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What role for profits and luxury consumption in the ecological transition?

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Abstract:

Given the empirical evidence showing the crucial role of income distribution and excessive consumption of richer households in determining greenhouse gas emissions, understanding their connection becomes especially important. Building on the distinction between subsistence and luxury emissions, we study where to intervene in reducing non-essential emissions. In doing so, we are able to connect the double role of luxury goods. Together with surplus production of other wage-goods, they are the reason why profits exist, but they are also the major constituent of wasteful luxury consumption and, hence, major drivers of consumer-generated greenhouse gas emissions. Among the three different scenarios ('greener consumption', 'reformist', and 'just transition') we depict, only the just transition is a viable option to respect both social and environmental boundaries.

Keywords: rate of profit, luxury goods, GHG emissions, just transition, climate change

JEL Codes: Q57, Q52, B24

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1. Introduction

The sixth assessment report of the IPCC (2022) offers for the first time a radical change in the understanding of the causes of climate change, identifying affluence along with the main causes of greenhouse gas (GHG) emissions. Similarly, recent contributions have highlighted the role of economic and carbon inequality in fuelling the ecological crisis, in particular pointing to high emitters in both rich and poor countries as the main responsible for GHG emissions (e.g., Chancel and Piketty, 2015; Gore, 2020; Khalfan et al., 2023; Chancel et al., 2023).

In this paper, we relate the existence in capitalist economies of positive profits and a positive rate of profit to both the physical surplus produced by workers beyond their subsistence real wage and to the carbon-intensive luxury consumption that such profit allows richer social groups to enjoy. By doing so, we address one of the most important defining elements of a capitalist economy and we link it to the need for a radical societal transition towards a sustainable economic system. In this transition not only "technology, work-time reduction and structural economic change all have a part to play" (Jackson and Victor, 2011), but there is a need to rethink what to produce, as we will discuss.

For this purpose, we use a model inspired by the Classical approach to political economy to address a contemporary, dramatically relevant issue (Babic and Sharma, 2023). Specifically, we employ the 'integrated wage-commodity sector' model (IWCS) (Garegnani, 1984; 1987; Fratini, 2015; 2019; Di Bucchianico, 2021; 2022). This model allows us to see profit as surplus production that then takes the form of luxury consumption. Therefore, we can pinpoint the connection between income distribution and environmentally wasteful emissions caused by luxury consumption.

Starting from the basic model, we discuss three alternative scenarios ('greener consumption', 'reformist', and 'just transition') that can describe, albeit in a stylised and simplified way, the direction to be pursued to keep the economy within both a socially and an environmentally safe boundary. According to our viewpoint, the most effective way would be that of a just transition (Newell and Mulvaney, 2013) in which the scale and composition of production are deliberately designed to implement 'sustainable consumption corridors' (Di Giulio and Fuchs, 2014). In this vein, Wollburg et al. (2023) estimate that if we eradicate global poverty the increase in global CO_2 emissions is almost insignificant.

Three important caveats. First, we explicitly focus on an economy in a long-run equilibrium position which reproduces itself on an unchanged scale and with a given technology, so as to focus specifically on the role of income distribution in the ecological transition[1]. Second, we make clear that addressing emissions related to luxury consumption does not exhaust all the complex issues related to climate change. For instance, we do not touch upon the issue of emissions related to production. We consider consumer-generated emissions, given that, although they often receive less attention, they

[1] For studies specifically handling the role of economic growth see, among others, Carnevali et al. (2020).

contribute to environmental issues (McAusland, 2008) and they must also be assessed differently with respect to production-generated emissions to understand the best public policies to address both (Halkos and Paizanos, 2016). Third, we point out the need to further integrate our framework by bringing in more nuanced representations of social groups and political interests at play, as in the Structural Political Economy approach (Cardinale, 2018; Cardinale and Landesmann, 2022).

The paper is structured as follows. Section 2 reviews the literature on the connection between luxury consumption, income distribution, and environmental degradation. Section 3 sets out the model we use to investigate the nexus among profitability, luxury goods and services, and GHG emissions from consumption. Section 4 discusses three fundamental stylised scenarios that can be envisaged. Section 5 concludes.

2. Related literature

2.1 The nexus linking luxury consumption to environmental degradation

In 1972, the famous report 'The limits to growth' (Meadows et al., 1972) by the Club of Rome already warned about the sudden and uncontrollable consequences an unsustainable population and economic growth would have. Several researchers have expressed their concerns that ecological limits may already have been exceeded by human actions or are close to the point of no return (Röckstrom et al., 2009). Recent studies (e.g., Roberts and Parks, 2006; Toth and Szigeti, 2016; Ivanova et al., 2020) have shown that, contrary to common thinking, major risks are posed by unsustainable and excessive consumption (or overconsumption) and, to a lesser extent, by population growth. Furthermore, the conventional focus on economic growth often masks underlying social dynamics and distribution (Foster et al., 2010). However, it is crucial to recognize that unequal social relations are deeply intertwined with profitability, both theoretically and empirically. This highlights the significance of social stratification, as observed by sociologists linking inequality with emissions (Jorgenson et al., 2016; Knight et al., 2017). Ultimately, how growth is distributed can matter more than growth itself (Soener, 2019).

On a macro level, profit-oriented businesses boost sales and profit, exacerbating income inequality (Magdoff and Foster, 2011; Richters and Siemoneit, 2017), leading to environmental degradation (Blauwhof, 2012; Jackson, 2017; Kallis, 2018) and the disruption of the carbon cycle, worsening climate change (Clark and York, 2005). In this light, Soener (2019) provides important insight into how functional income distribution impacts polluting emissions. In particular, the author estimates the impact of the rate of profit and the ratio between profits and wages (used as a proxy for the rate of exploitation) on greenhouse gas emissions and consumption-based CO_2 emissions in OECD countries between 1995 and 2016. The author calculates the rate of profit through the ratio between the net operating surplus and net fixed assets, and the rate of exploitation as the ratio between net operating surplus and wages and salaries. He also controls for additional elements such as per capita GDP, urbanization, and population. Results of the empirical analysis show that an increase in both the profit rate and the exploitation rate are associated with an increase in GHG and consumption-based CO_2 emissions at both the national level and at the industry level, especially in the transportation and the construction/manufacturing sectors. Importantly, once the coefficients across different estimations are standardized, profitability and exploitation rates exhibit larger effects on GHG and consumption-based CO_2 emissions compared to per-capita GDP growth, thereby suggesting a remarkable role for functional income distribution in shaping emission patterns.

Again, on functional income distribution and emissions, Mair et al. (2019) focus on the wage level rather than profitability and address a potential international trade channel. The authors estimate within an input-output framework the effects on carbon emissions and employment of paying a living wage to workers in the global clothing supply chain in BRIC (Brazil, Russia, India, and China) countries. They find that the direct effect on carbon emissions is negligible: an increase in the wage of the workers in BRIC reduces demand for clothes in Western countries, in turn reducing emissions. However, carbon savings are partly offset by the increase in income and employment in BRIC, which stimulates consumption. The authors also argue that the choice of the clothing industry as a case study, characterized by a low carbon intensity and high labour intensity, leads to conservative estimates of carbon savings compared to other sectors, such as food.

Additional evidence also brings into play the role of personal income distribution. There is a link between the consumption patterns of the richest 1% and 10% and rising emissions (e.g., Chancel and Piketty, 2015; Jorgenson et al., 2017; Gore, 2020; Hailemariam et al., 2020; Ivanova and Wood, 2020; Chancel, 2022; Cappelli, 2024). In 2019, the richest 1% of the world’s population were responsible for 16% of global carbon emissions, equivalent to the emissions of the poorest 66% of the world's population, or 5 billion people (Khalfan, 2023). Of these super-rich individuals, about a fifth are located in the European Union (Chancel and Piketty, 2015), where the top 1% of households have a carbon footprint of about 55 tCO_2eq/person, 22 times higher than per capita climate targets (Ivanova and Wood, 2020). This evidence is also linked to the role of functional income distribution. In fact, several works claim functional income distribution to be one of the main determinants of personal income distribution. In this vein, Atkinson (2009) maintains that the analysis of income shares is important to establish a link between incomes at the macroeconomic and household levels, as well as to investigate personal income inequality. On the empirical side, Daudey and García-Peñalosa (2007) work on a panel of 39 developed and developing countries (1970-1994), showing how the labour share is a fundamental determinant of personal inequality represented by the Gini coefficient. In their analysis, the former exerts a negative and significant impact on the latter. Bengtsson and Waldenström (2018) extend this kind of connection to the very long-run by using a panel dataset that spans from the beginning of the twentieth century to recent years.

Further, on a micro level, when businesses aim to maximize their profits, they often increase production and stimulate higher consumption through advertising. Investment driven by profit motives creates three interlinked feedback loops that foster consumerism: production, advertising, and planned obsolescence, ultimately increasing environmental harm (Hinton, 2020). Profit orientation also exacerbates income inequality through three main channels: the loop of private profit accumulation, market concentration, and wage stagnation (Hinton and Maclurcan, 2017).

Therefore, understanding the sources of excessive consumption of richer households – also known as 'the polluter elite' or 'high net worth individuals' (HNWIs) – and the ways to reduce them becomes especially important. Accordingly, their lifestyle is a matter that concerns the whole global population: were the present consumption patterns of HNWIs to continue unaltered, the 1.5°C global carbon budget would be fully depleted by 2030, even if everyone else achieved net zero emissions tomorrow (Gore, 2020). Furthermore, very few scientific publications inquire consumption patterns and ecological footprints of HNWIs, and no representative survey specifically targeting this group exists (Otto et al., 2019). This necessitates a critical examination of capitalist profitability and the social relations underpinning it (Pollin, 2018).

2.2 Luxury emissions vs. subsistence emissions

Given the high energy- and resource-intensity of consumption, a sustainable transition, as well as the attainment of the Sustainable Development Goals (SDGs), will not be possible without changing consumption patterns in such a way as to stick to the ecological limits posed by planetary boundaries and resource availability (Röckstrom et al., 2009; Steffen et al., 2015; Toth and Szigeti, 2016; O'Neill et al., 2018). This must happen, of course, while ensuring social limits in addition to ecological limits (Raworth, 2017). According to Henry Shue, a qualitative distinction should be made when allocating emissions in the design of climate policy, since "some sources are essential and even urgent for the fulfilment of vital needs and other sources are inessential or even frivolous" (Shue 1993, p. 55). He refers to the former as subsistence emissions, i.e., those produced when enjoying the right to "unpolluted air, unpolluted water, adequate food, adequate clothing, adequate shelter, and minimal preventive public health care" (Shue, 2020 [1980], p. 23). On the other hand, luxury emissions are the emissions generated to satisfy non-basic needs and that can, thus, be avoided or reduced. However, while the poor do not often have the possibility to change their consumption behaviour, the rich have this possibility, hence choosing to consume environmentally harmful goods constitutes a responsibility for them.

Since Shue's seminal work, a great deal of research has been devoted to studying the carbon content of essential goods. In particular, the theory of Decent Living Standards (DLS) (Rao and Min, 2018) defines, within a normative framework, a universal set of material goods and services required to achieve basic human wellbeing. The DLS is also designed to establish the foundation for identifying the energy and resource needs required to eradicate poverty (Rao and Baer, 2012). Research performing scenario analysis demonstrates that decent living standards can be met for all without exceeding 2°C global warming (Grubler et al., 2018; Burke, 2020) and redistribution can be the key to ensure wellbeing for all while minimising energy use (Otto et al., 2019; Oswald et al. 2020). Some authors advise that addressing income inequality may reduce vulnerabilities to climate change impacts (Cappelli, 2023) and relieve environmental stress (e.g., Wilkinson and Pickett, 2010; Laurent, 2014), for instance, making cleaner products affordable to a larger number of people (Berthe and Elie, 2015).

Turning to luxury emissions, the average couple of HNWIs has a carbon footprint of about 129.3 tCO_2eq per year (Otto et al., 2019). Luxury emissions are especially related to air travel, tourism, luxurious private vehicles, and large private mansions (Brand and Preston, 2010; Gössling, 2019; Lynch et al., 2019). These consumption categories, being highly energy-intensive, tend to be more elastic, increasing the energy footprint of HNWIs (Oswald et al., 2020). On a disaggregated level, inequality in energy consumption is mainly concentrated in the transport sector (Gössling, 2019; Oswald et al., 2020), with air travel being the leading emission contributor (Otto et al., 2019). In this context, especially worrisome is the role of conspicuous consumption, as postulated by Veblen (1934). This leads to a consumptive 'arms race' led by emulative behaviours in which both HNWIs compete in the construction of super-polluting mega-yachts and the world's largest home (Di Muzio, 2015) and middle-class households emulate consumption of the wealthy (Wilkinson and Pickett, 2010), contributing to increased energy and resource use and carbon emissions (Jackson, 2017).

2.3 Summing up

Drawing on the reviewed literature, we will use a theoretical framework capable of encompassing the following features. First, provide a channel that helps in rationalizing, without claims of exhaustiveness, the positive association between functional income distribution and profitability on one side, and emissions on the other side, as shown by Soener (2019). Second, account for the difference between luxury and subsistence emissions as in Shue (1993), thereby focusing on reducing the former, and connect this distinction to functional income distribution. Third, compared to Mair et al. (2019), we will focus on the composition of capitalists' consumption rather than the role of international trade, thereby expanding the list of channels that can be relevant to this literature.

3. The link between functional income distribution and luxury emissions

To rationalize one possible channel that connects profitability and consumer-generated luxury GHG emissions we move within a Classical standpoint, and we use the 'integrated wage-commodity sector' model (Garegnani, 1984; 1987).[2] In our view, this model can encompass all the three features listed in Sec. 2.3. In fact, this model is very flexible and can accommodate the analysis of various issues[3]. As in the Classical-Marxian tradition, for given social product and state of technology, the real wage rate is fixed exogenously according to the socially recognized level of subsistence (Pasinetti, 1977; 2019; Stirati, 1994). Once the subsistence physical real wage is assigned to workers (and reintegration of worn-out capital goods is accounted for), it is possible to derive what the economic system produces as surplus, hence an unnecessary part in light of its reproduction on an unchanged scale[4]. This was a crucial point in the Classical analysis (Martins, 2016, p. 38):

> The key question to address, as it was for the classical authors, concerns whether the surplus […] is distributed and used (indeed, recycled) in an efficient way, or whether it merely creates economic waste (that is, wasteful luxurious consumption, which was much criticized by the classical authors), and physical waste (with negative impact on ecosystems).

In the IWCS this point is highlighted by setting up a vertically integrated sector whose physical net product is the amount of physical real wages delivered to all workers (Pasinetti, 1980; Fratini, 2015). In this picture, first, profits derive from workers' surplus production. This can be seen once the given real wage bundle consumed by workers is specified in physical terms as a list of goods and services. Given that the net product of the IWCS is equal to total physical wages distributed to workers, profits will thus be a residual share of physical production. Specifically, it is the share that is not assigned to workers producing the goods and services that all workers consume. This means that there is a portion of the employed labour force that is producing goods and services that will be consumed by non-labour income recipients.

Second, what emerges is the fact that the economic and the physical (environmental) waste caused by profit in the form of surplus production takes the form of luxury consumption. Therefore, these elements are intimately related. This can be recognized once we have the content of profit, which can take the form of luxury goods and services or wage goods and services that are produced beyond those needed to satisfy workers' necessary consumption. Among the former list of goods and services we find those whose consumption constitutes luxury, environmentally wasteful consumption.

Therefore, this analysis can accommodate the prescriptions about the urgent necessity to curb wasteful luxury consumption so as to let it stay within environmentally sustainable

[2] The issue of what determines positive profits and a positive normal rate of profit in a capitalist economy can also be linked to other debates in ecological economics (Cahen-Fourot and Lavoie, 2016; Hein and Jimenez, 2022).

[3] Some examples are the study of financialization (Di Bucchianico, 2021; 2022) or technical change (Yoshihara and Veneziani, 2021).

[4] On the discussions among anthropologists and archaeologists on what surplus is, see Cesaratto and Di Bucchianico (2021a; 2021b).

limits, such as the consumption corridors purported by Di Giulio and Fuchs (2014). In fact, one interesting point that emerges from our picture is that the economic system only needs to produce what workers themselves consume (together with the necessary means of production to do so) to reproduce itself through time on an unchanged scale. Profits in the form of physical surplus production do not play a role in that. To analyse these points, we have in what follows a simplified case where only few goods of specific interest are represented, as in Di Bucchianico (2021). For a fully-fledged IWCS analysis, see Fratini (2015, 2019).

To begin with, we represent a stylized economic system in which only four goods or services are produced. Along with a good used as a generic means of production, we distinguish the following types of goods and services: a wage-good, a 'brown' luxury good/service whose consumption causes very high GHGs emissions, and a 'green' luxury good/service whose consumption causes low GHGs emissions. We suppose the brown luxury good to be a good such as a private jet, or a service such as space travel; hence, those kind of goods and services accessible only to a tiny portion of the population and whose consumption is responsible for disproportionately high amounts of GHG emissions. For instance, a study conducted by Greenpeace (2023) found that, in 2022, each private jet flight in Europe emitted an average of 5.9 tonnes of CO_2, more than the carbon emissions produced by driving a typical petrol car for 23,000 kilometres. Compared to commercial planes, private jets emit 5 to 14 times more GHGs than commercial planes per passenger, and 50 times more GHGs than trains (Murphy et al., 2021). These figures are even higher if we consider the environmental impact of space travel: it is estimated that the hourly global warming impact of supporting humans in space is approximately 1,500 to 3,500 kg CO2-eq, which is more than 2,000 times the emissions rate of the average people on Earth (Carbajales-Dale and Murphy, 2023).

On the other hand, we suppose the green luxury good to be a good such as an electric SUV, or eco-friendly luxury holiday villa: hence, those kind of goods and services accessible only to a tiny portion of the population and whose consumption causes comparatively much less GHG emissions with respect to 'brown' luxury goods. For example, electric SUVs dramatically reduce greenhouse gas emissions compared to conventional SUVs (IEA, 2023).[5]

Then, we proceed to use our stylized model to carry out a two-step process. At first, we verify that, in it, we can determine income distribution (the normal rate of profit and the real wage rate) and relative prices once a given real wage is assigned to workers in physical terms. Second, once the rate of profit has been determined, we go in more depth to understand the reason why it is positive. After that, we link these results to the role of luxury goods and services.

[5] Of course, they can be liable for other types of issues: they require large batteries to operate, so an expanding electric SUV market would put additional pressure on battery supply networks and increase demand for key minerals critical to battery production (IEA, 2023).

$$p_{mp} = (1+r)(p_{mp} \cdot mp_{mp}) + w \cdot p_\lambda \cdot l_{mp}$$
$$p_{w} = (1+r)(p_{mp} \cdot mp_{w}) + w \cdot p_\lambda \cdot l_{w}$$
$$p_{bl} = (1+r)(p_{mp} \cdot mp_{bl}) + w \cdot p_\lambda \cdot l_{bl} \tag{1}$$
$$p_{gl} = (1+r)(p_{mp} \cdot mp_{gl}) + w \cdot p_\lambda \cdot l_{gl}$$
$$p_\lambda = p_w \cdot \lambda_w$$
$$w \cdot p_\lambda = 1$$

In system (1) we have in the first four equations the prices *p* of four products: *mp* a circulating capital good used as a means of production, *w* the single wage-good, *bl* a 'brown' luxury good, *gl* a 'green' luxury good.[6] The fifth equation serves to calculate the price p_λ of the wage-commodity, hence, the value of one unit of the physical real wage; in this simplified example, the wage basket has been reduced to a single component. The sixth equation sets the numéraire to be the labour commanded by *w* units of the wage-commodity.

Following the modern reappraisal of the Classical approach, we know that to determine the normal rate of profit *r* we need: first, the price equations of the goods entering the wage basket and of their direct and indirect means of production; second, the value of the composite physical real wage used as numéraire (Garegnani, 1984). We can thus note how in (1) the two luxury-goods appear only as final products, but do not enter the direct and/or indirect production process of the wage basket. Hence, their price equations are not needed. Once we omit them, what we get is a system of 4 equations in 4 unknowns $(p_{mp}, p_w, p_\lambda, r)$ that determines relative prices and distributive variables, among which we have the normal rate of profit.

The next issue is to understand the reason why the simplified economic system we are describing allows for a positive rate of profit. Therefore, we need to verify what allows aggregate profits to be positive. To this end, we must identify at the abstract level a situation in which profits materialize without resorting to price valuations, so as to avoid the interconnection between income distribution and prices.[7] For this sake, we rescale the

[6] Technical coefficients of production have been normalized by the quantities produced of each good. Both production coefficients and quantities produced are taken as given. The *mp* and *l* coefficients are the quantities of means of production and labour needed in each specific production line. The coefficient λ_w represents a single unit of the wage-commodity while *w* stands for the units of the wage-commodity acquired by workers; both are taken as given. Thus, the physical real wage is taken as given in terms of composition and level. Wages are paid *post factum*.

[7] The need to address the interdependence between income distribution and relative prices has been the subject of numerous debates and contributions (see Bellino, 2021; Petri, 2021).

industries that concur to the direct and indirect production of the wage basket (in this case, of the single wage-good) so that the IWCS net product corresponds only to the given total amount of wages in physical terms to be distributed to all labourers employed in the entire economy. The gross product of the IWCS is its net product plus the other good used in the integrated process of production. In this way, we obtain physical homogeneity between the input and the output in the IWCS, and hence price valuations are not needed.

Once we setup this abstract example, we can proceed to derive the amount of profit in the IWCS as the difference between what is paid as wages to all workers employed in the economy and what is paid as wages to the workers that only take part in the production of those goods and services that workers themselves will consume. Similarly, profit per unit of labour (in the IWCS) corresponds to the amount of profit thus derived divided by labour employed in the IWCS. To extend the analysis from a positive amount of profits to the normal rate of profits, see the Appendix.

$$
\begin{aligned}
NP_v &= L \cdot w \cdot \lambda_w \\
W_v &= L_v \cdot w \cdot \lambda_w \\
MP_v &= mp_w \cdot Q_w + mp_{mp} \cdot Q_{mp} \\
L_v &= l_w \cdot Q_w + l_{mp} \cdot Q_{mp}
\end{aligned}
\tag{2}
$$

In (2) we have the IWCS net product NP_v, the amount of physical wages paid to the workers employed in the IWCS W_v, the means of production used in the integrated process of production MP_v, and the amount of labour employed in the IWCS L_v. The term Q stands for the gross outputs of the IWCS and are preceded by mp and l, which are the unit good and labour coefficients used in each single production line.

$$\Pi_v = L \cdot w \cdot p_w \cdot \lambda_w - L_v \cdot w \cdot p_w \cdot \lambda_w = (L - L_v) \cdot w \cdot p_w \cdot \lambda_w \tag{3}$$

$$w \cdot p_w \cdot \lambda_w = 1 \tag{4}$$

$$\Pi_v = L - L_v = L_{bl} + L_{gl} \tag{5}$$

From (3) we see that the amount of profit in the IWCS Π_v is calculated as the wage bill paid to all labourers minus the wage bill paid to labourers employed in the IWCS. Equation (4), resulting from coupling the fifth and sixth equations in (1), sets as before the numéraire to be the labour commanded by w units of the wage-commodity. By coupling equation (3) and (4), we see that the amount of profit emerges from the difference between labour employed in the whole economy $L = L_w + L_{mp} + L_{bl} + L_{gl}$, and in the IWCS $L_v = L_w + L_{mp}$. As mentioned, it can be calculated without resorting to price valuations, given the physical homogeneity between the net product of the sector and the wages given to its workers. The profit per unit of labour in the IWCS π_v is

$$\pi_v = \frac{L - L_v}{L_v} = \frac{L_{bl} + L_{gl}}{L_w + L_{mp}} \tag{6}$$

We can see that the origin of profits has to be traced back to the productivity of labour in the IWCS which allows the emergence of a physical surplus. The latter can in general take two forms: either wage-goods in excess of what is consumed by workers, or 'luxury' goods (or both). In this example, profit takes the second form, specifically, that of two luxury goods/services featuring different emissions in consumption.

We note two things. First, this picture is compatible with those viewpoints on ecological issues which stress the relevance of surplus production: "Profits from production result from societies producing a surplus. Surplus manifests as a surplus product, which is an additional amount of commodities produced above what people need for their subsistence" (Pirgmaier, 2020, p. 276). This discussion therefore extends to environmental issues the debates that linked aggregate surplus production to positive profits. (Shaikh, 2016, Ch. 6, Sec. VI).

Second, at a purely logical level, there is no need for the economic system to produce luxury-goods in order to have positive profits and a positive rate of profit. If there is a portion of the employed labour force that produces, say, a certain quantity of milk, bread, and clothes that are not going to be consumed by labourers themselves, then there is room for the emergence of positive profits. However, in reality the norm is for an economic system to produce a great deal of luxury-goods and services. Those are the main elements that define the consumption patterns of social classes that do not earn labour incomes (cf. Sec. 2).

Finally, in line with the first point highlighted in Sec. 2.3, we conclude this section by recalling the main message we want to stress: there is a channel linking excessive GHG emissions from luxury consumption to income distribution. In fact, by means of our theoretical model we pinpoint the strict connection among physical surplus production, positive profits and a positive rate of profit, and luxury consumer-generated emissions (Fig. 1). We proceed in the next section to use this picture as a starting point for further considerations, thereby discussing also the other two points listed in Sec. 2.3.

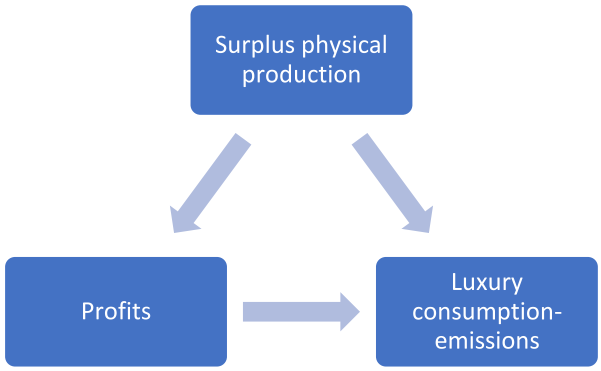

Figure 1 – The mutual relationships among surplus production, profits, and luxury consumption. *Source*: authors' elaboration.

4. Three alternative scenarios

At this point, we can use the picture provided by the IWCS to get some indications of the directions in which the economic system might be steered. To begin with, we define the objective that the community may wish to target: the desire to live in an economy that respects both social and ecological boundaries. Then, we illustrate three possible scenarios to see what the best policy action could be (Fig. 2). We stress that there is obviously no naïve policy prescription to be taken from these scenarios; reality is much more complex than our stylized representation.

In recent years, several theoretical approaches have been proposed to ensure an ecologically and socially sustainable consumption pattern – e.g., the maximum ecological boundary and minimum ethical boundary theorized by Daly (1977), the sustainable consumption corridors proposed by Di Giulio and Fuchs (2014), the doughnut postulated by Raworth (2017) – all aiming to define "a safe operating space for humanity" (Röckstrom et al., 2009). The main difference among these approaches lies in the criteria adopted to define the lower (i.e., the social boundary) and the upper limit to consumption (i.e., the ecological boundary). The *social boundary* is meant to ensure everyone an equitable and sufficient access to resources, and we adopt here the theory of Decent Living Standards (Rao and Min, 2018; cf. Sec. 2.2.). The *ecological boundary*, on the other hand, is needed to impose an upper limit on consumption that complies with emissions reduction targets.

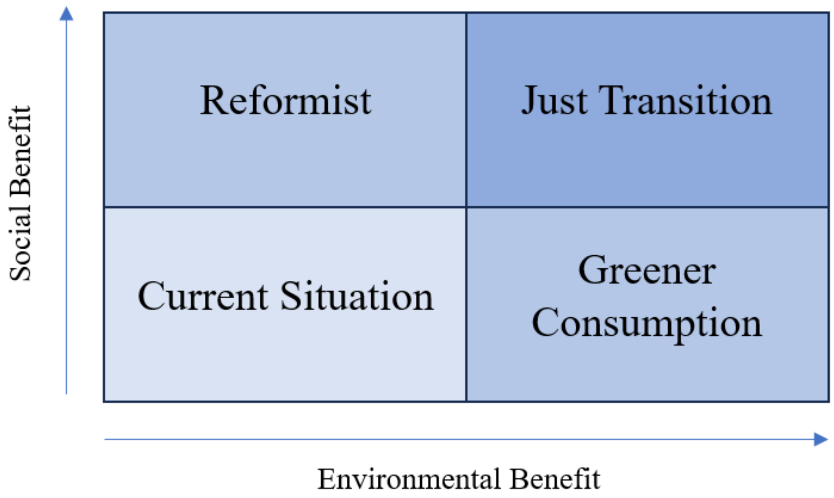

Figure 2 – Four scenarios and the associated potential benefits from moving away from the current situation. *Source*: authors' elaboration**.**

Scenario 1: 'greener consumption'. Social boundaries not respected, ecological boundaries respected.

In this first scenario, the pathway is supposed to be one that achieves more sustainable consumption patterns through the reduction of the carbon (and environmental) footprint of consumption by progressively replacing 'brown' for 'green' luxury-goods. For instance, this can be envisaged to be a scenario in which the vehicle fleet based on fossil fuels is wholly replaced by electric vehicles.

Therefore now, in our stylized economy, the only luxury goods produced are the 'green' ones *gl*. Hence, in (7) the distinction between the two luxuries as in (1) vanishes.

$$
\begin{aligned}
p_{mp} &= (1+r)(p_{mp} \cdot mp_{mp}) + w \cdot p_{\lambda} \cdot l_{mp} \\
p_{w} &= (1+r)(p_{mp} \cdot mp_{w}) + w \cdot p_{\lambda} \cdot l_{w} \\
p_{gl} &= (1+r)(p_{mp} \cdot mp_{gl}) + w \cdot p_{\lambda} \cdot l_{gl} \\
p_{\lambda} &= p_{w} \cdot \lambda_{w} \\
w \cdot p_{\lambda} &= 1
\end{aligned}
\tag{7}
$$

This scenario can therefore bring about an amelioration of the violated environmental boundary condition since the consumption of all goods and services generate low carbon emissions. An even more extreme situation would be one in which only wage-goods are produced. In this case, however, the social boundary would still remain violated: while this scenario would impact directly the concrete forms surplus production takes, surplus itself would still be there. Hence, profits emerge as in (8), analogous to (5), but this time they correspond only to the number of workers L_{gl} producing the green luxury good.

$$\Pi_v = L - L_v = L_{gl} \qquad (8)$$

However, it is increasingly recognized that we cannot resort solely on technological improvements to solve the climate crisis (Hickel et al., 2021). This is due to several reasons, including evidence of a rebound effect (Stern, 2020), the high energy and material intensity of the construction of renewable energy technologies that is in itself a cause of ecological degradation and conflicts (Sovacool, 2021), and the urgent time constraint that we face, which demands integrating technological solutions with more immediate policy actions (e.g., Hickel et al., 2021). An example of immediate policy action is, for instance, the progressive ban on the use of carbon-intensive luxury goods. Practical examples include Greenpeace's campaign urging governments to ban private jets[8], and the French government's 2023 ban on some short-haul flights that can be replaced by train journeys of less than three hours[9].

Moreover, note that in our model the economy is in a long-run normal position in which the scale of the economy is taken as given and all the surplus is consumed. Things may be rendered even worse by supposing a growing economy, so that problems related to the expanding scale of the economy should be also accounted for (Hickel and Kallis, 2020). In this respect, Cieplinski et al. (2021) find that green growth alone does not result in better societal conditions and needs to be integrated with social policies that directly address inequality.

Scenario 2: 'reformist'. Social boundaries respected, ecological boundaries not respected.

In Sec. 3, we made two suppositions once we took the scale of the economy and the composition of production as given. First, the composition of the real wage was such that it involved a positive amount of the single wage-good, and zero amounts of the two luxury-goods. Second, the physical surplus produced by workers beyond the reproduction of their wage bill was appropriated by people not belonging to the workers' class.

Now suppose that workers enjoy a particularly favourable socio-political environment (strong trade unions, low unemployment, a pro-labour state), so that they gradually manage both to introduce additional types of goods into their wage-commodity composition and to experience a constant increase in the wage-commodity units they acquire.

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[8] https://www.greenpeace.org/international/act/ban-private-jets/

[9] The *Climate and resilience law* (*Loi climat et resilience*) was promulgated in August 2021. Following the approvals of the European Commission and the Council of State in December 2022, it entered into force in May 2023.

$$w_1 = w_0(1 + x) \rightarrow L_{v1} > L_{v0}$$

$$\pi_{v1} = \frac{L - L_{v1}}{L_{v1}} < \pi_{v0} = \frac{L - L_{v0}}{L_{v0}} \tag{9}$$

$$\pi_v = \frac{L - L_v}{L_v} = 0 \rightarrow L = L_v$$

Considering a physical real wage that includes all goods produced, if we suppose a rise in the wage-unit such that it increases by a certain positive percentage x, this causes the amount of labour in the IWCS to rise, because now more workers out of the entire labour force are needed to produce the physical wages to be distributed to all workers (first equation in 9). Profit per unit of labour in the IWCS is falling given that the difference between total workers employed and those engaged in producing wages is shrinking (second equation in 9).

Let us focus on the situation in which the rate of profit falls to zero. This situation comes about when profit per unit of labour in the IWCS – and thus total profits – fall to zero, hence when the entire labour force is engaged in producing what workers consume (third equation in 9). Indeed, "[i]f workers only produced what was necessary for their own subsistence, there would be no surplus, no basis for profits and no good reason for capitalists to employ anyone" (Pirgmaier, 2021, p. 8). Therefore, the social boundary is respected in this second scenario[10].

This notwithstanding, the environmental boundary appears to be violated as much as it was in the initial situation. The problem in this case lies in the physical composition of production. In fact, the presence of luxury-goods in the input-output structure of the economy does not allow the economy to get rid of environmentally unsustainable wasteful consumption. The fact that workers appropriate the private jet and the space travel they produced is certainly appealing from a socio-political viewpoint, but the negative environmental impact they cause is still there. This aligns with earlier research indicating that rises in income are more closely linked to emissions growth stemming from luxury purchases rather than necessities (Ivanova et al., 2016; Kilian et al., 2023).

Furthermore, in the model we are using, the scale of production and employment are taken as given, but an income redistribution from capitalists to workers as the one we suppose could lead to an increase in aggregate consumption, and also in aggregate net income. Generally speaking, with given linear production technology, increased production would result in an increase of total employment and of employment in the

[10] Except that, in a capitalist economy, levels of unemployment might rise because capitalists would have no good reason to employ anyone.

IWCS of the same magnitude α. Therefore, while profit increases (10), profit per unit of labour in the IWCS does not change (11).[11]

$$\Pi_v = (1+\alpha)L - (1+\alpha)L_v = (1+\alpha)(L_{bl} + L_{gl}) \tag{10}$$

$$\pi_v = \frac{(1+\alpha)L - (1+\alpha)L_v}{(1+\alpha)L_v} = \frac{L_{bl} + L_{gl}}{L_w + L_{mp}} \tag{11}$$

However, if we suppose this happens within Scenario 2, we know that both profit and the amount of profit per unit of labour in the IWCS are nil. This makes clearer that production on an enlarged scale and the redistribution that allows workers to consume also luxury-goods do not impinge on profit (that is again zero) but could exacerbate the issue related to emissions due to the fact that workers can consume even more luxury goods and services.

Scenario 3: 'just transition'. Social and ecological boundaries respected.

In the third scenario, the policy action is informed by altogether different directives: the social and the ecological boundaries necessarily need to be addressed jointly. Instead of asking ourselves how to make the current economic system more sustainable (Scenario 1) or how workers can improve income distribution (Scenario 2), the starting point should be radically different. For an effective ecological transition to take place, the reduction of emissions due to luxury consumption has to be informed by criteria of fairness and sufficiency. Sufficiency is needed to put a cap on consumption so as not to exceed the Earth's regenerative capacity. Fairness is necessary in order to allow every individual to achieve human wellbeing. As Wiedmann et al. (2020, p. 3) posit:

> […] the strongest pillar of the necessary transformation is to avoid or to reduce consumption until the remaining consumption level falls within planetary boundaries, while fulfilling human needs. Avoiding consumption means not consuming certain goods and services, from living space (overly large homes, secondary residences of the wealthy) to oversized vehicles, environmentally damaging and wasteful food, leisure patterns and work patterns involving driving and flying. This implies reducing expenditure and wealth along 'sustainable consumption corridors', i.e. minimum and maximum consumption standards.

Therefore, a construction of the model which would be in line with the above-mentioned principles begins with the definition of a given number of units w^{dl} of the 'decent living' wage-commodity bundle λ^{dl} (first row in 12), meant to eradicate poverty while minimizing energy use (Sec. 2.2).[12] For instance, Rao and Min (2018) and Rao et

[11] With a given and unchanged state of technology, this will also cause the normal rate of profit to remain unchanged.
[12] Also in this case, for simplicity, the bundle is composed of a single commodity.

al. (2019) provide an estimation of the composition and associated energy needs to build a decent living bundle of services and commodities.[13]

$$\lambda^{dl} = [\lambda_w], \qquad w = w^{dl}$$
$$NP_v = L_{lf} \cdot w^{dl} \cdot \lambda^{dl}$$
$$MP_v = mp_w \cdot Q_w + mp_{mp} \cdot Q_{mp} \tag{12}$$
$$L_v = l_w \cdot Q_w + l_{mp} \cdot Q_{mp}$$
$$H_v = h_v \cdot L_v$$

At this point, social production is not taken as given in scale, but it is derived from the needs of the society: the provision of a decent living real wage in physical terms to all the available workers[14]. Therefore, by multiplying the number of available workers L_{lf} (labour force) by the given physical decent living real wage $w^{dl} \cdot \lambda^{dl}$ we obtain the net product of the economy NP_v (second row in 12). The means of production and the number of workers needed to produce the targeted net product are computed as in (2) (third and fourth row in 12). L_v is derived by supposing each labourer to work the current, conventional working day length during the conventional number of weeks in a year (say, 8 hours per day per 48 weeks). Therefore, there is a conventional per capita number of hours h_v that, multiplied by L_v, delivers the total number of hours H_v needed to produce the net product (fifth row in 12).

Full employment would be an additional desirable property, but, with given production techniques, the general case would be one in which the amount of labour needed to produce the net product falls short of total labour-force, hence $L_{lf} > L_v$.[15] It would then be possible to exploit the production possibilities of such system to reduce per capita working time. Now the question becomes: how many hours should be worked by each single worker to have full employment of available labour-force L_{lf}? In (14) we calculate it by equating H_v to the number of available workers L_{lf} multiplied by h_{lf}, the number of per capita working hours needed to let the entire labour force work. For given h_v, L_v, L_{lf} it is possible to derive h_{lf}.

$$h_{lf} = \frac{H_v}{L_{lf}} = \frac{h_v \cdot L_v}{L_{lf}} \tag{14}$$

[13] In particular, Rao and Min (2018) define the specific constituents of the decent living standard, taking into account both physical and social wellbeing, as well as the household and the aggregate social requirements.
[14] For a similar intuition, see the Not-for-Profit type of economy in Hinton (2020).
[15] Although there is evidence to envisage that transitioning to a more sustainable economy would actually benefit employment levels (Füllemann et al., 2020).

Hence, the transition can result in full employment after the decrease in per capita working hours.

In an economy built on such principles both profits and emissions caused by wasteful luxury consumption disappear. On the one hand, profits disappear because the economy is structurally meant to only provide workers with the physical real wage they produce for their own sake. On the other hand, wasteful consumption arising from luxury goods and services cannot materially arise because those goods and services are deliberately neither produced nor enjoyed by anyone. This does not automatically solve environmental issues, but it would constitute a decisive step in a radically new direction.

This notwithstanding, we do not know *a priori* what will happen to the level of production. In fact, starting from a pre-transition situation, this issue depends on the comparison between how much we reduce the product of the number of non-labour recipients times their per capita consumption and how much we increase the product of the number of available workers times their per capita physical wages. If the increase in the product of the number of available workers times their per capita physical wages prevails over the reduction in the product of the number of non-labour recipients times their per capita consumption, production levels could increase. However, in this case, empirical studies show that an increase in workers' wages (Mair et al., 2019) or in the income of the poorer segments of the population (Bruckner et al., 2022; Wollburg et al., 2023), even when holding the income of the richer segments constant, does not lead to a significant increase in GHG emissions. Thus, we expect the net effect on emissions to be negative, but again this is a matter of empirical simulations.

5. Conclusions

While the model proposed in this paper is certainly a stylized representation of reality, it still offers some useful implications in modern societies. First, we show that the existence of a physical surplus of production constitutes the source of profits. Second, its composition and repartition between different social groups is responsible for excessive GHG emissions associated with luxury consumption. As shown in the first scenario, greening the composition of consumption is not sufficient: on the one hand, technological improvements alone are not sufficient to solve the climate crisis (Hickel et al., 2021); on the other hand, improving income distribution is required to ensure such transition is just and also accepted more willingly by low- and medium-low-income classes (Mehleb et al., 2021). However, reducing inequality alone is not enough as well: our second scenario shows that despite a complete redistribution of the surplus to workers, luxury goods and services would still be produced and consumed, and the ecological transition would be far from complete. Our third scenario (the just transition) combines compliance with both social and ecological boundaries and shows that reduction of luxury emissions from consumption and improved income distribution go hand in hand. It proposes to rethink production in order to reverse the logic guiding the production process itself. The latter is organized so as to ensure the right amount of goods and services to allow each worker to fulfil a decent living standard while complying with improved environmental standards.

In theory, however, a limited amount of surplus can be allowed but conditioned on a total reinvestment of such surplus aimed at pursuing a social and ecological benefit, in order to avoid situations of "profit without prosperity" (Lazonick, 2014). In any case, for such a transition to take place, central states will have to play a key role in defining the lines of production that can be allowed while respecting ecological limits, and in expanding the welfare state to ensure that social limits are respected.

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Appendix

In this appendix we complete the steps needed to derive the normal rate of profit. Note that this passage is not strictly necessary in terms of the analysis we are carrying out given that positive profits as in (5) are sufficient to relate distribution to luxury emissions.

Besides profit per unit of labour in the IWCS in (6), we now need the value of capital per unit of labour v_v, expressing the investment in capital advances needed to start the production process.

$$v_v = p_{mp} \cdot \frac{\left(mp_w \cdot Q_w + mp_{mp} \cdot Q_{mp}\right)}{L_v} = p_{mp} \cdot \mu_{mp} \qquad \text{(a)}$$

In equation (a) we have the price p of the mean of production and the ratio between mean of production and labour μ. The price of the mean of production is reduced to dated quantities of labour (b) (Sraffa 1960, Ch. VI, pp. 40-47). Hence, the means of production are replaced by the labour coefficients deployed in their production over a series of t preceding periods, multiplied by the profit element.

$$p_{mp}(r) \equiv l_{mp} + \sum_{t=1}^{\infty} l_{mpt}(1+r)^t \qquad \text{(b)}$$

The ratio between means of production and labour is derived by making use of the technical coefficients in (2).

Next, we multiply the reduced terms by the respective means of production per unit of labour μ, and by summing the factors we obtain the value of capital per unit of labour v_v as a function of the normal rate of profit as in (c).

$$v_v(r) \equiv \left(l_{mp} \cdot \mu_{mp}\right) + \sum_{t=1}^{\infty} \left[l_{mpt} \cdot \mu_{mp}\right] \cdot (1+r)^t \qquad \text{(c)}$$

Then, we multiply v_v by r to get the so-called 'profit function' $f(r) \equiv r \cdot v_v(r)$. Its value is zero when the normal rate of profit is zero, it monotonically rises with r, it is convex, and when production is circular it has a vertical asymptote which corresponds to the maximum rate of profit (see Fratini 2019, pp. 13-15).

Finally, we equate the profit function to the profit per unit of labour in the IWCS (6).

$$\left[\frac{L_{bl} + L_{gl}}{L_w + L_{mp}}\right] = r \cdot \left\{l_{mp} \cdot \mu_{mp}\right\} + r \cdot \left\{\sum_{t=1}^{\infty} \left[l_{mpt} \cdot \mu_{mp}\right] \cdot (1+r)^t\right\} \qquad \text{(d)}$$

In (d) r is the only unknown, which can be calculated by means of this single equation.

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