low sustainability scores. Cluster B, a mix of mainly LMICs and UMICs, fares relatively much better on metrics of sustainability and inclusion, but with a trade-off in terms of lower economic transformation scores relative to cluster A. Cluster C (predominantly UMICs) comprises a smaller number of countries with particularly low sustainability

[6] We rely on the GAIN Readiness Index and Government Effectiveness scores within the risk measure, given data availability over the time horizon of interest. We perform similar steps to the other indicators, by normalising these variables and obtaining their average in our analysis.

outcomes, typically falling over two standard deviations below the mean, alongside moderate inclusion and transformation scores just below average. Clusters D and E (mainly LICs and LMICs) share weak transformation scores, though cluster D on average performs much better in inclusion and sustainability. Even so, both include a number of outliers performing particularly weakly on sustainability metrics.

A triple win is not readily evident from these clusters, though cluster B would be the closest with a 'triple moderate' outcome. A stronger result could occur if the inclusion performance of cluster B and the mean sustainability performance of cluster D were aligned with the economic transformation potential in cluster A, though in practice these examples are hard to identify. Another way to think about this is the extent to which countries may be willing to trade off slightly lower levels of transformation for strong sustainability and inclusion. At the moment, most LICs fall in clusters D and E, with relatively better environmental sustainability but moderate or low inclusion and low economic transformation.

5.2 Changes over time by income group

Even though most LICs have lower economic transformation scores in terms of absolute values, the change over time that they experience can be strong. Recognising this, we examine the extent to which countries have experienced mobility between clusters and complement this with descriptive analysis of rates of change in individual indicators by country income group. There are cases where results from the two methods may diverge, with a transition country not emerging as such in the descriptive analysis of rates of change. This points to heterogeneity of country experiences and offers insights into potential cases for further research.

Most LICs fell under cluster E, followed by cluster D. Table 2 highlights certain LICs (e.g., movements from cluster E to D) improving their cluster standing towards more inclusive outcomes that are on average at slightly improved levels of economic transformation. The practical significance of these movements is that improvements in Nexus outcomes are possible without necessarily compromising development pillars. Sierra Leone and Ethiopia, especially at the turn of the century, have vacillated between these two clusters, which may reflect contexts of insecurity and violence that act to undermine development. Conflict-affected South Sudan and Syria are included in clusters A and B, respectively, in some years. However, in both countries, the dimension scores deteriorate, particularly in recent years, though only in South Sudan is this consistently large across dimensions to result in a transition from cluster A to E.

Table 2: Countries experiencing transitions between clusters, LICs

Region	Country Yr:	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
LCN	Haiti												E	D						
MEA	Syria				D	B														
SSF	Burkina Faso								E	D										
SSF	Burundi										D	E								

SSF	Ethiopia	E	D	D	E	D														
SSF	Guinea										E	D								
SSF	Guinea-Bissau				D	E														
SSF	Liberia											E	D							
SSF	Malawi	D	E																	
SSF	Mali							E	D											
SSF	Niger								E	D										
SSF	Rwanda																		E	D
SSF	Sierra Leone	D	E	D	E	E	D													
SSF	South Sudan															A	E			
SSF	Togo							D	E											
SSF	Uganda						E	D												

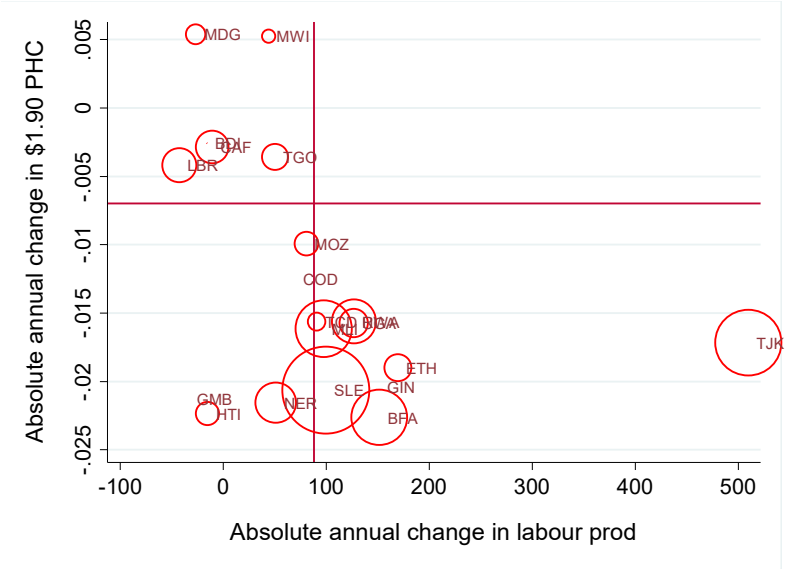
Note: Blank cells refer to cases where the cluster remained stable (e.g., Haiti was in cluster E until 2011, and then transitioned to cluster D). Only countries with transitions are listed in the table.

Figure 13[7] next explores the relationship between changes in poverty rates and material footprints, weighted by change in labour productivity per country income group. These effectively reflect sustainable human development and the extent to which this is shaped by labour productivity changes. Our analysis points to high labour productivity increases being associated with stronger poverty reduction, especially in LICs, where initial levels of poverty are typically higher. However, countries which are doing particularly well on both poverty reduction and labour productivity (bottom right quadrant of Figure 13) often have higher material footprints. There are nevertheless some countries where poverty is reducing and labour productivity increasing faster than the income-group averages that display comparatively lower environmental impacts: Ethiopia, Guinea, Rwanda, and Uganda.[8] These are some of the countries that have moved from clusters E to D over the period of analysis.

Even so, **among LICs, it is worth stressing that footprints are low, even if slightly increasing, and may be intuitively observed to constitute a fair share of consumption for a more decent standard of living (particularly if equitably distributed),** and not reaching ecological thresholds as in other income contexts. As such, other countries that have moved from cluster E to D and are at the bottom of quadrant IV but with a slightly larger bubble size in Figure 13 also similarly reflect improvements in inclusive growth without exceeding ecological limits. So, there seems to be a transition between LIC and LMICs where countries start to exceed their 'fair share' of consumption, and where accordingly sustainability considerations would need to be strongly embedded in policy.

Figure 13: Poverty reduction, material footprint, and labour productivity – LICs (bubble size represents annual change in footprint)

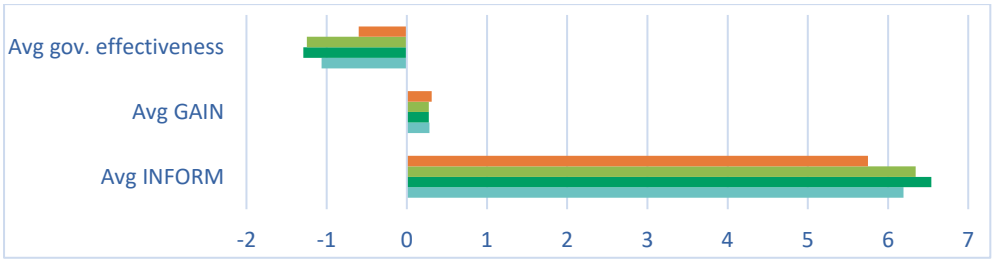
[7] Note: Red= LICs, orange= LMICs, green=UMICs. It is important to distinguish these dimensions across country groups given the caveats in directionality (Annex A) dependent not only on changes over time but also on base levels.
[8] Tajikistan, Ethiopia, Burkina Faso, Guinea, Rwanda, Uganda, Sierra Leone, Mali, and Chad are all in the bottom right quadrant of Figure 13. However, of these, Sierra Leone, Tajikistan, Mali, and Burkina Faso are increasing footprints at relatively higher rates, and also have the highest footprints in the latest survey year among LICs.



Note: lines cutting x- and y-axes are country-weighted average change

The LICs named above (Ethiopia, Guinea, Rwanda and Uganda) perform better relative to others in their income group, especially in terms of changes in risk (particularly measured by the INFORM index, see Table 1 above for definitions) and perceived government effectiveness over the period (Figure 14). However, it is worth noting that several indicators in the INFORM risk index constitute factors intrinsic to inclusion, and so represent a source of endogeneity. Even so, the analysis would still suggest that **government effectiveness might play an important role in helping support a road towards inclusive, sustainable economic transformation among LICs. However, as noted elsewhere, there are various other enabling factors,** with the role of risks and governance forming only part of the factors that may support Nexus outcomes.

Figure 14: Levels (top) and change (bottom) in risk and governance indicators



Among LMICs, there are also country transitions between constellations of inclusive, sustainable, economic transformation. LMICs fell most commonly within cluster D, followed by clusters B and E. Some countries in this set, especially in East Asia and Pacific, Europe and Central Asia, and South Asia have transitioned from cluster D to B on account of improvements in inclusion and economic transformation. Many countries have also churned between clusters D and B, particularly in Latin America and the Caribbean and in South Asia, signalling some volatility in inclusion and growth trajectories, in particular worsening for those moving from B to D (Table 3). In sub-Saharan Africa, movements into or out of group E are also particularly common, improving inclusion outcomes similar to the majority of LICs when transitioning out of cluster E.

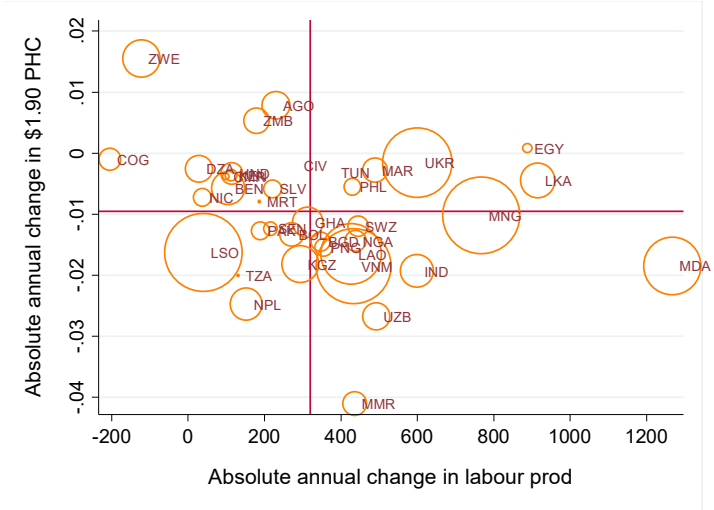
Table 3: Countries experiencing transitions between clusters, LMICs

Region	Country	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
EAS	Lao PDR	E	D												D	B				
EAS	Mongolia							D	B	B	C	B	C							
EAS	Myanmar			E	D						D	B	B	D						
EAS	Timor-Leste		D	B	B	D					D	B	B	D			D	B	D	B
EAS	Viet Nam					D	B													
ECS	Kyrgyzstan		D	B																
ECS	Moldova			D	B															
ECS	Ukraine						B	A		A	B	A			A	B				
ECS	Uzbekistan	E	D	D	E	E	D								D	B				
LCN	El Salvador						E	B												
SAS	India				E	B														
SAS	Nepal						D	B		B	D									
SAS	Pakistan										D	B	B	D	B	D				
SSF	Angola	D	E					E	A	B	A					A	E			
SSF	Benin					D	E													
SSF	Eswatini						E	B												
SSF	Ghana							E	D	E	E	D								
SSF	Nigeria																		E	D
SSF	Tanzania											E	D							

Examining rates of change alongside this cluster analysis, there are some LMICs that have seen poverty reduction and structural economic change while retaining footprint changes below the group average: Bangladesh, Myanmar, India, Uzbekistan, Eswatini, Nigeria and PNG – though the latter three with much higher poverty rates, and Eswatini also with a much higher footprint in the latest survey year (Figure 15).

Many of these countries (Myanmar, Uzbekistan, Nigeria, Eswatini and India) experienced movements out of cluster E and into clusters D or B in the cluster analysis (Table 3), all signalling improvements in inclusion at certain points over the period, though with variable improvements in growth, and for those moving from E to B also typically sacrificing environmental sustainability in the process. More generally, though, LMICs in Central and South Asia tend to do quite well in terms of poverty reduction accompanied by smaller per capita footprint increases (Myanmar, India, Nepal, Kyrgyzstan and Uzbekistan are in the bottom two quadrants of Figure 15) though with variable increases in productivity. Again, several of these countries experience improvements in inclusion, as observed through their cluster transitions presented in Table 3 above.

Figure 15: Poverty reduction, footprint, and labour productivity – LMICs [(weight is footprint)



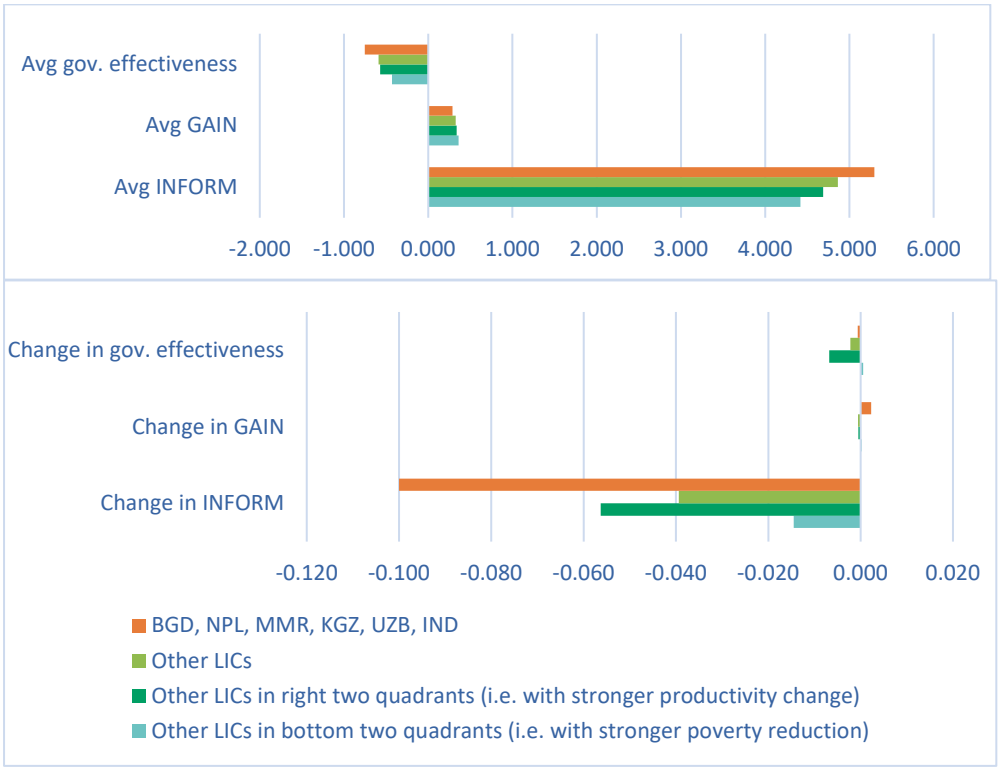
Note: lines cutting the x- and y-axes represent country-weighted average change

These South Asian countries however have varied human and natural hazard risks and varied government effectiveness. For example, among regions, South Asia has the lowest ND-GAIN readiness score (together with sub-Saharan Africa – both 0.30), and the highest average INFORM risk score on average over the last two decades, though also with the highest rate of improvement in its INFORM score during this period. This **improvement in a multi-dimensional risk profile (albeit from a high initial level) could signal a South Asian LMIC context where some of its transformations are less hard on the environment but still poverty reducing.**

Some of the basic measures to reduce risk – piped water, all-weather roads, stormwater drains, healthcare, emergency services – also contribute to poverty reduction. This once more underscores the need for complementary policies and investments to deliver inclusion and reduce risk. **Economic transformation is rarely enough on its own; and even where it is, faster poverty reduction with less**

environmental degradation could be achieved with additional measures. Indeed, many of these countries struggle with very degraded local environments with severe consequences for human health. In this analysis, this is apparent from their poor performance on air quality metrics.

Figure 16: Levels (top) and change (bottom) in risk and governance indicators



Finally, UMICs were most present in clusters A and C, followed by B. In terms of transitions, most countries moved into or out of group B. Some countries in Europe and Central Asia moved from clusters B to A, prioritising economic transformation and trading off inclusion and sustainability in the process. There was also considerable volatility in the Latin American and Caribbean countries across the range of clusters.

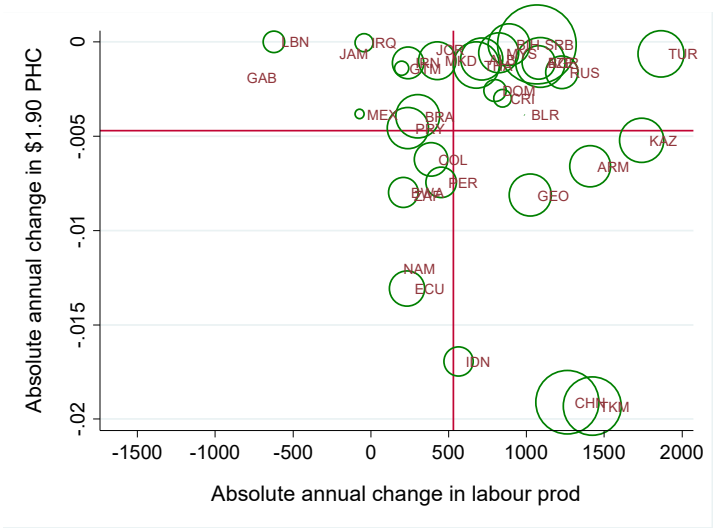
Table 4: Countries experiencing transitions between clusters, UMICs

Region	Country	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
EAS	China				B	A														
EAS	Indonesia				B	A	B	A	B											
EAS	Malaysia																A	C		
EAS	Thailand			B	A															
ECS	Armenia	D	B	D	D	B														
ECS	Azerbaijan				D	B														
ECS	Belarus										B	A								
ECS	Bosnia and							B	A											
ECS	Bulgaria				B	A														
ECS	Georgia						D	B												
ECS	Kazakhstan	A	C																	
ECS	Serbia						B	A												
ECS	FYR Macedonia		A	B	A															
LCN	Colombia		E	B		B	A													
LCN	Ecuador						E	B												

LCN	Guatemala	B	D	B								B	D	B			B	D	D	B	
LCN	Paraguay			E	C	D	C														
LCN	Peru			E	D	E					E	D	B								
LCN	Venezuela							E	A	E											
MEA	Iraq			B	D	D	B														

When examining rates of change over the period, there is a mixed relationship between poverty reduction and labour productivity among UMICs, but countries faring better on both dimensions tend to have higher material footprints. Indonesia is the only country in this set that is below the group average for changes in footprint and above average for poverty reduction and labour productivity increases. It churned between groups B and A in the early 2000s, with strong improvements especially in the inclusion and sustainability metrics in the years that followed. Armenia, Georgia and Indonesia (the latter at a relatively lower rate of change in labour productivity) stand out as three UMICs that have managed to have higher rates of change in labour productivity and poverty reduction than the country-weighted income group average while also having average footprints over the period lower than the income group average. All transitioned into group B in the early 2000s, though from different starting points (from group D in Armenia and Georgia, and group A in Indonesia). These may be regarded as more positive examples of Nexus outcomes.

Figure 17: Poverty reduction, footprint, and labour productivity – UMICs (weight is footprint)

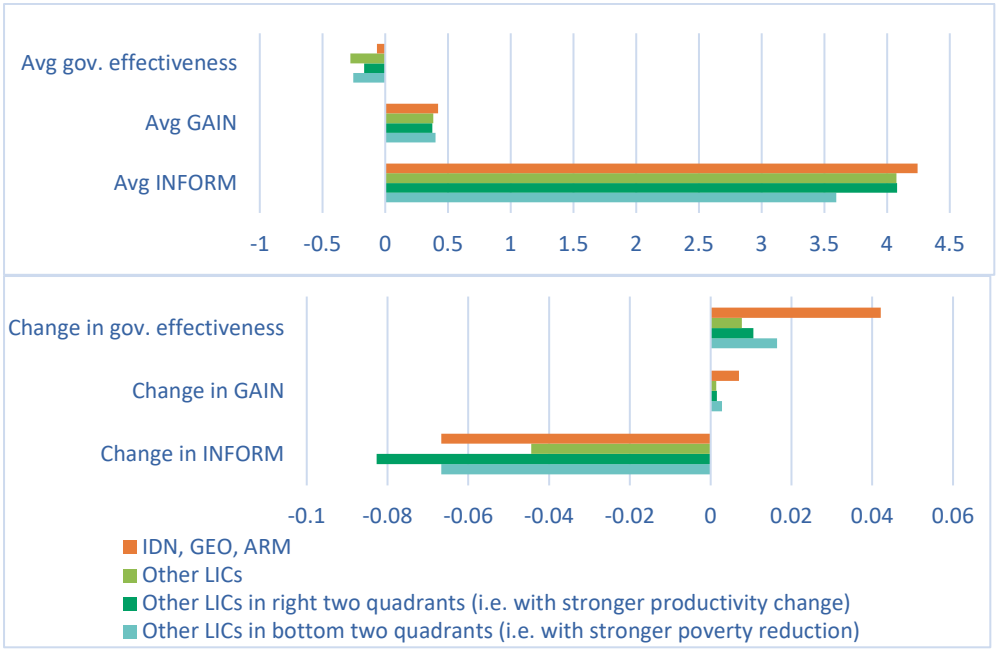


Note: lines cutting the x- and y-axes represent country-weighted average change

Although Georgia, Armenia and Indonesia have varied risk profiles, they also see **improvements in their risk scores over the period, and improvements in government effectiveness. There are other countries that have such experiences, particularly in terms of improving the risk context, suggesting that these improvements in risk and governance may be necessary but not sufficient conditions to promote Nexus outcomes**. Instead, building on the

analysis presented earlier, other social and environmental policies are likely to be necessary.

Figure 18: Levels (top) and change (bottom) in risk and governance indicators



6 A way forward

The analysis above suggests that while labour productivity improvements and poverty reduction are closely correlated, these processes have typically not been environmentally sustainable when global impacts are taken into account. Environmental transformation and social inclusion have corresponded to better local environments, though, manifested for instance in better air quality. So, the key Nexus question is how to enhance productivity improvement and poverty reduction while moving towards a fairer distribution of carbon and material budgets? What does an economy or society with these characteristics look like, and how does this vary in low-income contexts compared to elsewhere? What kinds of policies, investments and interventions can deliver this?

This section first provides a general discussion of economic sectors and infrastructure that may help rebalance the Nexus – for example, improving performance on sustainability, especially in LMICs and UMICs, but also starting these processes in LICs. It then proceeds to provide more disaggregated implications by income groups. Further analysis of key drivers behind the observed trends at the country level are examined in Pickard and Lemma (2022, forthcoming).

Economic composition and infrastructure[9]

First, there is a question of economic composition. In the primary sector, there are various options to make agriculture, forestry and fisheries greener. In MICs, though, economic transformation is typically about industrialisation. Different industrial sectors have vastly different environmental footprints. The challenge is to steer each country towards greener industries and greener industrial processes. Services, meanwhile, are typically sustainable, with the notable exception of tourism and its huge aviation footprint. On the other hand, eco-tourism can provide financial incentives to conserve natural habitats, so may offer a way forward.

Across these sectors, there is the important question of getting basic infrastructure right. Most LICs and MICs would need to expand their electricity supply to meet the needs of human development and growing economies. Investments in clean electricity generation are now cost-competitive with fossil fuels and can often lend themselves to lower-income contexts (for example, their modular nature enables incremental installation as budgets allow and can crowd in household/firm investment).

Countries would ideally also invest in low-carbon transport networks. Within cities, promoting walking, cycling and mass transit enables energy-efficient trips but also incentivises density, reducing the material, land and energy required to service households and firms. Low-carbon freight networks among cities and countries – rail, shipping, hopefully electric/hydrogen freight in the future – enables countries to access inputs and export markets with minimal emissions. This is harder to do: mass transit and freight transport are expensive and complex to plan, finance and build.

Finally, the provision of basic services – piped water, sanitation, stormwater drainage and solid waste collection – can all yield significant improvements in human health and local environmental quality. These foundations are particularly important in urban contexts due to the high population densities.

Income group differences

Differences in country income groups are also important to consider, and they call for context-specific solutions. Implications by country groups are presented below.

LICS: a strong growth–poverty reduction relationship with limited impact on global environmental footprint. Economic transformation accompanied by local ecological degradation (e.g., large PM2.5 increases). Government effectiveness potentially an important mechanism to contribute to improved Nexus outcomes.

[9] Thanks to Sarah Colenbrander for these recommendations on sectors and infrastructure

Among LICs, the relationship between growth and poverty reduction has been particularly strong, and material footprint and GHGs remain low with these gains (though air pollution is a problem). However, GHGs and material footprint increase rapidly from the low base. Some successes are Ethiopia, Rwanda, Guinea and Uganda, with strong labour productivity increases and poverty reduction over the 18-year period, with relatively low environmental impacts. Finally, when focusing on Nexus outcomes, government effectiveness emerges as a potential contextual enabler to these successes at all levels of income, though there are likely to also be other factors also constitutive of this enabling environment (e.g. related to norm change, diet, education of a middle class, aspects of political change).

LMICs: strong growth–poverty reduction relationship, weak correlation with sustainability, though potentially reversible through improvements in risk management.

In LMICs, the relationship between labour productivity increases and poverty reduction is also strong. Their relationship with environmental degradation is not as strong as in LICs and UMICs, but economic transformation still corresponds to increased consumption and pollution. This suggests a need to work intensively on improving sustainability in LMICs before they become UMICs.

The weak relationship between economic diversification and either poverty reduction or environmental sustainability underscores the importance of identifying and supporting the emergence of economic sectors with better social and ecological outcomes.

There are also some relative successes within LMICs, many located in South Asia, including Myanmar, India, Nepal, Kyrgyzstan and Uzbekistan. However, it is worth noting that many of these examples perform particularly badly on air quality, suggesting that economic transformation and poverty reduction have been accompanied by degraded local environments (even if global footprints remain small). Complementary measures to mitigate risk could promote more inclusive and sustainable outcomes.

UMICs: weak relationship between growth and poverty reduction – which can be fixed by policy development – and high increases in unsustainable environmental outcomes, with government effectiveness and risk management necessary alongside wider social and environmental policies to effect change.

The relationship between productivity increases and poverty reduction in UMICs is weak. Moreover, increases in GDP per capita, labour productivity and diversification tend to be accompanied by increases in GHGs and material footprints across country groups, but even more so among UMICs. Countries that are doing well in this group tend to see improvements in risk management and government effectiveness, though these appear to be necessary but not sufficient enabling

conditions to curb environmental degradation, promote poverty eradication and contribute to economic growth.

These findings suggest that additional factors such as education, social protection, and other social policies beyond economic development may play a stronger role in driving poverty reduction in UMICs. It also means that UMICs could theoretically shift away from economic growth-oriented policies (which drive significant increases in material footprint and GHGs for limited human gains) in favour of measures oriented to poverty reduction and social inclusion with minimal environmental impacts. This is easier said than done, however, as it is also a matter of growing sustainably in terms of consumption and production patterns. This moves into the terrain of culture and behaviour, which appear to be more important at these higher levels of income. Since poverty reduction appears to rely less on productivity changes in UMICs, it may be possible to disrupt the relationship between poverty reduction and ecological degradation through careful social and environmental policies alongside norm change.

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Appendices

Annex A: Indicator rationale

Our choice of indicators is the result of discussions between three teams at ODI: the International Economic Development Group, the Climate and Sustainability programme, and the Chronic Poverty Advisory Network hosted at the Equity and Social Policy programme. Each team presented three to four key metrics within their discipline to measure the domains of interest, capturing different aspects of the domain to the extent possible based on data availability and to at least partially limit multi-collinearity. The key rationale and caveats for our indicators are presented in Table A1.

In addition to the notes in Table A1, there are some other generalisable caveats to consider. Some variables selected are indices, while others are unidimensional indicators. Another key limitation is that we are relying only on quantitative data sources, which may not consistently be available or reliable. For example, PM2.5 values vary considerable depending on the dataset examined, as noted in the main text. We also rely on a small trend horizon, focusing on years since the turn of the century, though a longer time horizon would offer deeper insights into root alongside proximate causes of outcomes observed today. Even so, the analysis offers insights into recent and current trends and trade-offs across the three dimensions of interest.

Table A1: Rationale, caveats, and directionality of indicators

Indicator	Rationale	Caveats	Direction
Poverty headcount ratio	Extreme monetary poverty measure; reflects basic needs not being met	Very low, does not acknowledge poverty dynamics, questionable relevance for national contexts given differences with national poverty lines	smaller values better, change over time towards inclusion should be -
Multidimensional Poverty Index headcount	Captures deprivations beyond (and not including) monetary poverty; human development dimensions; relates to capabilities of humans	Slightly arbitrary decision into what indicators are included in the index, and variables to reflect these Covers outcomes and inputs variably Availability – generally around five years in 2010+, so not same timeframe as others	smaller values better, change over time towards inclusion should be -
Social Institutions and Gender Index	If there isn't underlying top-down (laws) or bottom-up (norms, practices) support, people have little basis to feel included	Covers outcomes and inputs, doesn't distinguish top-down from bottom-up interventions in the overall framing Some components with subjective interpretations	smaller values better, change over time towards inclusion should be -
Inequality in the bottom half	Attempt to reflect distribution of income among bottom half of the population – growth should benefit people at the bottom of the distribution	Uncertain what is happening across full distribution, or other forms of inequality (horizontal, intersecting) Many countries have limited change over time; typically data available only last few years	larger values better, change over time towards inclusion should be +
Greenhouse gas emissions per capita	Critical importance for understanding trends in physical climate change and the extent to which this is unsustainable	Does not distinguish within country differences which can be stark, may be difficult to monitor at local levels and there may be differing inventory tools with inconsistent methodologies[10]	smaller values better, change over time towards sustainability should be -
Material footprint per capita	Sustainability is in part about living within	Does not capture physical movement of materials within/ between countries	smaller values better, change over

[10] https://journals.openedition.org/sapiens/854

	planetary boundaries and not exceeding material consumption beyond fair shares	No understanding of footprint inequality within a country, which may be high, even in countries with low per capita footprints, or vice versa	time towards sustainability should be -
PM2.5 air pollution, mean annual exposure	Air pollution can contribute to deteriorating health of individuals and the environment – both in the short and long term	Air quality is primarily of local interest, primarily for human health and therefore overlaps with social inclusion considerations. By contrast, material footprint and GHGs both have global connotations	smaller values better, change over time towards sustainability should be -
Terrestrial and marine protected areas	It is important to protect depleted, threatened, rare, endangered species and populations to help maintain biodiversity and survival of species	Typically, data only available for the last few years, which limits trend analysis Difficulties of surveillance and monitoring of larger areas	larger values better, change over time towards sustainability should be +-; AVG (limited values)
Gross domestic product per capita	Wealth creation is a key part of transformation. Can have high GDP per capita and no/limited ET or high GDP and gross inequality. However, ET is unlikely without increases in per capita income	Very similar ranking to the GDP per person employed – double counting? What about sectoral growth? Need to avoid equating ET with manufacturing, since the path towards this can also be through services, and due to the ideas of premature de-industrialisation	larger values better, change over time towards transformation should be +
Diversification index	Diversification is often used as a direct measure of structural economic transformation, used as a strategy to promote economic growth	Hard to understand which direction is more relevant for ET, particularly after a certain threshold that is not easy to define. There is also likely to be varying specialisation across stages of development	smaller values better in general, change over time towards transformation should be
Labour productivity	Producing more goods and services for the same amount of work can enable improvements in efficiency and economic growth more generally	May not well capture the large share of informal workers Influenced by changing demographics which may not be equally consistent across income groups over time	larger values better, change over time towards transformation should be +
INFORM risk	Risk can undermine progress in inclusion, sustainability, and economic transformation	Includes various aspects of the risk profile, some of which may be conflated with the indicators already referred to above, e.g., on inclusion	smaller values better, change over time towards less risk should be -
GAIN Readiness	The ability of a country to adapt in the face of crises can help smooth the effects of shocks and enable continued wellbeing improvements	Includes various components that may overlap with INFORM and/or aspects of inclusion As a composite indicator the overall value makes it difficult to know which constituent dimensions are weaker	larger values better, change over time towards readiness should be +
Government effectiveness	Quality of public services and other aspects of government commitment to public policies can provide an enabling context for wellbeing improvements	This is a perceptions measure, which may not be representative of the full population and may itself include biases in its construction and may be less relevant to specific contexts given the heterogeneity of country experiences and forms of rule	larger values better, change over time towards improved effectiveness should be +

Annex B: Country codes and income groups

LICs		LMICs		UMICs		HICs	
code	**country**	**code**	**country**	**code**	**country**	**code**	**country**
AFG	Afghanistan	AGO	Angola	ALB	Albania	ARE	United Arab Emirates
BDI	Burundi	BEN	Benin	ARG	Argentina	AUS	Australia
BFA	Burkina Faso	BGD	Bangladesh	ARM	Armenia	AUT	Austria
CAF	Central African Republic	BOL	Bolivia	AZE	Azerbaijan	BEL	Belgium
COD	Congo (DR)	CIV	Cote d'Ivoire	BGR	Bulgaria	CAN	Canada
ERI	Eritrea	CMR	Cameroon	BIH	Bosnia and Herzegovina	CHE	Switzerland
ETH	Ethiopia	COG	Congo	BLR	Belarus	CHL	Chile
GIN	Guinea	DZA	Algeria	BRA	Brazil	CYP	Cyprus
GMB	Gambia	EGY	Egypt	BWA	Botswana	CZE	Czech Republic
GNB	Guinea-Bissau	GHA	Ghana	CHN	China	DEU	Germany
HTI	Haiti	HND	Honduras	COL	Colombia	DNK	Denmark
LBR	Liberia	IND	India	CRI	Costa Rica	ESP	Spain
MDG	Madagascar	KEN	Kenya	CUB	Cuba	EST	Estonia
MLI	Mali	KGZ	Kyrgyzstan	DOM	Dominican Republic	FIN	Finland
MOZ	Mozambique	KHM	Cambodia	ECU	Ecuador	FRA	France
MWI	Malawi	LAO	Lao PDR	GAB	Gabon	GBR	United Kingdom
NER	Niger	LKA	Sri Lanka	GEO	Georgia	GRC	Greece
PRK	DPR of Korea	LSO	Lesotho	GTM	Guatemala	HKG	Hong Kong, China (SAR)
RWA	Rwanda	MAR	Morocco	IDN	Indonesia	HRV	Croatia
SDN	Sudan	MDA	Moldova (Rep of)	IRN	Iran (Islamic Republic of)	HUN	Hungary
SLE	Sierra Leone	MMR	Myanmar	IRQ	Iraq	IRL	Ireland
SOM	Somalia	MNG	Mongolia	JAM	Jamaica	ISR	Israel

SSD	South Sudan	MRT	Mauritania	JOR	Jordan	ITA	Italy
SYR	Syrian Arab Republic	NGA	Nigeria	KAZ	Kazakhstan	JPN	Japan
TCD	Chad	NIC	Nicaragua	KOS	Kosovo	KOR	Korea (Republic of)
TGO	Togo	NPL	Nepal	LBN	Lebanon	KWT	Kuwait
TJK	Tajikistan	PAK	Pakistan	LBY	Libya	LTU	Lithuania
UGA	Uganda	PHL	Philippines	MEX	Mexico	LVA	Latvia
YEM	Yemen	PNG	Papua New Guinea	MKD	Former Yugoslav Rep of Macedonia	MUS	Mauritius
		PSE	Occupied Palestinian Territories	MYS	Malaysia	NLD	Netherlands
		SEN	Senegal	NAM	Namibia	NOR	Norway
		SLV	El Salvador	PER	Peru	NZL	New Zealand
		SWZ	Eswatini	PRY	Paraguay	OMN	Oman
		TUN	Tunisia	RUS	Russian Federation	PAN	Panama
		TZA	Tanzania (United Republic of)	SRB	Serbia	POL	Poland
		UKR	Ukraine	THA	Thailand	PRI	Puerto Rico
		UZB	Uzbekistan	TKM	Turkmenistan	PRT	Portugal
		VNM	Viet Nam	TUR	Turkey	QAT	Qatar
		ZMB	Zambia	VEN	Venezuela (Bolivarian Republic of)	ROM	Romania
		ZWE	Zimbabwe	ZAF	South Africa	SAU	Saudi Arabia
						SGP	Singapore
						SVK	Slovakia
						SVN	Slovenia
						SWE	Sweden
						TTO	Trinidad and Tobago
						URY	Uruguay
						USA	United States

Annex C: Cluster analysis methodology

This annex outlines the key steps undertaken in performing the cluster analysis presented in Section 4 of the main paper.

1) Selection of indicators: for this analysis, we select a subset of indicators of inclusion, environmental sustainability and economic transformation that have many data points and are not highly correlated. Given that some of our risk indices also comprise elements that relate to inclusion or sustainability, we exclude it from the calculation of cluster scores. The resulting indicators balances concerns on conceptual validity, with data reliability and availability.

2) Variable transformation: we include all LICs/MICs in our analysis as before, and to limit data gaps we linearly interpolate missing data points. For the inequality indicator we also carry forward and backward availability data to remove missing values at each end of the timeframe, which is necessary to balance the indicators within the inclusion dimension. The labour productivity indicator is strongly positively skewed, and so we take its logarithm assuming that marginal effects may be lower at higher values. We then normalise the raw data scores, and invert relevant indicators such that all follow a consistent gradation from weak to strong outcomes. Table C1 summarises the types of transformation performed for the set of indicators used in the cluster analysis.

Table C1: Transformation of indicators

Indicator	**Imputed**	**Logged**	**Inverted**
Poverty headcount ratio	No	No	Yes
Inequality in the bottom half	Yes	No	No
Greenhouse gas emissions per capita	No	No	Yes
Material footprint per capita	No	No	Yes
Diversification index	No	No	Yes
Labour productivity	No	Yes	No

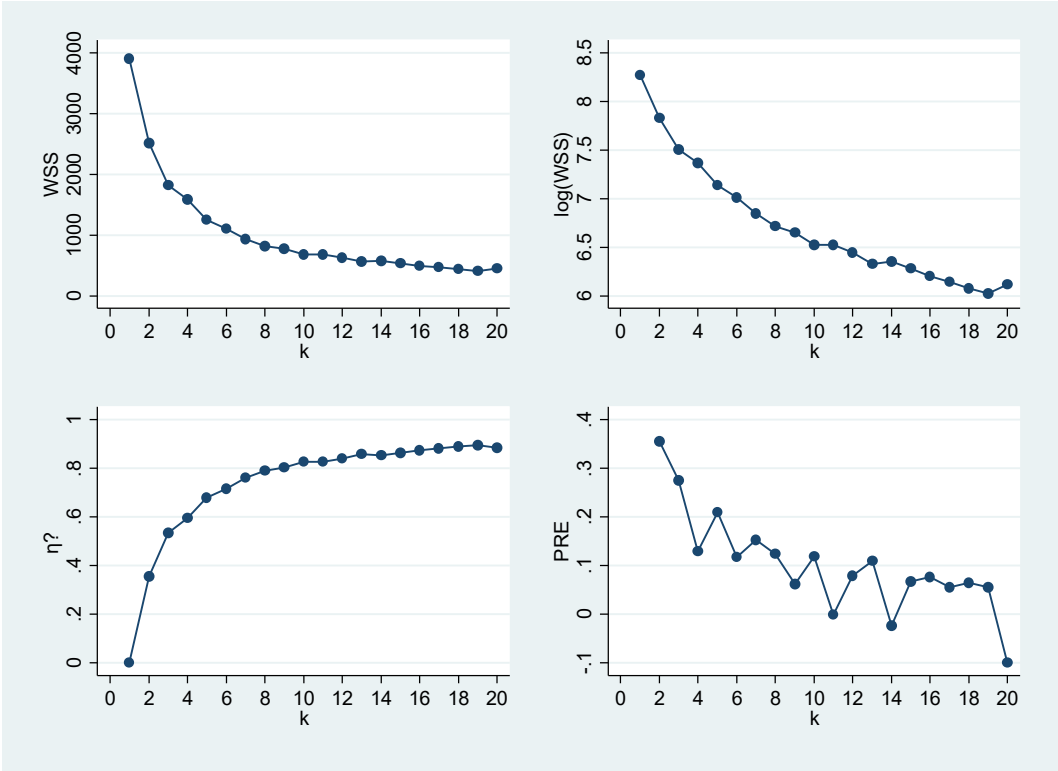
3) Pooling the data: like Ziaja et al. (2019), we pool all country-years in the sample to increase the number of observations. This has a limitation that clusters are assumed to be constant; however, in our

analysis we also examine the underlying data to examine the extent to which countries move between groups over time and comment where differences emerge. We additionally supplement this cluster analysis with additional descriptive statistics focusing on rates of change over time.

4) Determining dimension scores: the next question in our cluster analysis is how to determine dimension scores for social inclusion, environmental sustainability and economic transformation. The most common approach to indices is to select the dimension score corresponding to the average of indicators, which is our chosen method. We also adopt a different method to assess sensitivity of results, where rather than normalise our dimensions, we instead standardise them in a range from 0 to 1. The groups remained largely similar across methods.

5) Selecting the number of clusters: finally, to select the optimal k-means cluster solution for our dimensions, we rely on the curve from the within sum of squares, its logarithm, the proportional reduction of error coefficient, and the η2k (Makles, 2012). These methods together suggest that clustering with k=5 is the optimal local solution.

Figure C1: Selection of clusters

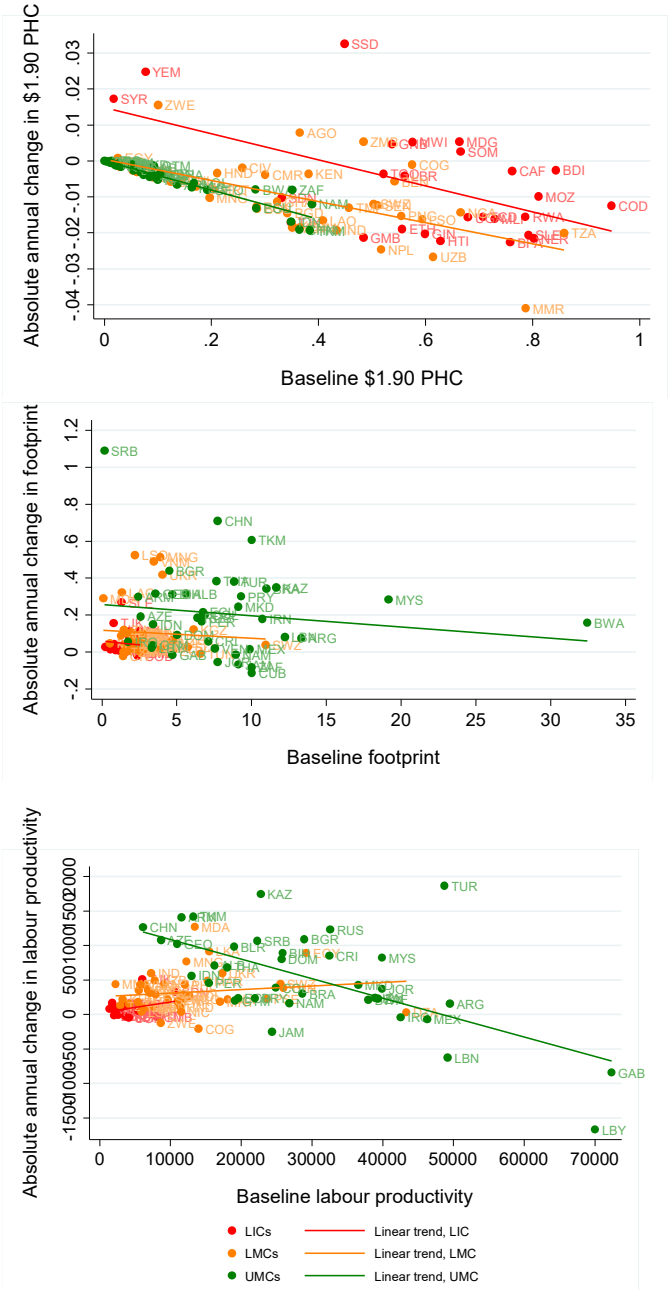


Annex D: Sensitivity analysis

D1. Change vs levels

We first examine the relationship between **change and levels** by income group. The relationship is generally consistent, where higher levels of an indicator on average is often associated with smaller changes over time. There is a slight exception for labour productivity, which in UMICs may signal decreasing marginal returns. From this, we can identify certain outliers in terms of discrepancies in performance on change compared to levels in Figure D1.1 below (e.g., South Sudan and Myanmar for poverty, Serbia, China and Turkmenistan for footprint, and Libya, Gabon, and Turkmenistan for labour productivity). These outliers merit further research beyond the present scope.

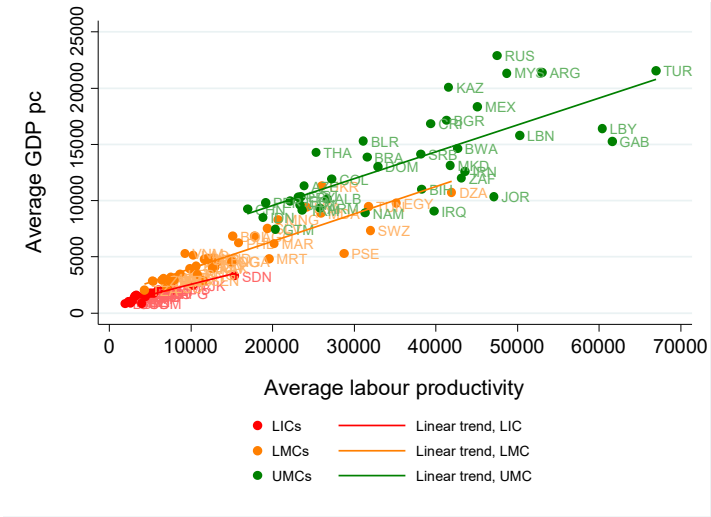
Figure D1.1: Comparing change versus levels of select indicators



D2. Economic transformation and sectoral composition

We first examine the relationship between GDP per capita and labour productivity per capita – both in terms of change and levels. This is to assess whether our focus in the text on labour productivity is reasonable. Results point to a **strong positive correlation between GDP per capita and labour productivity per capita**.

Figure D2.1: Rates and average levels of GDP per capita (top) and labour productivity per capita (bottom)



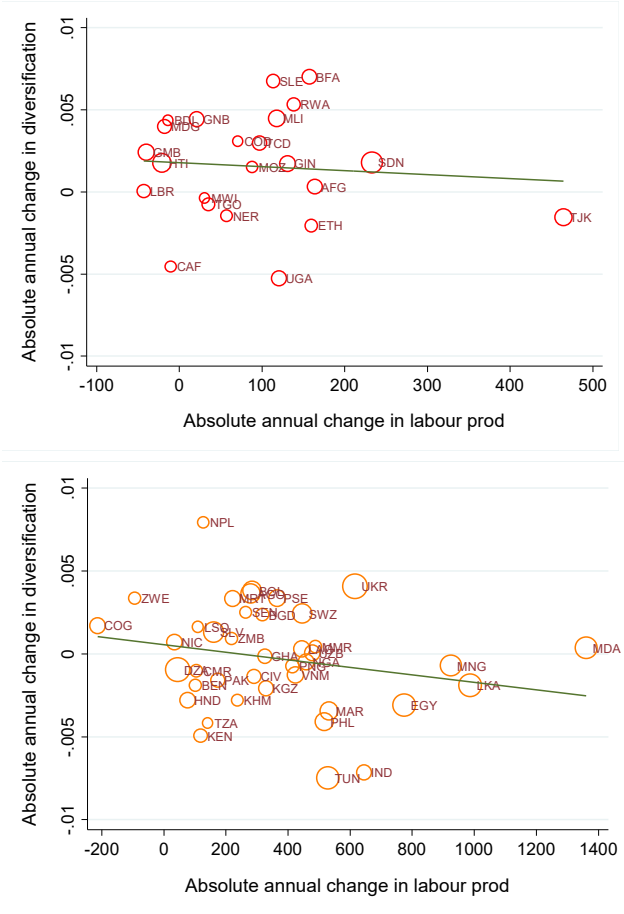
When coupled with growth and labour productivity increases, diversification can contribute strongly to economic transformation. We thus also examine the extent to which strong performance across dimensions is observed within country income groups.[11]

Among LICs, changes in labour productivity are accompanied by slight increases in diversification, although at a slower pace at higher changes in productivity. Uganda is the closest exception to

[11] Since there is a strong correlation between productivity and GDP per capita, we instead weight the country markers by average levels of GDP per capita over the period.

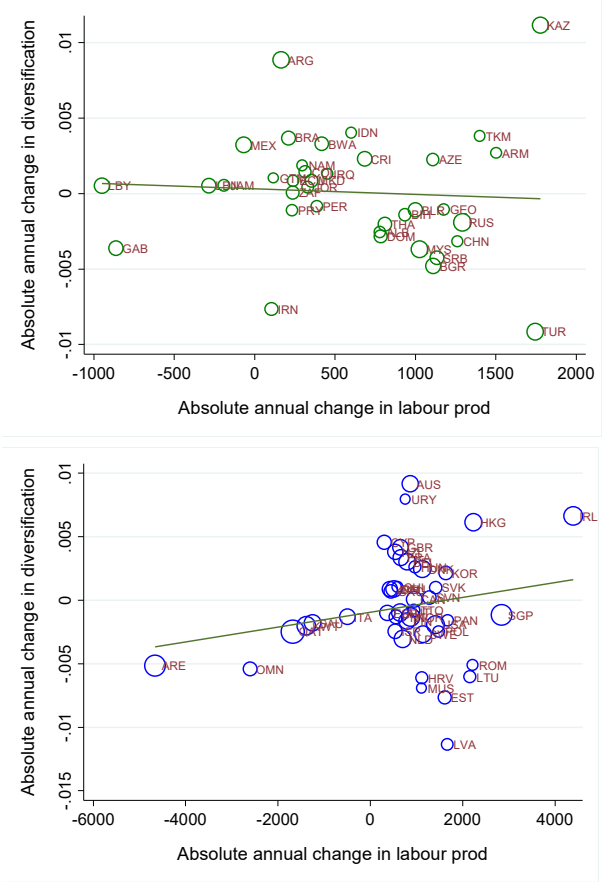
this rule, with strong diversification for a LIC and relatively average changes in productivity. Among LMICs, though, the relationship is particularly pronounced, especially in Tunisia and India, where although changes in labour productivity are slightly above average for the group of LMICs, there is a strong rate of diversification. It could be that economic diversification may enable economies to mitigate risk and better cope with crises (Goschin, 2019), with the relationship stronger for LMICs at relatively low to medium levels of diversification and productivity.

Figure D2.2: Diversification and labour productivity, LICs (top) and LMICs (bottom)



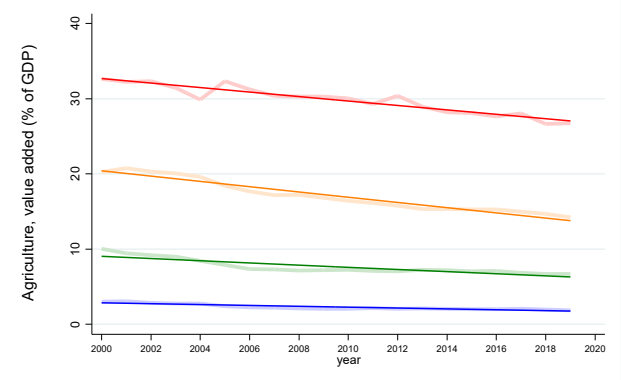
However, the relationship again becomes weaker among UMICs. Turkey and Iran are exceptions, the latter suggesting a move away from fossil fuel and energy dependent resources. Comparing this to HICs, in contrast, we observe the opposite relationship, where increases in labour productivity are accompanied by increasing specialisation rather than diversification, though this appears to be affected by certain outliers (e.g., Ireland, Oman, and UAE). This builds on the **stylised U-shaped curve relating sectoral concentration to per capita incomes** as articulated by Imbs and Warcziag (2003).

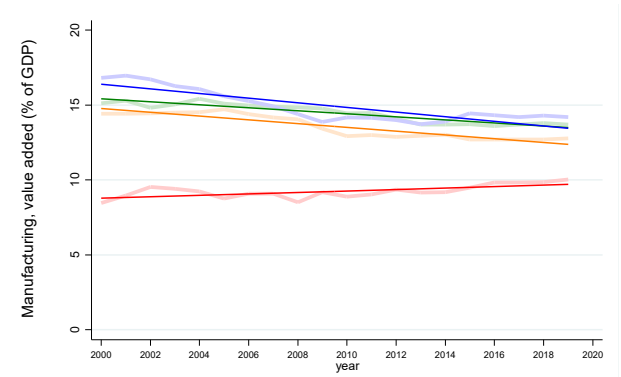
Figure D2.3: Diversification and labour productivity, UMICs (left) and HICs (right)

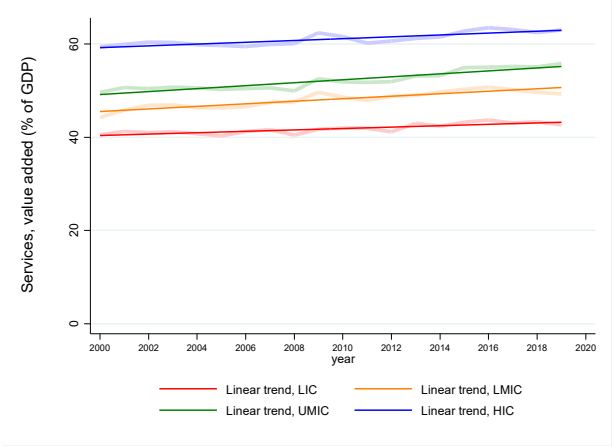


This relationship may also be affected by the sectoral composition of growth. Across income groups, the share of agriculture in GDP is declining, though the rate of change is strongest among LMICs. By levels, though, LICs had about 30% of GDP derive from agriculture over the last two decades. Instead, LICs saw their share of manufacturing in GDP increase, albeit from a low base. Finally, all country groups saw increases in the share of services in GDP, though slightly more pronounced among LMICs and UMICs, albeit at lower rates than HICs.

Figure D2.4: Changes over time in sectoral composition of GDP







Finally, **in many LICs and LMICs, structural transformation, when defined in terms of moving away from agriculture and into services, has not been accompanied by increases in labour productivity**. This is often because the change is not driven by productivity gains but by necessity. These considerations are worth bearing in mind when examining economic transformation within and between sectors, and offers scope for further research.

D3. Extreme values of inclusion

We finally also examine relationships between different values of some of our inclusion metrics. We do this to distinguish those in severe poverty from others: the former may require additional measures given the depth of poverty. In general, our results point to a **strong correlation between changes in our selected inclusion metrics compared to changes in their extreme values**.

A slight exception is observed when comparing the change in MPI to the change in MPI-destitution values. **There is close to a 1:1 decline among LICs, though for other income groups declines in overall MPI tend to be more pronounced than declines in destitution**. This is potentially on account of lower rates of destitution outside of LICs, or it could be more difficult for growth as a key mechanism of poverty reduction to tackle these extreme values, suggesting that additional policies are needed to close the multidimensional poverty gap.

Figure D3.1: Indicators and their extreme values