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INCOME COMPOSITION INEQUALITY

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The purpose of this paper is twofold. First, it introduces a novel inequality concept called *income composition inequality*, which describes how the composition of income in two sources, such as capital and labor income, varies across the income distribution. Second, it constructs an indicator for its measurement. This paper argues that the study of income composition inequality allows for: (i) a novel political economy analysis of the evolution of economic systems; and (ii) the technical assessment of the relationship between the functional and personal distributions of income. Following an empirical application, this paper discusses possible avenues for future research on the matter, ranging from development issues to public finance.

JEL Codes: C430, E250

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1. INTRODUCTION

The study of income distribution has been brought in from the cold. In his 1997 Presidential Address for the Royal Economic Society, Anthony Atkinson emphasized the need for the "re-incorporation of income distribution into the main body of economic analysis" (Atkinson 1997, p. 297). Twenty years later, this Presidential Address has made its mark in the growing number of inequality studies produced throughout this period. Among this new surge of inequality research, Thomas Piketty's book *Capital in the XXI Century* features as one of the most important contributions (Piketty, 2014). By collecting a large historical database on the structure of income and wealth together with other scholars from the World Inequality Lab, Piketty studied the evolution of income and wealth distributions

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for three centuries and in more than 20 countries. Among the several key facts about inequality dynamics that emerge from Piketty's work, we wish to emphasize one in particular. The rise in the top income shares in the US over the 1980–2010 period has been mainly driven by rising inequality in labor earnings. According to Piketty, this fact can be explained by two major factors: (i) rising inequality in access to skills and higher education; and (ii) rising top managerial compensation (see also Piketty, 2015). The structure of inequality in the US today is therefore considerably different from its structure before World War I, when high levels of inequality were mainly determined by an extreme concentration of capital incomes. This key fact teaches us an important lesson: similar levels of income inequality (like those in the US in 1930 and 2000) can be characterized by completely different compositions of income sources, such as capital and labor incomes, across the income distribution. This fact draws attention to the analysis of another important, and until now missing, dimension for distributional analysis: *inequality in income composition*. This paper aims at closing this gap by doing two things. First, it introduces in a formal setting the concept of income composition inequality across the income distribution. Second, it constructs a summary statistic, called *income-factor concentration (IFC) index*, to measure the novel inequality concept proposed.

This paper argues that the study of income composition inequality is useful for two reasons. First, it allows for novel political economy analysis of the evolution of economic systems. In this respect, this article is closely related to the recent work by Milanovic (2017), in which a novel classification of economic systems was introduced. Second, it links the functional and personal distributions of income. For the latter reason, this work fits into the literature on the relationship between the functional and personal distribution of income.

The structure of this paper is as follows: Section 2 reviews the literature on the relationship between the functional and personal distributions of income. Section 3 introduces in a formal setting the concept of income composition inequality. Section 4 constructs an indicator to measure income composition inequality. Section 5 applies the proposed method to six European countries, whereas Section 6 discusses possible avenues for future research on the matter. Section 7 concludes the study.

2. Literature

The study of the relationship between the functional and personal distributions of income has seen a revival of interest over the past two decades (Atkinson and Bourguignon, 2009; Piketty, 2014). Already in 1997, Atkinson argued that to understand the drivers of inequality, the economic theory of the distribution of income requires further development (Atkinson, 1997, p. 317). He argued that the current priority should be to bring the several existing contributions on this theory together into a single framework (p. 317). He also argued that among the different aspects affecting the dynamics of the distribution of income, the relationship between functional and personal distributions should feature prominently (p. 298).

This relationship binds a macroeconomic phenomenon with a microeconomic one. In a later article, Atkinson wrote that one reason for studying this link is that "there is at present and evident disjuncture between the macroeconomic measures of economic performance and the perceptions by citizens as to what is happening to their incomes" (Atkinson, 2009, p. 5). Brandolini (1992) claimed that this link connects economic systems and people, and it is provided by what he called "entitlement rules." According to Brandolini, the entitlement rules are "rules stating who has the right to receive a given type of income and the proportion of it" (Brandolini, 1992, p. 3). As Glyn (2011) pointed out, unfair entitlement rules could cause the employer's profit rate to grow more rapidly than the employee's wage rate. Moreover, unfair entitlement rules are likely to trigger political tensions between different interest groups. Income inequality must therefore be analyzed with an eye toward the multidimensional nature of the typologies of income. Unsurprisingly, the laws regulating distribution were considered to be the principal problem in political economy by the classical author Ricardo (Ricardo, 1911).[1]

Several contributions have recently explored the empirical nature of the link between functional and personal distributions. Piketty (2014) analyzed the long-term evolution of the functional distribution and of the top income shares at the international level. In his framework, Piketty considered top income shares as measures of income inequality.[2] His landmark book *Capital in the Twenty-First Century* (2014) is an attempt to combine the different data sources available, such as fiscal data, survey data, and national accounts, systematically.[3] One of the most important findings from his research is that the capital share of income has increased in many developed countries over the past decades (see also Piketty, 2015). Furthermore, Piketty showed that the capital income share tends to move together with the capital-income ratio in the long run. Given that inequality in capital income is generally greater than inequality in labor income, the rising share of capital income in net product leads to greater interpersonal inequality. This result emphasizes the positive relationship between the functional and personal distributions of income from a historical perspective.

Another empirical contribution on the matter is the article by Bengtsson and Waldenstrom (2018), who found evidence of a "strong, positive link [between the functional and personal distribution of income] that has grown stronger over the past century" (p. 712) using a novel historical cross-country database that they personally assembled. However, they do not believe that this relationship has remained stable over time insofar as it could be contingent on production technology, the structure of personal income, and the institutional context. Francese and Mulas-Granados (2015), based on an analysis that covers up to 93 countries between 1970 and 2013, found instead that the distribution of income between

[1]We report the famous statement by Ricardo: "the produce of the earth—all that is derived from its surface by the united application of labour, machinery and capital, is divided among three classes of the community, namely, the proprietor of the land, the owner of the stock or capital necessary for its cultivation, and the labourers by whose industry it is cultivated … To determine the laws which regulate this distribution is the principal problem in Political Economy" (Ricardo, 1911 [1817], p. 1 in 1911 edition).

[2]The advantage of considering top income share as a measure of income inequality is that the two factors can be easily compared both across countries and across time.

[3]Piketty himself stated that his book is primarily about the history of the distribution of income and wealth (Piketty, 2015).

labor and capital has not been a major factor in explaining income inequality. The two previous works provided evidence that, as Milanovic (2017) stated, "the link [...] is not as simple and unambiguous as it seems" (p. 237).

On a technical level, few works have attempted to precisely measure the strength of this link. In his recent work, Milanovic (2017) argued that, in the context of the rising share of capital income, the level of income inequality grows only under two conditions: (i) a high level of inequality in capital income; and (ii) a high and positive association between capital-rich and overall income-rich people. These two conditions, operationalized by the Gini coefficient of capital income and the correlation coefficient between capital and total income, respectively, suggest an important theoretical connection between factor shares and income inequality. In particular, the correlation coefficient between capital and total income, which is an elasticity of interpersonal income Gini to changes in capital income share, could act as an intuitive and simple measure of this link. However, this correlation coefficient does not formally determine the condition of the transmission of changes in the functional distribution into income inequality, as discussed later in this paper.

Atkinson and Bourguignon (2000) and Atkinson (2009) approached the measurement of this link by decomposing the squared coefficient of variation of income, where there are two types of income: wage income and capital income.[4] In this way, they managed to show the conditions under which an increase in the capital income share is transmitted into an increase in overall income inequality, as measured by the standard deviation of income. Another way of measuring the association between capital and labor was also recently proposed by Atkinson and Lakner, 2017. The authors studied the association between capital and labor by constructing a rank-based measure of association, which is a discrete approximation of the copula density. All these methods, however, do not aim at precisely measuring the strength of this link or creating a single summary statistic for this purpose. Atkinson and Lakner (2017), for instance, did not precisely discuss under which specific joint distributions of capital and labor the strength of the link is maximal and minimal. Furthermore, as is clear later in this paper, rank-based measures of associations are not suited to measuring the strength of the link between the functional and personal distribution of income. In contrast, Atkinson and Bourguignon (2000) did not provide any summary statistic that can be used to measure the strength of this relationship. As stated in the introduction, this paper argues that to determine a formal link between these two distributions, we must introduce a novel inequality concept, which we call *income composition inequality*. Then, by constructing an indicator of income composition inequality, it will be possible to measure the strength of this link.

[4]Particularly, the coefficient of variation of income V^2 can be written as a function of the capital share of income π, of the inequality of wage income V_w and capital income V_k, and of the correlation ρ between wage income and capital income: $V^2 = (1-\pi)^2 V_w^2 + \pi^2 V_k^2 + 2\pi(1-\pi)\rho V_w V_k$. Now, if we define λ as the relationship between wage income dispersion and capital income dispersion, then an increase in the capital share of income is transmitted into personal income inequality only when the following condition is satisfied: $\pi > \frac{1-\lambda\rho}{1+\lambda^2-2\lambda\rho}$.

3. Definition and Interpretation

We define income composition inequality in the following way.

Definition 3 If we decompose total income into *two* factors, such as capital and labor income, then income composition inequality is the extent to which the income composition is distributed unevenly across the income distribution.

From Definition 3.1 follows in a straightforward manner that inequality in income composition is *maximal* when individuals at the top and bottom of the income distribution separately earn the two different types of income and *minimal* when each individual earns the same composition of the two factors.

It is important to emphasize that, in this paper, we refer to income composition inequality *across* the income distribution. Therefore, instead of analyzing the distribution of individual factor shares per se, we study the association between the individual factor shares and the level of total income in a population. This association is important both to shed light on the relationship between the functional and personal income distributions and to undertake meaningful political economy analysis of economic systems.

A high level of income composition inequality is in fact associated with a strong relationship between the functional and personal distributions of income. The underlying intuition is straightforward: if the wealthy earn all the capital income in the economy, then an increase in the capital income share increases the income of the wealthy. Analogous reasoning can be proposed to show that, under a high level of income composition inequality, the functional distribution of income can be seen as a measure of income inequality.

From a political economy perspective, the level of income composition inequality can provide us with insights into the "type of capitalism" of a given social system. Particularly, following the classification proposed by Milanovic (2017, 2019), under maximal inequality in income composition, a society can be considered a case of *classical capitalism*, in which a group of rich individuals draws its income from capital, whereas a group of poor individuals draws its income from labor. In contrast, under minimal inequality in income composition, a society can be regarded as a case of *new capitalism* or of *multiple sources of income society*. For instance, a reduction in income composition inequality suggests that the corresponding economic system is moving toward becoming a new form of capitalism, in which individuals have multiple sources of income at their disposal, and there is a weaker relationship between functional and personal distributions of income.

Although we use capital and labor as income sources in this paper, it is important to emphasize that the study of income composition inequality can be useful for analyzing the joint distribution of *any pair* of income (or wealth) components, such as net income and taxes, saving and consumption, and financial and non-financial assets, among others.

In the next section, we introduce a statistical indicator to measure income composition inequality. This indicator is constructed using specific concentration curves for income source (Kakwani, 1977a, 1977b).

4. Method

4.1. *The Concentration Curve for Income Source*

Suppose we have a fixed population of n individuals, each endowed with income Y_i with i=1,…,n. We can define each individual's income share as $y_i = \frac{Y_i}{Y}$, where $Y = \sum_{i=1}^{n} Y_i$ is the total income of the population. Total income is divided into two sources, capital (Π) and labor (W), so that Y=Π+W and therefore y=1=π+w, where $\pi = \frac{\Pi}{Y}$ and $w = \frac{W}{Y}$ are the capital and labor shares of income, respectively. Consider the following decomposition of individual i's income:

$$y_i = \alpha_i \pi + \beta_i w, \tag{1}$$

where $\alpha_i = \frac{\Pi_i}{\Pi}$ and $\beta_i = \frac{W_i}{W}$ are the relative shares of capital and labor of individual i, such that $\sum_{i=1}^{n} \alpha_i = \sum_{i=1}^{n} \beta_i = 1$, and Π_i and W_i represent i's total amount of capital and labor. Assume that $y_i \leq y_{i+1} \quad \forall i = 1, \cdots, n-1$ and $y_0 = 0$ so that individuals are indexed by their income rankings. We can define $p = \frac{i}{n}$ as the proportion of the population with income less than or equal to y_p so that $p \in \mathbb{Q}: = [0, 1]$. Let $\mathscr{L}(\mathbf{y}, p) = \sum_{j=1}^{i} y_j$, with i=1,…,n be the Lorenz curve for income corresponding to the distribution $\mathbf{y}$. We are defining the Lorenz curve here as in Shorrocks (1983). We can define the concentration curve for capital income weighted by π, $\mathscr{L}(\boldsymbol{\pi}, p)$, corresponding to the distribution \boldsymbol$\pi$, as follows:

$$\mathscr{L}(\boldsymbol{\pi}, p) = \pi \mathscr{C}(\boldsymbol{\pi}, p) = \pi \sum_{j=1}^{i} \alpha_j \quad \forall i = 1, \cdots, n, \tag{2}$$

where $\mathscr{C}(\boldsymbol{\pi}, p)$ is the concentration curve for capital income, as defined by Kakwani (1977a).

Similarly, the concentration curve for labor income weighted by w, $\mathscr{L}(\mathbf{w}, p)$, corresponding to the distribution $\mathbf{w}$, is:

$$\mathscr{L}(\mathbf{w}, p) = w \mathscr{C}(\boldsymbol{w}, p) = w \sum_{j=1}^{i} \beta_j \quad \forall i = 1, \cdots, n, \tag{3}$$

where $\mathscr{C}(\boldsymbol{w}, p)$ is the concentration curve for labor income.

The two curves describe the cumulative distribution of capital and labor across the population with individuals being indexed by their income ranking. Therefore, it is possible that an individual with a higher capital share is ranked below someone with a lower capital share if the income of the latter is greater than that of the former (formally, we can find a pair (i,j) s.t. $\alpha_i > \alpha_j$ and $y_i < y_j$). In addition, note that when $i \Longrightarrow n$ (or $p \Longrightarrow 1$), then $\mathscr{L}(\boldsymbol{\pi}, p) \longrightarrow \pi$ and $\mathscr{L}(\mathbf{w}, p) \longrightarrow w$, where $\pi, w \leq y$. The concentration curves for income source here adopted can also be regarded as *pseudo-Lorenz curves* (Fei *et al.*, 1978) weighted by the level of the related income share.

According to the previous decomposition of individual income, we can write as follows:

$$\mathscr{L}(\mathbf{y}, p) = \mathscr{L}(\boldsymbol{\pi}, p) + \mathscr{L}(\mathbf{w}, p) = \pi \mathscr{C}(\boldsymbol{\pi}, p) + w \mathscr{C}(\boldsymbol{w}, p) \quad \forall i = 1, \cdots, n. \tag{4}$$

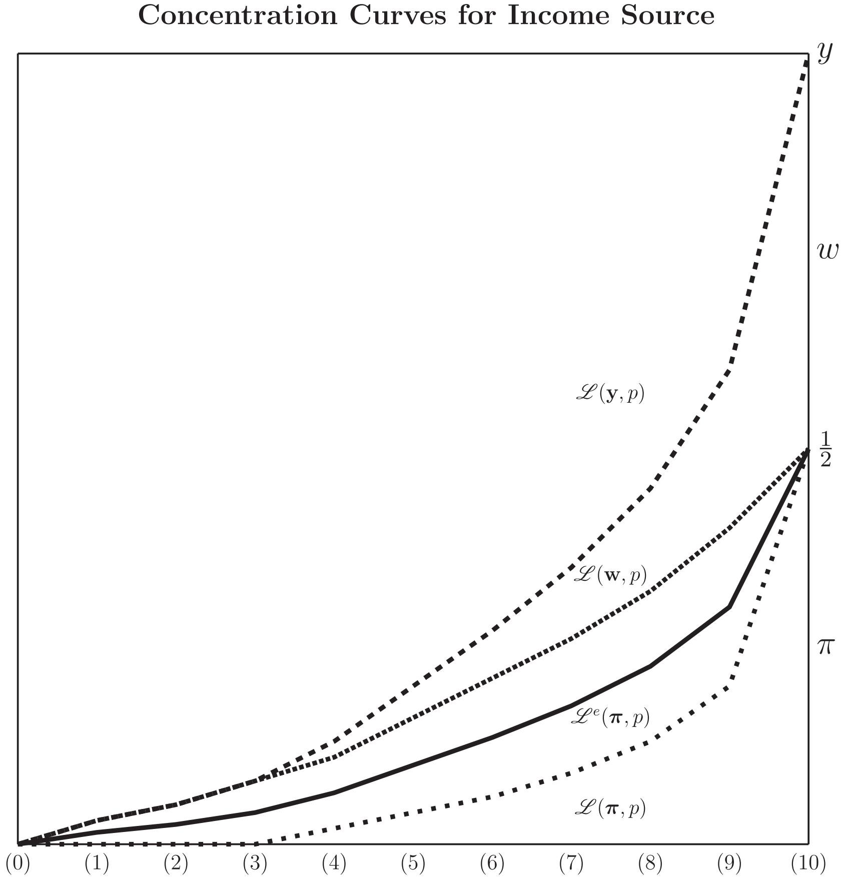


Figure 1. A Graphical Representation of the Concentration Curve for Capital $\mathscr{L}(\boldsymbol{\pi}, p)$, the Concentration Curve for Labor $\mathscr{L}(\mathbf{w}, p)$, the Lorenz Curve for Income $\mathscr{L}(\mathbf{y}, p)$, and the Zero-Concentration Curve $\mathscr{L}^e(\boldsymbol{\pi}, p)$ with 10 Individuals (or Groups) and Equal Sources of Income in the Economy ($\pi = w = \frac{1}{2}$). As Can Be Noted, for Each Population Decile p, the Lorenz Curve for Income $\mathscr{L}(\mathbf{y}, p)$ Equals the Sum of the Concentration Curve for Capital $\mathscr{L}(\boldsymbol{\pi}, p)$ and the Concentration Curve for Labor $\mathscr{L}(\mathbf{w}, p)$. In Addition, Given That π=w, the Two Zero-Concentration Curves Coincide: $\mathscr{L}^e(\boldsymbol{\pi}, p) = \mathscr{L}^e(\mathbf{w}, p) \quad \forall p$.

The Lorenz curve for income $\mathscr{L}(\mathbf{y}, p)$, for every p, can therefore be decomposed into the sum of the two previously defined concentration curves. Figure 1 plots an example of $\mathscr{L}(\mathbf{y}, p)$ and $\mathscr{L}(\boldsymbol{\pi}, p)$ for a population of size n=10. Total income is equally split between capital and labor; therefore, $\pi = w = \frac{1}{2}$.

The concentration curves allow us to understand whether a given income source is concentrated primarily at the bottom or at the top of the income distribution. Given the interdependence of the two concentration curves (i.e. when one source is concentrated at the top, the other is concentrated at the bottom), a single curve is sufficient to analyze the joint distribution of capital and labor. However, to precisely assess the extent to which capital and labor are polarized across the income distribution, two benchmark conditions must be defined: the *zero*- and *maximum-concentration conditions*. On the basis of these two conditions, the corresponding *zero*- and *maximum-concentration curves* are hence introduced.

4.2. *The Zero-Concentration Curve*

In this section, we introduce in a formal setting the concept of the zero concentration of two income sources. As anticipated in the introduction, we define the benchmark of zero concentration in the following way.

Definition 4 We say that two income sources are zero-concentrated across a population when each individual has the population average shares of capital and labor income. Formally, we have zero concentration of income sources when $\frac{W_i}{\Pi_i} = \frac{w}{\pi}\ \forall i$, or, equivalently, when $\alpha_i = \beta_i\ \forall i$.[5]

Note that the previous definition is not related to the concept of income inequality: The population can exhibit a zero concentration of income sources even with positive income inequality. Furthermore, note that only two elements are needed to determine the zero-concentration condition, notably the functional and personal distributions of income. Two populations characterized by different Lorenz curves or by different shares of capital income have two different conditions of zero concentration.

At this stage of the analysis, we can define the zero-concentration curve, $\mathscr{L}^e(\mathbf{z},p)$, corresponding to the distribution $\mathbf{z}$, which is the concentration curve for the income source z when the income sources are not concentrated as:

$$\mathscr{L}^e(\mathbf{z},p) = \mathbf{z}\sum_{j=1}^{i} y_j \quad \forall i = 1,\cdots,n, \tag{5}$$

with $\mathbf{z}$=π,w. The choice of $\mathbf{z}$ depends on the particular source that we analyze. If we were interested in the distribution of capital in the population, we would compare the *actual* concentration curve for capital with the concentration curve for capital in the case of zero concentration, $\mathscr{L}^e(\boldsymbol{\pi},p)$. It should be noted that the zero-concentration curve is a *weighted* version of the Lorenz curve for income; indeed, we can write $\mathscr{L}^e(\mathbf{z},p) = \mathbf{z}\mathscr{L}(\mathbf{y},p)\ \ \forall p$. Let us now consider the following relationship:

$$\mathscr{L}(\mathbf{z},p) = \mathscr{L}^e(\mathbf{z},p) + \mathscr{R}(\mathbf{z},p) \quad \forall i = 1,\cdots,n, \tag{6}$$

where $\mathscr{R}(\mathbf{z},p)$ is the residual-concentration curve corresponding to the distribution $\mathbf{z}$. When $\mathscr{L}(\mathbf{z},p)$ is greater than $\mathscr{L}^e(\mathbf{z},p)$ over all of the domain (i.e. $\mathscr{L}(\mathbf{z},p) > \mathscr{L}^e(\mathbf{z},p)\ \ \forall p$), then $\sum_{i=1}^{n}\mathscr{R}(\mathbf{z},p) > 0$, and source $\mathbf{z}$ is concentrated primarily at the bottom of the distribution; in contrast, when $\mathscr{L}(\mathbf{z},p)$ is below $\mathscr{L}^e(\mathbf{z},p)$ over all the domain, then $\sum_{i=1}^{n}\mathscr{R}(\mathbf{z},p) < 0$, and the opposite situation holds. In the case of zero concentration of income sources, the Gini coefficient for total income can be written as follows:

$$\mathscr{G} = 1 - \frac{1}{n}\left(\sum_{i=1}^{n}\left(\sum_{j=1}^{i}\beta_j + \sum_{j=1}^{i-1}\beta_j\right)\right), \tag{7}$$

[5]As $\frac{W_i}{\Pi_i} = \frac{w}{\pi} \iff \frac{W_i}{w} = \frac{\Pi_i}{\pi} \iff Y\times\frac{W_i}{W} = Y\times\frac{\Pi_i}{\Pi} \iff \alpha_i = \beta_i$.

which is also equivalent to:

$$\mathcal{G} = 1 - \frac{1}{n}\left(\sum_{i=1}^{n}\left(\sum_{j=1}^{i}\alpha_j + \sum_{j=1}^{i-1}\alpha_j\right)\right). \tag{8}$$

The Gini coefficient for total income in this particular case can thus be written as a function of individuals' relative shares of any one income source. Note that neither of the two expressions above are functions of π or w, indicating that an increase in either the capital share or the labor share of income does not affect personal income inequality when income sources are not concentrated. Similarly, we can say that the "elasticity of interpersonal income Gini to changes in capital income share" is zero.[6] This distribution of income sources represents the long-term distribution of factors across individuals in a neoclassical framework in which heterogeneity of both non-accumulated and accumulated factors is considered (Bertola *et al.*, 2005). It also represents the underlying distribution of factors in the *new capitalism 2* society defined by Milanovic (2017). We conclude this section with the following definition.

Definition 4 We say that, under zero concentration of income sources, inequality in income composition across the income distribution is minimal.

4.3. *The Maximum-Concentration Curve*

Let us focus our attention on the benchmark of maximum concentration of two income sources, which we can define as follows.

Definition 4 We say that two income sources are maximum concentrated when the bottom p% of the income distribution has an income consisting only of the source z, and the top $(1-p)$% of the income distribution has an income consisting only of the source $z_{\_}$, where p s.t. $y_p = \mathcal{L}(\mathbf{y}, p) = z$, $1-p$ s.t. $y_{1-p} = 1 - \mathcal{L}(\mathbf{y}, p) = z_{\_}$, $z_{\_} = 1 - z$ and $z{=}\pi{,}w$.

Regarding the condition of zero concentration, the condition of maximum concentration is also already present in the literature. In his recent article, Milanovic defined the classical capitalism as a society in which "ownership of capital and labor is totally separated, in the sense that workers draw their entire income from labor and have no income from the owner ship of assets, while the situation for the capitalists is the reverse. Moreover, we shall assume that all workers are poorer than all capitalists. This is an important simplifying assumption because it gives us [...] two social groups that are nonoverlapping by income level" (Milanovic, 2017, p. 243). We can therefore say that under the condition of maximum concentration and specifically when capital is owned by the top of the income distribution and labor by the bottom, a society is classical capitalism á la Milanovic.[7]

[6]See Milanovic (2017) for further details.
[7]This type of society can also be found in the works of Kaldor (1955) and Pasinetti (1962) or more recently the work of Stiglitz (2015), in which a class of capitalists is counterposed to a class of workers. However, these authors did not necessarily assume that the former class is poorer than the latter in terms of total income.

From a technical perspective, we can define the maximum-concentration curve, $\mathscr{L}^{max}(\mathbf{z},p)$, corresponding to the distribution $\mathbf{z}$, as follows:

$$\mathscr{L}^{max}(\mathbf{z},p) = \begin{cases} \mathscr{L}^{M}(\mathbf{z},p) = \begin{cases} \mathscr{L}(\mathbf{y},p) & \text{for } p \le p' \\ z & \text{for } p > p' \end{cases} \\ \mathscr{L}^{m}(\mathbf{z},p) = \begin{cases} 0 & \text{for } p \le p'' \\ \mathscr{L}(\mathbf{y},p) - z_{-} & \text{for } p > p'' \end{cases} \end{cases}, \tag{9}$$

with p' s.t. $\mathscr{L}(\mathbf{y},p') = z$, p'' s.t. $\mathscr{L}(\mathbf{y},p'') = 1 - z$, and $\mathbf{z}{=}\pi,w$. In addition, we have:

1. $\mathscr{L}^{max}(\mathbf{z},p) = \mathscr{L}^{M}(\mathbf{z},p)$ if $\mathscr{L}(\mathbf{z},p) \geq \mathscr{L}^{e}(\mathbf{z},p)$ $\forall p$ and $\exists$ p^{*} s.t. $\mathscr{L}(\mathbf{z},p^{*}) > \mathscr{L}^{e}(\mathbf{z},p^{*})$,
2. $\mathscr{L}^{max}(\mathbf{z},p) = \mathscr{L}^{m}(\mathbf{z},p)$ if $\mathscr{L}^{e}(\mathbf{z},p) \leq \mathscr{L}(\mathbf{z},p)$ $\forall p$ and $\exists$ p^{**} s.t. $\mathscr{L}^{e}(\mathbf{z},p^{**}) < \mathscr{L}(\mathbf{z},p^{**})$.

Stated simply, $\mathscr{L}^{max}(\mathbf{z},p) = \mathscr{L}^{M}(\mathbf{z},p)$ when the actual concentration curve lies above the zero-concentration curve and that $\mathscr{L}^{max}(\mathbf{z},p) = \mathscr{L}^{m}(\mathbf{z},p)$ when the actual concentration curve lies below the zero-concentration curve.

However, the two conditions mentioned above ((i) and (ii)) are rather strong because they require the two curves not to intersect along the distribution of income. In contrast, a weaker condition is the one that considers the area covered by each curve, as follows:

1. $\mathscr{L}^{max}(\mathbf{z},p) = \mathscr{L}^{M}(\mathbf{z},p)$ if $\sum_{i=1}^{n} \sum_{j=1}^{i} \eta_j^k > \sum_{i=1}^{n} \sum_{j=1}^{i} y_j$,
2. $\mathscr{L}^{max}(\mathbf{z},p) = \mathscr{L}^{m}(\mathbf{z},p)$ if $\sum_{i=1}^{n} \sum_{j=1}^{i} \eta_j^k < \sum_{i=1}^{n} \sum_{j=1}^{i} y_j$,

where $\eta_j^k = \alpha_j$ if $z{=}\pi$ and $\eta_j^k = \beta_j$ when $z{=}w$.

The first and second group of conditions can therefore be regarded as first- and second-order stochastic dominance conditions, respectively. As is the case for the previous section, we conclude this section with the following definition.

Definition 4 We say that, under maximum concentration of income sources, income composition inequality across the income distribution is maximized.

4.4. *Measuring Income Composition Inequality*

In the previous sections, we defined the two benchmarks of zero and maximum inequality in income composition, together with their corresponding concentration curves. When the actual concentration curve is close to the zero-concentration curve, then income composition inequality is low. In contrast, when the actual concentration curve is close to the maximum-concentration curve, then income composition inequality is high. To precisely measure income composition inequality, we introduce an indicator that serves this purpose, which we call the *IFC index*. We label this indicator $\mathscr{I}$, which is constructed in the following way.

Let us denote by $\mathscr{A}(\mathbf{z})$ the area between the zero-concentration curve and the concentration curve for income source z and by $\mathscr{B}^{max}(\mathbf{z})$ the area between the zero-concentration curve and the maximum-concentration curve in absolute value. We define the IFC index, $\mathscr{I}(\mathbf{z})$, corresponding to the distribution $\mathbf{z}$, as follows:

$$\mathscr{I}(\mathbf{z}) = \frac{\mathscr{A}(\mathbf{z})}{\mathscr{B}^{max}(\mathbf{z})}, \tag{10}$$

with $\mathbf{z}=\pi,\mathbf{w}$.

As discussed in the previous section, the choice of the maximum-concentration curve and hence of the denominator $\mathscr{B}^{max}(\mathbf{z})$ depends on whether the actual concentration curve is below or above the zero-concentration curve. If the actual concentration curve is below the zero-concentration curve, then the denominator $\mathscr{B}^{max}(\mathbf{z})$ is equal to the difference between the area of $\mathscr{L}^{e}(\mathbf{z},p)$ and that of $\mathscr{L}^{m}(\mathbf{z},p)$. In this particular case, we write: $\mathscr{B}^{max}(\mathbf{z}) = \mathscr{B}^{m}(\mathbf{z})$. If the actual concentration curve is above the zero-concentration curve, then the denominator $\mathscr{B}^{max}(\mathbf{z})$ is equal to the absolute value of the difference between the area of $\mathscr{L}^{e}(\mathbf{z},p)$ and that of $\mathscr{L}^{M}(\mathbf{z},p)$. In this particular case, we instead write: $\mathscr{B}^{max}(\mathbf{z}) = \mathscr{B}^{M}(\mathbf{z})$.

This measure has considerable intuitive appeal: it is the area between the zero-concentration curve $\mathscr{L}^{e}(\mathbf{z},p)$ and the concentration curve for income source $\mathscr{L}(\mathbf{z},p)$, divided by the area between the zero-concentration curve $\mathscr{L}^{e}(\mathbf{z},p)$ and the maximum-concentration curve $\mathscr{L}^{max}(\mathbf{z},p)$. Note that the areas between the curves $\mathscr{L}^{M}(\mathbf{z},p)$ and $\mathscr{L}^{e}(\mathbf{z},p)$ and the curves $\mathscr{L}^{e}(\mathbf{z},p)$ and $\mathscr{L}^{m}(\mathbf{z},p)$ are the same for the specific functional form of $\mathscr{L}(\mathbf{y},p)$ and for certain values of z (see the appendix for further details).

This measure lies therefore between −1 (when individuals at the bottom own source z and individuals at the top own source $z\_$) and 1 (when individuals at the bottom own source $z\_$ and individuals at the top own source z). It is equal to zero when the area of the concentration curve is the same as that of the zero-concentration curve. The latter can occur without the two curves coinciding.

The following property of this indicator can also be shown (see Appendix A1 for details):

$$\mathscr{I}(\mathbf{z}) = -\mathscr{I}(\mathbf{z}\_). \tag{11}$$

Equation 11 shows that the choice of the reference concentration curve for income source does not ultimately modify the absolute value of the indicator but only its sign.

In light of the relationship previously discussed between the concentration curves and the ideal-typical social systems proposed by Milanovic, we can also interpret this indicator as a measure of the degree of capitalism of a given social system. Furthermore, the new type of capitalism can also be considered multiple sources of income in a society.

The metric proposed is not a rank-based measure of association between labor and capital (Atkinson and Lakner, 2017). Indeed, a monotone transformation of the marginal distributions would affect the index by changing the ranking in the distribution of total income.[8]

[8]For a full discussion of rank-based measures of association, see Dardanoni and Lambert (2001), Atkinson and Lakner (2017), and Aaberge *et al*. (2018).

Although it might seem of little interest to consider negative values of the index, they have a powerful meaning in terms of income composition dynamics, as stated by the following definition.

Definition 4 Let $sign_{t,t+1}$ be the sign of $\mathscr{I}^t(\mathbf{z}) \cdot \mathscr{I}^{t+1}(\mathbf{z})$, where $\mathscr{I}^t(\mathbf{z})$ is the metric at time t, whereas $\mathscr{I}^{t+1}(\mathbf{z})$ the one at time t+1. We say that a change in the structure of income composition across the distribution of income occurs at time t if $sign_{t,t+1} < 0$.

When a change in sign occurs at time t+1 (i.e. $sign_{t,t+1} < 0$), those individuals who mainly own source z at time t earn mainly source $z\_$ at time t+1 and vice versa.

The normalization coefficient $\mathscr{B}^m(\mathbf{z})$ is a function of $\mathscr{L}(\mathbf{y},p)$, z, and p'', whereas the coefficient $\mathscr{B}^M(\mathbf{z})$ is a function of $\mathscr{L}(\mathbf{y},p)$, z, and p'. To simplify the notation, we generally denote by $\mathscr{B}(\mathbf{z})$ the denominator of the metric. A more compact expression for the index is, for z=π, as follows:

$$\mathscr{I}(\boldsymbol{\pi}) = \frac{w\pi(\tilde{\mu}_w - \tilde{\mu}_\pi)}{\mathscr{B}(\boldsymbol{\pi})}, \tag{12}$$

where $\tilde{\mu}_\pi = \frac{1}{2n}\sum_{i=0}^{n}\left(\sum_{j=0}^{i}\alpha_j + \sum_{j=0}^{i+1}\alpha_j\right)$ and $\tilde{\mu}_w = \frac{1}{2n}\sum_{i=0}^{n}\left(\sum_{j=0}^{i}\beta_j + \sum_{j=0}^{i+1}\beta_j\right)$ are the areas of the concentration curves for labor and capital multiplied by $\frac{1}{w}$ and $\frac{1}{\pi}$, respectively.[9] Similarly, for z=w, we have:

$$\mathscr{I}(\mathbf{w}) = \frac{w\pi(\tilde{\mu}_\pi - \tilde{\mu}_w)}{\mathscr{B}(\mathbf{w})}. \tag{13}$$

Equations 12 and 13 are simply intended to illustrate the functional forms of this indicator once we mainly focus on the concentration of capital and labor at the top, respectively. Particularly, when equation 12 is positive, then capital is concentrated primarily at the top of the income distribution and labor at the bottom. Conversely, when equation 13 is positive, then labor is concentrated primarily at the top of the income distribution and capital at the bottom. As previously discussed, the following relationship therefore holds true: $\mathscr{I}(\boldsymbol{\pi}) = -\mathscr{I}(\mathbf{w})$.

The two functions, $\tilde{\mu}_\pi$ and $\tilde{\mu}_w$, have precise dynamics: they increase (decrease) when the source in question moves toward the bottom (top) of the distribution. These areas can thus be considered approximate metrics of the indicator previously introduced.[10] Similarly, the function $\tilde{\mu}_y$ is a measure of income inequality: When it increases, so does the surface of the Lorenz curve by reducing its distance from the egalitarian line.

The functional form and mathematical properties of the indicator in the case of a two-person economy can be found in Appendix A3. Given that full population data are often missing, it is important to know how to approximate the level of

[9]Note that one minus twice $\tilde{\mu}_z$ yields the pseudo-Gini of income source z (see Shorrocks, 1982).

[10]We can also observe that the term $\tilde{\mu}_\pi$ (and similarly $\tilde{\mu}_w$ and $\tilde{\mu}_y$) can be expressed as follows: $\tilde{\mu}_\pi = \sum_{i=1}^{n}\alpha_i\left(\frac{2n-2i+1}{2n}\right)$. It suffices to note that $\tilde{\mu}_\pi = \frac{1}{2n}\sum_{i=0}^{n}\left(\sum_{j=0}^{i}\alpha_j + \sum_{j=0}^{i+1}\alpha_j\right) = \frac{1}{2n}\sum_{i=1}^{n}\left(2\sum_{j=1}^{i}\alpha_j + \alpha_i\right) = \frac{1}{n}\sum_{i=0}^{n}\sum_{j=0}^{i}\alpha_j + \frac{1}{2n}\sum_{i=0}^{n}\alpha_i$, from which we obtain the result.

income composition inequality with limited information. This need is particularly important when we address historical analysis.

At a first glance, this indicator might bear resemblance to the *pseudo-Gini coefficient*, first proposed by Fei et al. (1978). However, these two metrics are very different from each other. Let us consider, for instance, the pseudo-Gini for capital income $\overline{\mathcal{G}}_{\pi}$, which can be written as follows: $\overline{\mathcal{G}}_{\pi} = 1 - 2\tilde{\mu}_{\pi}$. This indicator is equal to zero when all individuals have the same *absolute level* of capital income, regardless of whether their total incomes differ. Let me better illustrate this point with a simple example. Suppose we have a population of three individuals, whose relative income shares are described by the following vector $\left(y_1, y_2 . y_3\right) = \left(\frac{1}{10}, \frac{3}{10}, \frac{6}{10}\right)$. The pseudo-Gini coefficient is equal to zero when the vector of the relative shares of capital income is of the following form $\left(\alpha_1, \alpha_2 . \alpha_3\right) = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right)$. Now, given that individual 1 has the same share of capital income of individual 3, it renders the former individual more capital abundant than the latter. Therefore, in a society as such, an increase in the population capital share of income would increase the income of individual 1 relatively more than the income of individual 3. For this reason, the pseudo-Gini coefficient cannot be regarded as a measure of the relationship between the functional and personal income distributions.

Given that the derivative of the Gini coefficient with respect to the factor share z yields (see Appendix A4 for the derivation):

$$\frac{\partial G}{\partial z} = 2\left(\tilde{\mu}_{z_-} - \tilde{\mu}_{z_-}\right), \tag{14}$$

and by noting that the term $\tilde{\mu}_{z_-} - \tilde{\mu}_{z_-}$ determines the sign of the IFC index, we can conclude that the *sign* of the indicator determines the relationship between the functional and personal distributions of income.

To conclude this section, it is of utmost importance to emphasize that, just as there are many indices that measure income inequality, there can be many different ways to measure income composition inequality. This aspect lays the ground for future methodological research on the matter.

5. Empirical Application

In this section, we illustrate how the method developed in this paper can be applied to data. To this end, we study the evolution of income composition inequality for six European economies, namely Germany, Norway, Spain, Switzerland, the Netherlands, and the UK. Given the theoretical nature of the present work, the objective of this section is, rather than providing a sound political economy analysis of the countries under scrutiny, to show how the method can be applied in practice and the results interpreted. For a thorough examination of the evolution of income composition inequality in Italy, see Iacono and Ranaldi (2020). For the study of the evolution of income composition inequality in the Scandinavian context, see Iacono and Palagi (2020), whereas for an assessment of the relationship between income composition inequality and income inequality at the global scale, see Ranaldi and Milanovic (2020). Finally, for an econometric analysis of the

TABLE 1
Total, Capital, and Labor Income Shares Across the Total Income Distribution

	Income Group	Norway		UK		The Netherlands		Germany		Switzerland		Spain	
		2007	***2015***	***2007***	***2015***	***2007***	***2015***	***2007***	***2015***	***2007***	***2015***	***2007***	***2015***
Total income	*0–50%*	31%	31%	25%	24%	28%	28%	28%	27%	30%	30%	27%	23%
	50–90%	46%	46%	46%	45%	45%	46%	46%	47%	45%	45%	47%	48%
	90–95%	8%	8%	10%	10%	9%	9%	9%	9%	8%	8%	9%	10%
	95–100%	13%	13%	18%	19%	16%	16%	15%	15%	15%	15%	15%	17%
Capital income	*0–50%*	21%	16%	21%	16%	11%	12%	23%	21%	24%	17%	14%	16%
	50–90%	30%	34%	33%	40%	24%	21%	40%	43%	35%	36%	35%	40%
	90–95%	11%	10%	10%	11%	9%	9%	9%	10%	11%	11%	9%	11%
	95–100%	36%	38%	34%	31%	53%	56%	27%	24%	28%	33%	40%	30%
Labor income	*0–50%*	32%	32%	25%	24%	29%	29%	28%	28%	31%	31%	27%	24%
	50–90%	47%	46%	46%	46%	46%	47%	46%	47%	45%	45%	47%	48%
	90–95%	8%	8%	9%	9%	9%	9%	9%	9%	8%	8%	9%	10%
	95–100%	12%	12%	17%	19%	14%	14%	15%	15%	14%	14%	15%	16%
	Capital share	3%	4%	4%	3%	4%	4%	3%	2%	5%	5%	2%	4%
	Gini	0.24	0.24	0.34	0.38	0.16	0.16	0.25	0.28	0.29	0.29	0.30	0.33
	IFC	0.32	0.38	0.21	0.23	0.52	0.52	0.14	0.16	0.21	0.33	0.37	0.24

political determinants of income composition inequality, see Petrova and Ranaldi (2020).

The data used come from the European Union Statistics of Income and Living Conditions (EU-SILC), providing a representative sample of the European population. These data are first produced by the national statistical offices and later harmonized and released by Eurostat. In our analysis, we consider the period between 2007 and 2016. The country samples vary between 7000 and 19,000 units and the unit of analysis is the individual.

Our analysis relies on a specific definition of capital and labor income.[11] Precisely, we define capital income as the sum of income from rental of a property or land (hy040g), interests, dividends, profit from capital investments in unincorporated business (hy090g), and pensions from individual private plans (py080g). Labor income is defined as the difference between total household gross income minus capital income.[12] Individuals with strictly negative capital or labor incomes are removed from the analysis.

We begin the analysis with some descriptive statistics. The first row of Table 1 presents the income shares of four different income groups: *0–50 percent*, *50–90 percent*, *90–95 percent*, and *95–100 percent*. These shares are computed for the six European countries in 2007 and 2015.

The distribution of total income is rather similar in 2007 and 2015 for almost all the countries, with the exceptions of the UK and Spain, where 2 percent and 3 percent of total income have moved from the bottom 50 percent to the top 50 percent, respectively. The UK and Spain are also the countries displaying the highest levels of total income inequality because their Gini coefficients are greater than 0.3. On average, all countries are characterized by bottom 50 percent and top 10 percent earnings less than the 30 percent of total income. We recall that survey data tend to underestimate incomes at the very top of the distribution (see Lustig, 2020, for a recent survey).

The second and third rows of Table 1 show, instead, the distributions of the capital and labor income, respectively, with individuals being indexed by their income ranking. Following Shorrocks (1982) and Atkinson and Lakner (2017), we may call these shares "pseudo-shares." Let us take a closer look at the second row. A way to read this table is the following: in 2007 in Norway, the individuals in the bottom 50 percent of the total income distribution earned 21 percent of the total capital income in the economy. The share of the capital income earned by the same income group in 2016 was 4 percent points less than the share in 2007.

[11]The definitions of capital and labor income can be, to a certain extent, arbitrary. For instance, Cirillo *et al*. (2017), who investigated the dynamics of the functional and personal distributions of income at the European level before and after the crisis, provided a slightly different definition of capital and labor income from those proposed in this paper. Particularly, their definition of income did not include self-employment remuneration.

[12]The sources of labor income that we consider are: gross employee cash or near cash income (py010g), company cars (py021g), unemployment benefits (py090g), old-age benefits (py100g), survivor's benefits (py110g), sickness benefits (py120g), disability benefits (py130g), education-related allowances (py140g), family/children-related allowances (hy050g), social exclusion not elsewhere classified (hy060g), regular inter-household cash transfers received (hy080g), income received by people younger than 16 (hy080g), and cash benefits or losses from self-employment (py050g).

In the Netherlands, the individuals at the top 5 percent of the income distribution earn more than 50 percent of all the capital income in the economy, whereas in Germany, they earn less than 30 percent. Different from the dynamics of the total income distribution, the capital income distribution has considerably changed over the period considered in almost all the countries. However, it is difficult to identify clear patterns among the six countries.

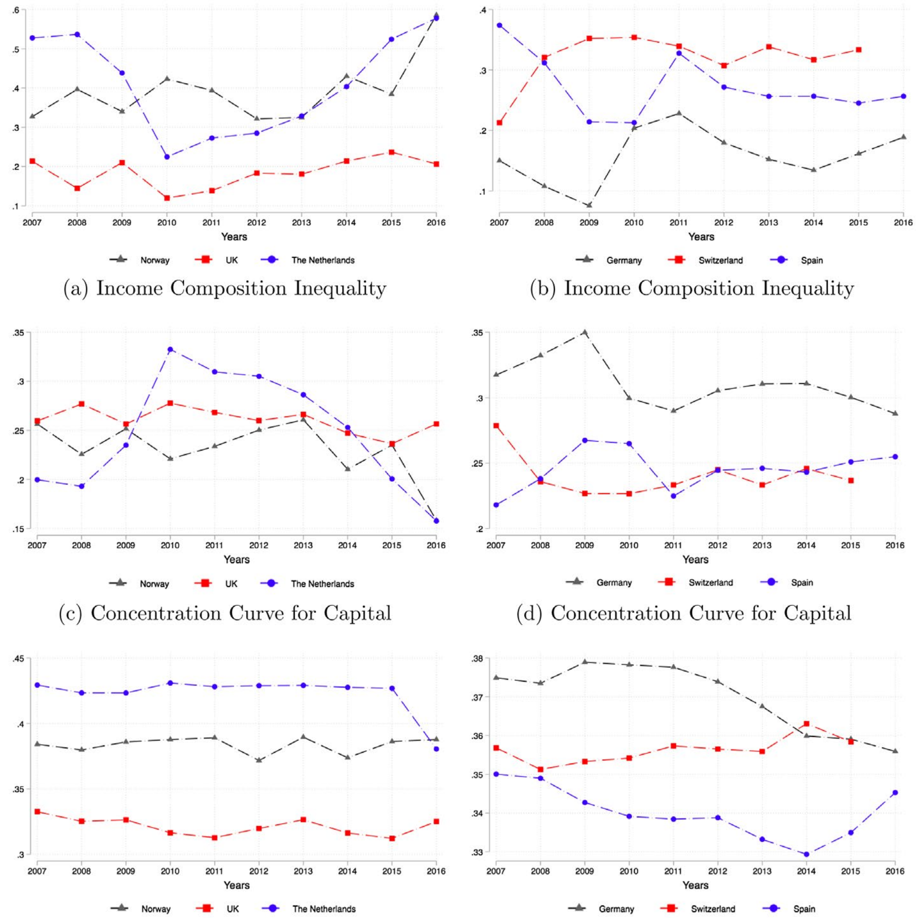
In Norway and Switzerland, the capital income has moved from the bottom 50 percent to the top 5 percent between 2007 and 2016. A similar pattern can be shown for Germany and the UK, although the capital income has shifted from the bottom 50 percent to the middle 40 percent, rather than the top 10 percent. In Spain, in contrast, the top 5 percent has seen a strong reduction of its capital income share, moving from 40 percent to 30 percent of the total.

The third row shows that very few changes have occurred in the labor income distribution of the six countries. It is worth mentioning that, in Spain, the labor income has mainly moved from the bottom 50 percent to the top 10 percent. Furthermore, in each country, the middle class (i.e. 50−90 percent) earns, on average, 50 percent of all the labor income in the economy.

As shown in Table 1, the dynamics of the total income shares are well captured by the dynamics of the Gini coefficient, a synthetic measure of the dispersion of individuals' income in a population. However, the question at stake here is: what can we say about the joint dynamics of the capital and labor shares? Are the capital and labor incomes better distributed across the populations or rather more concentrated at the top and at the bottom of the income distribution? Do these countries bear more resemblance to classical capitalism, characterized by a wealthy "capitalist class" and a poor "working class," or rather to the new capitalism, in which all individuals earn multiple sources of income? To answer these questions, we apply the method previously developed. Figure 2 shows the overall dynamics of income composition inequality for the six European countries, here divided into two groups. The first group is composed of Norway, the UK, and the Netherlands (subfigure a) and the second by Germany, Switzerland, and Spain (subfigure b). To begin, note that the IFC index ranges between 0.1 and 0.6 in all the countries. Therefore, different from the Gini coefficient, the IFC index is characterized by a larger standard deviation. This finding is unsurprising if we consider that the IFC index is influenced by the dynamics of the two areas of the concentration curves, rather than by the single Lorenz curve, as is the case for the Gini index. Another relevant observation is that, under the definitions of capital and labor income adopted, all six European countries considered display positive values of income composition inequality, indicating that the link between the functional and personal income distributions is positive. The magnitude, however, varies both between countries and across time.

From 2010 onward, income composition inequality increases in the first group and decreases in the second. However, from 2007 to 2010, income composition inequality falls short in the Netherlands, Germany, and Spain, whereas it increases in Switzerland. Income composition inequality is instead rather stable for Norway and the UK before the financial crises.

Following the framework previously discussed, we can therefore say that the first three countries considered are moving toward becoming classical capitalism,



(a) Income Composition Inequality (b) Income Composition Inequality

(c) Concentration Curve for Capital (d) Concentration Curve for Capital

(e) Concentration Curve for Labor (f) Concentration Curve for Labor

Figure 2. The Series of Income Composition Inequality (a and b), as Measured by the Income-Factor Concentration Index, and of the Areas of the Concentration Curves for Capital (c and d) and of Labor (e and f) Income Are Presented. Capital Income Is Defined as the Sum of Income from Rental of a Property or Land, Interests, Dividends, Profit from Capital Investments in Unincorporated Business, and Pensions from Individual Private Plans. Labor Income Is Defined as the Sum of Gross Employee Cash or Near Cash Income, Company Cars, Unemployment Benefits, Old-Age Benefits, Survivor's Benefits, Sickness Benefits, Disability Benefits, Education-Related Allowances, Family/Children-Related Allowances, Social Exclusion Not Elsewhere Classified, Regular-Inter-Household Cash Transfers Received, Income Received by People Younger Than 16, and Cash Benefits or Losses from Self-Employment. The Unit of Analysis Is the Individual. Individuals with Strictly Negative Capital or Labor Incomes Are Removed from the Analysis. *Source*: Author's computation on basis of EU-SILC.

characterized by a group of wealthy people owning capital income and a group of poor people owning labor income. This type of economic system allows for a greater transmission of changes in the functional distribution of income into personal income inequality. Conversely, the second group of countries is moving toward becoming new capitalism, in which both sources of income are better distributed across the entire population. In the latter economic system, the relationship between functional and personal distributions of income is relatively weak, implying that fluctuations in both the capital and labor shares of income have less severe impacts on the dynamics of income inequality.

When we focus on the absolute level of income composition inequality, we note that the Netherlands and Norway display the highest values and the UK and Germany the lowest.

At this point of the analysis, it is important to analyze the role played by the two components of the IFC index, notably $\tilde{\mu}_w$ and $\tilde{\mu}_\pi$, in shaping the overall income composition inequality dynamics. Recall that one minus twice the value of $\tilde{\mu}_w$ and $\tilde{\mu}_\pi$ is equal to the pseudo-Gini of capital and of labor income, respectively. The evolution of the areas of the concentration curves for capital and labor is illustrated in subfigures c–f. As already illustrated in Table 1, the two metrics $\tilde{\mu}_w$ and $\tilde{\mu}_\pi$ follow completely independent patterns. Let us begin with the first group of countries. For all of them, the area of the concentration curve for capital rises until 2013, and falls afterward. We remember that an increase (decrease) in $\tilde{\mu}_\pi$ implies that the capital income moves toward the bottom (top) of the income distribution. Therefore, we can state that Norway, the UK, and the Netherlands saw their capital income flowing first into the hands of the bottom part of the income distribution and then coming back into possession of the richest part of the population. At the same time, the almost flat motion of the area of the concentration curve for labor $\tilde{\mu}_w$ for all the first group of countries clearly suggests that the principal driver of income composition inequality was the fluctuation in capital income. A slightly different story can be told for the second group of countries. The evolution of income composition inequality for Germany, Switzerland, and Spain has been characterized by capital income moving first toward the top (until 2013) and then remaining relatively stable (from 2013 onward). However, the area of the concentration curve for labor has steadily decreased for Germany and Spain throughout the whole period, indicating that labor income has moved toward the top of the distribution. In contrast, the area of the concentration curve for labor in Switzerland has slightly increased, suggesting that a redistribution of labor income has occurred in the country during the period considered.

6. Discussion

The objective of the previous section was to illustrate how the method developed in the first part of the paper can be applied to study the evolution of the income composition in different countries and across time. The empirical application has clearly revealed the extent to which the IFC index summarizes information on the joint concentration of capital and labor income across the income distribution, similar to the way the Gini coefficient summarizes information about the distribution of income across the population. Furthermore, it has shown how the results can be interpreted in terms of the evolution of the relationship between the functional and personal distributions of income and the dynamics of socioeconomic systems, as defined by Milanovic (2017). The study of income composition inequality through the IFC index raises a number of questions for future inquiry. Let us focus on two in particular.

From a *development perspective*, examining the evolution of income composition inequality in a given country, jointly with its economic growth, it is crucial to answer several fundamental questions: does income composition inequality increase or decrease as an economy grows? In other words, is there any relationship between the type of capitalism at work in a country and its economic development? If this is the case, is this relationship country specific, or rather specific to the time period that we are analyzing? And how does it relate to Kuznets (1955)'s hypothesis about the relationship between income inequality and growth and to Milanovic's (2016) Kuznets waves? To answer all these questions in a context in which survey data are scarce, the IFC index can be approximated by its n=2 version. The latter version requires data on two representative individuals only: a wealthy individual and a poor representative individual. The wealthy individual can be represented by a given top share of the income distribution (e.g., top 10 percent or top 1 percent) and the poor individual by a given bottom share (e.g., 90 percent or 50 percent). As illustrated in this paper, the IFC index for n=2 can be expressed as a function of two variables only: the relative share of capital (or labor) income and the relative share of total income of one of the two individuals only. This function allows us to make reasonable assumptions concerning the degree of the IFC index in the distant past. The study of the relationship between the functional and personal distributions of income in the past has seen an important revival of interest in the recent years (see Gabbuti, 2020, for the case of Italy).

Regarding the potential macroeconomic relationship between the income composition inequality and economic growth of a given country, Ranaldi (2020) showed that the IFC index and hence the concept of income composition inequality endogenously emerge from a simple Kaldorian model of growth and distribution and affect the long-term evolution of the same country's rate of profit and capital share of income.

From a *public finance* perspective, it is important to understand the impact that redistribution policies have not only on income inequality but also on income composition inequality. In this regard, it can be simply shown that through a simple tax and transfer scheme that taxes everyone's income at a rate τ and gives everyone an equal absolute transfer (see Kakwani 1993; Ferreira and Leite, 2003), the following result holds (see Appendix A5 for the proof):

$$\widehat{\mathcal{I}}(\pi) \approx -\tau, \tag{15}$$

where the hat stands for percentage changes. Therefore, a 1 percent increase in τ implies a 1 percent reduction in the IFC index, similar to what happens to the Gini coefficient under the same tax and transfer scheme.[13] This result occurs because a redistribution of income components proportional to the population's share of capital and labor income is implicitly assumed. This latter aspect automatically implies a convergence toward a steady state of equal composition of income sources across the population. However, a tax and transfer scheme that mainly redistributes labor, rather than capital income, has the double effect of reducing income inequality and increasing income composition inequality. The latter would

[13]It can be shown that $\widehat{\mathcal{G}} \approx -\tau$, where $\widehat{\mathcal{G}}$ represents a percentage change in the Gini coefficient (Kakwani, 1993).

happen if we assumed that the pre-tax and transfer level of income composition inequality was positive (which is a reasonable assumption given the previous empirical applications). In a context in which the capital income share is rising, a similar tax and transfer scheme can lead, in the long run, to an increase in income inequality via the resulting higher level of income composition inequality.

In summary, studying the impact that a tax and transfer scheme has on a country's level of income composition inequality could help us to highlight the contradictory nature of current redistribution policies that, on one hand, reduce income inequality in the short run and, on the other hand, increase income inequality in the long run via the increase in income composition inequality in the context of rising capital income shares.

These examples illustrate the potential macroeconomic, as well as policy, implications that the analysis of a country's income composition inequality can have and lay the foundations for future research on the matter.

7. Conclusion

One of the most important findings from Piketty's *Capital in the Twenty-First Century* (Piketty, 2014) is the rise in the capital share of income in many developed countries over the past decades (see also Piketty, 2015). Similar results were also found by Stockhammer (2012), who showed that the labor share has fallen over the past 25 years in the OECD countries. The dynamics of the capital share of income (and hence of the labor share) are influenced by many macroeconomic phenomena, such as technical change, globalization, financialization, and the bargaining power and market power of firms, among others (see Stockhammer, *et al*. 2017). The rise in the capital share of income is generally considered to be one of the causes of the increase in personal income inequality (Piketty 2014; Bengtsson and Waldenstrom, 2018). However, the study of the link between changes in the capital share of income and changes in personal income inequality must be further investigated. For this reason, the present paper proposed a method to examine the relationship between the functional and personal distributions of income. To this end, it introduced the concept of inequality in income composition. If we decompose total income into *two* factors, such as capital and labor income, then income composition inequality is the extent to which the income composition is distributed unevenly across the income distribution. Inequality in income composition is *maximal* when individuals at the top and at bottom of the income distribution separately earn the two different types of income. On the contrary, it is *minimal* when each individual earns the same composition of the two factors. Under a high level of income composition inequality, the link between the functional and personal distributions of income is strong, whereas under a low level of income composition inequality, the link is weak. We then constructed a summary statistic to measure income composition inequality: the IFC index. We showed that this summary statistic can be looked at in two ways. First, from a technical perspective, the elasticity of personal income inequality to fluctuations in the functional income distribution can be considered. In other words, it mathematically links the functional and personal distributions of income. Second, from a political economy perspective, it measures the "degree of capitalism" of a given social system. We then applied the method to study the evolution of income composition inequality in six European economies. Although these countries are characterized by different trends, they all display a positive value of the IFC index, indicating that capital incomes are mainly concentrated at the top of the income distribution, whereas labor incomes are mainly concentrated at the bottom. Finally, we discussed how the study of income composition inequality can pave the way for further research on different economic aspects, from development to public finance.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

A. Appendix
A.1 Sign of the Indicator
A.2 Normalization Coefficient
A.3 The Case of a Two-Person Economy
A.4 From Functional to Personal Distribution of Income
A.5 Tax and transfer scheme and ICI