

# Measuring the Full Extent of Fiscal Losses and Gains

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## Abstract

Current measures of fiscal impoverishment and gains are not consistent with the law of diminishing returns. This paper proposes new measures of fiscal impoverishment and gains that are consistent with the law of diminishing returns, based on a methodology that gives more significance to greater income gaps, and more importance to the experience of the poorest individuals within the fiscal system. The new indicators are decomposable and cover the incidence, intensity, and severity of fiscal impoverishment and

gains. An empirical illustration using the 2014 household consumption data reveals that, overall, in Niger the fiscal system is improving the welfare of the population: only 33.2 percent of the population has become poorer due to the fiscal system, while the remaining 66.8 percent has become richer because of it. Moreover, the mean relative fiscal loss (0.014), is 11 percent lower than the mean relative fiscal gain (0.126).

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# Measuring the Full Extent of Fiscal Losses and Gains

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## 1. Introduction

The intervention of a fiscal system has an effect on the income and the welfare of a population. This happens through the taxes people are paying; the social spending they are receiving; or both. As a result, some people may become richer owing to the fiscal system used during a given time, while others may become poorer due to the same system. Therefore, it is important to evaluate the extent to which people are being fiscally impoverished and/or enriched in order to understand whether a fiscal system is contributing overall to the improvement of the population's well-being.

Until recently, evaluating the fiscal impoverishment and gains of a given fiscal system had been neglected in the standard approaches to fiscal incidence analysis. Higgins and Lustig (2016) have lately pointed out some of the problems with the standard approaches. They explain that the traditional practices in the literature fail to capture an important aspect, which is that sometimes a substantial proportion of the poor are made poorer (or the nonpoor are made poor) due to the intervention of a fiscal system. They call this *fiscal impoverishment*, and derive an axiomatic measure of its extent, which is specifically the amount of money required to transfer to the nonpoor who have become poor in order to move them back above the poverty line; and the amount of money that must be transferred to the poor who have become poorer in order to prevent them from being fiscally impoverished. They also define an analogous measure of the fiscal gains of the poor by considering the proportion of poor people who become richer owing to the fiscal system.

Nevertheless, current advances in the field do not measure the whole aspect of fiscal impoverishment and gains in a given economy. For instance, the current measures do not include the experience of some people who are above the "chosen poverty line" although some of them may have a higher *prefiscal income* (income before the intervention of the fiscal system) than *postfiscal income* (income after the intervention of the fiscal system), meaning that they are literally being impoverished by the fiscal system. Others have a lower prefiscal income than postfiscal income, meaning that they have been literally enriched by the fiscal system. Moreover, even if the "development" argument is to focus only on what happens below a chosen poverty line, the current measures are not consistent with the law of diminishing marginal utility. Using this law, one would argue that, at the same absolute level, a fiscal impoverishment (gain) of the poorest poor is less (more) desirable than a fiscal impoverishment (gain) of the richest poor. In fact, all things being equal, a fiscal system that impoverishes the poorest poor at the same absolute level as a fiscal system that impoverishes the richest poor, for example, will have the same impoverishment effect according to the current indicator of fiscal impoverishment used in the literature, because the current indicator only looks at absolute impoverishment. Consequently, the current measures are not ideal for comparing various fiscal systems, or different socioeconomic groups within a population.

Given these limitations, this paper proposes a new family of indicators for use in measuring the full extent of fiscal losses and gains. In this new method an individual is considered a fiscal loser if he or she becomes poorer due to the fiscal system, and a fiscal winner (gainer) if he or she becomes richer owing to the fiscal system, regardless of his or her poverty status, which may change depending on "the chosen poverty line." This allows the experience of every single individual within the fiscal system to be considered when measuring fiscal losses and gains.

The proposed methodology incorporates the necessary judgments about how to aggregate individual income gaps (which in this context means the gap between prefiscal and postfiscal incomes), following the literature on poverty measurement and income mobility (Foster, Greer, and Thorbecke 1984; Bárcena *et al* 2018). For instance, the *relative income gap of a fiscal loser* is the difference between his or her prefiscal and postfiscal income, divided by the prefiscal income; and the *relative income gap of a fiscal winner* is the difference between his or her postfiscal and prefiscal income divided by the prefiscal income. In this regard, the new measures of fiscal losses (or gains) assign greater weights to higher fiscal losses (or gains) while considering the income level of the individuals, which means that they show sensitivity to higher relative losses (or gains) and consider inequality in the distribution of individual fiscal losses (or gains). The new family of fiscal losses (or gains) measures derived here provides a way to understand the incidence, intensity, and severity of fiscal losses (or gains) in a society. Furthermore, the measures are consistent across subgroups, which is particularly interesting when attempting to identify whether some population subgroups are experiencing greater fiscal losses than others, in order to help policy makers design targeted fiscal policies. For example, if the development focus is on the poor within a given society, the new measures can be easily applied to understand the incidence, intensity, and severity of fiscal losses and gains within the subpopulation of prefiscal poor in that society. If, on the other hand, the development focus is on *shared prosperity*, which can be defined as an improvement in the well-being of the bottom 40 percent of the income distribution, one can undertake the same exercise to understand the incidence, intensity, and severity of fiscal losses and gains in the subpopulation at the bottom of the distribution.

This paper presents an empirical illustration of how the new measures of fiscal losses and gains could be used, using the 2014 household consumption data of Niger. The results show that the experience of the prefiscal poor with the fiscal system is overall better than that of the prefiscal nonpoor in Niger. Looking at fiscal losses, we find that both the incidence and the intensity of fiscal losses are higher in the subpopulation of the prefiscal nonpoor. This is also observed by analyzing the population by the gender and the area of residence of the head of household.

Regarding fiscal gains, the results indicate that the prefiscal poor benefitted more from the fiscal system, with an incidence and an intensity of fiscal gains of 72 percent and 0.17, respectively, compared to 63 percent and 0.09 for the prefiscal nonpoor in Niger.

Finally, when the current method of measuring fiscal gains is contrasted with the new measures proposed in this paper, the findings reveal that the former method is clearly incomplete. Indeed, according to the current measures used in the literature, fiscal gains would be found to be much higher in rural than in urban areas. Yet, following the new measures we propose, the incidence and the intensity of fiscal gains were both higher in urban areas. Moreover, considering the subpopulation of prefiscal poor alone, or the subpopulation of the prefiscal nonpoor alone, the incidence and the intensity of fiscal gains were still higher in urban areas.

Section 2 of this paper describes the current practices in the fiscal incidence literature, and demonstrates their limitations in capturing fiscal impoverishment and fiscal gains. Section 3 defines the new measures of fiscal losses and gains proposed in this paper. Section 4 describes the empirical illustration from Niger that was used. Section 5 discusses the usefulness of this approach over the current one used in the literature, especially in comparing various fiscal reforms and

analyzing the relationship between fiscal impoverishment or gains, and shared prosperity. Section 6 is the conclusion.

## 2. Current Practices and Their Limitations

The standard approaches to analyzing the effects of taxes and transfers in an economy consist of comparing the welfare indicators (such as poverty and inequality indices) before and after the intervention of the fiscal policy, measuring horizontal equity and progressivity, and so on. Higgins and Lustig (2016) have shown that the traditional approaches leave out important information about how the poor are affected by the fiscal system: that is, a substantial proportion of the poor are made poorer (or the nonpoor made poor) by the tax and transfer system. They call this fiscal impoverishment, and derive an axiomatic measure of its extent. Likewise, they derive an analogous measure for identifying the fiscal gains of the poor. This section sums up the main problem with the conventional measures for determining the effects of a fiscal system as described in their study, and shows that, although extremely informative, the axiomatic measure of fiscal impoverishment (or gains) proposed by the authors does not provide the full extent of the actual fiscal impoverishment (or gains).

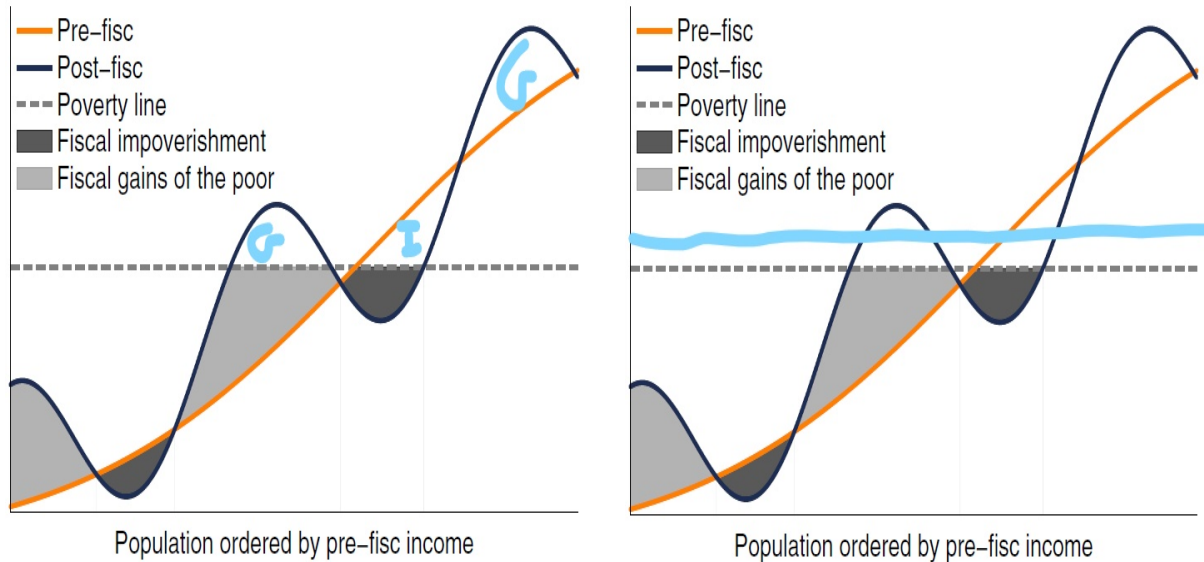
Higgins and Lustig (2016) showed that the conventional approaches for comparing poverty measures before and after the intervention of the tax and transfer system can neglect fiscal impoverishment because of the anonymity axiom<sup>2</sup> they adhere to. Indeed, a fiscal system can reduce poverty while simultaneously making a considerable portion of the poor poorer, or making some who were not poor before, poor. In addition, the authors show that the anonymity axiom is not the only reason for the imperfection of traditional measures of capturing fiscal impoverishment. Considering the measures designed to incorporate information about an individual's prefiscal rank, such as index of horizontal equity and progressivity, the authors demonstrate that these measures may also fail to capture fiscal impoverishment. Moreover, in studying real-world examples from 17 developing countries, the authors found that in 10 of the countries where the tax and transfer system is poverty-reducing and progressive, the fiscal system is still hurting a significant portion of the poor by pushing them deeper into poverty.

However, the measures proposed by Higgins and Lustig (2016) do not allow for a complete snapshot of what could be the real welfare losses and gains that may be induced by a fiscal system. Their definition of fiscal impoverishment is sensitive to a chosen poverty line; therefore, it neglects any effects of the fiscal system that are not big enough to make a person who is not poor fall into poverty. For instance, consider Figure 1, which shows the existence of fiscal impoverishment in a society. The current definition of fiscal impoverishment neglects the situation of people in Area **I** (left-side figure), although they are literally being impoverished by the fiscal system: their prefiscal incomes are higher than their postfiscal incomes, indicating that they have become poorer due to the fiscal system. Likewise, the individuals in Area **G** (left-side figure) are not included in the current definition of fiscal gains, even though they become richer owing to the fiscal system, simply because they are not considered as poor with the chosen poverty line.

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<sup>2</sup> The anonymity axiom implies that poverty measures fail to take into account individuals' initial positions.

**Figure 1. Sensitivity of Fiscal Impoverishment Measure of Higgins and Lustig (2016) to a Given Poverty Line**



Source: The authors.

Note: This figure has been modified with the drawing in blue from its original version reported as **Figure 1**. In Higgins and Lustig (2016).

Looking now at the right-side figure, and assuming that the poverty line grows from the dashed line to the blue line, it appears that fiscal impoverishment will increase to include a subgroup of the individuals in **I** (left-side figure), because they are now considered poor. One consequence of this sensitivity to a poverty line is to make the current measures inappropriate for comparing among countries with different levels of development. For instance, with the World Bank international poverty line of US\$1.9 per day per person, some countries may have a majority of their population that is poor (for example, Tajikistan, which had a poverty rate of 69.4 percent in 2003), while others may have a population that is all considered nonpoor (for example, Azerbaijan in 2003). As a result, comparing the effects of fiscal gains of the poor in Tajikistan and Azerbaijan in 2003, the conclusion will necessarily be that the effects in Tajikistan are higher (or equal<sup>3</sup>) to those in Azerbaijan: because there are no poor people in the latter country, meaning that the fiscal gains of the poor are equal to zero. Yet, in reality, the proportion of individuals having their postfiscal incomes higher than their prefiscal incomes (literally fiscal gainers) could have been substantially higher in Azerbaijan in 2003.

Sensitivity to a given poverty line is not the only problem with current measures of fiscal impoverishment and gains. The axiomatic formulation proposed for fiscal impoverishment enables having the total amount of money by which people are impoverished—which is equal to the total loss of the prefiscal poor who become poorer due to the fiscal system---plus the difference between the poverty line and the postfiscal incomes of the nonpoor who become poor due to the fiscal system.

Let us consider a theoretical population of two individuals with their prefiscal incomes given by (2,3). Assume that the poverty line is given by 4, and there are two distinct fiscal systems that

<sup>3</sup> It can be equal only if none of the 69.4 percent of the population have their postfiscal income higher than the prefiscal income.

change the incomes to their postfiscal levels of (1,3) and (2,2). Following Higgins and Lustig (2016), the fiscal impoverishment is the same for the two fiscal systems, although with the former the poorest individual is fiscally impoverished and with the latter, the richest individual is fiscally impoverished. This is because the current measure of fiscal impoverishment focuses only on the absolute values of change in incomes, and of course, this is informative.<sup>4</sup> Yet if one wants to rank the impoverishment of each individual on the basis of the change in individual welfare levels, the law of diminishing returns would argue that the fiscal impoverishment of the second fiscal system is more desirable than that of the first. The advantage of being consistent with the law of diminishing return is that one can give more importance to the way the poorer individuals within a society are being affected by the fiscal system in measuring the total impoverishment effect.

Given the limitations of current practices in measuring the actual welfare losses and gains induced by a fiscal system, Section 3 proposes a family of measures that aim to evaluate the various dimensions of fiscal losses and gains.

### 3. Methodological Framework

The intervention of a fiscal system modifies the incomes of people in a society. This may happen either through the taxes they are paying, the social spending they are receiving, or both. Thus, during a given time, some people may have their incomes lowered due to the fiscal system, while others may have their incomes increased.

Consider, as an illustration, a theoretical economy of five individuals. Their prefiscal and postfiscal incomes, as well as the fiscal system in place, are known for one given year, as reported in Table 1.

**Table 1. Effects of Fiscal Policy on a Theoretical Population of Five Individuals**

individuals	1	2	3	4
Pre-fiscal Income	5	7	4	10
Taxes	2	3	1	5
Transfer	3	1	1	2
Post-fiscal income	6	5	4	7

*Source:* The authors.

As can be seen in Table 1, in the absence of the fiscal system, the incomes of the five people are stated as 5, 7, 4, 10, and 8, for individuals 1, 2, 3, 4, and 5. After the intervention of the fiscal system, their incomes change, and are now stated as 6, 5, 4, 7, and 9. The incomes of individuals 2 and 4 have worsened due to the fiscal system, while the income of individual 3 remains unchanged, and the incomes of individuals 1 and 5 have improved.

For any given economy, the intervention of a fiscal system may have one of the three effects described in the example given on the incomes of the individuals. The following notations are used

<sup>4</sup> The measures of fiscal impoverishment violate the transfer principle first formulated by Dalton (1920), which states that transfers from a richer to a poorer person should improve the measure of welfare.



throughout this section. We will let  $x_i^{pref}$  and  $x_i^{post}$  denote the prefiscal and postfiscal incomes of individual  $i$  in a population  $S$  of size  $n$  observed during a given time.

**Definition 1** (*fiscal gainers and fiscal losers*): For any given fiscal system, an individual  $i$  is fiscal gainer (loser) if and only if  $x_i^{post} > x_i^{pref}$  ( $x_i^{post} < x_i^{pref}$ ).

A fiscal gainer is an individual who experiences an increase in his or her income owing to the fiscal system, and a fiscal loser is an individual who experiences a decrease: that is, the fiscal system has a positive (or negative) effect on the welfare of fiscal gainers (or losers). The postfiscal income of a fiscal gainer, all other things being equal, allows him to acquire more goods and services during the given time than his or her prefiscal income did: therefore, the fiscal gainer has been fiscally enriched. A fiscal loser becomes poorer after the intervention of the fiscal system: that is, he or she is fiscally impoverished. Similarly, an individual for whom  $x_i^{post} = x_i^{pref}$  will not see his or her welfare affected by the fiscal system at all.

### 3.1 Measures of Fiscal Losses

In evaluating fiscal losses, the objective is to account for the situation of every single fiscal loser (or person who is fiscally impoverished), and aggregate all the individual effects into a single measure. The aggregate measures proposed in this paper are explicit, and they incorporate the necessary judgments about how to aggregate individual income gaps (that is, the gap between prefiscal and postfiscal incomes). The relative income gap of a fiscal loser is the difference between his or her prefiscal income and his or her postfiscal income, divided by his or her prefiscal income.<sup>5</sup>

**Definition 2** (*a family of measures of fiscal losses*): For any population of size  $n$ , a class of fiscal impoverishment measures is given by

$$FI_\alpha(x^{pref}, x^{post}) = \frac{1}{n} \sum_{i \in I} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^\alpha,$$

where  $FI_\alpha$  is the indicator of fiscal impoverishment,  $I$  is the set of fiscal losers (the individuals for whom the prefiscal income is greater than the postfiscal income), and  $\alpha$  can be viewed as a measure of aversion to fiscal losses.  $FI_\alpha$  is a weighted sum of the individual relative fiscal impoverishment, where the weights are the relative decreases in income. Therefore, greater weight is assigned to greater fiscal losses (while considering the income level of the individuals), meaning that the measure  $FI_\alpha$  shows sensitivity to higher relative impoverishment and considers inequality in the distribution of individual fiscal losses within a population for  $\alpha > 1$ . A larger  $\alpha$  gives greater emphasis to greatest relative fiscal losses, and as  $\alpha$  becomes very large,  $FI_\alpha$  approaches the ‘‘Rawlsian’’ measure, which only considers the situation of the individual with the largest fiscal loss.

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<sup>5</sup> This is an adaptation of the income mobility indicators proposed in Barcena and Canto (2018), which were inspired by the family of poverty indices proposed by Foster, Greer, and Thorbecke (1984).

For  $\alpha = 0$ , the measure  $FI_0$  is the proportion of individuals who experience fiscal loss, that is named incidence of fiscal losses:

$$FI_0 = \frac{1}{n} \sum_{i \in I} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^0 = \frac{card(I)}{n}$$

For  $\alpha = 1$ , the measure  $FI_1$  is the renormalization of the mean relative fiscal losses, which is named the intensity of fiscal losses:

$$FI_1 = \frac{1}{n} \sum_{i \in I} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^1 = \frac{1}{n} \sum_{i \in I} \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} = FI_0 * \frac{1}{card(I)} \sum_{i \in I} \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}}$$

For  $\alpha = 2$ , the measure  $FI_2$  can be viewed as the severity of fiscal losses:

$$FI_2 = \frac{1}{n} \sum_{i \in I} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^2$$

As the variance of the relative fiscal losses,  $var_{FI}$ , is given by

$$var_{FI} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right) = \frac{1}{card(I)} \sum_{i \in I} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^2 - \left( \frac{1}{card(I)} \sum_{i \in I} \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^2$$

The measure  $FI_2$  can be rewritten as

$$\begin{aligned} FI_2 &= FI_0 * var_{FI} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right) + FI_0 * \left( \frac{1}{card(I)} \sum_{i \in I} \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^2 \\ &= \left( FI_1 * \frac{1}{card(I)} \sum_{i \in I} \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right) [1 + VC_{FI}^2], \end{aligned}$$

where  $VC_{FI}$  is the coefficient of variation of the relative fiscal losses. Consequently,  $FI_2$  includes a well-known inequality measure, the square coefficient of variation; that is, the generalized entropy index.

**Proposition 1:** The  $FI_\alpha$  family of measures satisfies the following axioms:

- *Focus.* For all  $x^{pref}, x^{post^1}, x^{post^2}, FI_\alpha(x^{pref}, x^{post^1}) = FI_\alpha(x^{pref}, x^{post^2})$  whenever  $x^{post^2}$  is obtained from  $x^{post^1}$  by the income change of a nonfiscal loser, meaning that  $FI_\alpha$  is not concerned about what happens to a nonfiscal loser.
- *Continuity.*  $FI_\alpha$  is a continuous function for any vector of relative income changes (with the fiscal system) in its domain. This property guarantees that small changes in relative fiscal losses do not lead to large changes in the fiscal losses index.
- *Anonymity.* For all  $x^{pref^1}, x^{pref^2}, x^{post^1}, x^{post^2}, FI_\alpha(x^{pref^1}, x^{post^1})$  is symmetric  $FI_\alpha(x^{pref^1}, x^{post^1}) = FI_\alpha(x^{pref^2}, x^{post^2})$  whenever  $x^{pref^2}$  and  $x^{post^2}$  are obtained after applying the same permutation of fiscal losers on  $x^{pref^1}$  and  $x^{post^1}$ . This property guarantees that the index does not favor any particular fiscal loser.
- *Replication invariance.* For all  $x^{pref^1}, x^{pref^2}, x^{post^1}, x^{post^2}, FI_\alpha(x^{pref^1}, x^{post^1}) = FI_\alpha(x^{pref^2}, x^{post^2})$  whenever  $x^{pref^2}$  and  $x^{post^2}$  are obtained after applying the same  $k$ -replication on fiscal losers on  $x^{pref^1}$  and  $x^{post^1}$ .
- *Monotonicity.* Given the vector of prefiscal and postfiscal incomes  $x^{pref} = \{x_1^{pref}, \dots, x_i^{pref}, \dots, x_j^{pref}, \dots, x_q^{pref}, \dots, x_n^{pref}\}$  and  $x^{post} = \{x_1^{post}, \dots, x_i^{post}, \dots, x_j^{post}, \dots, x_q^{post}, \dots, x_n^{post}\}$ , consider any  $\varepsilon \in \mathbb{R}$  such that  $x^{pref^{\varepsilon(i)}} = \{x_1^{pref}, \dots, x_i^{pref} + \varepsilon, \dots, x_j^{pref}, \dots, x_q^{pref}, \dots, x_n^{pref}\}$  and  $x^{post^{\varepsilon(i)}} = \{x_1^{post}, \dots, x_i^{post} + \varepsilon, \dots, x_j^{post}, \dots, x_q^{post}, \dots, x_n^{post}\}$ . For all  $i \in I, FI_\alpha(x^{pref}, x^{post^{\varepsilon(i)}}) > FI_\alpha(x^{pref}, x^{post})$  and  $FI_\alpha(x^{pref}, x^{post}) > FI_\alpha(x^{pref^{\varepsilon(i)}}, x^{post})$ . This property is satisfied for  $\alpha \geq 1$ . It refers to the intensity of fiscal losses; so that a worsening in the fiscal losses yields a higher value of the index. Therefore, *ceteris paribus*, the lower the postfiscal income is, the greater the fiscal losses index will be. Likewise, the greater the prefiscal income, the greater the fiscal losses index will be.
- *Concern about greater fiscal losses.* Given the vector of relative income changes,  $C_i = \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}}$ , arranged in ascending order  $C = \{C_1, \dots, C_i, \dots, C_j, \dots, C_q, \dots, C_n\}$ , consider any  $\pi > 0$  such that  $C(\pi_i) = \{C_1, \dots, C_i + \pi, \dots, C_j, \dots, C_q, \dots, C_n\}$  and  $C(\pi_j) = \{C_1, \dots, C_i, \dots, C_j + \pi, \dots, C_q, \dots, C_n\}$ . For all  $i, j \in I, i < j, FI_\alpha(C(\pi_i)) < FI_\alpha(C(\pi_j))$ . This property is satisfied for  $\alpha > 1$ . It implies inequality aversion with respect to the distribution of individual fiscal losses. The allocation of any additional negative income change increases the index more if it is allocated to an individual with a greater initial fiscal loss.

**Proposition 2:** The  $FI_\alpha$  family of measures satisfies the following properties:

- *Individualistic and additive in relative income changes.* For all  $x^{pref}$  and  $x^{post}$ ,  $FI_\alpha(x^{pref}, x^{post})$  is the sum of individual relative income changes for a person with prefiscal income  $x_i^{pref}$  and postfiscal income  $x_i^{post}$ .

$FI_\alpha(x^{pref}, x^{post}) = \frac{1}{n} \sum_{i \in I} \left( \frac{x_i^{pref} - x_i^{post}}{x_i^{pref}} \right)^\alpha$  only depends on the individual's own income, and not on the incomes of the other fiscal losers.

- *Scale invariance.* For all  $x^{pref}$ ,  $x^{post}$ , and  $\lambda > 0$ ,  $FI_\alpha(x^{pref}, x^{post}) = FI_\alpha(\lambda x^{pref}, \lambda x^{post})$ .
- *Subgroup decomposability.* Consider that the population is divided in  $G$  subgroups indexed by  $g$ . Let  $P$  be a partition of the set  $N = \{1, \dots, n\}$  in  $G$  subsets of individuals and let  $\phi$  denote the set of all such possible partitions of  $N$ . For each group  $g$  of size  $n^g$ , the income vectors are partitioned into  $(x^{pref^g}, x^{post^g})$ . For all  $P \in \phi$

$$FI_\alpha(x^{pref^1}, x^{pref^2}, \dots, x^{pref^G}, x^{post^1}, x^{post^2}, \dots, x^{post^G}) = \sum_{g=1}^G \frac{n^g}{n} FI_\alpha^g(x^{pref^g}, x^{post^g})$$

This property allows decomposition of the overall fiscal losses index into that of subgroups according to any sociodemographic characteristics that are of interest. This feature is particularly helpful in identifying whether some population subgroups are experiencing more fiscal losses than others, so that policy makers can design targeted fiscal policies. This property can also be used to account for the contribution of each population subgroup to the overall fiscal losses.

- *Concern about the downward movement of poorer individuals.* Given the vector prefiscal and postfiscal incomes  $x^{pref} = \{x_1^{pref}, \dots, x_i^{pref}, \dots, x_j^{pref}, \dots, x_q^{pref}, \dots, x_n^{pref}\}$  and  $x^{post} = \{x_1^{post}, \dots, x_i^{post}, \dots, x_j^{post}, \dots, x_q^{post}, \dots, x_n^{post}\}$ , consider  $\pi > 0$ ,  $\pi < x_i^{post}$ ,  $\pi < x_j^{post}$ , such that  $x^{post^{\pi_i}} = \{x_1^{post}, \dots, x_i^{post} - \pi, \dots, x_j^{post}, \dots, x_q^{post}, \dots, x_n^{post}\}$  and  $x^{post^{\pi_j}} = \{x_1^{post}, \dots, x_i^{post}, \dots, x_j^{post} - \pi, \dots, x_q^{post}, \dots, x_n^{post}\}$  all arranged in ascending order of prefiscal incomes and  $C_i = C_j$ . For all  $i, j \in I$ ,  $FI_\alpha(x^{pref}, x^{post^{\pi_i}}) > FI_\alpha(x^{pref}, x^{post^{\pi_j}})$ . This is satisfied for  $\alpha \geq 1$ .

This property means that, given two fiscal losers with the same amount of change in income, the same additional absolute reduction in income between the prefiscal and postfiscal system will increase the index more if it is allocated to an individual who initially had a lower prefiscal income. Therefore, the index is more sensitive to fiscal losses of the poorest individuals.

The family of measures of fiscal impoverishment proposed here satisfies a set of good normative properties for welfare indicators. These measures make it possible to include the situations of all individuals negatively affected by the fiscal system, and rank their impoverishment on the basis of

the change in their level of welfare. Thus it gives more importance (weight) to the way poorer individuals are affected by the fiscal system.

### 3.2 Measures of Fiscal Gains

The objective in measuring fiscal gains is to account for the situation of every single fiscal gainer (or fiscally enriched person), and aggregate all of the individual effects into a single measure.

**Definition 3** (*a family of measures of fiscal gains*): For any population of size  $n$ , a class of measures of fiscal gains is given by

$$FG_{\alpha}(x^{pref}, x^{post}) = \frac{1}{n} \sum_{i \in G} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^{\alpha}$$

where  $FG_{\alpha}$  is the indicator of fiscal gains,  $G$  is the set of fiscal gainers, and  $\alpha$  can be viewed as a measure of inclination to fiscal gains.  $FG_{\alpha}$  is a weighted sum of the individual relative fiscal gains, where the weights are the relative income increase themselves. Therefore, greater weight is assigned to greater fiscal gains, meaning that the measure  $FG_{\alpha}$  is considered a value judgment. As a result, there is greater sensitivity to higher gains, and the ability to accounts for inequalities in the distribution of individual fiscal gains within a population for  $\alpha > 1$ . A larger  $\alpha$  places greater emphasis on greater relative gains. And as  $\alpha$  becomes very large, the family  $FG_{\alpha}$  approaches a measure that considers only the situation of the individual with the greatest relative gain.

For  $\alpha = 0$ , the measure  $FG_0$  is the proportion of individuals who experience fiscal gains, which we call the incidence of fiscal gains:

$$FG_0 = \frac{1}{n} \sum_{i \in G} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^0 = \frac{card(G)}{n}$$

For  $\alpha = 1$ , the measure  $FG_1$  is the renormalization of the mean relative fiscal gains, which we call the intensity of fiscal gains:

$$FG_1 = \frac{1}{n} \sum_{i \in G} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^1 = \frac{1}{n} \sum_{i \in G} \frac{x_i^{post} - x^{pref}}{x_i^{pref}} = FG_0 * \frac{1}{card(G)} \sum_{i \in G} \frac{x_i^{post} - x^{pref}}{x_i^{pref}}$$

For  $\alpha = 2$ , the measure  $FG_2$  is given by:

$$FG_2 = \frac{1}{n} \sum_{i \in G} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^2$$

As the variance of the relative fiscal gains,  $var_{FG}$ , is given by

$$var_{FG} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right) = \frac{1}{card(G)} \sum_{i \in G} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^2 - \left( \frac{1}{card(G)} \sum_{i \in G} \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^2.$$

The measure  $FG_2$  can be rewritten as

$$\begin{aligned} FG_2 &= FG_0 * var_{FG} \left( \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right) + FG_0 * \left( \frac{1}{card(G)} \sum_{i \in I} \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right)^2 \\ &= \left( FG_1 * \frac{1}{card(G)} \sum_{i \in I} \frac{x_i^{post} - x^{pref}}{x_i^{pref}} \right) [1 + VC_{FG}^2], \end{aligned}$$

where  $VC_{FG}$  is the coefficient of variation of the relative fiscal gains. Consequently,  $FG_2$  includes a well-known inequality measure, the square coefficient of variation; that is, the generalized entropy index.

**Proposition 3:** The  $FG_\alpha$  family of measures satisfies the following axiom: *focus, continuity, anonymity, replication invariance, monotonicity* for  $\alpha \geq 1$ , *concern about greater fiscal gains* for  $\alpha > 1$ .

**Proposition 4:** The  $FG_\alpha$  family of measures satisfies the following properties: *individualistic and additive in relative income changes, scale invariance, subgroup decomposability, concern about fiscal gains of poorer individuals* for  $\alpha \geq 1$ .

The family of measures of fiscal gains proposed here satisfies a set of good normative properties for indicators of welfare. These measures allow the situation of all the individuals positively affected by the fiscal system to be included, and to have their enrichment ranked on the basis of the amount of change in their level of welfare. Thus, it assigns more importance to the way poorer individuals are affected by the fiscal system.

#### 4. Illustration: Comparing the Effects of Fiscal Impoverishment and Gains in Niger Following Higgins and Lustig (2016), with the Family of Measures Proposed Here

Before fiscal impoverishment and gains can be analyzed, it is necessary to determine for each observed individual his or her prefiscal and postfiscal income. Essama-Nssah (2008) argues that this determination requires using analytical methods that account for individual behavior and social interaction. The author reviews some of the approaches used in the literature, including reduced form regression analysis, microsimulation models, computable general equilibrium models, and a combination of computable general equilibrium and microsimulation models. In the current application in Niger, the incomes are determined through applying the Commitment to Equity (CEQ) Institute fiscal incidence methodology (Lustig 2016) for Niger for the year 2014. This comprehensive and rigorous framework for tax and benefit incidence analysis has been

widely used over the past few years for fiscal incidence analysis in both developing and developed countries.

The application of this fiscal incidence framework requires both microdata and macrodata. The microdata come from the second wave of the National Survey on Household Living Conditions and Agriculture<sup>6</sup> (ECVMA), and the state budget and national account data provide the macrodata. The ECVMA is a survey analogous to the Living Standards Measurement Study-Integrated Survey on Agriculture (LSMS-ISA), which is a program of the World Bank Group designed to collect nationally representative data at the household and individual levels on a variety of social indicators, such as consumption and agriculture. The LSMS-ISA is a survey conducted every three years. The second wave of the panel survey in Niger was implemented in 2014, covering both urban and rural areas in all regions of the country. The ECVMA sample was chosen through a random two-stage process. In the first stage, a number of enumeration areas were selected with probability proportional to size, using the 2001 General Census of Population and Housing as the base for the sample. In the second stage, 12 (urban) or 18 (rural) households were selected, with equal probability in each enumeration area.

The state budget and national accounts data come from Niger's BOOST,<sup>7</sup> and the Statistics Book of Niger's National Institute of Statistics. Government social spending in education and health come from BOOST, which is a World Bank Group project to enhance budget analysis across the globe by improving access to government expenditure data and linking spending to outputs and outcomes to the extent of possibilities. Data on public taxes come from the Statistics Book. The fiscal system analyzed here includes both direct interventions (direct taxes and direct transfers); and indirect interventions, such as value-added tax (VAT), excise tax, and other indirect taxes; and the monetized value of public education and health services. Additional details on the application of the CEQ in Niger can be found in Appendix A.

#### **4.1 Fiscal Impoverishment**

In presenting the findings on fiscal losses, we contrast the conclusion Higgins and Lustig (2016) made, with the conclusions we have drawn. Table 2 reports fiscal impoverishment effects as defined by Higgins and Lustig in Niger at the national level as well as at some subgroup levels, for example, gender of the head of household, and area of residence.

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<sup>6</sup> *Enquête nationale sur les Conditions de Vie des Ménages et Agriculture (ECVMA).*

<sup>7</sup> A World Bank-wide collaborative effort launched in 2010 to facilitate access to budget data.

**Table 2. Proportion of Fiscally Impoverished and per capita Impoverishment in Niger, 2014**

	Proportion	Per capita impoverishment
National level	0.132	677.952
<i>Gender of HH</i>		
Female	0.136	508.741
Male	0.131	696.575
<i>Area of residence of HH</i>		
Urban	0.009	55.059
Rural	0.156	798.669

Note: The table gives the proportion of fiscal impoverished and the average fiscal impoverishment following the definition of Higgins & Lustig (2016) considering the national moderate poverty line of 189233.2 CFA francs.

HH=Household Head

*Source:* The authors

According to the fiscal impoverishment indicator of Higgins and Lustig, 13.2 percent of the population in Niger were fiscally impoverished in 2014, with a per capita impoverishment amount equal to CFAF 677.95.<sup>8</sup> The results show that although there were a few more fiscally impoverished individuals in the subpopulation of households headed by a female, the per capita level of impoverishment in the subpopulation of households headed by a male was higher. Looking at the area of residence, we note that in rural areas, there is more fiscal impoverishment. Indeed, 15.57 percent of people living in a rural area are fiscally impoverished, whereas less than 1 percent of those living in an urban area were fiscally impoverished. In addition, the per capita impoverishment in rural areas is 14 times higher than the per capita impoverishment in urban areas.

However, according to the family of measures of fiscal losses defined in Section 3.1, the conclusion drawn is quite different. Table 3 presents both the incidence and the intensity of fiscal losses in Niger as defined in this paper. The results reveal that 33.2 percent of the population in Niger became poorer due to the fiscal system in 2014. In the subpopulation of the prefiscal poor, 28.1 percent were fiscal losers, while more than 37 percent of the prefiscal nonpoor were fiscally impoverished by the fiscal system. Moreover, the mean relative fiscal loss was higher in the prefiscal nonpoor population than in the poor one. Therefore, in Niger, the welfare of the prefiscal nonpoor was more negatively affected by the fiscal system than that of the prefiscal poor.

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<sup>8</sup> The CFA franc is the name of two currencies used in some West and Central African countries. They are guaranteed by the French treasury.



**Table 3. Incidence and Intensity of Fiscal Losses in Niger, 2014**

	Weights	$FI_0$	Decomposition of $FI_0$	$FI_1$	Decomposition of $FI_1$
<b>National level</b>		<b>0.332</b>		<b>0.014</b>	
Poor	0.449	0.281	0.126	0.011	0.005
Non-poor	0.551	0.373	0.205	0.017	0.010
<i>Gender of HH</i>					
<b>Female</b>	<b>0.099</b>	<b>0.378</b>	<b>0.037</b>	<b>0.015</b>	<b>0.002</b>
Poor	0.314	0.388	0.122	0.013	0.004
Non-poor	0.686	0.373	0.256	0.017	0.011
<b>Male</b>	<b>0.901</b>	<b>0.327</b>	<b>0.294</b>	<b>0.014</b>	<b>0.013</b>
Poor	0.463	0.273	0.127	0.010	0.005
Non-poor	0.537	0.373	0.200	0.018	0.009
<i>Area of residence of HH</i>					
<b>Urban</b>	<b>0.162</b>	<b>0.318</b>	<b>0.052</b>	<b>0.026</b>	<b>0.004</b>
Poor	0.089	0.099	0.009	0.004	0.000
Non-poor	0.911	0.339	0.309	0.029	0.026
<b>Rural</b>	<b>0.838</b>	<b>0.334</b>	<b>0.280</b>	<b>0.012</b>	<b>0.010</b>
Poor	0.518	0.287	0.149	0.011	0.006
Non-poor	0.482	0.385	0.185	0.013	0.006

**Note:** The poverty status is determined following the prefiscal incomes and the national poverty line of 189,233.2 CFA francs

*Source:* The authors.

Regarding the fiscal losses according to the gender of the head of household, we find that the proportion of individuals living in a female-headed household who were fiscal losers was greater than that of those living in a male-headed household, as measured by the indicator of the *incidence* of fiscal losses. However, the mean relative fiscal loss is not much different in the two subpopulations as measured by the indicator of the *intensity* of fiscal losses. While the incidence of fiscal losses in the subpopulation living in a female-headed household was higher for the prefiscal poor, the proportion of prefiscal nonpoor who were fiscally impoverished by the fiscal system was greater in the subpopulation living in a male-headed household. Yet, fiscal losses were more intense in the subpopulation of prefiscal nonpoor for both female and male-headed households.

The effects of fiscal impoverishment by area of residence show that the mean relative income loss due to the fiscal system was higher in urban areas, although in rural areas there was a greater percentage of the population who were fiscally impoverished. The prefiscal nonpoor were the most fiscally impoverished in both regions, given the incidence and intensity of their fiscal losses compared to those of the prefiscal poor.

Finally, the conclusion that the male-headed household subpopulation was fiscally more impoverished than the female-headed household subpopulation (following Higgins & Lustig) appears to be incomplete. In fact, the incidence and intensity of fiscal losses are higher for the subpopulation living in a female-headed household when the experience of everyone within the fiscal system is considered. Besides, when the situation of the prefiscal poor alone is considered, the conclusion remained unchanged: the incidence and intensity of fiscal losses are higher for the prefiscal poor living in a female-headed household. It turns out, therefore, that the current measure of fiscal impoverishment used in the literature is not accurately capturing the real extent to which people are fiscally impoverished, that is, the extent to which they are becoming poorer after the

intervention of the fiscal system in Niger. The new alternative measures proposed in this paper give a more complete picture of real fiscal impoverishment in Niger, by taking into consideration the experience of every single Nigerien. The new measures also give us the possibility to focus on specific groups within the population, and to understand their experience with the fiscal system compared to that of the rest of the country.

## 4.2 Fiscal Gains

This subsection presents and compares the fiscal gains in Niger using Higgins and Lustig’s method of measuring, and the new family of fiscal gain measures defined here. Table 4 reports the fiscal gains in Niger as defined by Higgins and Lustig.

**Table 4. Proportion of Fiscal Gainers and per capita Gains in Niger, 2014**

	Proportion	Per capita gains of the poor
National level	0.323	7251.386
<i>Gender of HH</i>		
Female	0.192	4357.090
Male	0.337	7569.926
<i>Area of residence of HH</i>		
Urban	0.008	1935.245
Rural	0.369	8281.655

**Note:** The table gives the proportion of fiscal gains and the average fiscal gains following the definition of Higgins & Lustig (2016) considering the national moderate poverty line of 189233.2 CFA francs.

HH=Household Head

HH=Household Head

*Source:* The authors.

According to Higgins and Lustig’s fiscal gains indicator, 32.3 percent of the population in Niger were fiscal gainers in 2014, with a per capita gain equal to CFAF 7,251.39. The results show that the male-headed household subpopulation benefitted more from the fiscal gains than the female-headed subpopulation —33.7 percent of the former are fiscal gainers, with a per capita gain equal to CFAF 7,569.93; whereas less than 20 percent of the latter are fiscal gainers, with a per capita gain equal to CFAF 4,357.09. Regarding the fiscal gains per area of residence, the results show that there were more fiscal gains in rural areas than in urban ones.

Turning now to the family of measures proposed in this paper, the results are reported in Table 5. More than two-thirds (66.8 percent) of the population were enriched by the fiscal system in Niger, as reflected in the incidence of fiscal gains. We found that the prefiscal poor benefitted more from the fiscal gains than the prefiscal nonpoor: the incidence of fiscal gains was 71.9 percent for the prefiscal poor, and 62.7 percent for the prefiscal nonpoor. Furthermore, the mean relative fiscal gain was higher in the subpopulation of the prefiscal poor than in the subpopulation of the prefiscal nonpoor. Therefore, the welfare of the prefiscal poor was improved more by the fiscal system than the welfare of the prefiscal nonpoor in Niger.

**Table 5. Incidence and Intensity of Fiscal Gains in Niger, 2014**

	Weights	$FG_0$	Decomposition of $FG_0$	$FG_1$	Decomposition of $FG_1$
<b>National level</b>		<b>0.668</b>		<b>0.126</b>	
Poor	0.449	0.719	0.322	0.173	0.078
Non-poor	0.551	0.627	0.346	0.087	0.048
<i>Gender of HH</i>					
<b>Female</b>	<b>0.099</b>	<b>0.622</b>	<b>0.062</b>	<b>0.126</b>	<b>0.013</b>
Poor	0.314	0.612	0.192	0.158	0.050
Non-poor	0.686	0.627	0.430	0.112	0.077
<b>Male</b>	<b>0.901</b>	<b>0.673</b>	<b>0.607</b>	<b>0.126</b>	<b>0.113</b>
Poor	0.463	0.727	0.337	0.174	0.081
Non-poor	0.537	0.627	0.337	0.084	0.045
<i>Area of residence of HH</i>					
<b>Urban</b>	<b>0.162</b>	<b>0.682</b>	<b>0.111</b>	<b>0.172</b>	<b>0.028</b>
Poor	0.089	0.901	0.081	0.378	0.034
Non-poor	0.911	0.661	0.602	0.152	0.138
<b>Rural</b>	<b>0.838</b>	<b>0.666</b>	<b>0.558</b>	<b>0.117</b>	<b>0.098</b>
Poor	0.518	0.713	0.369	0.166	0.086
Non-poor	0.482	0.615	0.296	0.064	0.031

Note: The poverty status is determined following the prefiscal incomes and the national poverty line of 189,233.2 CFA francs

*Source:* The authors.

The results also show that although the *incidence* of fiscal gains was a bit higher in the male-headed household subpopulation, the mean relative gains were similar in both kinds of households, as measured by the *intensity* of fiscal gains.

The results also indicate that the prefiscal poor living in urban areas benefitted the most. More than 90 percent of this group became richer owing to the fiscal system, compared to 71.3 percent of the rural prefiscal poor. The mean relative income gain was also much more important in the subpopulation of prefiscal poor living in urban areas.

Finally, the conclusion that fiscal gains were much more important in rural than in urban areas in Niger (following Higgins and Lustig) appears to be incomplete. Indeed, when the situation of every Nigerien is considered, both the incidence and the intensity of fiscal gains were higher in urban areas, and they were also greater in urban areas when looking at the prefiscal poor and the prefiscal nonpoor alone. These findings suggest that people living in urban areas in Niger are likely benefitting the most from fiscal gains in the country.

## 5. Discussion

This paper proposes a new set of indicators that are preferable to the current measures of fiscal impoverishment and gains in several ways. It is especially useful for comparing various fiscal reforms within a country, and analyzing and understanding the relationship between fiscal impoverishment (or enrichment) and key development-related topics such as shared prosperity in a variety of countries simultaneously, and so on. Shared prosperity is defined in terms of improvement in the incomes of the bottom 40 percent of the population within each country; and the World Bank Group has made a public commitment to supporting policies that foster shared prosperity. And while poverty may not be a major concern in some of the more developed countries, concerns about shared prosperity are universal, since a given policy may or may not benefit people near the bottom of the distribution, regardless of the development level of the country.

The measures proposed by Higgins and Lustig are not ideal for choosing among a variety of fiscal reforms. As a matter of fact, let us consider again five individuals with their prefiscal incomes stated as (2,4,5,8,9). Assume that the chosen poverty line is 5.5, and there are two proposals of tax<sup>9</sup> reforms  $F_1$  and  $F_2$ , which change their prefiscal incomes to postfiscal levels of (2,4,4,8,9) and (1,4,5,6,6). According to Higgins and Lustig's fiscal impoverishment measure, the two tax reforms have similar impoverishment effects: for both, the proportion of fiscally impoverished is 20 percent, the total impoverishment is equal to 1, and the per capita impoverishment is equal to  $1/5$ . But concluding that the two reforms have similar impoverishment effects is confusing. For clearly, with reform  $F_2$ , the incomes of nonpoor individuals are lowered; while their incomes remained unchanged with reform  $F_1$ . Thus, they cannot really have similar impoverishment effects overall. Moreover, even if the main argument is to care only about what happens to the poor, the two reforms cannot have similar impoverishment effects in the context of the law of diminishing marginal utility. In fact, according to this law, one should prefer a situation where the richest poor are fiscally impoverished to a situation where the poorest poor are fiscally impoverished at the same absolute level. As a result, if one cares only about the situation of the poor (and of those who become poor),  $F_1$  should be preferable to  $F_2$ . However, current measures fail in this respect.

As explained in Section 3, these flaws are not a concern when using the new measures proposed in this paper. Comparing reforms  $F_1$  and  $F_2$  using the new measures of fiscal losses, the incidence of fiscal losses of reform  $F_2$  (60 percent), is higher than that of reform  $F_1$  (20 percent). Fiscal losses are also much more intense with reform  $F_2$ . The intensity of fiscal losses is 0.04 for  $F_1$  and 0.22 for  $F_2$ . Besides, reform  $F_2$  is still worse, even when the focus is on what happens to the situation of the poor alone. Although the incidence of fiscal losses in the subpopulation of the poor is the same for the two reforms, the losses are more intense for  $F_2$ . Indeed, considering only the poor, the intensity of fiscal losses of reform  $F_2$  (0.17) is higher than that of reform  $F_1$  (0.07). Therefore, reform  $F_1$  is clearly preferable to reform  $F_2$  both for the population overall, and for the subpopulation of poor individuals.

Furthermore, the measures proposed by Higgins and Lustig are not able to compare the relationships between fiscal impoverishment and shared prosperity among a group of countries.

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<sup>9</sup> This example is given such that there is no fiscal gain: that is, no one is becoming richer owing to the two fiscal reforms.

The main reason for this is that, as currently defined, the fiscal impoverishment indicator of the authors is based on a given poverty line, whereas shared prosperity is determined by following a distribution of income within a country. As a result, the bottom 40 percent of a population may be below a chosen poverty line in one country, while in another population, only a fraction of the bottom 40 percent will be below the same line.

However, the measures proposed in this paper can be used to assess the relationship between fiscal impoverishment and shared prosperity among different socioeconomic groups within a country as well as in comparing a group of countries. Indeed, these measures consider the experience of every single individual in an economy, and they allow researchers to compare fiscal losses among specific population subgroups, especially different quantiles (such as the bottom 40 percent), both within a country and among a group of countries.

## **6. Conclusion**

In this paper, the main focus has been on measuring the various dimensions of the fiscal losses and gains of a given fiscal system. We are proposing a family of measures that can accurately assess the extent to which a population is fiscally impoverished or fiscally enriched after the intervention of a fiscal system. This set of indicators addresses the incidence, intensity, and severity of fiscal losses and gains. An empirical illustration using the 2014 household consumption data in Niger, and contrasting the conclusions drawn based on current measures used in the literature with the new measures proposed here provides evidence of the benefits of these new measures.

The findings reveal that the incidence and the intensity of fiscal losses in Niger were 33.2 percent and 0.014, respectively; whereas those of fiscal gains were 66.8 percent (incidence) and 0.126 (intensity) in Niger. This suggests that overall the fiscal system is improving the welfare of the Nigerien population. Comparing the experience of the prefiscal poor to that of the prefiscal nonpoor, we found that the poor are more favored by the fiscal system. Fiscal losses are lower, and fiscal gains are higher in the subpopulation of prefiscal poor.

In contrast to current measures used in the literature, according to which people living in rural areas benefit more from fiscal gains, we find that the incidence and the intensity of fiscal gains are higher in urban areas when considering the situation of every Nigerien. Besides, while looking at the experience of the prefiscal poor or the prefiscal nonpoor alone, the results show that the incidence and the intensity of fiscal gains are greater in urban areas for both subpopulations. These findings show that people living in urban areas in Niger are likely benefiting the most in terms of fiscal gains in the country.

This paper can be extended along several dimensions of research. One natural extension would be to apply the measures developed here to identify the specific subgroups that are the most affected by a fiscal system within a country. These measures could also be readily applied to comparing fiscal losses and gains among any group of countries, regardless of their development level. Another avenue for future research is application of the measures proposed in this paper to discriminate among different fiscal reforms. A given fiscal reform may not improve the welfare of everyone in the country: some will be better off, while others will be worse off with the implementation of the reform. A rule for choosing the specific fiscal reform to implement among a group of reforms may be the one that will have the least amount of fiscal impoverishment and

the highest fiscal gains, either at the national level, in the subpopulation of the poor, or in the subpopulation of a specific bottom quantile, in line with the objectives being sought through the reform.

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### **Declarations of Interest**

None

## Appendix A. Implementation of the CEQ Fiscal Incidence Methodology in Niger

### CEQ Methodology

The general objective of the CEQ methodology is to assess the impact of a state's fiscal policy and its public spending on household welfare. This method seeks to identify which households are bearing the burden of taxes, and which are benefitting from state social spending. The method uses two types of data: *macrodata* from the state budget and national accounts, and *microdata* from household surveys. Eligible households are allocated the amount of social spending they have received and the taxes they have paid, using institutional criteria and household survey data. When information is not available from a household survey, information from other sources, like the government budget, may be used. The analysis uses various income concepts to measure the implications of each fiscal intervention.

*Market income* is the prefiscal income, or an individual's income *before* any fiscal intervention. It includes gross income from labor and capital, self-production, and private transfers. *Net market income* is constructed by deducting direct taxes paid from the market income. The direct taxes included here are taxes on salaries and wages. *Disposable income* is obtained by adding direct transfers to the net market income. Household consumption is assumed to be equal to disposable income. That assumption is often used in low-income economies, where the data available on consumption are more reliable than data on income and savings. Other income concepts are calculated using a backward-and-forward approach. The direct transfers considered are scholarships and other support to students, and school feeding programs. The beneficiary households are directly identified in the microdata for the former, and they are randomly selected on the basis of the rules and the geographical areas covered by the program for the latter.

When indirect subsidies are added to disposable income, and indirect taxes are deducted, the result is *consumable income, or postfiscal income*, that is, household income after the various fiscal interventions. Agricultural subsidies are the only type of indirect subsidies considered. Indirect taxes include VAT, import taxes, and other indirect taxes. Given the importance of the informal sector in Niger (informality contributes approximately 70 percent of the GDP according to the National Institute of Statistics), the risk of tax evasion is high. The rates used for the various indirect taxes are therefore effective rates, and they are calculated based on the Niger 2012 Social Accounting Matrix (SAM) rather than the statutory rates. Moreover, in addition to the direct effects of indirect taxes, indirect effects are included using the input-output matrix from the 2012 SAM. The overall effect of indirect taxes on household welfare is therefore equal to the sum of the direct effect and the indirect effect, and this is calculated following the Paasche variation by assuming price-inelastic demand. The *final income* is computed by adding the monetized value of public education and health services net of payments made by households to benefit from those services.

Once all the income concepts are defined, the measures defined in Section 3 can easily be applied, considering market income as the prefiscal income and final income as the postfiscal income, to determine the fiscal impoverishment effects.

## Methods of Allocation

The CEQ methodology consists of different methods for allocating taxes and social spending from the national account to individuals in the household survey. The methods include *direct identification*, used when the survey reports the beneficiaries of social spending (the taxpayers) and the amount they received (paid); *imputation*, used when the beneficiaries of spending (the taxpayers) are reported in the survey but not the amount they receive (are paid); and *simulation*, used when neither the beneficiaries of spending (the taxpayer) nor the amount they received (were paid) is reported in the survey. The allocation method is selected regarding the availability of information in the survey. The allocation methods used in the case of Niger are described in the following paragraphs for each item of the fiscal system.

### *Direct Transfers*

Scholarships and support to non-grant students in Niger are given to university students meeting the criteria of the *Direction des Bourses et des Aides Financières* (holding the nationality, having filled an application). Thus, the coverage of that program is university students who are citizens of Niger. The beneficiaries of that program, as well as the amount they received, are reported in the two surveys; thus, the allocation method is direct identification.

There are two types of school feeding programs that the government has put into place (*cantines nomades* and *cantines sédentaires*), for the purpose of improving school attendance and success rates. The school feeding program covers primary and secondary students, mostly those located in nomadic and sedentary regions. While the surveys do not directly identify the beneficiaries, they do provide information about the educational level and the type of school for each individual. The statistical book of the National Institute of Statistics also contains data about the geographical repartition of school feedings. The potential beneficiaries (pupils attending either primary or secondary education) are identified, and the current program repartition is considered through the regional quotas, to randomly select beneficiaries in each region, and impute to them the per capita cost of the program.

### *Direct Taxes*

Tax on wages, which is a monthly progressive rate on gross salary, are due from any type of salaried employment except work done for international organizations or family employees. The surveys allow determining the different types of salaried employment and the (net) wages received by each employee. The net wages are grossed up, and the corresponding taxes paid by employees are simulated based on the prevailing tax brackets and holding the wages fiscal pressure in the surveys (total taxes on wages/total household consumption) to be equal to the wages fiscal pressures in the national account (total taxes on wages/total household consumption).

### *Indirect Taxes*

VAT, import duties, and other taxes on goods and services are included through their effective rate, which is derived from Niger's SAM in 2012 for each category (sector) of products. The consumption level of the individual in each product category (SAM classification) is computed in the surveys by matching the survey's products to the SAM categories. Then, the SAM effective rate in each category for the different taxes is applied to the corresponding categories in the surveys



to deduct (or impute) the part of the total consumption expenditure falling into indirect taxes (or direct effects). Moreover, the input-output matrix is used to determine the indirect effects of each tax, taking into account that the nonexempt sectors of VAT only have direct effects.

### *Indirect Subsidies*

Subsidies on agriculture, consisting of agricultural extension services, are provided by the government to farmers to help train them in farming techniques, mechanization, and so on. The surveys have one section on agricultural extension services that allows researchers to directly identify the beneficiaries of the program. Then the amount of the program total expenditure is divided by the total number of beneficiaries to determine and impute to each beneficiary the per capita program cost.

### *Monetized Value of Public Expenditure in Health and Education*

The surveys provide information about the level of education, and the type of school each individual is attending. Education spending is organized by school levels (primary, secondary, and university). The average cost of public spending, depending on the number of students and the school level (primary, secondary or university), is imputed to each individual.

The surveys make it possible to determine which individuals are benefitting from free health services, and those who are using other public health services. For free health services, the average cost of public spending in those services is imputed to each beneficiary. For other public health services, the average cost of central health expenditure is imputed to each beneficiary, while the average cost of regional health expenditure is imputed to beneficiaries in the corresponding regions.

## Appendix B. Niger's Fiscal Table from 2010 to 2017 (in percentage of GDP)

	2010	2011	2012	2013	2014	2015	2016	2017
<b>Total Revenues and Grants</b>	<b>18.2</b>	<b>17.9</b>	<b>21.4</b>	<b>24.6</b>	<b>23.0</b>	<b>23.3</b>	<b>20.3</b>	<b>21.2</b>
Tax Revenues	12.8	13.4	13.9	15.2	15.6	16.0	13.5	13.1
Taxes on Goods and Services	3.9	3.5	5.0	5.3	5.6	5.8	5.3	4.9
Direct Taxes	3.1	3.2	4.3	4.6	4.7	3.9	3.5	3.6
Taxes on International Trade	4.8	5.4	3.5	3.9	3.8	4.4	3.7	3.6
Other Taxes	1.1	1.3	1.0	1.4	1.5	1.8	1.1	0.9
Non-Tax Revenues	0.7	0.7	1.2	1.2	1.9	1.8	0.6	1.0
Grants	4.6	3.8	6.1	8.0	5.5	5.4	6.0	6.7
Other Revenues	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.3
<b>Total Expenditures</b>	<b>20.6</b>	<b>19.4</b>	<b>22.5</b>	<b>27.2</b>	<b>31.1</b>	<b>32.4</b>	<b>26.3</b>	<b>26.9</b>
Current Expenditures	12.9	12.6	11.4	13.5	14.6	15.4	14.0	13.7
Wages and Compensation	3.6	4.5	4.4	5.0	5.3	5.8	5.9	5.7
Goods and Services	4.3	4.6	2.5	3.2	3.5	4.2	2.8	2.4
Interest Payments	0.2	0.3	0.3	0.3	0.4	0.6	0.9	1.1
Current Transfers	4.4	3.5	4.2	5.0	5.4	4.8	4.4	4.6
Capital Expenditures	7.7	6.8	11.1	13.7	16.4	16.9	12.3	12.7
Other Expenditures	0.4	-0.3	0.0	0.0	0.0	0.0	0.0	0.5
Government Balances (incl. grants)								
General Government Balance	<b>-2.4</b>	<b>-1.5</b>	<b>-1.1</b>	<b>-2.6</b>	<b>-8.0</b>	<b>-9.0</b>	<b>-6.1</b>	<b>-5.7</b>
General Government Balance (excl grants)	-7.0	-5.2	-7.2	-10.6	-13.5	-14.4	-12.1	-12.4
Other Financing Needs (eg. arrears)	-0.5	-3.4	0.2	-0.6	1.4	-0.3	0.4	-1.1
Financing								
Financing Requirement	-2.9	-4.9	-0.9	-3.2	-6.6	-9.3	-5.7	-6.8
Total Financing (External and Domestic)	2.9	4.9	0.9	3.2	6.6	9.3	5.7	6.8
External Financing (Net)	1.0	3.3	2.1	2.7	3.0	4.3	3.8	3.4
Amortization	-0.4	-0.3	-0.5	-0.4	-0.5	-0.6	-0.7	-0.5
Disbursement	1.2	3.0	2.5	3.1	3.5	4.9	4.5	3.9
Other External Financing	0.1	0.6	0.1	0.0	0.0	0.0	0.0	0.0
Domestic Financing (Net)	1.9	1.6	-1.2	0.5	3.7	5.0	1.9	3.4

Source: Government of Niger.

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