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RESEARCH

Systemic efficiency beyond income: resource intensity and market orientation

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Abstract

This paper offers a resource-intensity perspective on systemic efficiency. Instead of assessing whether economic systems satisfy the conditions of allocative efficiency, it studies how intensively two primary scarce resources—human time and ecological capacity—are used to generate socially relevant outcomes. Labour-efficiency and environmental-efficiency indicators are constructed for a cross-country sample by relating worked hours per capita and Ecological Footprint per capita to income, the Human Development Index (HDI), its education and health components, happiness, and innovation. These indicators are then related to two measures of market orientation derived from the Fraser Institute and the Heritage Foundation. The results suggest two main findings. First, efficiency rankings depend crucially on the outputs and inputs considered: systems that perform well in labour-efficiency terms for income do not necessarily perform similarly when broader outcomes or ecological capacity are considered. Second, the relationship between market orientation and efficiency is itself heterogeneous. More market-oriented systems tend to show comparatively favourable efficiency patterns when the output is income, whereas for broader outcomes higher market orientation is associated with lower environmental efficiency and with labour-efficiency patterns that are more often nonlinear. The evidence suggests that income growth alone provides an incomplete basis for assessing systemic efficiency and raises questions about some claims associated with green growth.

Keywords Systemic efficiency · Labour efficiency · Environmental efficiency · Market orientation · Green growth

JEL classification P18 · Q32 · Q50

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1 Introduction

Economics is commonly defined as the science that studies how societies allocate scarce means among competing ends; in Robbins's classic formulation, it is "*the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses*" (Robbins 1935, p. 16). Taking this definition seriously, this paper asks how efficiently economic systems convert their most fundamental scarce resources—human time and ecological capacity—into desired ends.

At the macro level, economic systems can be interpreted as coordination regimes that organise the transformation of resources into outcomes through institutional structures and patterns of interaction among agents.

In empirical analysis and public debate, the performance of such systems is usually evaluated through aggregate output measures, most prominently GDP and income growth. However, a broad literature has emphasised that socially desirable ends are multidimensional and cannot be entirely captured by income alone (Sen 1999; Stiglitz et al. 2009, 2018). Moreover, ecological economics has stressed that economic activity is embedded in biophysical constraints and depends fundamentally on material and energy throughput (Daly 1973; Daly and Farley 2011). From this perspective, the scale and intensity of resource use become central dimensions of systemic performance.

These debates suggest that evaluating economic systems solely by output levels may provide an incomplete picture. If economic systems are coordination mechanisms transforming scarce resources into outcomes, a natural question arises: how efficiently do they convert fundamental scarce inputs—such as human time and ecological capacity—into multidimensional measures of well-being?

In standard economic theory, efficiency is typically discussed in allocative terms, mainly within the Pareto framework. Under specific conditions, competitive equilibria yield Pareto-efficient allocations (Arrow and Debreu 1954). This result concerns consistency between preferences, technologies, and allocations, but it does not directly address the intensity with which primary scarce resources are used at the systemic level.

This paper proposes a complementary, productivity-based perspective on systemic efficiency. Inspired by the standard engineering (or physics) definition of efficiency as an output–input ratio, and consistent with the throughput perspective in ecological economics, I define efficiency as the intensity of use of fundamental scarce resources in generating socially relevant outcomes. Two inputs are considered: worked hours per capita, which capture the intensity with which human time is allocated to labour rather than to leisure and other non-work activities, and the Ecological Footprint per capita, which captures the biophysical resources appropriated by economic activity. On the output side, several indicators of well-being and systemic performance are employed, including the Human Development Index and its components, subjective well-being, and innovative output.

By combining these outputs and inputs, I construct labour-efficiency and environmental-efficiency indicators at the national level. In a second step, I relate these indicators to measures of market orientation and institutional deregulation. Rather than testing the internal validity of welfare theorems, the analysis assesses whether different coordination regimes are systematically associated with different patterns of resource intensity.

In other words, this paper asks how intensively economic systems use primary scarce resources—human working time and ecological capacity—to generate income and broader social outcomes, and how these systemic efficiency patterns are associated with different degrees of market orientation.

The empirical analysis suggests two main results. First, the country-level efficiency indicators depend crucially on the outputs and inputs considered: systems that rank highly when efficiency is assessed in terms of labour time per unit of income do not necessarily rank similarly when efficiency is assessed with respect to ecological capacity or to broader well-being outcomes. Second, the relationship between these efficiency indicators and market orientation is itself heterogeneous. More market-oriented systems tend to display comparatively favourable efficiency patterns when the output is income, whereas for broader outcomes the picture is less favourable, especially in environmental-efficiency terms.

These findings highlight that different concepts of efficiency capture distinct dimensions of systemic performance and coordination.

The remainder of the paper is structured as follows. Section 2 reviews alternative concepts of efficiency and relates them to insights from ecological economics. Section 3 presents the proposed indicators and data. Section 4 reports country-level results. Section 5 analyses the association between efficiency measures and market orientation. Section 6 concludes.

2 Concepts of efficiency and systemic performance

2.1 Allocative and technical efficiency: scope and limits

In economic theory, efficiency is most prominently discussed in allocative terms. An allocation is Pareto efficient if no individual can be made better off without making another worse off. This concept concerns the internal consistency of allocations given preferences, technologies, and initial endowments.

Beyond allocative efficiency, production theory has developed the concept of technical efficiency—a unit's ability to obtain maximum output from given inputs (Farrell 1957)—and the related notion of X-efficiency (Leibenstein 1966), which attributes performance gaps to organisational slack and incentives even under identical technological conditions. Empirically, technical efficiency is measured as distance from an estimated best-practice frontier, using Data Envelopment Analysis (Charnes et al. 1978; Cooper et al. 2011) or Stochastic Frontier Analysis (Aigner et al. 1977; Kumbhakar and Lovell 2000).

These approaches have proven analytically powerful and remain central to economic analysis. However, they primarily assess whether resources are optimally combined within a given technological and institutional setting. They do not directly examine how, at the systemic level, fundamental scarce means are transformed into socially desirable ends, nor how the overall scale and intensity of resource use relate to the achievement of such ends. In line with the definition of economics as the study of the relationship between scarce means and competing ends, the perspective adopted here evaluates economic systems precisely in terms of this transformation process.

In much of economic theory, allocative efficiency is closely associated with competitive market coordination. Under specific institutional assumptions, decentralised market interactions lead to Pareto-efficient allocations (Arrow and Debreu 1954). This association has contributed to the widespread interpretation of market-oriented systems as efficient coordination regimes. In the empirical part of this paper, I examine whether this association persists when efficiency is defined in terms of resource intensity, that is, the ratio of socially relevant outputs to fundamental scarce inputs.

2.2 Scale, throughput, and primary scarce resources

The distinction between allocation and resource intensity becomes especially relevant when economic systems are viewed as subsystems of a finite biophysical environment. The bioeconomic tradition initiated by Georgescu-Roegen (1971) emphasises that economic processes are governed by the entropy law and necessarily involve the irreversible transformation of low-entropy matter and energy into high-entropy waste. Economic activity is therefore not merely a circular exchange process, but a throughput process embedded in physical constraints.

Relying on this foundation, Daly (1973) argues that economic analysis must distinguish clearly between allocation and scale. Allocation concerns the distribution of given resources among competing uses, whereas scale refers to the absolute magnitude of resource throughput relative to ecological limits (Meadows et al. 1972). Sustainable scale cannot be derived solely from market allocation. This is also because market signals may be systematically misleading: when key material and energy inputs are used at prices that do not adequately reflect their ecological costs and scarcity implications, competition itself may become distorted (Pigou 1920; Parry et al. 2021; Black et al. 2023). As Daly and Farley (2011) emphasise, sustainable scale, efficient allocation, and just distribution represent analytically separate objectives, each calling for separate institutional instruments (Tinbergen 1956). The present paper does not attempt a full policy treatment of Daly's institutional proposals—such as quantitative restrictions on resource throughput or the source–sink distinction—but only draws on his framework to clarify why allocative efficiency and sustainable scale should not be conflated. Markets may coordinate allocation efficiently under specific conditions, but they do not automatically determine whether the overall scale of activity remains within ecological boundaries. This concern is also reflected in arguments that unlimited economic growth is not compatible with a finite planet (Jackson 2009).

Ecological economics also highlights that certain resources possess a primary character: they cannot be reproduced within the economic system itself and impose ultimate constraints on economic processes. Natural capital and ecosystem capacity are such resources. Complementary research in the energy–growth literature further suggests that material and energy inputs account for a significant part of economic growth often attributed, in conventional production-based analyses, to technical progress (Ayres et al. 2003, 2013; Ayres and Warr 2005; Kümmel 2011). At the same time, some authors argue that technical progress may itself reinforce growth imperatives, insofar as productivity gains can generate pressures associated with technological unemployment and thus induce states to pursue growth-oriented policies (Richters and Siemoneit 2019), potentially reinforcing dependence on energy and natural resources.

However, biophysical resources are not the only primary constraints. Human time represents another irreducibly scarce resource. Unlike produced capital, time cannot be accumulated or expanded above biological limits. As emphasised in the theory of time allocation (Becker 1965) and in more recent analyses of time as a fundamental economic resource (Hamermesh 2019), individuals face unavoidable trade-offs in allocating limited time between market work, household production, and leisure. In standard economic analysis, labour is often modelled as involving an opportunity cost in terms of foregone leisure and other non-work activities. This does not imply that work is necessarily experienced as pure disutility: employment may also provide meaning, identity, and social interaction. Nevertheless, at the aggregate level, working time remains a primary constraint because time devoted to market work cannot simultaneously be devoted to leisure, care, household production, or other welfare-relevant activities. The distribution of time between work and non-work activities, therefore, does not reflect only production requirements but also fundamental welfare trade-offs. At the systemic level, the aggregate allocation of working time thus constitutes a primary dimension of economic organisation.

From this wider perspective, evaluating systemic efficiency calls for examining how economic systems transform primary scarce resources—both ecological capacity and human time—into socially desirable outcomes. The issue is therefore not limited to environmental sustainability alone but concerns the intensity with which foundational constraints are used to achieve economic and social ends.

2.3 A resource-intensity perspective on systemic efficiency

The preceding discussion illustrates two complementary dimensions of economic performance. Allocative and frontier-based approaches evaluate whether resources are optimally combined within a given technological and institutional setting, while ecological economics emphasises the relevance of scale and the role of primary scarce resources.

Building on these insights, I adopt a resource-intensity perspective on systemic efficiency. The approach proposed here extends the familiar concept of productivity—commonly defined as output per unit of input—to the level of economic systems and to primary scarce resources. In this sense, systemic efficiency is defined as the ratio between socially relevant outputs and the fundamental inputs required to generate them.

This interpretation closely mirrors the standard definition of efficiency in physics (or engineering) as the ratio of useful output to required input (Moran et al. 2010). Rather than measuring distance from a frontier, the focus lies on the intensity with which primary scarce resources are required to generate economic and social outcomes. Systemic efficiency is thus operationalised as an index of resource-use intensity: it captures the amount of ecological capacity or human time required per unit of achieved outcome. In this sense, the proposed indicators are close to resource-productivity measures. I retain the term "efficiency" because the paper is concerned with the intensity with which economic systems transform primary scarce means into socially relevant ends, but the concept should not be confused with allocative efficiency or frontier-based technical efficiency. It is intended as a complementary resource-intensity metric, not as a replacement for standard efficiency concepts.

Unlike conventional productivity measures, where labour is typically treated mainly as a factor contributing to economic output as conventionally measured, the present approach stresses the role of labour and natural resources as primary constraints. This point is also consistent with Daly's critique of the assumption that produced capital can substitute almost indefinitely for natural capital. If some ecological functions are complementary to, rather than fully substitutable by, produced inputs, then resource-intensity measures capture a dimension of systemic performance that conventional productivity indicators may obscure**.** In the case of ecological resources, increased output requires greater throughput and a larger appropriation of environmental capacity. In the case of working time, an increase in labour input necessarily reduces the time available for leisure and other non-work activities that directly enter individual well-being. Systemic efficiency is therefore evaluated in terms of how intensively ecological capacity and working time are used in generating multidimensional social outcomes, rather than only in terms of GDP or other single aggregates of market production per unit of input.

Early attempts to relate performance to resource utilisation can be traced back to Debreu (1951), who introduced a coefficient of resource utilisation within a production-theoretic framework. While developed in the context of frontier analysis, this approach stresses the importance of relating outputs to resource use. The perspective adopted here differs in that it does not evaluate deviations from best practice but instead examines the magnitude of primary resource use associated with achieved ends.

Two categories of primary scarce resources are considered in this paper: ecological capacity and human time. In both cases, the relevant question is how intensively these foundational resources are used in generating specific social and economic outcomes.

The next section operationalizes this framework by specifying the selected output indicators and constructing corresponding measures of labour efficiency and environmental efficiency at the national level.

3 How to measure the "efficiency" of an economic system: a proposal

Following the framework introduced in Sect. 2**,** this section proposes a measurement strategy that operationalizes systemic efficiency as a set of resource-intensity indicators. For each country, I combine socially relevant outcomes ("ends") with primary scarce resources ("means") into output–input ratios. These measures can be interpreted as indicators of the intensity of resource use required to achieve socially desirable ends, consistent with the eco-efficiency approach discussed in UN ESCAP (2009).

3.1 The choice of outputs ("ends")

A substantial literature has questioned whether GDP (or consumption, or monetary wealth) should be regarded as the sole—or even the dominant—objective of an economic system. At the same time, GDP has an important analytical advantage: it provides a relatively parsimonious and widely comparable monetary measure of economic output. In this sense, the argument developed here is not that GDP is useless or illegitimate, but that it becomes insufficient when treated as the sole or dominant criterion for evaluating the overall performance of economic systems. This debate has highlighted that well-being is multidimensional and that reliance on a single aggregate measure may provide an incomplete representation of socially desirable ends. Moreover, evidence from the happiness literature suggests that, beyond some thresholds, increases in income need not translate proportionally into higher reported well-being (Easterlin 1974). At the same time, as Richters and Siemoneit (2019) argue, political systems may continue to rely on GDP as a policy compass because they are concerned not only with socially desirable ends but also with employment, fiscal stability, and broader macroeconomic stability.

To operationalise the "ends" dimension, I use a set of output variables that capture different aspects of development, well-being, and systemic performance. The primary outcome indicator is the Human Development Index (HDI), which combines three fundamental dimensions (UNDP, 1990): longevity (life expectancy at birth), education, and income (GDP/GNI per capita adjusted for purchasing power parity). Since relying on a single composite index may conceal important differences across dimensions, I also consider the main components separately in additional indicators. Data are taken from UNDP (2025).[1] The variables used are: Human Development Index (0–1), average years of schooling, life expectancy at birth (years), and gross national income per capita (2021 PPP$). The UNDP data cover the years 2000–2023.

To include a direct measure of subjective well-being, I use a widely adopted proxy: self-reported happiness. The specific variable is the Cantril Ladder, ranging from 0 to 10. Respondents are asked to place their current life on a hypothetical ladder, where 10 represents the best possible life and 0 the worst possible life. The data are sourced from the Wellbeing Research Centre (2025)[2] and downloaded via Our World in Data.[3] Data are available for the period 2011–2024.

[1] The data can be downloaded from this link: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

[2] The number of people and countries surveyed varies year to year, but typically more than 100,000 people in 130 countries participate in the Gallup World Poll each year. The survey scores are weighted by Gallup to make the estimates representative.

[3] Data can be downloaded via https://ourworldindata.org/happiness-and-life-satisfaction

Finally, I include an indicator of innovative capacity, which is relevant because it captures a potential channel through which different institutional and coordination regimes may affect long-run outcomes beyond current income levels. The measure is the "Innovation Output" sub-index ("OUT") of the Global Innovation Index, published by the World Intellectual Property Organization (WIPO).[4] The Innovation Output Sub-Index provides information about outputs that are the results of innovative activities within the economy and includes two pillars: "Knowledge and technology outputs" (patents, scientific articles, productivity growth, high-tech production and exports, etc.…) and "Creative outputs" (trademarks, brands, design, cultural and creative services exports, etc.…). Observations are available for the years 2021–2023, and scores are normalised on a 0–100 scale (WIPO 2024).

Innovation is included as an outcome because it can be interpreted as a systemic by-product generated with scarce resources, similarly to other socially relevant outputs. This is particularly relevant for the following empirical analysis of the association between efficiency and market orientation: neglecting innovation would risk overlooking an important channel through which more competitive coordination regimes are often expected to foster long-run improvements in welfare, namely their propensity to generate innovative outputs.

In summary, the outputs used to construct systemic efficiency indicators include: HDI, income (GNI per capita), education (average years of schooling), health (life expectancy), subjective well-being ("happiness"), and innovation output.

3.2 The choice of inputs ("primary scarce resources")

On the input side, an efficient economic system is one that achieves socially desirable ends while using primary scarce resources as sparingly as possible. In line with the conceptual discussion in Sect. 2, I focus on two fundamental constraints: human time and ecological capacity.

The first input is working time, measured as hours worked per capita and year ("labour utilisation"). This variable captures the aggregate intensity with which human time is devoted to market work rather than to leisure and other non-work activities that enter individual well-being (Krueger 2009). Operationally, the variable is retrieved from the Penn World Table (PWT) database (release 10.01) (Feenstra et al. 2015). It is derived from the number of engaged persons, average hours worked per engaged person, and population. The data cover the period 2000–2019.

The second input is ecological capacity, proxied by the Ecological Footprint of Consumption per capita, measured in global hectares. Following the National Footprint Accounts documentation, the Ecological Footprint measures the area of biologically productive land and water needed to supply resource consumption and to absorb waste (including carbon uptake) and is computed as the sum of components such as cropland, grazing land, forest products, fishing grounds, built-up land, and forest carbon uptake. The data are sourced from the National Footprint and

[4] Data can be downloaded via https://www.wipo.int/en/web/global-innovation-index

Biocapacity Accounts (Lo et al. 2025; Lin et al. 2018; Borucke et al. 2013). I use the "Ecological Footprint of Consumption" per capita, where consumption equals production plus imports minus exports. Data are available for the period 1961–2024. While widely used as a compact accounting indicator of biophysical appropriation, the Ecological Footprint has well-known methodological and interpretative limitations (Wiedmann and Barrett 2010; Mamghaderi et al. 2023). The choice of the Ecological Footprint is, however, deliberate and closely tied to the notion of efficiency adopted here. Unlike indicators that capture a single pressure, such as consumption-based CO_2 emissions, or that measure the mass of materials mobilised, such as the material footprint, the Ecological Footprint is explicitly constructed as the ratio of human demand to the biosphere's finite regenerative capacity (biocapacity), expressed in a common productivity-adjusted unit (Borucke et al. 2013; Lin et al. 2018). This demand-on-regenerative-capacity logic matches precisely the conceptual role assigned here to ecological capacity as a primary, finite, and non-reproducible constraint, analogous to human time. For the resource-intensity perspective developed in this paper, the relevant question is not only how much carbon is emitted or how much material is extracted, but how intensively the overall regenerative envelope of the biosphere is appropriated per unit of socially relevant outcome. The Ecological Footprint is the indicator most directly aligned with this question (Lin et al. 2015).

It is important to note that the variables employed refer to per capita (or average) values. Consequently, when analysing the use of ecological resources, the absolute scale of economic systems in terms of population is not directly reflected in the indicators.

3.3 Resource-intensity efficiency indicators

As discussed in Sect. 2, the proposed measures extend the productivity logic to primary scarce resources and mirror the standard definition used in physics as a ratio between useful output and required input. In this sense, they can be interpreted as the intensity of resource use required to achieve socially desirable ends (UN ESCAP, 2009).

For each selected output Y and input X, I compute an efficiency indicator as an output–input ratio:

$$E_{Y,X} = \frac{\overline{Y}}{\overline{X}}$$

where Y can be: HDI (0–1), gross national income per capita (2021 PPP\$), average years of schooling (years), life expectancy (years), happiness (0–10), and innovation output (0–100); and X can be: worked hours per capita (labour-intensity indicators) or ecological footprint per capita (environmental-intensity indicators). The unit of measurement of each indicator follows directly from those of the numerator and denominator.

The indicators are computed over the period 2013–2023. Because the databases used do not fully overlap in coverage and contain missing observations for some countries and years, I adopt the following procedure: (i) compute the average value of each numerator using all available observations within 2013–2023; (ii) compute the average value of each denominator using all available observations within 2013–2023; and (iii) compute the ratio of these averages. This approach is appropriate for the paper's purposes, which focus on medium-run structural differences in resource intensity rather than short-run fluctuations.

The set of countries included in the empirical analysis is determined solely by data availability across the selected outputs and inputs.

4 Country-level economic efficiency

Tables 1 and 2 report the country-level values for labour efficiency and environmental efficiency, respectively. As discussed in Sect. 3, these indicators are not intended to identify a single "best" economic system in an absolute sense. Rather, they describe how intensively countries use two primary scarce resources—working time and ecological capacity—to generate different kinds of outputs. The emphasis should therefore be placed on broad empirical regularities across outputs and inputs, rather than on the exact rank of each country. To keep the presentation compact, Tables 1 and 2 list only the ten highest- and ten lowest-ranked countries by HDI efficiency while retaining all output dimensions; the complete rankings for all 63 countries and all outputs are reported in Appendix 1 (Tables 3 and 4).

Two rank correlations capture the central regularity. In labour-efficiency terms, the income-based and HDI-based rankings are strongly and positively correlated (Spearman's $\rho = 0.74$, $p < 0.001$): countries that convert working time into income efficiently also tend to convert it into broad human development efficiently. In environmental-efficiency terms, by contrast, the same two rankings are essentially unrelated ($\rho = -0.10$, $p = 0.42$): efficiency in generating income per unit of ecological appropriation carries almost no information about efficiency in generating human development per unit of ecological appropriation. The contrast is reinforced when the two inputs are compared for a given output: for income, the labour- and environmental-efficiency rankings move together ($\rho = 0.64$), whereas for HDI they diverge ($\rho = -0.37$). This quantifies the pattern visible in Fig. 1 below and supports the paper's central point—income behaves as a special case, aligning the different efficiency dimensions, while for broader outcomes the choice of scarce input materially changes which systems appear efficient.

This contrast is analytically important because the Human Development Index is itself a composite that includes income alongside life expectancy and education; examining the components separately shows that converting scarce resources into income efficiently does not imply doing so for health, schooling, subjective well-being, or innovation. Systemic efficiency is therefore not a unitary property: it depends crucially on which end is placed in the numerator.

This point is already visible in Table 1**.** Several Western and Northern European countries occupy the top of the rankings for HDI, life expectancy, schooling, happiness, and innovation, indicating that they achieve relatively strong social outcomes per unit of labour time. By contrast, the ranking for income is only partially aligned

Table 1 Labour efficiency, top 10 and bottom 10 for HDI (rank in parentheses)

Country	HDI (0–1, per 100h worked per capita)	INCOME (2021 PPP$ per hour worked)	LIFE EXP (years per 10h worked per capita)	SCHOOLING (years per 100h worked per capita)	HAPPINESS (0–10, per 100h worked per capita)	INNOVATION (0–100, per 10h worked per capita)
France	0.145 (1)	85.742 (6)	1.312 (1)	1.830 (3)	1.049 (3)	0.815 (1)
Belgium	0.143 (2)	93.009 (4)	1.239 (2)	1.866 (2)	1.050 (2)	0.623 (11)
Denmark	0.135 (3)	95.937 (2)	1.149 (6)	1.826 (4)	1.074 (1)	0.724 (6)
Turkey	0.133 (4)	45.303 (28)	1.231 (3)	1.349 (37)	0.825 (22)	0.589 (13)
Spain	0.133 (5)	64.300 (17)	1.221 (4)	1.509 (21)	0.942 (8)	0.585 (14)
Norway	0.133 (6)	123.759 (1)	1.138 (8)	1.781 (5)	1.026 (4)	0.537 (17)
Germany	0.130 (7)	85.568 (7)	1.105 (10)	1.934 (1)	0.949 (7)	0.758 (2)
Italy	0.127 (8)	69.374 (15)	1.173 (5)	1.493 (25)	0.881 (12)	0.626 (10)
Cyprus	0.127 (9)	58.743 (20)	1.149 (7)	1.730 (6)	0.840 (17)	0.608 (12)
Finland	0.126 (10)	74.857 (13)	1.086 (11)	1.706 (8)	1.022 (5)	0.696 (8)
…	…	…	…	…	…	…
Dom. Rep	0.079 (54)	19.622 (49)	0.759 (52)	0.908 (52)	0.565 (53)	0.140 (61)
Indonesia	0.076 (55)	12.558 (56)	0.743 (54)	0.880 (53)	0.565 (52)	0.231 (56)
Peru	0.070 (56)	12.667 (55)	0.681 (57)	0.873 (54)	0.516 (56)	0.154 (60)
Bangladesh	0.069 (57)	7.113 (61)	0.766 (51)	0.670 (60)	0.492 (58)	0.161 (59)
Thailand	0.066 (58)	16.074 (53)	0.644 (59)	0.716 (58)	0.514 (57)	0.258 (54)
China	0.063 (59)	14.140 (54)	0.633 (60)	0.634 (61)	0.440 (59)	0.447 (26)
Singapore	0.061 (60)	69.837 (14)	0.544 (62)	0.759 (57)	0.426 (62)	0.319 (45)
Vietnam	0.060 (61)	8.544 (60)	0.607 (61)	0.688 (59)	0.440 (60)	0.259 (53)
Myanmar	0.058 (62)	4.667 (62)	0.654 (58)	0.556 (62)	0.434 (61)	0.095 (62)
Cambodia	0.045 (63)	3.213 (63)	0.543 (63)	0.347 (63)	0.343 (63)	0.090 (63)

Table 2 Environmental efficiency, top 10 and bottom 10 for HDI (rank in parentheses)

Country	HDI (0–1, per global hectare of footprint per capita)	INCOME (2021 PPP$ per global hectare of footprint per capita)	LIFE EXP (years per global hectare of footprint per capita)	SCHOOLING (years per global hectare of footprint per capita)	HAPPINESS (0–10, per global hectare of footprint per capita)	INNOVATION (0–100, per global hectare of footprint per capita)
Bangladesh	0.887 (1)	9196 (20)	99.0 (1)	8.66 (1)	6.36 (2)	20.85 (4)
Pakistan	0.667 (2)	6408 (54)	82.7 (2)	5.93 (4)	6.38 (1)	26.68 (2)
India	0.624 (3)	7072 (47)	67.3 (3)	5.92 (5)	3.92 (4)	31.96 (1)
Philippines	0.556 (4)	7484 (41)	55.2 (4)	7.17 (3)	4.48 (3)	21.57 (3)
Sri Lanka	0.540 (5)	9273 (19)	53.3 (6)	7.41 (2)	3.02 (10)	13.53 (8)
Myanmar	0.482 (6)	3855 (62)	54.0 (5)	4.59 (9)	3.59 (5)	7.82 (34)
Uruguay	0.456 (7)	15,110 (3)	42.4 (9)	5.08 (6)	3.54 (6)	10.85 (15)
Indonesia	0.434 (8)	7200 (45)	42.6 (8)	5.05 (7)	3.24 (7)	13.22 (11)
Ecuador	0.416 (9)	7379 (43)	41.4 (10)	4.78 (8)	3.19 (8)	6.76 (49)
Cambodia	0.394 (10)	2795 (63)	47.3 (7)	3.02 (23)	2.99 (11)	7.81 (35)
…	…	…	…	…	…	…
Belgium	0.149 (54)	9699 (16)	12.9 (55)	1.95 (55)	1.09 (52)	6.50 (53)
Austria	0.148 (55)	10,193 (14)	13.1 (54)	1.95 (54)	1.15 (51)	7.01 (44)
Australia	0.134 (56)	7619 (40)	11.8 (56)	1.77 (57)	1.02 (56)	5.31 (59)
Denmark	0.124 (57)	8830 (23)	10.6 (57)	1.68 (60)	0.99 (57)	6.66 (50)
Latvia	0.119 (58)	4534 (60)	10.3 (58)	1.80 (56)	0.81 (60)	4.14 (62)
USA	0.116 (59)	8475 (27)	9.8 (60)	1.69 (59)	0.87 (59)	7.10 (43)
Canada	0.115 (60)	6601 (52)	10.1 (59)	1.69 (58)	0.89 (58)	5.17 (60)
Estonia	0.111 (61)	4719 (58)	9.7 (61)	1.68 (61)	0.74 (61)	5.39 (58)
Singapore	0.106 (62)	12,039 (7)	9.4 (62)	1.31 (62)	0.73 (62)	5.49 (56)
Luxembourg	0.067 (63)	6576 (53)	6.0 (63)	0.93 (63)	0.52 (63)	3.11 (63)

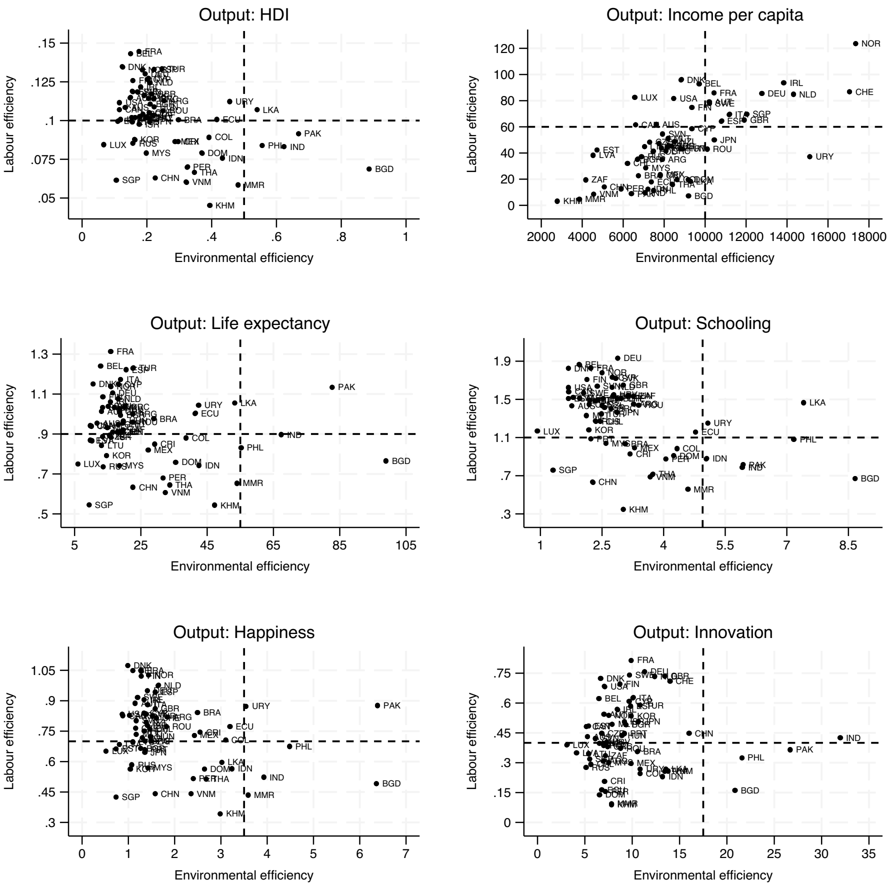

Fig. 1 Labour and environmental efficiency, by output

with this pattern. The ability to transform working time into monetary output is therefore not equivalent to the ability to transform it into broader measures of social performance.

The Turkish case illustrates why this decomposition matters. Turkey ranks highly in HDI labour efficiency, but this result is not matched by equally strong positions in schooling or income. This is reflected directly in the component ranks: Turkey is 4th in HDI labour efficiency and 3rd in life-expectancy labour efficiency, but only 28th in income and 37th in schooling efficiency (Table 1; full ranks in Appendix 1, Table 3). Because the HDI combines income, education, and health, its strong HDI position rests almost entirely on the longevity component, while its schooling and income efficiency are middling. More generally, this confirms that composite indicators can conceal substantial heterogeneity across their constituent parts.

The same divergence between the two inputs appears across the other outputs as well: as Fig. 1 shows, it is especially evident for HDI, life expectancy, schooling, happiness, and, to a large extent, innovation. In environmental-efficiency terms, many countries with relatively low ecological footprints move upward in the ranking even when they are not among the strongest performers in income or labour-efficiency terms. This follows directly from the indicator's logic: environmental efficiency measures the amount of a socially relevant outcome obtained per unit of ecological appropriation, not the absolute level of the outcome alone.

A further caution applies to schooling. Average years of schooling capture the duration of formal education rather than its quality. The schooling-efficiency indicator should therefore be interpreted as educational attainment per unit of resource use, not as a measure of the quality or internal efficiency of education systems. For instance, Germany ranks first in the schooling-based labour-efficiency indicator in Table 1, but this ranking refers to years of schooling per unit of labour time and should not be read as evidence that the German education system performs best in terms of learning outcomes or educational quality. This distinction is illustrated by international assessments such as PISA: German students perform around the OECD average in mathematics and reading, and above the OECD average in science.

A parallel caution applies to health. Life expectancy captures the length of life but not the quality of the years lived; healthy life expectancy, which discounts years spent in poor health, can diverge appreciably from raw life expectancy across countries. The life-expectancy efficiency indicator should therefore be read as longevity per unit of resource use, not as a measure of health-adjusted well-being.

The happiness-based indicators should also be interpreted with caution. Subjective well-being is not only a function of absolute living conditions, but may also reflect adaptation, aspirations, and relative comparisons. Moreover, the Cantril Ladder is an evaluative judgement of life as a whole and need not coincide with experiential or affect-based measures of well-being (e.g. day-to-day positive and negative affect), which can produce somewhat different country rankings. In this sense, happiness efficiency should be read as the amount of reported life satisfaction obtained per unit of labour time or ecological footprint, rather than as a direct measure of absolute welfare. This interpretation is consistent with the broader literature on relative evaluation and relative consumption (Kahneman and Tversky 1979; Stiglitz 2008; Dutt 2009).

This pattern is particularly clear in Table 2, where countries such as Bangladesh, Pakistan, India, the Philippines, and Sri Lanka rank very highly in environmental efficiency for HDI and several of its components, as well as for happiness and, in some cases, innovation. This does not imply that these countries display the highest absolute levels of well-being. It means, rather, that relative to the ecological resources appropriated per capita, they generate more outcome per unit of ecological input than many richer economies. From the perspective adopted in this paper, this is precisely the relevant point: once efficiency is interpreted as resource intensity, countries with modest material throughput may appear relatively efficient in producing some social outcomes even when their absolute income levels remain comparatively low.

By contrast, the efficiency pattern associated with income in Table 2 again differs from those associated with the other outputs. Environmental efficiency in income generation is not led by the same group of countries that dominate the rankings for the broader social outcomes. This confirms that income is a special case in the empirical analysis. Since it is itself a market-valued measure of production, it remains more closely aligned with the conventional productivity logic by which economic systems are often assessed. Once the output shifts from income to health, education, happiness, or innovation, the ecological cost of achieving those outcomes becomes much more heterogeneous across countries.

A few country cases help clarify the wider picture. Uruguay stands out as a positive outlier, combining strong environmental efficiency across several outputs—including income—with a comparatively good position in HDI labour efficiency (Appendix 1). Luxembourg illustrates the opposite configuration: it performs relatively well in labour-income terms but much less favourably in environmental-efficiency terms (Appendix 1). Such cases are useful not because the paper's purpose is to provide country narratives, but because they show that the two dimensions of efficiency need not move in tandem.

Figure 1 summarises the relationship between labour efficiency and environmental efficiency across outputs. For HDI, life expectancy, schooling, happiness, and innovation, most countries tend to fall into one of two broad groups: either they are relatively efficient in labour terms but not in environmental terms, or they are weakly positioned on both dimensions. In addition, some Asian countries occupy a distinct area characterised by relatively low labour efficiency but comparatively high environmental efficiency. Income again displays a distinct efficiency pattern. It is the only output for which labour efficiency and environmental efficiency more often tend to be high together (i.e., to co-move positively), suggesting that the mechanisms that favour the generation of market income per unit of labour time may also favour income generation per unit of ecological throughput. This joint movement, however, does not extend to the wider set of social outcomes considered here. Taken together, the country-level results support three conclusions. First, the empirical assessment of efficiency depends decisively on the choice of output. Second, the choice of scarce input also matters, since labour time and ecological capacity reveal different dimensions of systemic performance. Third, the results do not point to a single hierarchy of countries, but to a plurality of efficiency patterns. For outputs closely related to market production, especially income, countries that perform well in one dimension of resource intensity often perform well in the other. By contrast, for broader outcomes, strong labour efficiency frequently coexists with weak environmental efficiency, while countries with low ecological throughput may appear relatively efficient in environmental terms despite lower income rankings. These patterns motivate the next step in the analysis: examining whether they are systematically associated with differences in market orientation across countries.

5 Market orientation and resource-intensity efficiency

The patterns emerging from the country-level evidence discussed in Sect. 4 indicate that no single ranking of economic systems can be established independently of the outputs and inputs considered. The next step is therefore to examine whether these heterogeneous profiles of resource-intensity efficiency are systematically associated with differences in market orientation. To this end, this section relates the labour-efficiency and environmental-efficiency indicators introduced above to measures of economic freedom and institutional deregulation. The purpose is not to reassess the welfare-theoretic properties of competitive equilibria under their standard assumptions. Rather, it is to ask whether more market-oriented coordination regimes are empirically associated with different patterns of resource-intensity efficiency when efficiency is defined, as in this paper, as the intensity with which primary scarce resources are used to generate income and broader social outcomes.

This distinction is important for interpreting the results. As argued in Sects. 2 and 3, allocative efficiency and resource-intensity efficiency capture different dimensions of systemic performance. The empirical analysis developed here does not address whether market allocations are Pareto efficient in the abstract sense of welfare theory; instead, it examines whether countries characterised by greater market orientation tend to use working time and ecological capacity more or less intensively in producing selected outcomes. In this respect, the analysis should be interpreted as descriptive and comparative rather than as a direct test of economic theory.

The results presented in Sect. 4 already suggest why this second step is necessary. For income, labour efficiency and environmental efficiency were more closely aligned than for the other outputs. By contrast, for broader outcomes, the relationship between the two efficiency dimensions was less consistent. This is true both for the Human Development Index, which combines income, schooling, and health, and for the other outcomes examined separately in this paper, namely health, education, happiness, and innovation. This implies that any association between market orientation and efficiency may depend critically on the output considered and on whether the relevant scarce input is working time or ecological capacity. The analysis that follows is designed precisely to investigate this issue more systematically.

To reduce dependence on a single measurement framework and to verify whether the main results replicate across alternative datasets, I rely on two widely used cross-country sources on economic freedom: the Fraser Institute and the Heritage Foundation.

The Economic Freedom of the World index of the Fraser Institute ranges from 0 (low freedom) to 10 (high freedom) and is composed of five dimensions, which in turn include several sub-dimensions: Size of Government; Legal System and Property Rights (judicial independence, impartial courts, protection of property rights, military interference in the rule of law and politics, integrity of the legal system, legal enforcement of contracts, regulatory restrictions on the sale of real property, reliability of police); Sound Money (money growth, standard deviation of inflation, inflation, freedom to own foreign-currency bank accounts); Freedom to Trade Internationally; and Regulation (freedom to enter markets and compete, business regulations, labour-market regulations, credit-market regulations).[5]

[5] The data can be downloaded from https://efotw.org/economic-freedom/dataset

The Index of Economic Freedom of the Heritage Foundation ranges from 0 (low freedom) to 100 (high freedom) and is composed of four dimensions, which in turn include several sub-dimensions: Rule of Law (property rights, judicial effectiveness, government integrity); Government Size (tax burden, government spending); Regulatory Efficiency (business freedom, labour freedom, monetary freedom, including government influence over prices); and Market Openness (trade freedom, investment freedom, financial freedom).[6]

For the purposes of this analysis, however, components primarily related to the quality and independence of legal and political institutions—such as the rule of law, impartial courts, judicial effectiveness, government integrity, and the protection of property rights—are not central to the specific notion of market orientation examined here. These aspects are clearly important and desirable in their own right, but they do not directly pertain to the measurement of market deregulation and the extent of direct government intervention in economic activity, which are the main focus of this section. Including all dimensions of the Fraser and Heritage indices would make interpreting the results more difficult, as it would blur the distinction between features more directly related to market-oriented coordination and broader institutional characteristics that affect the economy's functioning.

I therefore construct two narrower measures designed to capture the specific dimension of interest here: the extent of market deregulation and the relative weight of direct government intervention in the economy, especially through expenditure and taxation. Accordingly, two synthetic indices are employed, derived from the mean of the most pertinent dimensions within the two datasets: Government Size, Freedom to Trade Internationally, and Regulation for the Fraser index; and Government Size, Regulatory Efficiency, and Market Openness for the Heritage index.[7] In both cases, higher values correspond to a more market-oriented institutional configuration, combining greater market deregulation with a smaller direct role of government in economic activity, especially through expenditure and taxation. As a robustness check, Appendix 3 replicates the entire analysis using the full Fraser and Heritage indices, i.e. including the legal-institutional and (for Fraser) monetary dimensions excluded here. As discussed at the end of this section, the main patterns are confirmed.

The two market orientation indices are averaged over the period 2000–2023. This period is longer than that used for the efficiency indicators, which refer to 2013–2023. This choice reflects the idea that market orientation is more appropriately understood as a medium-run institutional characteristic, whereas the efficiency indicators are constructed for a more recent period. If a causal interpretation were to be hypothesised—an issue not examined in this study—the relevant direction would be from market orientation to efficiency rather than the reverse. This provides an

[6] The data can be downloaded from https://www.heritage.org/index/

[7] Hence, there is a difference in the methodology employed for deriving indexes from the two institutions. Specifically, the index derived by the Fraser Institute does not incorporate monetary factors, while the Heritage Foundation incorporates a sub-dimension titled "monetary freedom." This decision is partly influenced by the Heritage Foundation's focus on the government's capacity to regulate prices, absent in the Fraser approach.

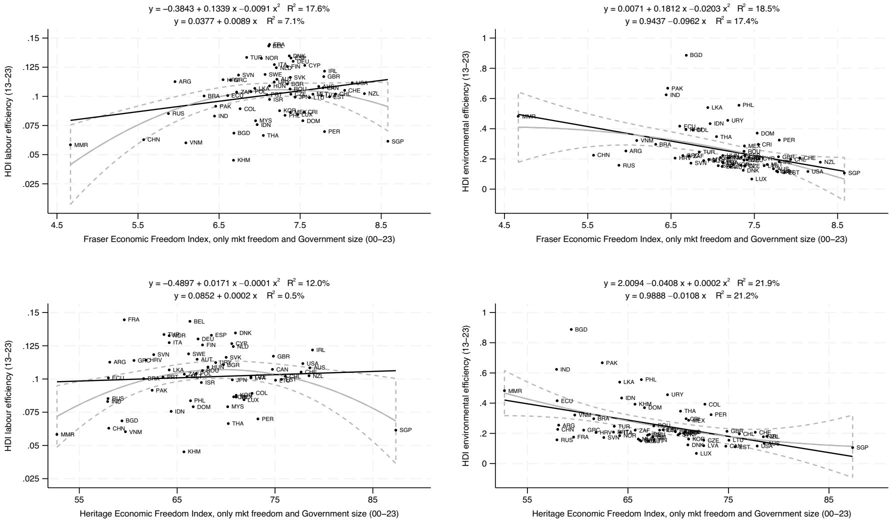

Fig. 2 HDI efficiency and market orientation. Higher values on the x-axis indicate greater market deregulation and a smaller direct role of government in expenditure and taxation. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

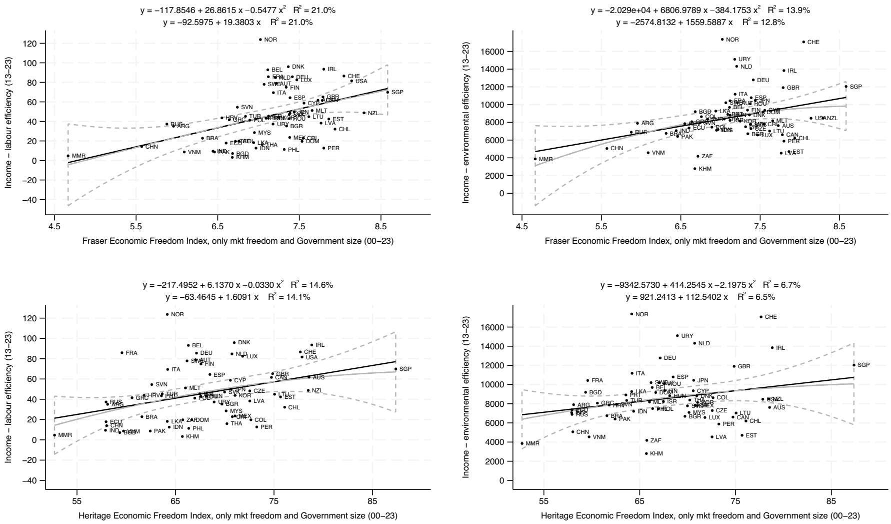

Fig. 3 Income efficiency and market orientation. Higher values on the x-axis indicate greater market deregulation and a smaller direct role of government in expenditure and taxation. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

additional reason for using a longer period for the former. Moreover, varying the time windows yields results qualitatively very similar to those reported here.

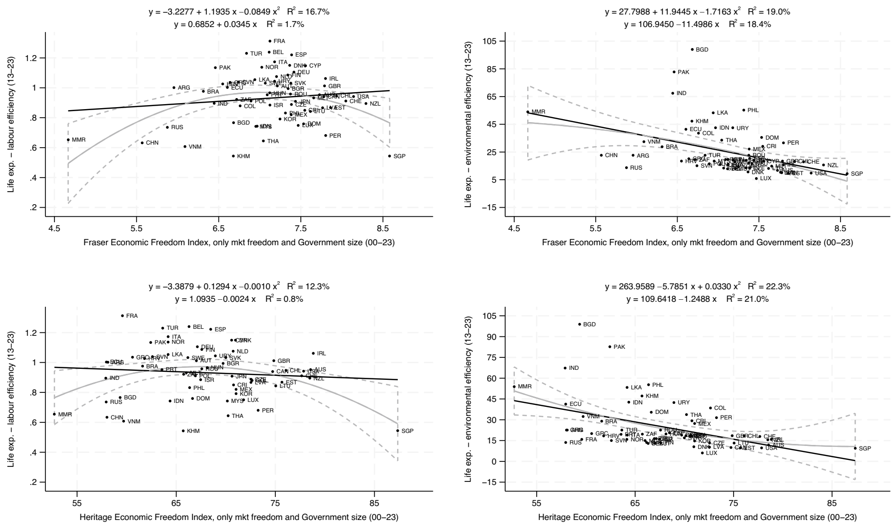

Fig. 4 Life expectancy efficiency and market orientation. Higher values on the x-axis indicate greater market deregulation and a smaller direct role of government in expenditure and taxation. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

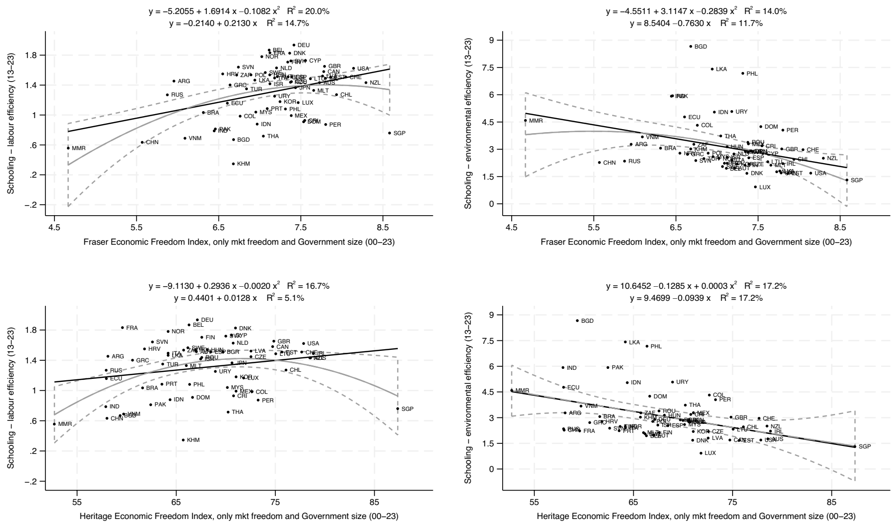

Fig. 5 Schooling efficiency and market orientation. Higher values on the x-axis indicate greater market deregulation and a smaller direct role of government in expenditure and taxation. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

Figures 2, 3, 4, 5, 6, 7 provide a visual summary of the relationship between market orientation and the two resource-intensity measures introduced above. Each figure refers to one output dimension—HDI, income, life expectancy, schooling, happiness, and

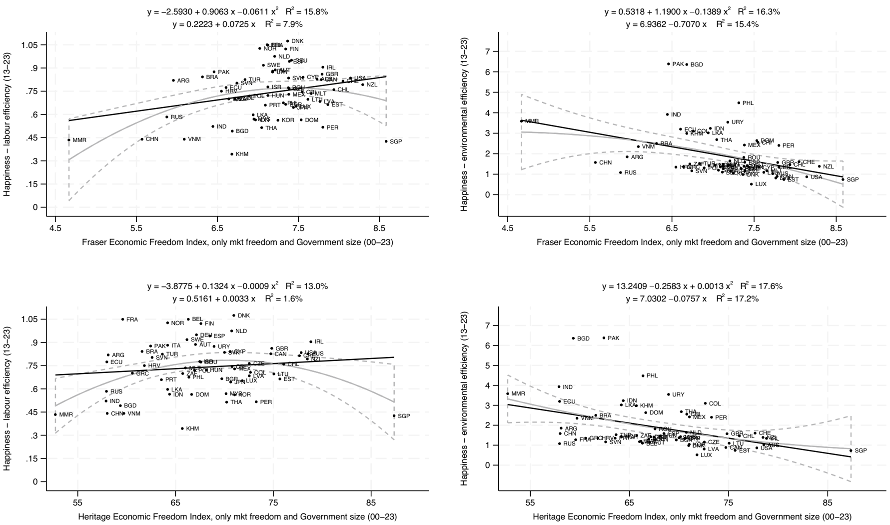

Fig. 6 Happiness efficiency and market orientation. Higher values on the x-axis indicate greater market deregulation and a smaller direct role of government in expenditure and taxation. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

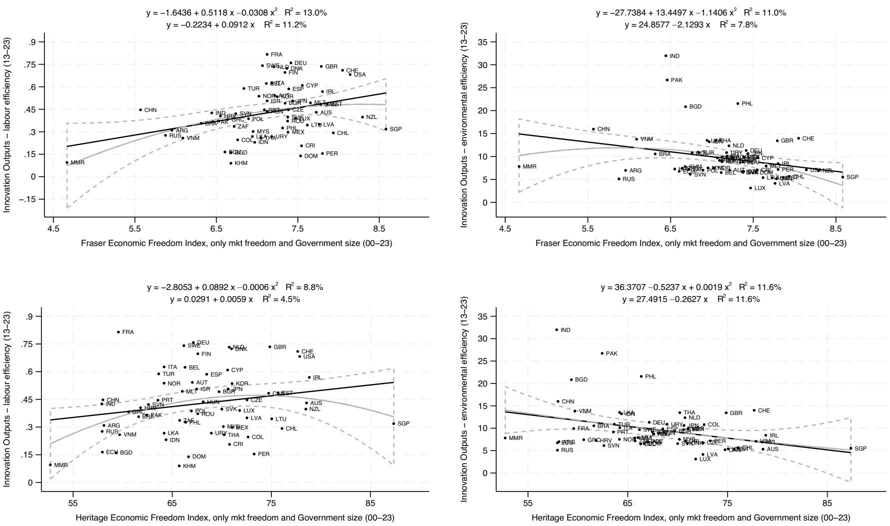

Fig. 7 Innovation efficiency and market orientation. Higher values on the x-axis indicate greater market deregulation and a smaller direct role of government in expenditure and taxation. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

innovation, respectively—and reports the association of that output's labour efficiency and environmental efficiency with the two market orientation indices derived from Fraser and Heritage. To facilitate interpretation, both linear and quadratic fits are superimposed in each panel, together with the estimated equations and corresponding R^2 values, while the dashed lines indicate the 95% confidence interval of the quadratic fit. The figures should be read primarily as descriptive evidence. In this respect, the comparison between linear and quadratic fits is substantively informative, since it helps identify whether the association is approximately linear or instead exhibits a more clearly nonlinear pattern. Appendix 2 reports Ramsey RESET tests applied to the corresponding linear specifications, together with quadratic specifications where the linear form is rejected (Table 5 for the Fraser-based index and Table 6 for the Heritage-based index). These tests provide a formal diagnostic check on the nonlinear interpretations discussed below. The results should nevertheless be read as descriptive cross-country associations, not as evidence of causal mechanisms or precise structural thresholds.

The key issue is the nature of the relationship between market orientation and the two efficiency dimensions considered here, with the use of two alternative market orientation indices serving mainly as a robustness check.

A first broad pattern emerges from Figs. 2, 3, 4, 5, 6, 7 and Appendix 2. The efficiency patterns associated with income clearly stand out from those associated with the other outputs ("ends"). Labour efficiency and environmental efficiency in income generation both tend to be higher in more market-oriented systems. For the other outputs, however, the picture is different. For the Human Development Index (HDI)—which combines income, education, and health—as well as for health, education, happiness, and, more tentatively, innovation considered separately, environmental efficiency tends to be lower in more market-oriented systems across the whole observed range. Labour efficiency, by contrast, displays a different pattern: in several cases it tends to be higher at low-to-intermediate levels of market orientation and lower at the highest levels, a non-monotonic (inverted-U) association rather than a monotone one. In other words, intermediate levels of market orientation tend to be associated with higher labour efficiency in the production of broader outcomes, whereas the highest levels of market orientation—and a very limited direct role of government—tend to be associated with lower labour efficiency as well. This suggests that systems that are relatively effective in transforming scarce resources into income are not necessarily equally effective in transforming that income into broader social outcomes. Put differently, the empirical association appears stronger for the production of material wealth itself than for the conversion of that wealth into health, education, subjective well-being, or innovative performance.

The contrast between income and happiness is especially informative in this respect. Since Easterlin (1974), it has been widely recognised that increases in income do not necessarily translate into proportional gains in subjective well-being (see also Friedman-Sokuler and Senik 2024). The results reported here are consistent with that insight. More market-oriented systems appear, on average, to be relatively efficient at producing income, including from an environmental perspective, yet this does not imply a similarly efficient conversion of material wealth into happiness. Here again, environmental efficiency tends to be lower in more market-oriented systems in a fairly systematic way, whereas the labour-efficiency dimension is more nonlinear, with lower values especially at the highest levels of market orientation. The same wider tension is visible when the focus shifts from efficiency in the generation of income alone to efficiency in the generation of the HDI, which combines income with education and health, and of the other non-income outcomes considered separately. In this sense, the findings are also consistent with Jackson's

(2006) argument that highly consumption-oriented systems tend to reproduce a continual expansion of wants (see also Scitovsky 1976). Production and consumption may grow efficiently in terms of resource intensity when the output is income, but the satisfaction or wider well-being associated with that expansion does not increase correspondingly once multidimensional outcomes are considered.

A related interpretation can be advanced for health and education, and therefore for the HDI as well, since the HDI is a composite of income, education, and health rather than a purely monetary indicator. These outcomes are not generated simply by increasing the volume of market production. Their achievement depends to a considerable extent on institutional arrangements, collective provision, and long-term public investment. If market orientation increases alongside deregulation and a reduced direct role of government in economic activity, the production of income may remain more resource-efficient, while the translation of that wealth into health, education, and wider human development may become less efficient. The figures suggest that this gap is widest and most systematic in environmental-efficiency terms. For labour efficiency, the pattern seems to be nonlinear in the cases of health and education, where the formal tests reported in Appendix 2 support the interpretation suggested by the fitted curves; for schooling, however, the quadratic term in the Fraser-based specification is only marginally significant ($p = 0.052$; Appendix 2, Table 5) and should not be read as definitive evidence of nonlinearity. In this sense, the results are consistent with the idea that some degree of market coordination may coexist with improvements in labour efficiency, while a very limited direct role of public intervention may be associated with weaker efficiency in the production of these broader outcomes. This interpretation remains descriptive and should not be read as evidence of a causal mechanism.

Innovation should be interpreted somewhat more cautiously. On the one hand, innovative output is often associated with market competition, entrepreneurial incentives, and decentralised experimentation. On the other hand, the literature has repeatedly emphasised the role of public action in basic research, mission-oriented investment, and high-risk activities that private actors may underprovide (Mazzucato 2013). For this reason, the relationship between market orientation and innovation efficiency is likely to depend on the balance between market incentives and public support. In labour-efficiency terms, the fitted curves suggest a possible nonlinear pattern, but the formal tests reported in Appendix 2 do not provide the same support for this interpretation as in the cases of health and education. The labour-efficiency results for innovation should therefore be read cautiously: they suggest that innovation does not follow a simple income-efficiency logic, but they do not provide strong evidence of a clear threshold or systematic nonlinear pattern. In environmental-efficiency terms, however, the pattern is more consistent: innovation efficiency tends to be lower in more market-oriented systems, both in the fitted relationships and in the formal diagnostics. This is consistent with more market-oriented systems generating innovative outputs at comparatively higher ecological resource intensity, even if the labour-time relationship is less clear-cut.

These patterns are robust to using the full Fraser and Heritage indices instead of the narrower market orientation measures employed in the main analysis. Appendix 3 (Figs. 8, 9, 10, 11, 12, 13) replicates the analysis with the complete indices, which also incorporate the legal-institutional dimensions (rule of law, security of property rights) and, for Fraser, the sound-money dimension. For environmental efficiency, the results are essentially unchanged: the association with market orientation remains positive for income and negative, and approximately linear, for all the broader outcomes; if anything, the negative association becomes more pronounced, with markedly higher R^2 values (for instance, for HDI environmental efficiency the linear fit rises from about 17% to about 43% with the Fraser-based measure). This indicates that the central environmental result is not an artefact of excluding the legal and monetary components. For labour efficiency the qualitative picture is also preserved—income stands apart with a positive association, while the broader outcomes display a weaker relationship—but the nonlinearity is less pronounced than in the main specification, particularly for the Fraser-based measure, where the linear positive fit captures most of the explained variation; with the Heritage-based measure the nonlinear pattern is more persistent. A plausible reading is that the full indices combine the dimension of interest here—market deregulation and the direct role of government—with institutional-quality and monetary-stability components that are themselves positively and more monotonically associated with these efficiency outcomes. Pooling these dimensions therefore tends to attenuate the specifically nonlinear pattern associated with deregulation and a shrinking government role, which is precisely the dimension the narrower measure is designed to isolate. This supports, rather than weakens, the rationale for the construction adopted in the main analysis, while confirming that the environmental findings hold under the full, widely used indices.

Taken together, the evidence reported in this section points to a systematic distinction between the efficiency with which more market-oriented systems generate income and the efficiency with which they translate material wealth into broader social outcomes. While market orientation is more often associated with comparatively favourable resource-intensity patterns when the output is income, the same is not generally true when the outputs are wider measures of human development—including the HDI, which combines income, education, and health—or when health, education, happiness, and innovation are considered separately. More specifically, for these broader outcomes, environmental efficiency tends to be systematically lower in more market-oriented systems, whereas labour efficiency displays more heterogeneous patterns. In several cases, the formal tests reported in Appendix 2 support a nonlinear specification, but the evidence should not be interpreted as identifying precise thresholds. Overall, the results do not establish a causal mechanism, but they do suggest that evaluating economic systems cannot be reduced to their capacity to expand GDP or income alone. The concluding section returns to this point and discusses its wider implications for the assessment of systemic efficiency, the environmental limits of growth-centred coordination regimes, and the debate on whether increases in material output can be relied upon to secure wider forms of human well-being.

6 Concluding remarks

This paper has proposed a resource-intensity perspective on systemic efficiency. Rather than evaluating whether economic systems approximate a technological frontier or satisfy the internal conditions of allocative efficiency, the analysis has asked how intensively primary scarce resources are used to generate different social and economic outcomes. In this sense, the paper has treated ecological capacity and human time as foundational constraints and has measured systemic efficiency as the ratio between selected outputs and these underlying inputs. The aim has therefore not been to replace existing concepts of efficiency, but to complement them with an empirical perspective focused on the transformation of scarce means into socially relevant ends.

The empirical results indicate that the relationship between market orientation and systemic efficiency depends critically on both the output considered and the scarce input taken into account. When the output is income, more market-oriented systems tend, on average, to display comparatively favourable patterns in both labour and environmental efficiency. For the efficiency patterns associated with broader outcomes, however, the picture is different. For the Human Development Index (HDI), which combines income, education, and health, and for health, education, happiness, and innovation considered separately, environmental efficiency tends to be systematically lower in more market-oriented systems. Labour efficiency follows a more heterogeneous pattern. In several cases, especially for broader non-income outcomes, the formal tests reported in Appendix 2 support a nonlinear specification, but these patterns should be interpreted cautiously and not as evidence of precise thresholds. These findings suggest that systems that are relatively efficient in generating material wealth are not necessarily equally effective in translating that wealth into wider forms of human development and well-being. This should not be read as a denial of the informational value of GDP as a measure of market output, but as evidence that GDP alone is too narrow to serve as a sufficient criterion of systemic performance.

Interpreted in light of the conceptual discussion developed in Sects. 2 and 3, these results are consistent with the distinction, central to ecological economics, between allocation and scale. Following Georgescu-Roegen's throughput perspective and Daly's distinction between sustainable scale, efficient allocation, and just distribution, the findings should not be read as a refutation of the allocative logic of markets within its own theoretical domain. Rather, they suggest that coordination regimes that may perform relatively well in generating income are not thereby shown to achieve broader social outcomes with equal economy in the use of ecological capacity and human time. In particular, the results are consistent with Daly's argument that sustainable scale cannot be inferred from market allocation alone, and with the related idea that different policy objectives require distinct institutional instruments.

From this perspective, the environmental results are especially significant. The analysis suggests that, for outcomes other than income, greater market orientation is associated quite systematically with lower environmental efficiency. In the cross-country patterns examined here, broader objectives such as health, education, happiness, innovation, and multidimensional human development are associated with comparatively higher environmental costs in more market-oriented systems. This does not establish a causal mechanism, but it suggests that growth-centred coordination regimes may not easily reconcile expanding material output with the efficient achievement of wider social ends. In this respect, the findings are consistent with Antoci and Borghesi's (2010) argument that environmental deterioration may interact with economic dynamics in self-reinforcing ways, and they also resonate with the debate on growth imperatives, which emphasises that GDP expansion often functions as a structural policy priority rather than as one objective among others (Richters and Siemoneit 2019; Koundouri et al. 2023). Jackson's (2021) call to move beyond GDP-centred economic organisation is therefore relevant, but it should not be interpreted as implying that political systems can simply replace GDP with alternative objectives by choice alone. Rather, the results presented here suggest that, if wider forms of well-being are the ultimate ends, their pursuit cannot be assessed adequately through income growth alone and may require distinct institutional supports. This reinforces Daly's argument that sustainable scale requires policy instruments separate from those governing allocation, including constraints on the absolute scale of resource throughput.

The paper has several limitations. First, efficiency should not be confused with effectiveness. As Sen (1985) emphasised, the fact that a system uses fewer scarce resources per unit of outcome does not by itself determine whether the achieved level of that outcome is normatively adequate. Second, some outcomes involve qualitative dimensions that are not fully captured by the indicators employed here; this applies in particular to education, where years of schooling do not necessarily reflect the quality of learning, and also to health, where life expectancy is only one aspect of human well-being. On the input side, similarly, the labour-efficiency indicator treats working time purely as a scarce resource and therefore abstracts from the non-pecuniary benefits of employment—meaning, identity, and social interaction—acknowledged in Sect. 2, which a fuller welfare assessment would need to weigh against the opportunity cost of time. Third, the analysis is based on average national indicators and therefore does not directly address distributional issues. If inequality were taken more fully into account, the assessment of systemic performance might become less favourable to strongly market-oriented configurations, especially where a reduced fiscal and spending role of government limits the social translation of material output. Fourth, the empirical analysis is cross-sectional and descriptive. It identifies associations between market orientation and resource-intensity efficiency, but it does not isolate the independent causal effect of market orientation from broader development patterns such as capital deepening, human-capital accumulation, sectoral transformation, and demographic structure. These factors are not necessarily external controls, since they may themselves be shaped by the institutional and market arrangements captured by the market orientation indices. Finally, although the Ecological Footprint provides a useful synthetic proxy for ecological appropriation, it does not capture all environmental pressures—most notably freshwater use, soil erosion, non-CO_2 greenhouse gases, and toxic emissions not mediated by bioproductive area—and its known biases, in particular the dominance of the carbon component and its land-based logic, should be kept in mind. I nonetheless retain it as the single most appropriate measure for the specific notion of efficiency developed here, namely the intensity with which a finite, non-reproducible regenerative capacity is used, a dimension that single-pressure or mass-based indicators capture less directly. A full parallel analysis using an alternative environmental indicator was not added so as not to further lengthen an already analysis-intensive paper; instead, the likely direction of any resulting bias can be assessed directly. Because the carbon component dominates the Ecological Footprint, the measure is strongly correlated with consumption-based carbon emissions, and both carbon and material footprints tend to be high in affluent, more market-oriented economies. An alternative indicator would therefore be likely to reinforce, rather than reverse, the negative association between market orientation and environmental efficiency found here for broader outcomes, suggesting that this association is, if anything, conservatively estimated.

These limitations do not invalidate the perspective developed here. On the contrary, they reinforce the wider conclusion that the evaluation of economic systems depends fundamentally on how efficiency is defined, which outputs are treated as socially relevant ends, and which scarce resources are recognised as binding constraints. If GDP or income alone is taken as the objective, more market-oriented systems appear relatively efficient. Once the analysis is extended to broader outcomes and to primary constraints such as ecological capacity and human time, however, the picture becomes more complex. The main implication is therefore not that one single coordination regime can be declared universally efficient or inefficient, but that different concepts of efficiency illuminate different dimensions of systemic performance. In particular, the results suggest that the environmental sustainability of growth cannot be inferred solely from the efficiency with which market-oriented systems generate income. If broader outcomes such as health, education, happiness, innovation, and multidimensional human development are considered, the relationship between growth, efficiency, and ecological pressure appears considerably more problematic. For this reason, debates on development and green growth cannot be settled by reference to income alone.

The present contribution is necessarily limited in scope, but it also opens several avenues for further research. A first direction would be to examine the relationship between resource-intensity efficiency and market orientation using more refined statistical tools, moving beyond the bivariate analysis developed here. Future work based on larger cross-country samples or panel data could use multivariate designs to assess the robustness of the observed patterns, while carefully distinguishing between genuine confounding variables and possible channels through which market orientation is associated with resource-intensity outcomes. This is particularly important because capital deepening, human-capital accumulation, tertiarisation, and demographic structure may be both correlated with market orientation and partly shaped by it. A second direction would be to investigate more closely the mechanisms that may underlie the empirical regularities identified in this paper. Further research could examine why, for non-income outcomes, labour efficiency appears more often to follow a nonlinear relationship with market orientation, whereas environmental efficiency tends to show a more clearly negative association. In the present paper, these mechanisms are discussed only indirectly, based on the existing literature; they warrant more direct and systematic analysis.

Appendix 1: Full version (with all countries) of Tables 1 and 2

Table 3 Labour efficiency, all countries (rank in parentheses)

Country	HDI (0–1, per 100h worked per capita)	INCOME (2021 PPP$ per hour worked)	LIFE EXP (years per 10h worked per capita)	SCHOOLING (years per 100h worked per capita)	HAPPINESS (0–10, per 100h worked per capita)	INNOVATION (0–100, per 10h worked per capita)
France	0.145 (1)	85.742 (6)	1.312 (1)	1.830 (3)	1.049 (3)	0.815 (1)
Belgium	0.143 (2)	93.009 (4)	1.239 (2)	1.866 (2)	1.050 (2)	0.623 (11)
Denmark	0.135 (3)	95.937 (2)	1.149 (6)	1.826 (4)	1.074 (1)	0.724 (6)
Turkey	0.133 (4)	45.303 (28)	1.231 (3)	1.349 (37)	0.825 (22)	0.589 (13)
Spain	0.133 (5)	64.300 (17)	1.221 (4)	1.509 (21)	0.942 (8)	0.585 (14)
Norway	0.133 (6)	123.759 (1)	1.138 (8)	1.781 (5)	1.026 (4)	0.537 (17)
Germany	0.130 (7)	85.568 (7)	1.105 (10)	1.934 (1)	0.949 (7)	0.758 (2)
Italy	0.127 (8)	69.374 (15)	1.173 (5)	1.493 (25)	0.881 (12)	0.626 (10)
Cyprus	0.127 (9)	58.743 (20)	1.149 (7)	1.730 (6)	0.840 (17)	0.608 (12)
Finland	0.126 (10)	74.857 (13)	1.086 (11)	1.706 (8)	1.022 (5)	0.696 (8)
Netherlands	0.125 (11)	84.859 (8)	1.075 (12)	1.629 (11)	0.975 (6)	0.733 (5)
Ireland	0.122 (12)	93.447 (3)	1.062 (13)	1.489 (26)	0.905 (10)	0.568 (15)
Sweden	0.119 (13)	77.961 (12)	1.032 (18)	1.566 (14)	0.918 (9)	0.741 (3)
Slovenia	0.118 (14)	54.557 (21)	1.039 (16)	1.641 (10)	0.803 (25)	0.422 (31)
UK	0.117 (15)	65.167 (16)	1.013 (22)	1.652 (9)	0.861 (15)	0.735 (4)
Slovak Rep	0.116 (16)	47.098 (26)	1.032 (19)	1.721 (7)	0.835 (18)	0.397 (34)
Austria	0.115 (17)	78.897 (11)	1.013 (21)	1.513 (20)	0.887 (11)	0.542 (16)
Croatia	0.114 (18)	43.691 (31)	1.026 (20)	1.549 (15)	0.750 (32)	0.404 (32)
Greece	0.114 (19)	41.608 (36)	1.036 (17)	1.402 (35)	0.701 (39)	0.382 (37)
Argentina	0.113 (20)	35.072 (42)	1.001 (24)	1.453 (29)	0.820 (23)	0.309 (46)
Uruguay	0.112 (21)	37.242 (40)	1.045 (15)	1.252 (41)	0.874 (14)	0.268 (52)
USA	0.112 (22)	81.559 (10)	0.942 (32)	1.623 (12)	0.835 (19)	0.683 (9)

Table 3 (continued)

Country	HDI (0–1, per 100h worked per capita)	INCOME (2021 PPP$ per hour worked)	LIFE EXP (years per 10h worked per capita)	SCHOOLING (years per 100h worked per capita)	HAPPINESS (0–10, per 100h worked per capita)	INNOVATION (0–100, per 10h worked per capita)
Bulgaria	0.111 (23)	35.221 (41)	0.995 (25)	1.509 (22)	0.665 (44)	0.491 (22)
Hungary	0.109 (24)	43.263 (33)	0.966 (27)	1.538 (16)	0.723 (36)	0.437 (28)
Australia	0.108 (25)	61.712 (18)	0.954 (29)	1.433 (33)	0.828 (20)	0.430 (29)
Canada	0.107 (26)	61.583 (19)	0.940 (33)	1.580 (13)	0.826 (21)	0.482 (24)
Sri Lanka	0.107 (27)	18.343 (51)	1.054 (14)	1.466 (28)	0.597 (49)	0.268 (51)
Romania	0.106 (28)	42.864 (34)	0.959 (28)	1.439 (31)	0.773 (29)	0.372 (38)
Switzerland	0.105 (29)	86.645 (5)	0.911 (36)	1.508 (23)	0.815 (24)	0.710 (7)
Poland	0.104 (30)	41.185 (37)	0.911 (37)	1.536 (17)	0.719 (37)	0.386 (36)
South Africa	0.104 (31)	19.584 (50)	0.921 (35)	1.534 (18)	0.700 (40)	0.336 (43)
New Zeal	0.102 (32)	48.738 (24)	0.895 (40)	1.434 (32)	0.793 (26)	0.398 (33)
Chile	0.102 (33)	32.164 (43)	0.946 (31)	1.271 (39)	0.760 (31)	0.293 (49)
Malta	0.102 (34)	51.157 (22)	0.932 (34)	1.329 (38)	0.735 (34)	0.494 (21)
Czechia	0.102 (35)	48.213 (25)	0.888 (41)	1.446 (30)	0.764 (30)	0.447 (25)
Portugal	0.101 (36)	43.374 (32)	0.953 (30)	1.085 (45)	0.659 (46)	0.446 (27)
Latvia	0.101 (37)	38.296 (38)	0.867 (45)	1.522 (19)	0.683 (42)	0.350 (41)
Ecuador	0.101 (38)	17.885 (52)	1.003 (23)	1.158 (44)	0.774 (28)	0.164 (58)
Brazil	0.100 (39)	22.782 (46)	0.976 (26)	1.034 (48)	0.842 (16)	0.356 (40)
Estonia	0.100 (40)	42.457 (35)	0.868 (44)	1.507 (24)	0.663 (45)	0.485 (23)
Japan	0.099 (41)	49.789 (23)	0.909 (38)	1.365 (36)	0.644 (48)	0.507 (19)
Lithuania	0.099 (42)	44.921 (29)	0.843 (47)	1.486 (27)	0.697 (41)	0.344 (42)
Israel	0.097 (43)	45.452 (27)	0.884 (42)	1.416 (34)	0.777 (27)	0.506 (20)
Pakistan	0.092 (44)	8.790 (59)	1.135 (9)	0.814 (55)	0.876 (13)	0.366 (39)

Table 3 (continued)

Country	HDI (0–1, per 100h worked per capita)	INCOME (2021 PPP$ per hour worked)	LIFE EXP (years per 10h worked per capita)	SCHOOLING (years per 100h worked per capita)	HAPPINESS (0–10, per 100h worked per capita)	INNOVATION (0–100, per 10h worked per capita)
Colombia	0.089 (45)	19.673 (48)	0.879 (43)	0.984 (50)	0.706 (38)	0.246 (55)
Korea, Rep	0.088 (46)	43.951 (30)	0.791 (50)	1.180 (42)	0.562 (54)	0.535 (18)
Costa Rica	0.086 (47)	22.771 (47)	0.850 (46)	0.928 (51)	0.744 (33)	0.207 (57)
Mexico	0.086 (48)	23.553 (45)	0.820 (49)	0.992 (49)	0.730 (35)	0.298 (48)
Russian Fed	0.085 (49)	37.335 (39)	0.736 (56)	1.270 (40)	0.583 (50)	0.277 (50)
Luxembourg	0.084 (50)	82.504 (9)	0.749 (53)	1.166 (43)	0.653 (47)	0.390 (35)
Philippines	0.084 (51)	11.278 (57)	0.832 (48)	1.081 (46)	0.675 (43)	0.325 (44)
India	0.083 (52)	9.412 (58)	0.896 (39)	0.787 (56)	0.522 (55)	0.425 (30)
Malaysia	0.079 (53)	28.461 (44)	0.742 (55)	1.040 (47)	0.570 (51)	0.302 (47)
Dom. Rep	0.079 (54)	19.622 (49)	0.759 (52)	0.908 (52)	0.565 (53)	0.140 (61)
Indonesia	0.076 (55)	12.558 (56)	0.743 (54)	0.880 (53)	0.565 (52)	0.231 (56)
Peru	0.070 (56)	12.667 (55)	0.681 (57)	0.873 (54)	0.516 (56)	0.154 (60)
Bangladesh	0.069 (57)	7.113 (61)	0.766 (51)	0.670 (60)	0.492 (58)	0.161 (59)
Thailand	0.066 (58)	16.074 (53)	0.644 (59)	0.716 (58)	0.514 (57)	0.258 (54)
China	0.063 (59)	14.140 (54)	0.633 (60)	0.634 (61)	0.440 (59)	0.447 (26)
Singapore	0.061 (60)	69.837 (14)	0.544 (62)	0.759 (57)	0.426 (62)	0.319 (45)
Vietnam	0.060 (61)	8.544 (60)	0.607 (61)	0.688 (59)	0.440 (60)	0.259 (53)
Myanmar	0.058 (62)	4.667 (62)	0.654 (58)	0.556 (62)	0.434 (61)	0.095 (62)
Cambodia	0.045 (63)	3.213 (63)	0.543 (63)	0.347 (63)	0.343 (63)	0.090 (63)

Table 4 Environmental efficiency, all countries (rank in parentheses)

Country	HDI (0–1, per global hectare of footprint per capita)	INCOME (2021 PPP$ per global hectare of footprint per capita)	LIFE EXP (years per global hectare of footprint per capita)	SCHOOLING (years per global hectare of footprint per capita)	HAPPINESS (0–10, per global hectare of footprint per capita)	INNOVATION (0–100, per global hectare of footprint per capita)
Bangladesh	0.887 (1)	9196 (20)	99.0 (1)	8.66 (1)	6.36 (2)	20.85 (4)
Pakistan	0.667 (2)	6408 (54)	82.7 (2)	5.93 (4)	6.38 (1)	26.68 (2)
India	0.624 (3)	7072 (47)	67.3 (3)	5.92 (5)	3.92 (4)	31.96 (1)
Philippines	0.556 (4)	7484 (41)	55.2 (4)	7.17 (3)	4.48 (3)	21.57 (3)
Sri Lanka	0.540 (5)	9273 (19)	53.3 (6)	7.41 (2)	3.02 (10)	13.53 (8)
Myanmar	0.482 (6)	3855 (62)	54.0 (5)	4.59 (9)	3.59 (5)	7.82 (34)
Uruguay	0.456 (7)	15,110 (3)	42.4 (9)	5.08 (6)	3.54 (6)	10.85 (15)
Indonesia	0.434 (8)	7200 (45)	42.6 (8)	5.05 (7)	3.24 (7)	13.22 (11)
Ecuador	0.416 (9)	7379 (43)	41.4 (10)	4.78 (8)	3.19 (8)	6.76 (49)
Cambodia	0.394 (10)	2795 (63)	47.3 (7)	3.02 (23)	2.99 (11)	7.81 (35)
Colombia	0.392 (11)	8640 (25)	38.6 (11)	4.32 (10)	3.10 (9)	10.81 (16)
Dom. Rep	0.370 (12)	9175 (21)	35.5 (12)	4.25 (11)	2.64 (13)	6.54 (51)
Thailand	0.347 (13)	8390 (28)	33.6 (13)	3.74 (13)	2.68 (12)	13.47 (9)
Peru	0.325 (14)	5884 (56)	31.6 (15)	4.05 (12)	2.40 (17)	7.16 (40)
Vietnam	0.322 (15)	4558 (59)	32.4 (14)	3.67 (14)	2.35 (18)	13.80 (27)
Brazil	0.297 (16)	6746 (50)	28.9 (17)	3.06 (21)	2.49 (15)	10.55 (18)
Costa Rica	0.297 (17)	7811 (37)	29.2 (16)	3.18 (19)	2.55 (14)	7.10 (42)
Mexico	0.287 (18)	7811 (38)	27.2 (18)	3.29 (16)	2.42 (16)	9.87 (22)
Argentina	0.254 (19)	7899 (35)	22.6 (22)	3.27 (17)	1.85 (19)	6.97 (46)
Romania	0.251 (20)	10,096 (15)	22.6 (21)	3.39 (15)	1.82 (20)	8.76 (30)
Turkey	0.246 (21)	8352 (29)	22.7 (19)	2.49 (39)	1.52 (26)	10.85 (14)
China	0.225 (22)	5063 (57)	22.7 (20)	2.27 (45)	1.58 (24)	15.99 (5)

Table 4 (continued)

Country	HDI (0–1, per global hectare of footprint per capita)	INCOME (2021 PPP$ per global hectare of footprint per capita)	LIFE EXP (years per global hectare of footprint per capita)	SCHOOLING (years per global hectare of footprint per capita)	HAPPINESS (0–10, per global hectare of footprint per capita)	INNOVATION (0–100, per global hectare of footprint per capita)
Spain	0.223 (23)	10,792 (10)	20.5 (23)	2.53 (36)	1.58 (23)	9.82 (23)
Hungary	0.222 (24)	8823 (24)	19.7 (25)	3.14 (20)	1.47 (28)	8.90 (29)
Greece	0.221 (25)	8073 (33)	20.1 (24)	2.72 (33)	1.36 (37)	7.41 (38)
South Africa	0.221 (26)	4172 (61)	19.6 (26)	3.27 (18)	1.49 (27)	7.15 (41)
UK	0.214 (27)	11,918 (8)	18.5 (32)	3.02 (22)	1.57 (25)	13.44 (10)
Bulgaria	0.210 (28)	6693 (51)	18.9 (30)	2.87 (26)	1.26 (46)	9.34 (26)
Netherlands	0.210 (29)	14,310 (4)	18.1 (36)	2.75 (32)	1.64 (21)	12.36 (12)
Japan	0.209 (30)	10,457 (11)	19.1 (28)	2.87 (27)	1.35 (39)	10.64 (17)
Portugal	0.208 (31)	8913 (22)	19.6 (27)	2.23 (46)	1.35 (38)	9.16 (27)
Switzerland	0.207 (32)	17,057 (2)	17.9 (37)	2.97 (24)	1.60 (22)	13.97 (6)
Croatia	0.205 (33)	7852 (36)	18.4 (33)	2.78 (29)	1.35 (40)	7.27 (39)
Italy	0.205 (34)	11,178 (9)	18.9 (29)	2.41 (41)	1.42 (32)	10.08 (19)
Cyprus	0.202 (35)	9358 (18)	18.3 (34)	2.76 (31)	1.34 (42)	9.69 (25)
Malaysia	0.198 (36)	7107 (46)	18.5 (31)	2.60 (34)	1.42 (31)	7.54 (36)
Chile	0.197 (37)	6208 (55)	18.3 (35)	2.45 (40)	1.47 (29)	5.65 (55)
Germany	0.194 (38)	12,770 (6)	16.5 (40)	2.89 (25)	1.42 (33)	11.32 (13)
Slovak Rep	0.191 (39)	7763 (39)	17.0 (38)	2.84 (28)	1.38 (36)	6.54 (52)
Poland	0.189 (40)	7461 (42)	16.5 (39)	2.78 (30)	1.30 (43)	6.99 (45)
Norway	0.186 (41)	17,353 (1)	16.0 (43)	2.50 (38)	1.44 (30)	7.53 (37)
Ireland	0.180 (42)	13,848 (5)	15.7 (44)	2.21 (48)	1.34 (41)	8.42 (32)
New Zea	0.179 (43)	8498 (26)	15.6 (45)	2.50 (37)	1.38 (35)	6.94 (47)
Israel	0.176 (44)	8222 (30)	16.0 (41)	2.56 (35)	1.41 (34)	9.15 (28)

Table 4 (continued)

Country	HDI (0–1, per global hectare of footprint per capita)	INCOME (2021 PPP$ per global hectare of footprint per capita)	LIFE EXP (years per global hectare of footprint per capita)	SCHOOLING (years per global hectare of footprint per capita)	HAPPINESS (0–10, per global hectare of footprint per capita)	INNOVATION (0–100, per global hectare of footprint per capita)
France	0.176 (45)	10,425 (12)	16.0 (42)	2.23 (47)	1.27 (45)	9.91 (20)
Slovenia	0.172 (46)	7925 (34)	15.1 (46)	2.38 (42)	1.17 (49)	6.12 (54)
Malta	0.163 (47)	8179 (31)	14.9 (47)	2.13 (52)	1.18 (48)	7.90 (33)
Korea, Rep	0.162 (48)	8130 (32)	14.6 (48)	2.18 (50)	1.04 (55)	9.90 (21)
Russian Fed	0.158 (49)	6902 (49)	13.6 (49)	2.35 (43)	1.08 (54)	5.11 (61)
Finland	0.157 (50)	9361 (17)	13.6 (50)	2.13 (51)	1.28 (44)	8.71 (31)
Sweden	0.156 (51)	10,211 (13)	13.5 (51)	2.05 (53)	1.20 (47)	9.71 (24)
Lithuania	0.155 (52)	7029 (48)	13.2 (53)	2.33 (44)	1.09 (53)	5.39 (57)
Czechia	0.154 (53)	7291 (44)	13.4 (52)	2.19 (49)	1.16 (50)	6.77 (48)
Belgium	0.149 (54)	9699 (16)	12.9 (55)	1.95 (55)	1.09 (52)	6.50 (53)
Austria	0.148 (55)	10,193 (14)	13.1 (54)	1.95 (54)	1.15 (51)	7.01 (44)
Australia	0.134 (56)	7619 (40)	11.8 (56)	1.77 (57)	1.02 (56)	5.31 (59)
Denmark	0.124 (57)	8830 (23)	10.6 (57)	1.68 (60)	0.99 (57)	6.66 (50)
Latvia	0.119 (58)	4534 (60)	10.3 (58)	1.80 (56)	0.81 (60)	4.14 (62)
USA	0.116 (59)	8475 (27)	9.8 (60)	1.69 (59)	0.87 (59)	7.10 (43)
Canada	0.115 (60)	6601 (52)	10.1 (59)	1.69 (58)	0.89 (58)	5.17 (60)
Estonia	0.111 (61)	4719 (58)	9.7 (61)	1.68 (61)	0.74 (61)	5.39 (58)
Singapore	0.106 (62)	12,039 (7)	9.4 (62)	1.31 (62)	0.73 (62)	5.49 (56)
Luxembourg	0.067 (63)	6576 (53)	6.0 (63)	0.93 (63)	0.52 (63)	3.11 (63)

Appendix 2: Formal tests for nonlinearity

Variable x is market orientation index. The linear coefficient and p-value are estimated from the linear specification. The Ramsey RESET test is applied to the linear model as a test of whether higher-order powers of the market orientation variable improve the specification. Quadratic coefficients are reported only when the RESET test rejects linearity at the 5% level. Empty cells indicate that the linear specification is not rejected.

Table 5 Tests for nonlinearity; Fraser index of market orientation

Dep. variable	Linear coeff. x	Linear p-value x	RESET p-value after linear reg	Quadratic coeff. x	Quadratic p-value x	Quadratic coeff. x^2	Quadratic p-value x^2
HDI Labour efficiency	0.0089	0.054	0.017	0.1339	0.004	-0.0091	0.007
Income Labour efficiency	19.380	0.000	0.818				
Exp. Life Labour efficiency	0.0345	0.385	0.005	1.1935	0.002	− 0.0849	0.003
Schooling Labour efficiency	0.2130	0.004	0.046	1.6914	0.023	− 0.1082	0.052
Happiness Labour efficiency	0.0725	0.038	0.034	0.9063	0.014	− 0.0611	0.025
Innovation Labour efficiency	0.0912	0.002	0.378				
HDI Env. efficiency	-0.0962	0.000	0.266				
Income Env. efficiency	1559.6	0.001	0.476				
Exp. Life Env. efficiency	− 11.499	0.000	0.293				
Schooling Env. efficiency	− 0.7630	0.001	0.281				
Happiness Env. efficiency	− 0.7070	0.001	0.374				
Innovation Env. efficiency	− 2.1293	0.066	0.308				

Robust standard errors are used. $N=63$ for all regressions

Table 6 Tests for nonlinearity; heritage index of market orientation

Dep. variable	Linear coeff. x	Linear *p*-value x	RESET *p*-value after linear reg	Quadratic coeff. x	Quadratic *p*-value x	Quadratic coeff. x^2	Quadratic *p*-value x^2
HDI Labour efficiency	0.0002	0.651	0.022	0.0171	0.000	-0.0001	0.000
Income Labour efficiency	1.6091	0.000	0.721				
Exp. Life Labour efficiency	−0.0024	0.574	0.016	0.1294	0.001	−0.0010	0.000
Schooling Labour efficiency	0.0128	0.145	0.029	0.2936	0.000	−0.0020	0.000
Happiness Labour efficiency	0.0033	0.428	0.029	0.1324	0.000	−0.0009	0.000
Innovation Labour efficiency	0.0059	0.104	0.239				
HDI Env. Efficiency	−0.0108	0.000	0.901				
Income Env. efficiency	112.54	0.038	0.334				
Exp. Life Env. efficiency	−1.2488	0.000	0.805				
Schooling Env. efficiency	−0.0939	0.000	1.000				
Happiness Env. efficiency	−0.0757	0.001	0.951				
Innovation Env. efficiency	−0.2627	0.024	0.522				

Robust standard errors are used. $N=63$ for all regressions

Appendix 3: Robustness check with all dimensions of economic freedom indexes

Appendix 3 reports the same set of associations using the full Fraser and Heritage Economic Freedom indices (all dimensions, averaged over 2000–2023), as a robustness check on the narrower market orientation measures used in the main text. The results are discussed at the end of Sect. 5.

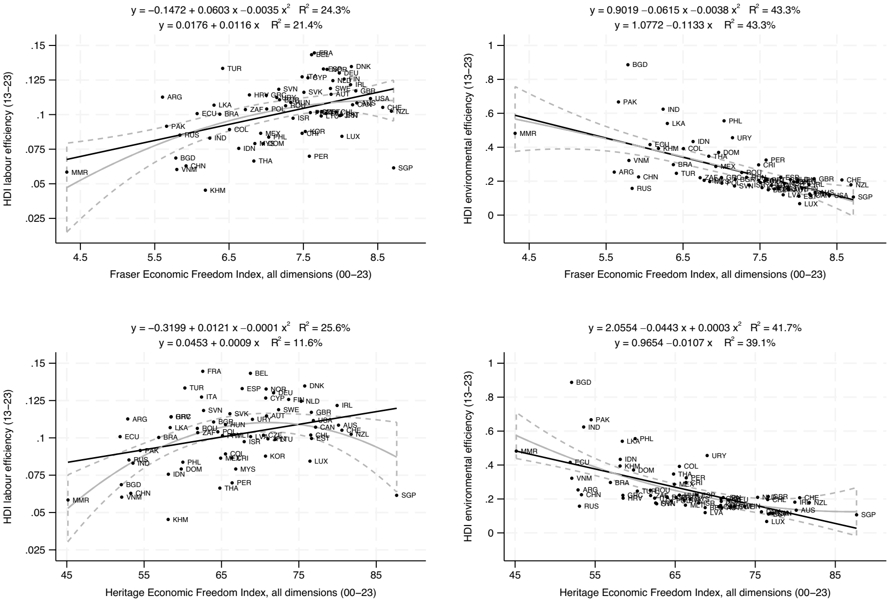

Fig. 8 HDI efficiency and market orientation. Higher values on the x-axis indicate greater economic freedom. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

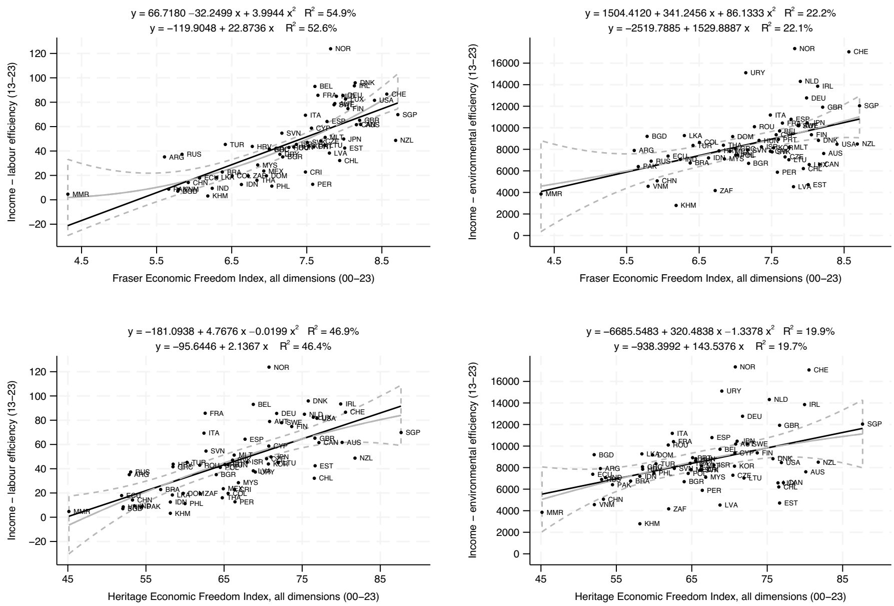

Fig. 9 Income efficiency and market orientation. Higher values on the x-axis indicate greater economic freedom. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

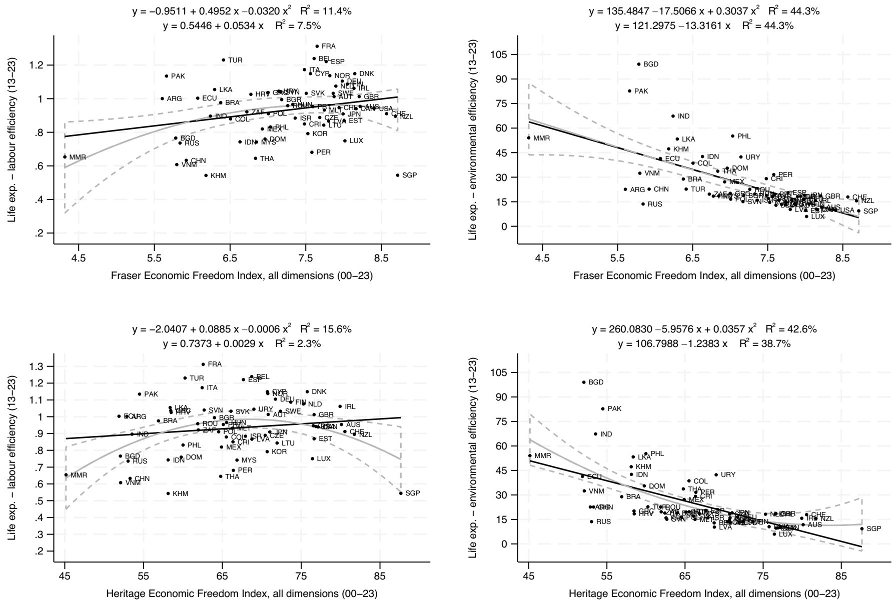

Fig. 10 Life expectancy efficiency and market orientation. Higher values on the x-axis indicate greater economic freedom. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

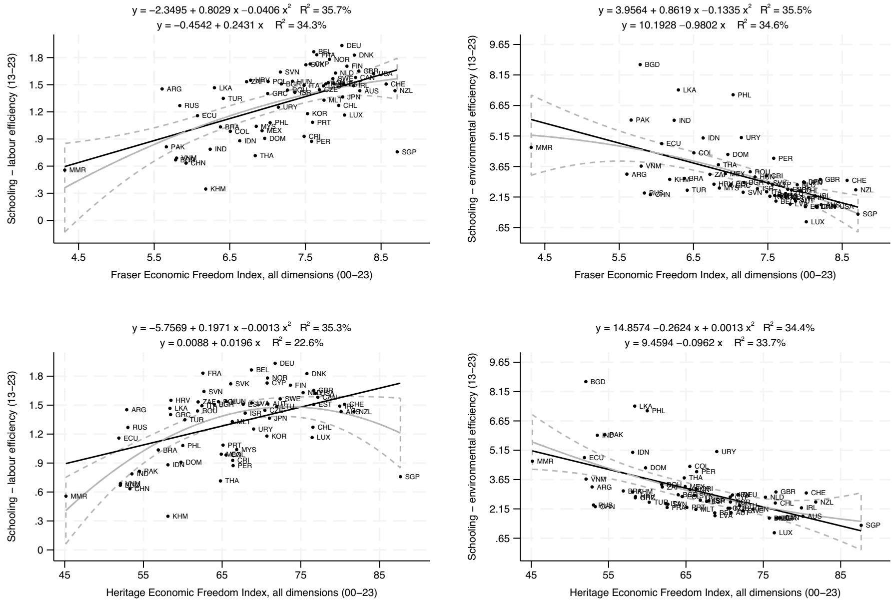

Fig. 11 Schooling efficiency and market orientation. Higher values on the x-axis indicate greater economic freedom. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

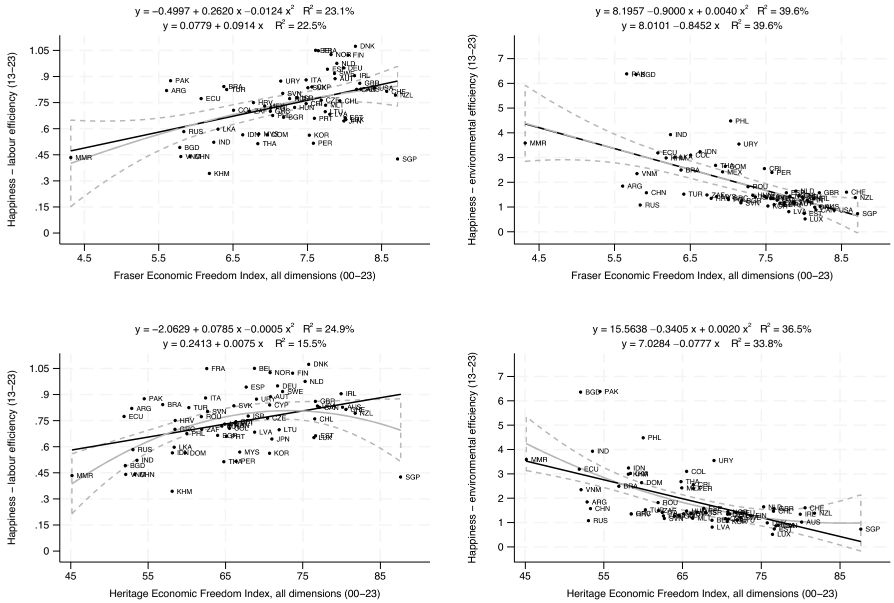

Fig. 12 Happiness efficiency and market orientation. Higher values on the x-axis indicate greater economic freedom. Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

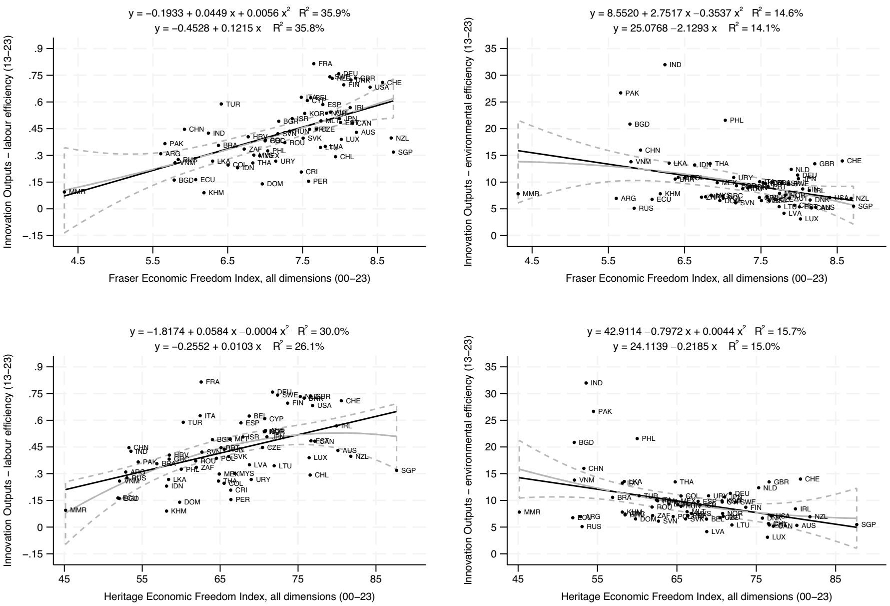

Fig. 13 Innovation efficiency and market orientation. Higher values on the x-axis indicate greater economic freedom Black line: linear fit. Grey line(s): quadratic fit (dashed lines indicate the 95% confidence interval)

Author contributions I am the sole author of both the research and the paper.

Data availability The original data used in this study are publicly available, and links to download them are provided in footnotes to the text. The data can also be requested from the corresponding author.

Declarations

Conflict of interest The author declares no conflict of interest.

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