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Collect more, spend better? Assessing the incidence of fiscal systems and public spending in three Francophone West African countries

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Collect more, spend better? Assessing the incidence of fiscal systems and public spending in three Francophone West African countries

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Abstract
The objective of this study is to analyse and compare the incidence of fiscal systems of 3 western African countries: Côte d'Ivoire, Mali and Senegal. The analysis relies on different data and tools: (1) individual and household level data from 3 recent household surveys (EMOP 2011, ESPS 2011, ENV 2014), (2) a detailed description of the 3 fiscal systems, (4) the CEQ conceptual framework, and (4) the Openfisca platform an open source tax-benefit calculator parameterized to simulate the fiscal systems of each country. Results indicate that fiscal systems in Mali, Senegal and Côte d'Ivoire have a slightly progressive impact on inequality. This stems from the combination of slightly progressive direct taxes, regressive indirect taxes, and progressive public spending on education. Various features are likely to explain these results: (1) Direct taxes are paid by a very small fraction of the population; (2) Indirect taxes such as VAT and import tariffs affect poorest households more since they consume a higher share of their income; (3) Primary schooling rates are high and poorer households tend to have more children. These results point to some recommendations to enhance the redistributive power of existing systems: expand the reach of direct PIT ; reexamine the incidence of exemptions to VAT and import taxes ; increase transparency on public spending to maintain Willingness-to-Pay-taxes at high levels; improve household survey data quality and promote access to fiscal data.

Keywords
Fiscal incidence; Inequality; West Africa.

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Résumé

L'objectif de cette étude est d'analyser et de comparer l'incidence des systèmes fiscaux de 3 pays d'Afrique de l'Ouest: la Côte d'Ivoire, le Mali et le Sénégal. L'analyse s'appuie sur différentes données et outils : (1) des données individuelles et au niveau des ménages provenant de 3 enquêtes récentes auprès des ménages (EMOP 2011, ESPS 2011, ENV 2014), (2) une description détaillée des 3 systèmes fiscaux, (4) le cadre conceptuel du CEQ, et (4) la plateforme Openfisca: un calculateur d'impôts et de bénéfices open source paramétré pour simuler les systèmes fiscaux de chaque pays. Les résultats indiquent que les systèmes fiscaux du Mali, du Sénégal et de la Côte d'Ivoire ont un impact légèrement progressif sur l'inégalité. Cela provient de la combinaison d'impôts directs légèrement progressifs, d'impôts indirects régressifs et de dépenses publiques progressives dans le domaine de l'éducation. Diverses caractéristiques sont susceptibles d'expliquer ces résultats : (1) Les impôts directs sont payés par une très petite fraction de la population ; (2) Les impôts indirects tels que la TVA et les droits d'importation affectent davantage les ménages les plus pauvres, car ils consomment une part plus importante de leur revenu ; (3) Les taux de scolarisation primaire sont élevés et les ménages les plus pauvres ont généralement plus d'enfants. Ces résultats font ressortir certaines recommandations visant à renforcer le pouvoir de redistribution des systèmes existants : étendre la portée de l'impôt direct sur le revenu des personnes physiques ; réexaminer l'incidence des exonérations de la TVA et des taxes à l'importation ; accroître la transparence des dépenses publiques afin de maintenir des niveaux élevés de consentement à payer les impôts ; améliorer la qualité des données des enquêtes sur les ménages et promouvoir l'accès aux données fiscales.

Mots-clés

Inégalités; mobilité salariale; dynamiques de cycle de vie; panels synthétiques; Afrique du Sud.

Introduction

Advocacy for Domestic Resources Mobilization (DRM) is promoted both by the 2030 Agenda for Sustainable Development, the Addis Ababa Action Agenda (AAAA), and the "Collect more, Spend Better" Agenda. The promotion of DRM is based on two arguments. First, it provides fiscal space, allowing the well-functioning of the state and the provision of public goods. Second DRM is part of a social contract that underpins participation, social cohesion and contributes to shaping good governance. While the sustained economic growth of African economies over the last decades has provided some room to raise more fiscal resources domestically, the objectives of DRM must be pursued in agreement with the other SDGs set by the 2030 Agenda for Sustainable Development, in particular the need to eliminate extreme poverty (SDG1) and to reduce inequality (SGD10).

With this background in mind, the objective of this paper is to analyse and compare the incidence of benefit, tax and public spending in three western African countries: Côte d'Ivoire, Mali and Senegal. These three countries share a number of characteristics: they are of similar size in terms of population, they are democracies, they were under French rule during colonial times and have kept relatively similar fiscal and administrative systems since gaining Independence. Despite these similarities, these countries achieve different levels of fiscal performance, whether measured in terms of tax ratio or redistribution. Understanding why is the main objective of this paper. To that end, this analysis aims at answering the following questions:

- Who pays direct and indirect taxes and who benefits from transfers and public spending?
- What is the global impact of tax and benefit systems on inequality?
- Which tax instruments will allow raising domestic resources while achieving poverty and inequality reduction?
- How do country characteristics interact with tax and benefit system parameters to determine the incidence of tax benefit systems?

Using the CEQ conceptual framework, an open source fiscal calculator and recent household survey data, tax and benefit incidence analysis is carried out to try and answer these questions. The approach provides a picture of the distribution of taxes and public spending between households to determine whether fiscal instruments and public spending are progressive or regressive. The approach is based on an analysis of the tax code to extract key fiscal parameters, administrative data to estimate the costs of public services provision, and household survey data. The latter is used to extract data on income and consumption as well as variables needed to simulate tax payment, entitlement to benefits, and use of public services.

Using this information, we make use of "static" tax incidence analysis tools that allows (i) measuring the "first order" distributive impact of existing tax and social systems and (ii) simulating the impact of the reforms applied to them (Bourguignon and Spadaro, 2006). Similar static approaches, such as Benefit Incidence Analysis, can also be used to analyse the distributive impact of public spending on social services such as health and education. Recently, these two "branches" of static impact simulation have been brought together by the CEQ project (Lustig and Higgins (2017); Inchauste and Lustig (2017)) to analyze the "full" incidence of

fiscal systems and public spending and compare it across countries. In the context of this study, we use the CEQ conceptual framework to analyse the incidence of taxation and public spending in Côte d'Ivoire, Mali and Senegal. The use of the CEQ methodology allows comparisons between the three countries of the study, as well as with other case studies of the CEQ project.

In each country, we use a relatively recent national household survey:

- Enquête Niveau de Vie des Ménages (ENV 2014) for Côte d'Ivoire;
- Enquête Modulaire et Permanente auprès des Ménages (EMOP 2011) for Mali;
- Enquête de Suivi de la Pauvreté au Sénégal (ESPS 2011) for Senegal.

For the imputation of taxes and benefits at the household level, we use the OpenFisca platform that allows a rigorous modeling of tax systems and provides flexibility to simulate fiscal reforms.

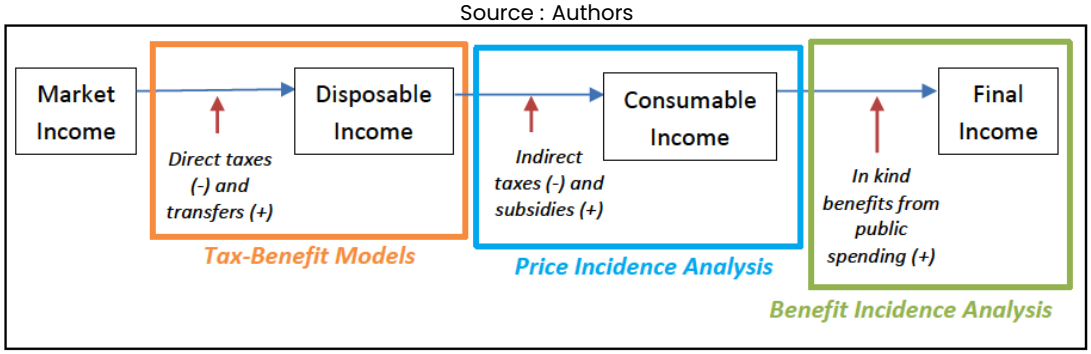
1. Conceptual Framework, Methodology and Data

1.1. The CEQ Framework

The CEQ project provides a framework to analyse how fiscal systems impact inequality and poverty. This framework relies on the definition of four income concepts[1] that are connected by the different tax and benefit instruments. Figure 1.1 provides a picture of how these income concepts are related.

Figure 1: CEQ Income concepts

Source : Authors



The first income concept, Market Income – also known as Pre-Tax Income or Primary Income – refers to income before any direct taxes are paid and any direct transfers are received. Next, Disposable Income – also known as Post Tax Income or Secondary Income – refers to the income that is available to households after they have paid taxes and benefited from direct public transfers. Third, Consumable Income refers to income available after taking into account indirect taxes and indirect subsidies. Last, Final Income – also known as Tertiary Income – includes the monetized value of the use of assignable public services such as education and health.

By comparing the distribution of these different income concepts, one can assess the distributive impact of the different elements that constitute the fiscal system. The comparison of the distribution of Disposable Income with that of Market Income provides an estimation of the incidence of direct taxation. Similarly, the comparison of the distribution of Consumable Income with that of Disposable Income provides an estimation of the incidence of indirect taxation. Finally, the comparison of the distribution of Final Income with that of Consumable Income provides an estimation of the incidence of public spending.

As mentioned above, this framework brings together techniques and tools that have been developed in different contexts: tax benefit models (TBM) in developed countries, price incidence analysis (PIA) and benefit incidence analysis (BIA) in developing countries.

The analysis of how taxes and benefits affect the distribution of income is a central objective of tax and benefit models (TBM) developed since the late 1980s in many OCDE countries. Another important objective of these models is to simulate the "cost" of the tax-benefit system. Indeed, given the complexity of tax and benefit systems in developed countries, this assessment is

[1] Sometimes five.

not straightforward. It requires a precise knowledge of the rules and parameters in order to identify tax payers and beneficiaries and to compute the value of the taxes they must pay and the transfers they are entitled to. Since the late 1990s, TBMs have been in use in many developed countries, both by public administrations and by think tanks and research centers. These models contribute to fiscal and social policy management as well as to policy evaluation.

In developing countries, tax and benefit systems are much smaller than in OECD countries. Accordingly, the share of GDP collected by fiscal systems (or tax ratio) is much smaller. Hence the need for full-fledged TBMs did not appear pressing from a policy management perspective. Instead, in the 90s, the need to rationalize public spending while enhancing the provision of social services for the more vulnerable gave rise to benefit incidence analysis (Castro-Leal et al., 1999). Benefit incidence analysis (BIA) shows who is benefiting from public services and describes how government spending affects the welfare of different groups of people or individual households (Castro-Leal et al., 1999). It does so by combining information about the unit costs of providing those services with information on their use. In effect, this approach amounts to imputing to those households using a particular service the cost of providing it. While simple in principle, the implementation of the approach requires appropriate data, and, depending on its availability and quality, a number of assumptions will be needed to provide an accurate picture of the benefit incidence. Similarly, price incidence analysis (PIA) tools have also been used to analyze indirect tax incidence questions in the context of the transition from trade to domestic taxes to compensate for the fiscal loss resulting from trade liberalization (Younger et al., 1999).

The CEQ conceptual framework brings together these different approaches to provide a more complete picture of the incidence of fiscal systems, including both the receipt and spending sides.

1.2. The OpenFisca platform

https://fr.openfisca.org/OpenFisca is an open source software written in Python that allows translating any tax and benefit legal systems into a computer code. Initially created in 2011, the first objective was to replicate the microsimulation models used by the French administrations to calculate taxes and transfers at the national level in an open-source environment. Since then the platform has been incrementally enriched by several contributors (developers and economists) and now allows to model elements of the French system since 1914. This work has resulted into the consolidation of a specific branch - https://github.com/openfisca/openfisca-franceOpenFisca-France - which is now used by the Institut des Politiques Publiques (www.ipp.euIPP) to simulate the impact of past and future public reforms of the French system. Other teams of researchers or developers from New Zealand, Spain and Tunisia, have started designing other country-specific extensions.

Its very flexible nature allows OpenFisca to simulate any legislation that can be translated into arithmetic operations. Each system will consist of a set of different fiscal objects (variables, parameters, formulas and reforms) which together form the building blocks of any Tax and Benefit systems. Fiscal objects can be parameterized so as to represent the country-

specific legal rules, and within countries, these elements can be further refined to account for variations across any dimensions (type of taxpayers, space, time). They are already multiple examples of analysis using the Openfisca calculator. For instance, It is used to investigate the distributional impact of the budget.ipp.euFrench budget law. It has also been used in a prospective way to assess the potential impact of a reform - e.g. reform housing benefits or introduction of basic income. Finally, it can be a very useful tool to analyze counter-factual legislation and its distributional impact.

Unlike many microsimulation tools, a key feature of the OpenFisca approach to microsimulation is to disconnect the implementation of the legislation in code from the specification of survey data or any particular data. Adhering to the original legislation concepts and matching them to appropriate entities (individual, fiscal unit, ...), eases and speeds up the coding of the legislation. The testing and maintenance of the legislation content is also considerably simplified.

The injection of the data, either from survey or administrative origin, is done in a separate module by projecting the available data on the legislative concepts, thus clarifying the assumption made in this stage and disentangling it from the implementation of the legislation. Moreover, modulo a marginal redefinition of the data projection, the same legislation can be used on different data sets. This clear separation between data and legislation also allows the analyst to easily refine a previous coarse-grained legislation implementation or introduce a reform without having to deal with the entanglement between data and legislation. Finally, applying the socio-fiscal system of one country to another one is made easier since it simply requires an adequate projection of the data.

We use the OpenFisca framework to simulate the tax and benefit systems of Côte d'Ivoire, Mali and Senegal for two reasons essentially. First, for transparency: OpenFisca like Python is a free and open-source software which anybody can freely use, and, if appropriately trained, understand. Each country specific package (https://github.com/openfisca/openfisca-cote-d-ivoireopenfisca-cote-d-ivoire, https://github.com/openfisca/openfisca-maliopenfisca-mali, https://github.com/openfisca/openfisca-senegalopenfisca-senegal) is freely accessible online. This enhances replicability. Secondly and most importantly, for reutilization: the availability of the code online, together with OpenFisca documentation allows anybody willing to contribute to build upon our microsimulation models. This reuse may take several forms. The mutual legislation component can be reused by different state agencies for their specific purpose. Additional modules can be added to simulate elements which were not coded initially, possible mistakes can be corrected, potential reforms can be tested. Additional data sources can be mobilized. A promising approach is to use statistical matching to pair survey and administrative data to produce rich data sets for policy evaluation.

Eventually, the microsimulation models can be used by other software through OpenFisca's application programming interface (API). This implies for instance that a website can be designed to send some specific input data to OpenFisca and receive the results of applying some tax and benefit system to the input data. In other words, using this framework incidentally allows opening the by-product of economic research to non academic members of the society.

1.3. Data

Data Sources The main data sources used in this work are household surveys collected in each country including information at both household and individual levels (table 1). These surveys were selected because of their representativeness at the national level on the one hand, and for containing detailed information relating to employment, the income, personal characteristics and expenditure they contain on the other. As administrative data would only cover a very small share of the economy in society where the informal sector is still dominant, such surveys are the only available micro data to study the full distributional incidence of the tax and benefit system. Unfortunately they remain very sporadic in time, can be hard to make comparable across countries, and suffer from a number of shortcomings [2].

Table 1: **Sample size by household survey**

Source : Authors

Country	Households	Individuals	Sources
Mali	6,914	78,140	Modular and permanent household survey-2011 (EMOP-2011)
Senegal	5,953	55,016	Senegal Poverty Monitoring Survey-2011 (ESPS-2011)
Cote d'Ivoire	11,797	47,607	Survey on households living standards in Cote d'Ivoire-2014 (ENV-2014)

In addition to the micro surveys, this simulation exercise requires essentially two other type of sources : tax codes, to collect complete and reliable legal information, national accounts and aggregate figures from miscellaneous administrative reports (the tax authority, the customs etc ...), to gauge the extent by which the simulated micro-economic totals (before and after simulation) depart from those assembled by the administration.

Data Preparation and Harmonization Harmonizing data sets produced by different actors can be difficult. For this study the challenged proved particularly complicated as several types of data sources had to be harmonized both within and across the three countries, and with respect to the CEQ framework.

Table 1.3 presents the different income modules included in each household survey. Most types of incomes are measured at the individual level in each survey except for own-consumption and imputed rent. We estimate imputed rents first by estimating the average predictive power of a set of housing and geographic characteristics on the (log of the) rents paid by tenants, then by applying these coefficients to the same characteristics but on the homeowner sample to obtain predicted values. For each of the micro-surveys, we define implausibly extremes as values whose natural logarithm would exceed the mean by more than 3 standard deviations, as is common in the literature. We assume they are due to measurement errors and set them to the average calculated from the distribution after excluding them. We applied this method for each income component separately. We cannot discard the possibility for such method

[2] For instance, EMOP 2014 does not include 3 regions which were not surveyed due to security issues.

to decrease high but well-measured income level. However, in the absence of more reliable data, there is no perfectly accurate method to distinguish the later from pure measurement errors.

Several data limitations are important to highlight here, which make the three country-level data sets only imperfectly comparable. First, the time unit used by the different surveys/component were significantly different in Côte d'Ivoire. While Senegal and Mali respondents had to declare how much they earned on average per month, per quarter, or throughout the last year; in Côte d'Ivoire, respondents could also choose to declare the average amount received by day or week which may lead to some extreme values once annualized. Unfortunately there is no consensus as to what method should be applied to correct for such time unit biases. We therefore applied no trimming technique other than the one explained above.

Table 2: Income modules : presence, scale and time unit

	Mali			Senegal			Côte d'Ivoire		
Pensions	NO			Yes	ind.	year	Yes	ind.	diverse
Rental income	NO			Yes	ind.	year	Yes	ind.	diverse
Agricultural mixed income	Yes	ind.	month	Yes	ind.	month	Yes	ind. and hh.	diverse
Informal wages	Yes	ind.	month	Yes	ind.	month	Yes	ind.	diverse
Public wages	Yes	ind.	month	Yes	ind.	month	Yes	ind.	diverse
Formal private wages	Yes	ind.	month	Yes	ind.	month	Yes	ind.	diverse
Non-agricultural mixed income	Yes	ind.	month	Yes	ind.	month	Yes	ind.	diverse
Public transfers	NO			Yes	ind.	year	Yes	ind.	diverse
Dom. Private transfers	Yes	hh.	trim/year	Yes	ind.	year	NO		
Int. Private transfers	Yes	hh.	trim/year	Yes	ind.	year	Yes	ind.	diverse
Own consumption	Yes	hh.	trim/year	Yes	hh.	year	Yes	hh.	days per months
Imputed rent	Yes	hh.	estimates	Yes	hh.	year	Yes	hh.	estimates
Other capital income	NO			Yes	ind.	year	Yes	ind.	diverse

Notes: Authors' elaboration

Overall, ENV-2014 survey of Cote d'Ivoire and ESPS-2011 of Senegal include more income modules than EMOP-2011 of Mali. The latter does not measure pension, rental income, public transfers, nor other capital income (dividends, interest). Importantly also, transfers received from other households in Côte d'Ivoire are absent from the data set. The question does appear in the questionnaire but none of the version of the data we obtained actually features a corresponding variable. This component is a relatively important one in Senegal and Mali, where it can be measured. Moreover, Côte d'Ivoire's micro survey has significantly more household with no income (not even imputed rent or auto-consumption). We assume that households having no income in Côte d'Ivoire live from those unreported transfers received from other households. We then used consumption as a proxy for income for these households only.

On the expenditure side, ENV-2015 of Cote d'Ivoire includes many more items compared to Senegal and Mali (figure 2). In total, ENV-2015 includes roughly 250 items whereas ESPS-2011 has 150 items and EMOP-2011 only has 100 items. Most of these items are food or equipment

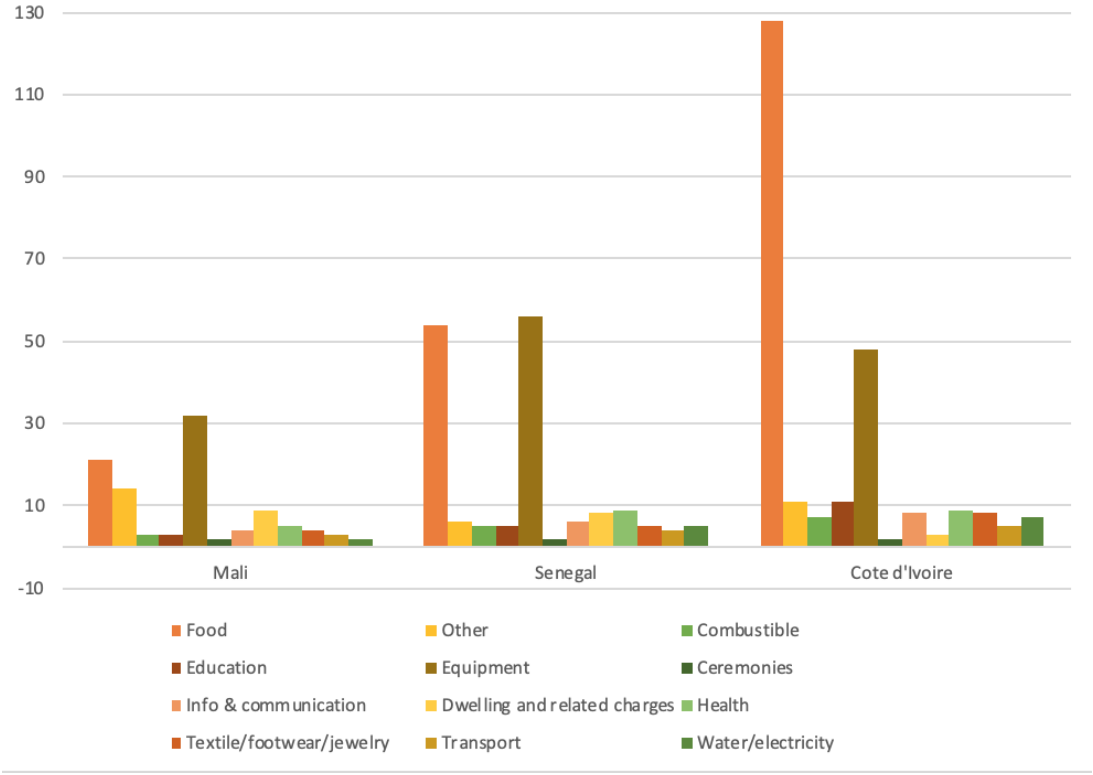
(or durable assets) in the three surveys. To harmonize the several items, each of them were assigned to the closest COICOP category using the U.N (2018) nomenclature. Then the different COICOP categories were matched to the tax legislatures to assign VAT, excise and customs rates to each COICOP category[3].

Extensive information about the source and method applied to construct the different variables is available on

https://github.com/openfisca/openfisca-ceq/blob/master/documentation/description.mdgithub.

Figure 2: Number of items by expenditure module

Source : Authors



The data preparation also revealed some serious inconsistencies within surveys. The major one relates to the comparison between income and consumption. Ranks implied by both dimensions are only weakly correlated, and consumption levels are very often above income levels. Savings collected by directly asking the respondents are very poor predictors of savings measured by taking the difference between income and consumption. This phenomenon has recently been documented in high income countries (Bastagli, 2015) - but is probably more pronounced in low income countries (Czajka, 2017). Unfortunately it considerably complicates any micro-simulation exercise as indirect taxes are computed based on consumption data, while direct taxes are based on income.

We uncovered a few other serious inconsistencies such as the systematic mismatch between agricultural income measured at the household level from a section entirely devoted to agri-cultural activities, and the sum of revenues streams individually declared by farmers.

[3]Excise taxes were not coded in this version of the study. This is left for future work.

Given these data issues, our results should be considered with caution. More generally our inspection demonstrate that much better data would be needed to more precisely answer the questions addressed in this paper.

2. Comparative Analysis

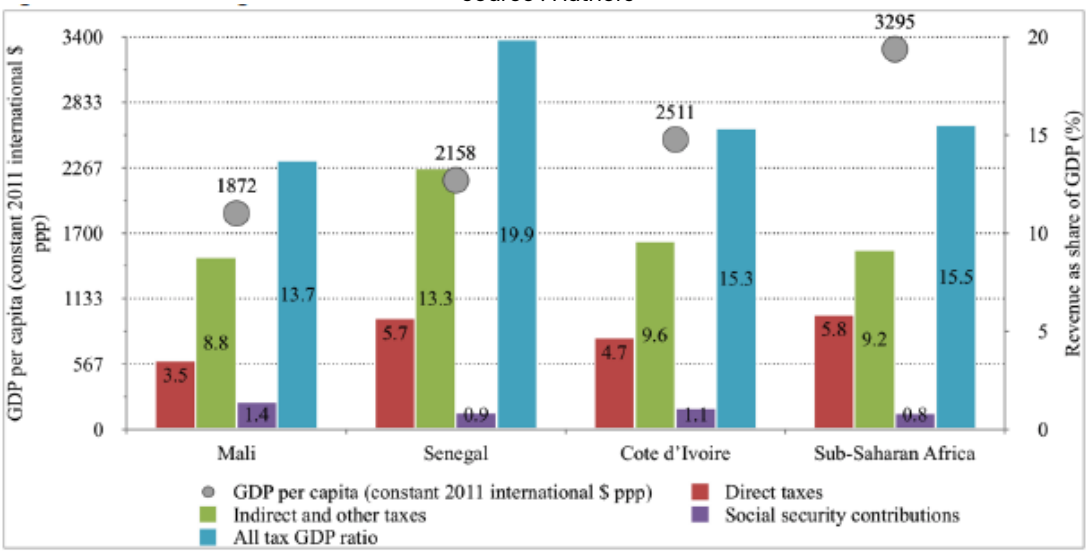
Although the three West African countries considered here share a number of characteristics - population, political regime, former colonial rule - they differ on a number of features that are explored in more detail in the following sections.

2.1. Aggregate revenue and spending

The size and composition of government revenue is presented in Figure 3. The three countries are ranked by GDP per capita. Senegal presents a higher ability to mobilize fiscal resources with respect to country wealth compared to Mali and Cote d'Ivoire. Indeed, the global tax to GDP ratio of Senegal reaches 19.9% exceeding the average tax ratio in Sub-Saharan Africa. While the Cote d'Ivoire tax ratio (15.3%) is close to the average of Sub-Saharan Africa countries, the ratio for Mali (13.7%) is lower. Figure 3 also shows that indirect taxes constitute the principal source of government revenue in all three countries. Indeed, the volume of indirect taxes represents more than 60% of government revenue in each of the three countries.

Figure 3: Structure of government revenue

Source : Authors



Policy-oriented analyses of revenue mobilization tend to emphasize ineffective tax collection – i.e. low capacity to tax – as the main driver of the relationship between income and taxation. Instead, the academic literature points at more fundamental factors related to economic structure, political institutions, as well as culture and identity issues (Besley and Persson, 2014).

- First, low-income countries typically have a large informal economy and many small-scale firms and farms. These economic activities are difficult to tax (Tanzi, 1992). In addition, many developing countries tend to be dependent on natural resources and foreign aid, which may crowd out domestic revenue collection efforts.
- Second, political systems, political control and the political economy determine the level, type and incidence of taxation (Besley and Persson, 2014). Weak institutional capacity makes corruption and evasion more likely and lobbying more profitable (Reinikka and Svensson, 2004). For example, strong control by rich elites and low contestability, which characterize many political systems of poor countries, may be associated with less progressive taxation. Similarly, tax exemptions may be used to buy-off opposition or to favour political supporters (Svensson, 2005).
- Third, the argument has been made that a "culture of compliance" – based on intrinsic motivations beyond material costs and benefits – is a key parameter that determines taxation (Putnam et al., 1994). However, this cultural explanation remains contested, as the lack of compliance may also be traced back to other fundamental factors, in particular the failure of the state to provide public goods. The latter assertion is confirmed for example by a study by Ali et al. (2014) that shows a positive correlation between tax compliance and the provision of public services in four African countries using Afrobarometer data.

There does not seem to be a simple correlation between tax ratio and income in our three data points. A thorough investigation of the fiscal system will allow us to better understand the origin of tax ratio differences between the three countries.

The Afrobarometer fiscality indicators provide some elements to understand the perception that people have of their countries fiscal system. Four indicators are investigated (Figure 4). We begin by analyzing the willingness to pay taxes approximated by a direct question asking the respondent[4] if he or she agrees that citizens must pay taxes. The proportion of the population who agrees that citizens must pay taxes is high in all 3 countries and ranges from 79% in Mali to 83.9% in Cote d'Ivoire. The willingness to pay taxes in the three countries is higher than the average in Sub-Saharan Africa. While the willingness to pay taxes is high and similar across the three countries, the actual tax compliance seems in contrast to be heterogeneous[5]. The proportion of people who comply with taxation in Mali (68.2%) is considerably higher than in Senegal (50.1%) and Cote d'Ivoire (32.4%). Tax compliance in Mali exceeds the average in Sub-Saharan Africa (58.0%) while it is lower in Senegal and Cote d'Ivoire. The higher tax compliance observed in Mali could be explained by two other indicators. On the one hand, the proportion of people thinking it easy to avoid paying taxes is higher in Senegal and Cote d'Ivoire than in Mali. This suggests that people are less tempted to avoid paying taxes in Mali in relation to the other countries. On the other hand, the share of people saying it easy to find out information on the use of fiscal revenues is higher in Mali than in the other two countries. This result suggests that public resource management is more transparent in Mali than in Senegal and Cote d'Ivoire.

[4]Respondents are individuals aged over 18 years old.

[5]Tax compliance is measured through the response to a question asking respondent how often he or she did not pay his/her taxes. It is a dummy which equals to 1 if the respondent never or rarely avoids paying taxes and 0 if he or she often or always avoids paying taxes.

Figure 4: Tax to GDP ratio and Afrobarometer indicators

Source : Authors

On the expenditure side, the structure of social spending reveals the important share allocated to education in comparison to the other sectors in the three countries (Figure 5). Senegal differs from Mali and Cote d'Ivoire with a relatively higher share of social spending. Senegal education expenditures represent 6.1% of GDP in Senegal against 4.1% in Cote d'Ivoire and 3.8% in Mali. Concerning health, the government allocates 1.4% of GDP in Senegal while Mali and Cote d'Ivoire spend 0.7% and 0.8% of GDP respectively. Subsidies[6] constitutes a considerable share of public expenditures in Senegal with a share (4.8%) higher than the share of the health sector. This share represents a volume of 323 billion FCFA of which 154 billion (2.05% of GDP) are spent to subsidize energy [7]. In other words, half of these subsidies support energy consumption. The amount spent on subsidies are unfortunately not available for Mali and Cote d'Ivoire in the World Bank Indicators Dataset so that it is not possible to compare between the three countries.

2.2. Population

2.2.1. Demography and household structure

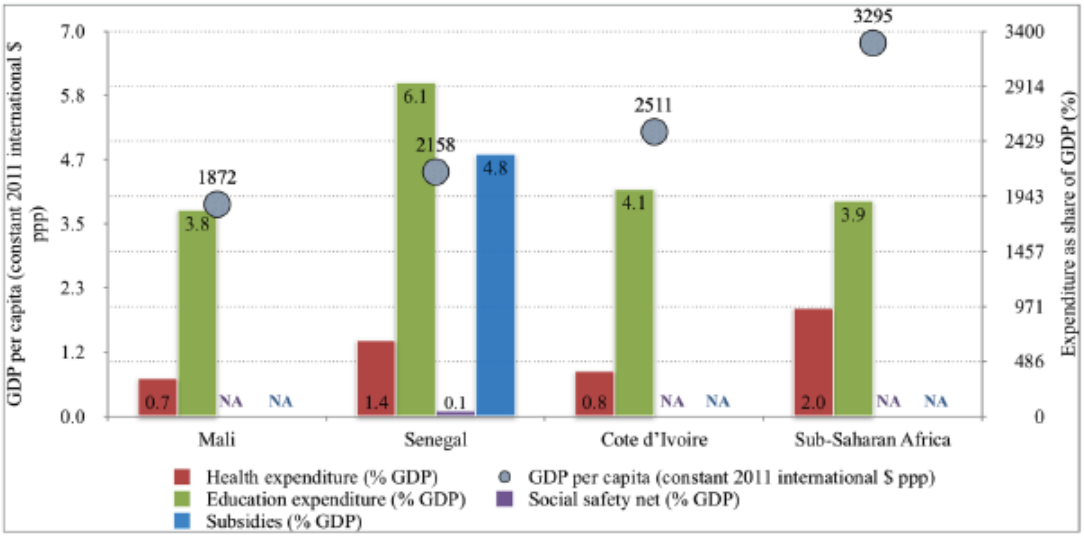
The three countries differ in terms of population structure by residence area (Figure A1). Cote d'Ivoire's population is larger compared to the other countries which have similar population size. In the same way, there are differences in terms of residence area of population between the 3 countries. Whereas the majority of the population in Cote d'Ivoire (50.1%) lives in urban area, the reverse is observed in Senegal and Mali: urban population represents 43.3% in Senegal and only 22.2% in Mali.

[6]Subsidies are current unrequited payments that governments make to enterprises, resident producers and importers. Subsidies may be designed to influence enterprises level or type of production, or the prices at which the products are sold. Subsidies consists of 'subsidies on products', subsidies payable per unit of a good or a service, and 'other subsidies on production', which cover all other subsidies enterprises receives as a consequence of engaging in production. Data are in current local currency.

[7]http://www.dpee.sn/-TOFE-.html?lang=frDirection de la prévision et des études économiques, tofe 2001-2025

Figure 5: Structure of government spending

Source : Authors



The three countries present a similar pattern regarding the spatial distribution of population (Figure A2). Population is concentrated in the urban centers particularly in the capital cities. The population density is higher in the region including the capital cities compared to other regions. As evidence, population of region including capital cities represent more than 20% in Senegal and Cote d'Ivoire and more than 10% in Mali.

In terms of age structure, the population of the three countries is relatively young compared to Western European countries (Figure A3). The population pyramids of each country are indeed larger at the basis. There is however a noticeable difference for Cote d'Ivoire where the working age population is more important in comparison to Mali and Senegal

Overall, most of people in the three countries have no education (figure A4). Mali's population appears to have the lowest education level compared to Senegal and Cote d'Ivoire. The proportion of the population with no education is estimated at 61.8% against 58.5% in Senegal and 55.8% in Cote d'Ivoire.

Concerning household structure, households are in average smaller in Cote d'Ivoire compared to Mali and Senegal (Figure A5). Households include only 5 persons in Cote d'Ivoire against 10.8 in Mali and 9.1 in Senegal. The composition of the households in terms of age shows that there are more children on average in households in Mali.

2.2.2. Consumption structure

Table 3 presents our own estimates of consumption aggregates by country obtained from household surveys in comparison to official sources. As expected, Cote d'Ivoire has higher consumption in total and per capita compared to Senegal and Mali. Estimated at 12,440 billion FCFA, Cote d'Ivoire consumption aggregate is more than triples that of Senegal or Mali. Cote d'Ivoire consumption per capita is 535,830 FCFA against 203,081 FCFA in Mali and 310,171 FCFA in Senegal.

Overall, the size of our aggregates is comparable to that of official sources, although there are differences. Estimates of total consumption in Côte d'Ivoire are similar to the aggregate provided by the World Bank (12 636 billion FCFA in 2015). The gap between our estimates and official sources is however greater in Senegal and Mali. We find a total of 4 228 billion FCFA in Senegal while the National Institute of Statistics provides a total of 3 880 billion FCFA. On the other hand, our aggregate seems underestimated compared to the World Bank estimates (4 901 billion FCFA in 2006). In Mali, our aggregate is lower in relation to the most of official sources except for economic accounts of 2012 (3 097 billions FCFA).

Table 3: Consumption aggregates by country

Source: EMOP-2011, ESPS-2011, ENV-2014, WDI, Statistic National Institutes, authors' elaborations

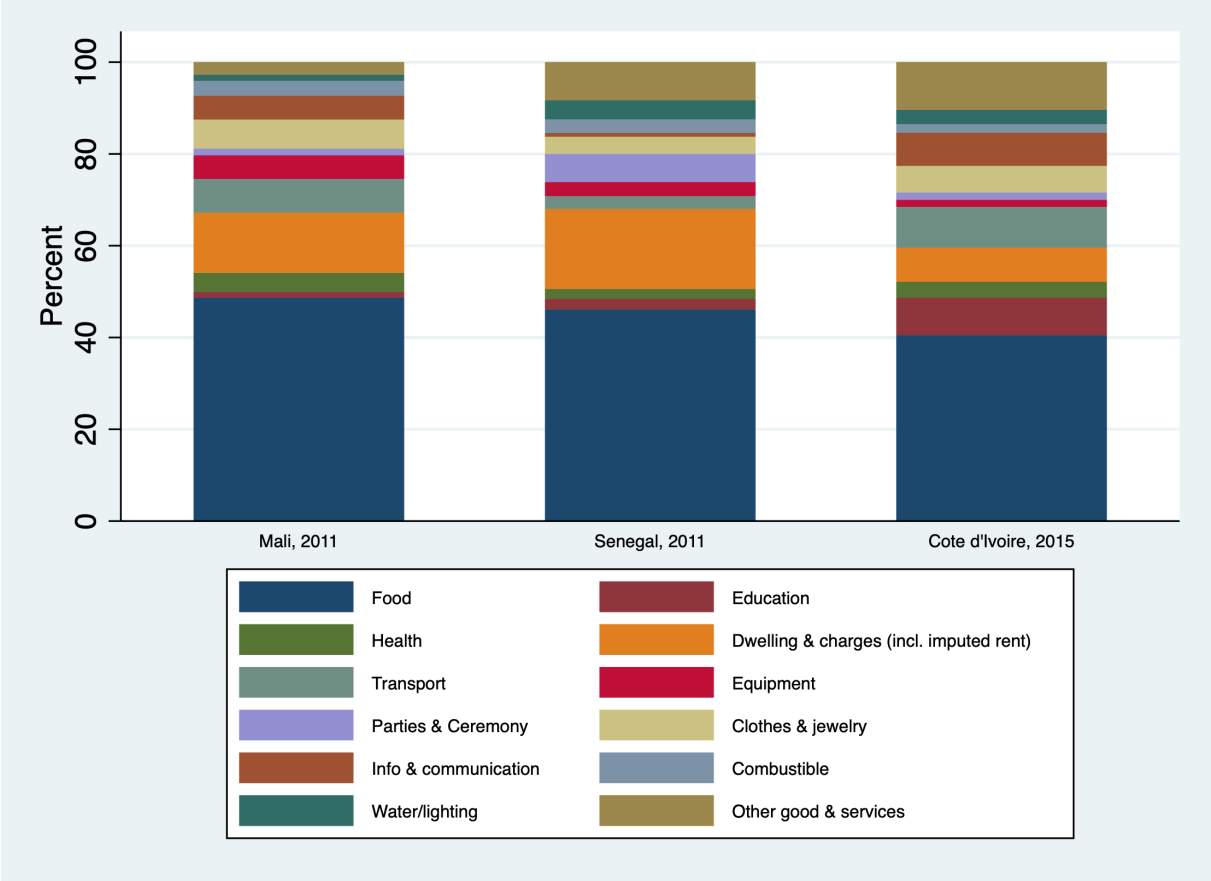
Country	Own estimates		National Institute of Statistics			World Bank	
	Total (billions FCFA)	Per capita (FCFA)	Total (billions FCFA)	Per capita (FCFA)	Sources	Total (billions FCFA)	Sources
Mali	3 119	195 230	3 912	251 004	INSTAT (2013), rapport d'analyse de l'EMOP 2010-2011, passage 1-4.	3 840	WDI 2010
	-	-	3 097	-	INSTAT, comptes économiques du Mali 2012	4 283	WDI 2011
Senegal	4 313	316 388	3 880	284 615	ANSD (2013), rapport du deuxième enquête de suivi de la pauvreté au Sénégal de 2011.	4 901	WDI 2006
	-	-	-	-	-	6 381	2011 -Imputation*
Cote d'Ivoire	11 836	512 900	_	386 215	INS (2015), rapport de l'enquête sur le niveau de vie des ménages en côte d'Ivoire de 2014-2015.	11 005	WDI 2014
	-	-	-	-	-	12 636	WDI 2015

* Note: Imputation based on the growth rate of WDI's final consumption dataset between 2006 and 2011.

The structure of the consumption across the three countries show two common patterns (Figure 6). First, food represents the biggest share of household consumption in each country. This is specially true in Mali where food represents almost half of total consumption. Second, dwelling and related costs represent a significant spending for households, particularly in Senegal.

Figure 6: Consumption structure by country

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' elaboration



2.2.3. Labor force and income structure

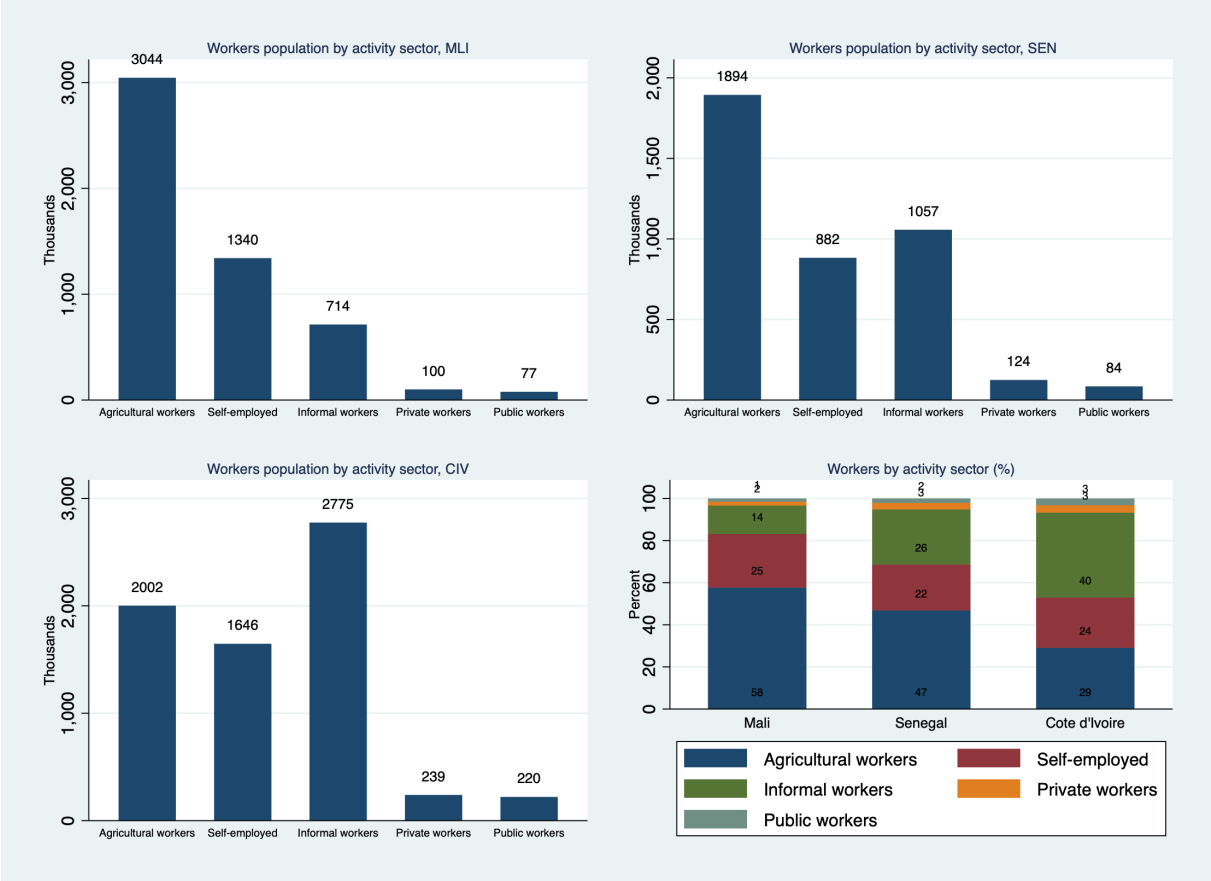
Figure 7 presents the structure of employed population by sector of activity. More than the majority of employment is in the agricultural sector in Mali. Compared to Mali, the share of agriculture in total employment in Senegal is lower but remains important with 47% of the labor force. Contrary to Mali and Senegal, the informal sector employs most of the workers (40% of total employment) in Cote d'Ivoire even though the contribution of the agriculture sector is also significant (29% of total employment).

Globally, the three countries do not have the exact same employment structure but share some patterns. In particular, the contribution of formal employment including both public and formal private employees is very low. Formal employment represents roughly 6.6% of total labor force in Cote d'Ivoire, 5.2% in Senegal and only 3.3% in Mali. Instead, the share of non agricultural self-employment is quite similar between the three countries with a proportion between 22% and 25%.

The main contributing sectors to total employment also generate an important share of household income (figure 8). Agricultural and self-employment income appear to be the most important households' income sources in Mali and Senegal. Agricultural income represents 28% of total income in Mali and 22% in Senegal. Income generated by self-employment is

Figure 7: Workers population by activity sector

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations



proportionally comparable to agricultural income in these two countries. In Cote d'Ivoire however, informal wages seem to be the main households' income source (23%) even though agricultural (14%) and self-employment (16%) incomes are also important.

2.2.4. Poverty and Inequality

The overview of the structure of government revenue and social expenditures is completed by a comparative analysis of the income inequality across the three countries (Figure 9). Two indicators based on the most recent available data from World Income Inequality Database are considered: the Gini Index and the income share of the top 10%. Income inequality appears higher in Cote d'Ivoire in relation to the other countries w.r.t the Gini index (43.2) and the share of income held by the top 10% (32.6%). With a Gini index evaluated at 40.3, income inequality is lower in Senegal than in Cote d'Ivoire. Income distribution in Mali seems the most equal among the three countries with a Gini index estimated at 33.0. Furthermore, the top 10% holds only 25.7% of total income vs more than 30% for the two other countries.

Figure 8: Income structure by country

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations

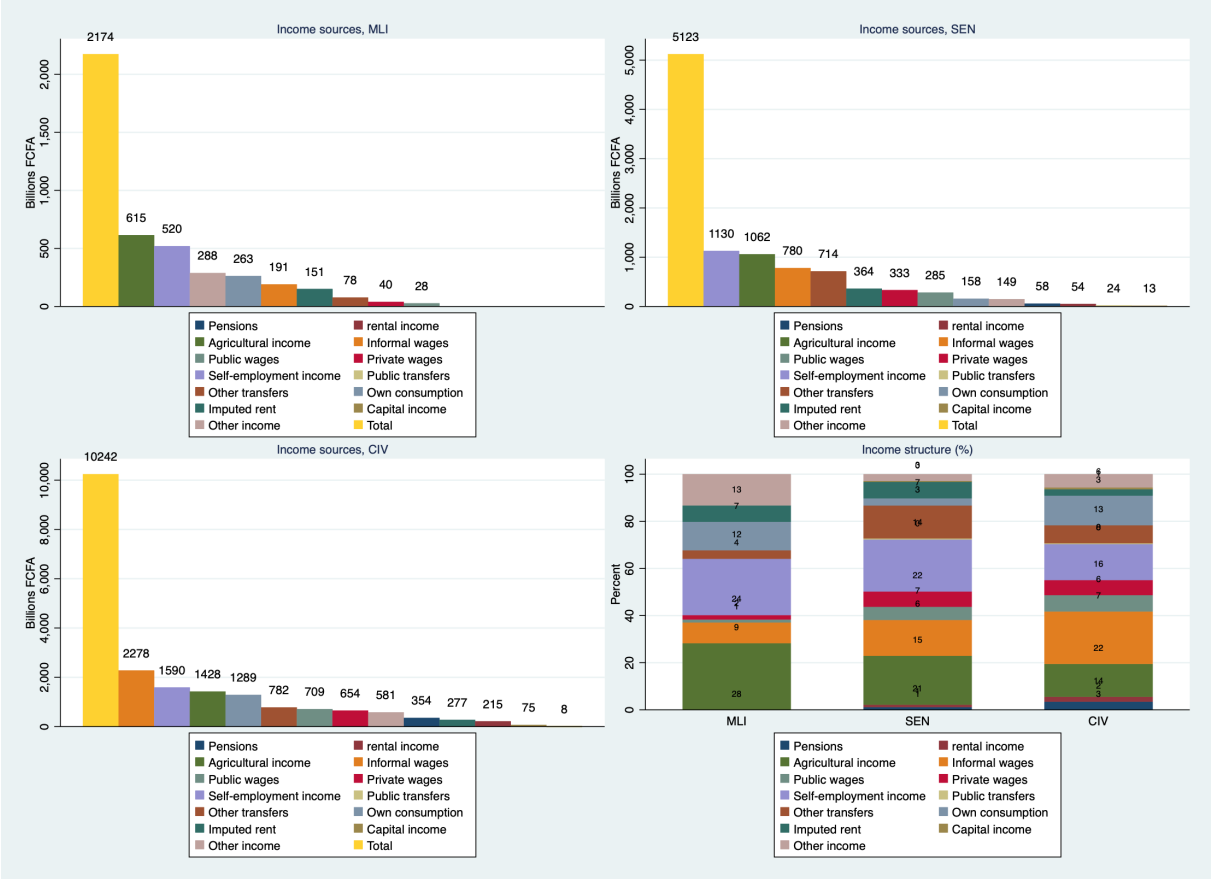
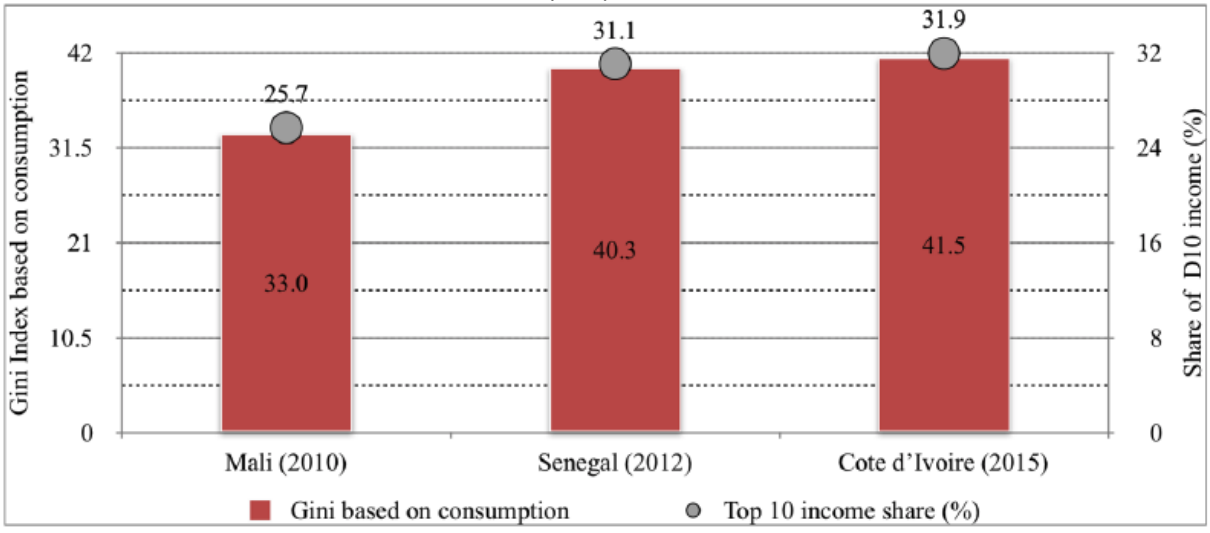


Figure 9: Inequality indicators

Source: World Income Inequality Database, authors' calculation



3. Model assumptions

3.1. Fiscal system and spending parameters

The description of the three fiscal systems is based on Senegal's General Tax Codes of 2012, Mali's General Tax Code of 2011 and Cote d'Ivoire's General Tax code of 2015. The fiscal systems of the three countries are different in many respects even though they are similar regarding some concepts inherited from the French colonial system. For example, all three countries have a tax on wages and a value added tax. Nonetheless, taxation rules and taxation basis differ from one country to another. Given the complexity of each fiscal system, only tax categories that contribute significantly to fiscal revenue are presented and which are likely to be simulated in the study given available data.

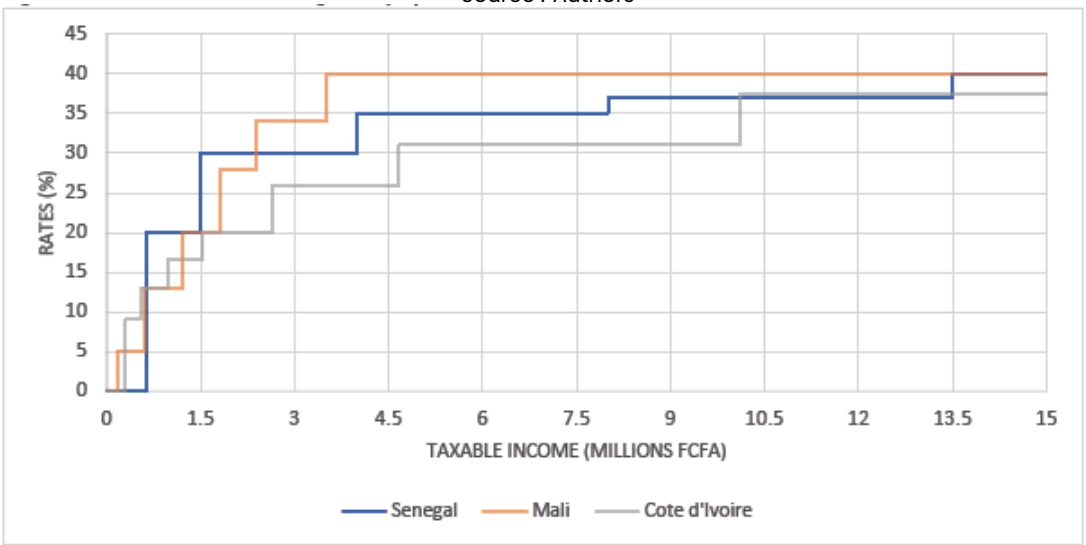
3.1.1. Direct taxes

Tax on wages

The tax schedule for wages that applies in each country is presented in Figure 10. Tax rates in Côte d'Ivoire are overall lower for wages between 1,5 million and 9.5 millions than the rates in both Senegal and Mali. This comparison presents however some limits as taxation rules are different. Taxable income is specific to each country regarding tax allowances, how the tax reduction for family is considered and the rules used to calculate the amount of the tax. Tax allowances in Senegal and Cote d'Ivoire are considerably higher in comparison to Mali: taxable income represents gross wages after deducting a tax allowance of 30% in Senegal, 20% in Cote d'Ivoire and only 4% in Mali.

Figure 10: Tax schedule for a single taxpayer with no kids

Source : Authors



While the taxation rates apply directly to the wages after deduction of tax allowances in Senegal and Mali, the rules are different in Cote d'Ivoire. First, a proportional rate of 1.5%

is applied to the total taxable income. Second, progressive taxation rates are applied to taxable income divided by the number of shares (or "quotient familial"). Table 3 presents the definition of the number of shares according to family situation of the taxpayer. Tax reductions for family are somewhat similar in Senegal and Mali. The rates are different though and the amount of the reductions is capped in Senegal. The final amount of tax to be paid is assessed after taking into account these reductions in Senegal and Mali. In Cote d'Ivoire, taxable income per family share is multiplied by the number of shares to calculate the total tax.

Table 4: Family deductions

Source : Authors

Mali	Senegal	Cote d'Ivoire
Tax cuts: i. Single, divorced, widow with 0 Child: 0% ii. Married with 0 child: 10% iii. Per child up to 10: 2.5% additional	Tax cuts: i. Single, divorced, widow with 0 child: 0 % ii. Married with 0 child: 10 % within [100 000; 300 000] iii. Single, divorced with 1 child: 10 % within [100 000; 300 000] iv. Married, widow with 1 child: 15 % within [200 000; 650 000] v. Single, divorced with 2 children: 15% within [200 000; 650 000] For each additional child, the rate increases by 5 % within specific range. In any case, the maximum cut rate is 45% of the taxable income.	Definition of the number of shares: i. Single, divorced or widow without kids: 1 ii. Married without kids: 2 iii. Single or divorced with one kid: 2 iv. Married or widow with one kid: 2.5 v. Single or divorced with 2 kids: 2.5 vi. Married or widow with 2 kids: 3 vii. Single or divorced with 3 kids: 3 viii. Married or widow with 3 kids: 3.5 ix. Single or divorced with 4 kids: 3.5 The number of shares increase by 0.5 for each additional child up to 5.

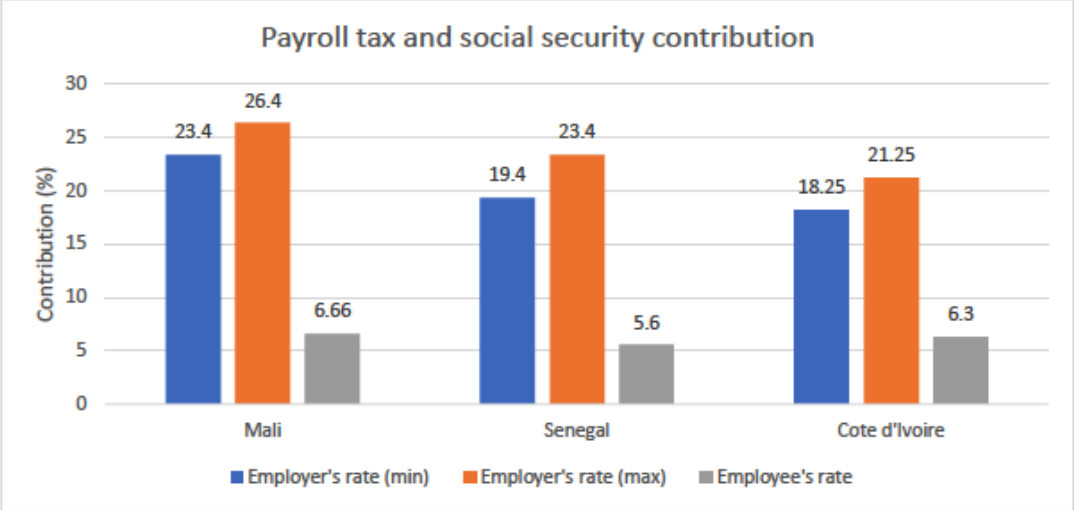
Payroll tax and social security contribution

Payroll tax and social contributions are paid by both employers and employees to varying degrees (Figure 11). Social contributions include pension contributions and all benefits related to the position covering industrial accidents and family benefits. Overall, employers' contribution is higher in comparison to employees' contribution within each of the three countries[8]. It is worth highlighting that employers contribute less in social security contribution and payroll tax in Cote d'Ivoire than the two other countries.

[8]In Senegal, the ceiling amount of social contribution paid by employers is set to 5.076 millions FCFA per year.

Figure 11: Payroll and social security contribution by country

Source: https://www.cleiss.fr/docs/regimes/regimemali.htmlhttps://www.cleiss.fr/docs/regimes/regimemali.html, authors' calculations



Taxes on industrial, commercial and agricultural benefit

The benefits generated by firms engaged in production and trade activities of various goods and services are taxed in the three fiscal systems. The taxation rules can be regrouped into two broad categories based mainly on the nature of the firms that is corporate society or individual firm. The first category is a corporate tax on the benefits of industrial and commercial activities (Table 5). The corporate tax has two regimes according to the size of the firms measured by turnover: a normal regime and a simplified regime. The definition of the size of the firms is different by country. In Senegal for example, the normal regime applies to firms whose turnover exceeds 100 millions FCFA while the simplified regime carries on firms with a turnover between 50 and 100 millions FCFA. The range of turnover for simplified regime is larger in both Mali and Cote d'Ivoire in comparison to Senegal. Eligible firms for the simplified regime have a turnover between 30 and 100 millions in Mali and 50 and 150 millions in Cote d'Ivoire. Beyond the definition of firms size, the taxation rates are also different between the three countries. The rate is higher in Mali (35%) followed by Senegal (30%) and then Cote d'Ivoire (25% except ICT companies' rate which is 30%).

The second category is called the synthetic tax and is a tax on physical persons who own a firm. This tax is of primary interest in this study because we use mainly household survey data including individual firms in the analyses. As shown in Table 6, the synthetic tax is specific to each country. Theoretical fiscal population and taxation rules differ from one country to another. For instance, the Senegalese synthetic tax makes a distinction based on the nature of the product. Firms providing services are taxed differently than those providing cement and food retail. Both Mali and Cote d'Ivoire fiscal systems do not make this distinction as all individual firms are taxed the same way.

Senegal also differs from the two other countries in the mode of taxation. The synthetic tax in Senegal is a rate varying according to the range of turnover while it is a lump-sum tax based on a list of operator categories in Mali and on turnover range in Cote d'Ivoire. Typically, the

Table 5: Taxes on industrial and commercial benefits

Source: General tax codes, authors

Regime	Mali		Senegal		Cote d'Ivoire	
Simplified	Physical persons or corporations with a turnover between 30 and 100 millions FCFA	35 % on benefit*	Corporations with a turnover between 50 and 100 millions FCFA	30% on benefit	Physical persons or corporations with a turnover between 50 and 150 millions FCFA	i. 25% on benefit* ii. 30% on benefit* for ICT companies.
Normal	Corporations with a turnover exceeding 100 millions FCFA	35 % on benefit*	Corporations with a turnover exceeding 100 millions FCFA	30% on benefit*	Corporations with a turnover exceeding 150 millions FCFA	i.Minimum lump-sum tax : 0.5% on turnover ii.25% on benefit* * The difference with the simplified regime is the calculation of benefit as it includes (see art 48).

synthetic tax in Cote d'Ivoire varies from 491,400 (for turnover between 5 millions FCFA and 6 millions) to 3.9 millions FCFA when turnover is between 48 millions FCFA and 50 millions FCFA (table A6). In Mali, the synthetic tax range from 10,585 FCFA to 1.2 million FCFA. In contrast, pastry with a turnover between 25 million FCFA and 30 million FCFA or advertising agency or travel agency with similar range of turnover are included among the top synthetic tax payers (see art. 74 for details on categories).

Other direct taxes

Other income categories such as rental income or securities income are also taxed, with different taxation rules across the three countries (table A1, A6). For example, rental income tax is 3% in Cote d'Ivoire while the rate is 15% in Mali and progressive rates are applied in Senegal (table A6). In addition, the taxation basis for rental income tax is not the same for the three countries. Taxable income is obtained after deducting some operating costs in Senegal. Mali and Cote d'Ivoire consider however the gross rental income including operating costs as taxable income. Likewise, taxation rates on securities income differ between the countries (table A1). Tax on interests from Bank saving account varies from 1% to 13.5% in Cote d'Ivoire depending on interest payment date. The rate is 9% in Mali and only 8% in Senegal.

Table 6: Synthetic tax by country

Source: General tax codes, authors

Mali		
Theoretical fiscal population		Taxation rules
Individual operator whose turnover is less than 30 million FCFA		Lump-sum tax based on a list of different categories of operators (see art 74 for more details).
Senegal		
Nature of the product	Theoretical fiscal population	Taxation rules (amount expressed in FCFA)
Service provision	Firms whose annual turnover does not exceed 50 million FCFA	i. 0 - 0.5 millions: 4% ii. 0.5 - 3 millions: 5% iii. 3 - 10 millions: 6% iv. 10 - 37 millions: 7% v. 37 - 50 millions: 8%
Cement and food retail		i. 0 - 10 millions: 1% ii. 10 - 37 millions: 2% iii. 37 - 50 millions:2.8%
Other products		i. 0 - 10 millions: 2% ii. 10 - 37 millions: 3% iii. 37 - 50 millions:3.8%
Cote d'Ivoire		
Theoretical fiscal population		Taxation rules
Individual operator whose turnover is between 5 and 50 millions FCFA		Lump-sum tax based on different range of annual turnover (see table A6)

3.1.2. Indirect taxes

Similarly to direct taxes, main indirect taxation rules are different in each country even though the taxation basis seems similar. The taxation basis of tax on import includes cost of the product, insurance and freight of import duties. The taxation basis of special taxes on products includes the same elements plus taxes on import. VAT applies to value added of production augmented of import taxes and any other taxes or fees.

Tax on imports

As member of the Economic Community of West African States (ECOWAS), the three countries belong to a customs union and, as result, share the same tax rules on imports. This tax is divided into 5 categories (Table 7). Social goods such as cereal products or health products are exempted. Rates range from 5% for inputs such as fertilizer or agricultural equipment to 35% for sensitive products regarding their strategic dimension for economic development of the region. This latter category is meant to protect local production and include products such as poultry products, onions, wheat flour, etc.

Table 7: Tax on Imports

Source: General tax codes, authors

Categories	Products	Description	Rates
0	Social goods (pharmaceutical, medical, surgical devices, books, etc.)	Health products, cultural goods and cereal products	0%
1	Commodities, basic materials, capital equipment, etc.	Inputs to produce other goods (fertilizer, agricultural equipment)	5%
2	Intermediate consumption	More elaborate products than the previous ones but not being manufactured in enough quantity in the region or not likely to be manufactured there.	10%
3	Final consumption products and any products not included in the previous 3 categories	Finished products having reached the final stage of processing.	20%
4	Specific goods for economic and social development	Sensitive products because of their strategic dimension for the economic development of the region. This rate is meant to promote a sector or to protect vulnerable sectors.	35%

Value Added Tax (VAT)

The normal VAT rate is the same within the three countries (18%). However, the three countries introduced a reduced rate on some products specific to each (Table 8). The reduced VAT rate is 5% in Mali and applies to computers, agricultural materials and solar materials production

(Table 7). The reduced rate is 9% in Cote d'Ivoire for a larger range of products such as milk, petroleum products, solar energy production, etc. In Senegal, accommodation and restaurant services benefit from a reduced VAT rate of 10%.

Table 8: Value Added Tax rates

Source: General tax codes, authors

VAT	Mali	Senegal	Cote d'Ivoire
Normal rate (%)	18	18	18
Reduced rate (%)	5	10	9

Many products are also exempted of VAT within each country. These products are generally first necessity products such as cereal and bread or pharmaceutical products (Table 9). Exempted products are not systematically the same for the three countries. Transportation services are for instance exempted in Cote d'Ivoire while they are not in the two other countries. Because exempted products are not the same might introduce difference of incidence of VAT across countries.

Table 9: Products benefiting from reduced and exempted VAT

Source: General tax codes, authors

VAT	**Mali**	**Senegal**	**Cote d'Ivoire**
Reduced	Computer and agricultural materials and solar energy production	Accommodation and restaurant services	Milk, hard wheat semolina pasta, petroleum products, solar energy production materials, etc. (see art 359)
Exempted	i. Export related to the sale and transformation of aircraft ii. Sale of unprocessed agricultural products iii. Bank and insurance services iv. Some first necessity products and pharmaceutical products (see art. 195)	i. Sales, imports and printing of books, newspapers ii. Bank and insurance services iii. Delivery of water and electricity within the limits of the social bracket iv. Delivery and sale of pharmaceutical products v. Butane gas for domestic use vi. Unprocessed or first necessity products (see art. 361)	Transportation (road, rail, river / sea, air), sales of unprocessed food for consumption, bread, cereal meal, medical member fees, educational activity, fertilizer, seeds, social bracket of water and electricity delivery.

Excise taxes

On top of VAT and tax on imports, the three countries raise excise taxes on some products. Table 10 presents the most relevant products regarding our study. Two similar categories of products are taxed across countries. First, alcohol is taxed at 40% at least in Senegal, 10 to 40% in Mali and 17 to 45% in Cote d'Ivoire. Second cigarettes are taxed in the three countries. The taxation rate is higher in Senegal with a range of 40 to 45% according to the type of cigarettes

while the rate varies between 10 and 40% in Mali. Unlike Senegal and Mali, Cote d'Ivoire has a single rate of 37% and does not differentiate according to the type of cigarettes. In Senegal, the excise tax applies to more products than in the two other countries. Beyond tobacco and alcohol, additional products such as perfumes, cosmetic products, sodas, butters/creams, coffee and tea are also taxed.

Table 10: Excise Tax

Source: General tax codes, authors

	Taxation rules		
	Mali	Senegal	Cote d'Ivoire
Champagnes, sparkling wines	10 to 45%	40% for any alcohol plus: i. 800 FCFA for alcohol of degree between 6 and 15 degrees. ii. 3 000 FCFA for alcohol of degree over 15 degrees.	40%
Ordinary wines			35%
Beers			17%
Other alcohol of degrees over 35			45%
Perfumes	_	10%	_
Soda and other beverages	0 to 20%	3%	_
coffee and tea	_	5%	_
Cheap cigarette	10 to 40%	40%	37%
Premium cigarettes		45%	
Butters, creams and substitutes, or mixtures containing butter or cream	_	12%	_
Other fatty substances	_	5%	_
Cosmetic products	_	10% (15% for depigmenting cosmetics)	_
Cola nuts	10 to 30%	_	_

Special taxes on fuel and petroleum products

Fuel and petroleum products are also subject to special taxes (Table 11). Contrary to other indirect taxes, these taxes are not proportional and apply to the volume consumed. The list of products concerned by this tax differs from a country to another except for ordinary gasoline which is taxed in the three countries. Levels in Senegal taxes are higher than in Mali and Cote d'Ivoire. For instance, tax on ordinary gasoline is 18 847 FCFA per hectoliter in Senegal while it is 7 528 FCFA in Mali and only 2 500 FCFA in Cote d'Ivoire. Another example is the Super fuel taxed at 20 665 FCFA per hectoliter in Senegal and only 8 500 FCFA in Cote d'Ivoire.

3.2. Tax allocation

The principle of a static model consists in allocating taxes, benefits and social contributions to each household in the sample. The CEQ framework considers three alternative allocation methods depending on the information available in the survey data Lustig and Higgins (2017). The first method is direct identification which is used when the survey allows identifying both the actual taxpayers (or beneficiaries) and the actual amount of tax paid (or benefit received). The second method is imputation which is used when the survey identifies taxpayers (or beneficiaries) but not the amount of tax paid (or benefits received). The third allocation

Table 11: Special taxes on oil products

Source: General tax codes, authors

Products	Taxation rules		
	Mali	Senegal	Cote d'Ivoire
Super fuel	–	20 665 FCFA per hectoliter	8 500 FCFA per hectoliter
Ordinary gasoline	7 528 FCFA per hectoliter	18 847 FCFA per hectoliter	7 500 FCFA per hectoliter
Gasoline for canoe	–	3 856 FCFA per hectoliter	–
Diesel fuel	4 007 FCFA per hectoliter	9 395 FCFA per hectoliter	2 500 FCFA per hectoliter
Petroleum	355 FCFA per hectoliter	–	–
Mineral oils	–	–	2 500 FCFA per hectoliter
Distillate Diesel Oil (DDO)	–	–	45 FCFA per kilo
Fuel oil (light, domestic, heavy)	–	–	10 FCFA per Kilo
Consistent grease	–	–	20 FCFA per kilo

method is simulation which is used when no information related to who actual pays or receive the benefit is reported in the survey. Given the data available in the surveys, simulation is the main method used to allocate taxes to households while imputation is used to allocate public spending in education.

Table 12 presents which category of tax is included in the model. On the direct taxes side, the model includes payroll taxes, social contributions, and personal income taxes. On the indirect taxes side, VAT and import taxes are simulated in the model.

3.2.1. Direct tax allocation

When the survey data does not report the actual direct taxes paid by households, these taxes must be simulated at the personal or household level. The simulation rests on two steps:

- Identifying taxpayers,
- Computing the amount paid by each taxpayer given its characteristics.

Personal Income Tax, Payroll Tax, and Social Contributions

Concerning the identification of taxpayers, we assume the Personal Income Tax (PIT), the Payroll Tax (PT) and Social Contributions (SC) are paid by all employees of the formal sector. Given that these taxes are withheld by the employer, the assumption is reasonable. The formal sector includes employees of public administration plus employees of private firms covered by social security or receiving a payslip.

Next, making use of the fiscal system rules and parameters for direct taxes in each country

Table 12: Category of tax revenue included in the microsimulation model

Source: IMF, Ministry of finance and Economy, authors' elaboration

	Mali (2011)			Senegal (Senegal 2012)			Cote d'Ivoire (2015)		
Taxes	Millions FCFA	%	Included	Millions FCFA	%	Included	Millions FCFA	%	Included
Total tax revenue	**873.9**	**100**	-	**1,430.0**	100	-	**3,117.9**	**100**	-
Direct taxes	**307.5**	**35**	-	**494.5**	**35**	-	**1,186.8**	**38**	-
Personal Income Taxes	57.6	7	YES	238.1	17	YES	395.6	13	YES
Social Security contributions	86.7	10	YES	95.4	7	YES	383.5	12	YES
Corporate Income Tax	113.3	13	NO	113.9	8	NO	318.9	10	NO
Other Direct Taxes	49.9	6	NO	47.1	3	NO	88.8	3	NO
Indirect taxes	566.4	65	-	935.5	65	-	1,931.1	62	-
VAT	282.2	32	YES	519.1	36	YES	732.5	23	YES
Import Taxes	112.1	13	YES	195.2	14	YES	490.1	16	YES
Excise taxes of which	16.1	2	-	79.8	6	-	33.1	0	-
- Oil	4.7	1	YES	53.8	4	YES	0.1	0	YES
- Non-oil	11.4	1	YES	26.0	2	YES	33.0	0	YES
Other Indirect Taxes	156.0	18	NO	141.4	10	NO	675.4	22	NO

(see section 4.1.1), one can compute the amount of tax paid by each taxpayer given its characteristics. As presented in section 4.1.1, beyond income, the important characteristics to be taken into account in the case of the personal income taxes are the marital status and the number of children. The model then combines information on characteristics and parameters to compute the amount of PIT, PT and SC paid by each individual.

Tax on self-employment income

In the case of self-employment income, we assume taxpayers are all those who declare to have paid taxes or who have a fiscal number. Beyond income, the variables to be taken into account are the sector of activity or products. The combination of this information with the tax rules (see section 4.1.2) allows to simulate the amount of taxes paid by each individual or household.

3.2.2. Indirect tax allocation

The allocation of the three indirect taxes (import duties, VAT, excise taxes) rests on the combination of (country specific) fiscal rules and parameters (see section 4.2) with information on each household expenditures. For instance, if a household h spends a given amount Y(h,i) on good i and if we know this good is subject to an indirect tax at a rate r(i), then we assume that the amount of indirect tax paid by the household will be equal to r(i)*Y(h,i).

While simple in principle, the actual allocation of indirect taxes raises a number of difficulties:

- The identification of goods that are subject to each tax (and tax rate) is not straightforward as the categories used in Tax Code differ significantly from the categories used in

the surveys. This can be seen when comparing the list of goods mentioned in the Tax Codes with the classification of goods used in the consumption module of the surveys (see Appendix B).

- In addition, the categories of goods vary between surveys, making it difficult to allow for "cross" simulations (see Appendix B)
- As mentioned in the "Data" section, expenditures are higher than income for a significant number of households. In some cases, this entails that the amount of indirect tax paid will be higher than household income.
- The location of purchase is unknown which is problematic because goods bought on informal markets are likely to evade some taxes.
- A significant portion of indirect taxes, for instance import duties and excise taxes, are raised on intermediate goods - e.g. wheat and petroleum. However, the information at the household level is on final consumption only.

In this study we tackle the first two issues. Concerning the classification of goods, a significant harmonization effort was undertaken to match all 3 survey-specific good classifications to a common harmonized classification (COICOP). Country-specific exemptions and rates for each tax are then applied.

Concerning the third issue, one option is to follow the CEQ strategy which is to compute the effective taxation rate of consumption at the household level given the structure of its expenditure and then apply that rate not to consumption but to each household's income (Lustig, 2018). This approach has two disadvantages however. First, it "neutralizes" the incidence of indirect taxes with respect to income. A more satisfactory method should account for the fact that richer households save a bigger share of their income and are thus taxed indirectly on a smaller share of their income, making indirect taxes regressive. The second disadvantage is related to the use of an incorrect tax base - income instead of consumption. This is problematic because it will bias the simulated aggregate fiscal income.

Concerning the last 2 issues (location of purchase and indirect taxation of intermediate goods), we leave their resolution to future work.

3.3. Benefit allocation

For a complete picture of fiscal incidence both the receipt side (the tax system) and the expenditure side (cash transfers and public spending) need to be taken into account. Concerning the latter, the distributional impact of the public sector's budget has been a topic of enduring interest for economists and policymakers (Castro-Leal et al., 1999). The main question to be addressed is how to measure the benefit that household derive from public spending. Measurement is not problematic for direct transfers since the monetary value of the benefit received is clear. But the problem arises when governments subsidize the provision of goods and services or when governments provide them free of charge. This makes it more difficult to account for the benefit obtained by the users of the service.

Two types of benefits are included in the model: social transfers and public education spending.

Social assistance transfers are incorporated in the model for Senegal and Cote d'Ivoire but not for Mali given the available data. The direct identification method is used to allocate the benefit since the surveys in these two countries identifies the beneficiaries and report the amount of benefits received.

Concerning education, the structure of public expenditure across levels is presented in table 13. Since the schooling status of individuals is collected in the survey, the actual beneficiaries of education spending can easily be identified except for Mali. However, the monetary equivalent of the benefit - i.e. the amount "received" by each household corresponding to its use of education services - has to be imputed.

Different approaches exist to value public services (Bastagli, 2015). The first is the opportunity cost method which consists in valuing public services by what an individual would spend if similar services were private, i.e. brought by the market. The second approach is based on estimating individuals willingness to pay which requires carrying out surveys to elicit WTP. These two approaches are very data intensive which motivates our choice to use the unitary cost of production approach. This approach consists in dividing total government spending on a particular service by the number of users of that service. We present the different steps and data used in the remainder of this section.

Government spending

Table 14 presents government spending on education and health collected from official documents. The source of the main documents are presented in table A2. The figures show that health expenditures represent a much smaller amount of public spending than education[9].

Estimates of number of users

Two sources of information are used to estimate the number of users (Table 15). The first source is official documents such as statistical yearbook or national report on education (table A2), the second is household survey data. The two sources of information yield similar figures except for Mali where public schools' students can not be identified due to the lack of information related to the type of school in the survey. As a result, the unit cost is likely to be underestimated in Mali if household survey data are used as estimates since they include both public and private school users. The percentage of students enrolled in private schools is estimated at roughly 22% for fundamental primary and 62.7%[10] for general secondary in 2010 providing hence a minimum magnitude of the potential upper bias of the household survey data estimates.

Concerning the number of users of health public service, the available data does not provide enough information to compute credible estimates. First, official documents are insufficiently

[9]In the remainder of this report, we will focus on education expenditure, also because the allocation of public health expenditures at the household level requires estimating models of health risk. This is left for future work.

[10]UNESCO (2015), Diagnostique de la question enseignante en République du Mali, Bureau de Bamako.

Table 13: Category of expenditure included in the microsimulation model

Source: Statistical yearbook, Ministry of education, Ministry of budget, authors' elaboration

Country	Category	Amount (billions FCFA)	% total	Included	Allocation method
Mali (2011)	Total expenditure	1216	100	-	-
	Social assistance & subsidies	**164**	**13**	**NO**	-
	Education	**256**	**21**		
	Basic education	183	15	YES	Simulation
	Secondary and tertiary education	73	6	YES	Simulation
	Health	**82**	**7**	**NO**	-
Senegal (2011)	Total expenditure	1980	100	-	-
	Social assistance	**37**	**3**	**YES**	Direct identification
	Subsidies	**155**	**13**	**NO**	-
	Education	**445**	**22**		
	Preschool	1	0	YES	Imputation
	Elementary	190	10	YES	Imputation
	Middle and general secondary	113	6	YES	Imputation
	Tertiary	104	5	YES	Imputation
	Technical and professional training	28	1	NO	–
	Non formal training	1	0	NO	–
	Administrative management	8	0	NO	–
	Health	**99**	**5**	**NO**	–
Cote d'Ivoire (2015)	Total expenditure	4970	100	-	-
	Social assistance	**180**	**4**	**YES**	Direct identification
	Subsidies	**140**	**3**	**NO**	-
	Education	909	18	-	
	Preschool	22	0	YES	Imputation
	Elementary	373	8	YES	Imputation
	General secondary 1	167	3	YES	Imputation
	General secondary 2	102	2	YES	Imputation
	Professional and technical formation (sec. + post. sec.)	70	1	NO	–
	Alpha. And non-formal education	5	0	NO	–
	Tertiary	171	3	YES	Imputation
	Health	**280**	**6**	**NO**	–

detailed. Second, while household surveys include information about the use of health service, the recall period is less than on month and does not allow to estimate the annual users of health service. Given the lack of the data on the users of health public survey, we are not able to estimate the unit cost of this service.

Estimation of unit cost of education

Levels of education are harmonized for comparative analysis purpose between Senegal and Cote d'Ivoire (Table 16). Four levels are considered: preschool, primary, secondary and tertiary.

Table 14: Education and health expenditure

Source: General tax codes, authors

Country	Category	Amount (billions FCFA)	Total (% total expenditure)
Mali (2011)	Total expenditure	1215.7	100.0
	Education	256.4	21.1
	|Basic education	183.0	15.1
	|Secondary and tertiary education	73.0	6.0
	Health	81.6	6.7
Senegal (2011)	Total expenditure	1980.2	100.0
	Education	444.5	22.4
	|Preschool	1.4	0.1
	|Elementary	189.8	9.6
	|Middle and general secondary	113.1	5.7
	|Tertiary	103.8	5.2
	|Technical and professional training	28.1	1.4
	|Non formal training	0.9	0.0
	|Administrative management	7.5	0.4
	Health	98.90	5.0
	|National hospitals and intermediary level	67.6	3.4
	|Peripheral level	31.3	1.6
Cote d'Ivoire (2015)	Total expenditure	4970.1	100.0
	Education	909.3	18.3
	|Preschool	22.2	0.4
	|Elementary	373.2	7.5
	|General secondary 1	166.6	3.4
	|General secondary 2	101.7	2.0
	|Professional and technical formation (sec. + post. sec.)	69.7	1.4
	|Alpha. And non-formal education	4.8	0.1
	|Tertiary	171.1	3.4
	Health	279.5	5.6

Table 15: Number of users of education public service

Source: General tax codes, authors

Country	Category	Estimated from	
		Official sources (millions)	Household survey data (millions)
Mali (2011)	Fundamental Education	1.8	2.8
	Secondary and Higher Education	0.1	0.6
	Total	1.9	3.2
Senegal (2011)	Preschool	0.0	0.0
	Elementary	1.5	1.4
	Middle and general secondary	0.7	0.8
	Tertiary	0.1	0.1
	Total	2.3	2.4
Cote d'Ivoire (2015)	Preschool	0.1	0.1
	Primary	2.8	2.9
	General secondary 1	0.6	0.7
	General secondary 2	0.2	0.2
	Tertiary	0.1	0.1
	Total	3.8	4.0

Based on this harmonization, we compute unit cost by dividing the expenditure and the number of users associated to each level of education[11] (Table A5). In overall, total education

[11]We use estimates from household surveys for Cote d'Ivoire and Senegal. Regarding Mali's number of users, we use administrative data figures given the lack of information in Mali's household survey.

Table 16: Correspondence of education levels

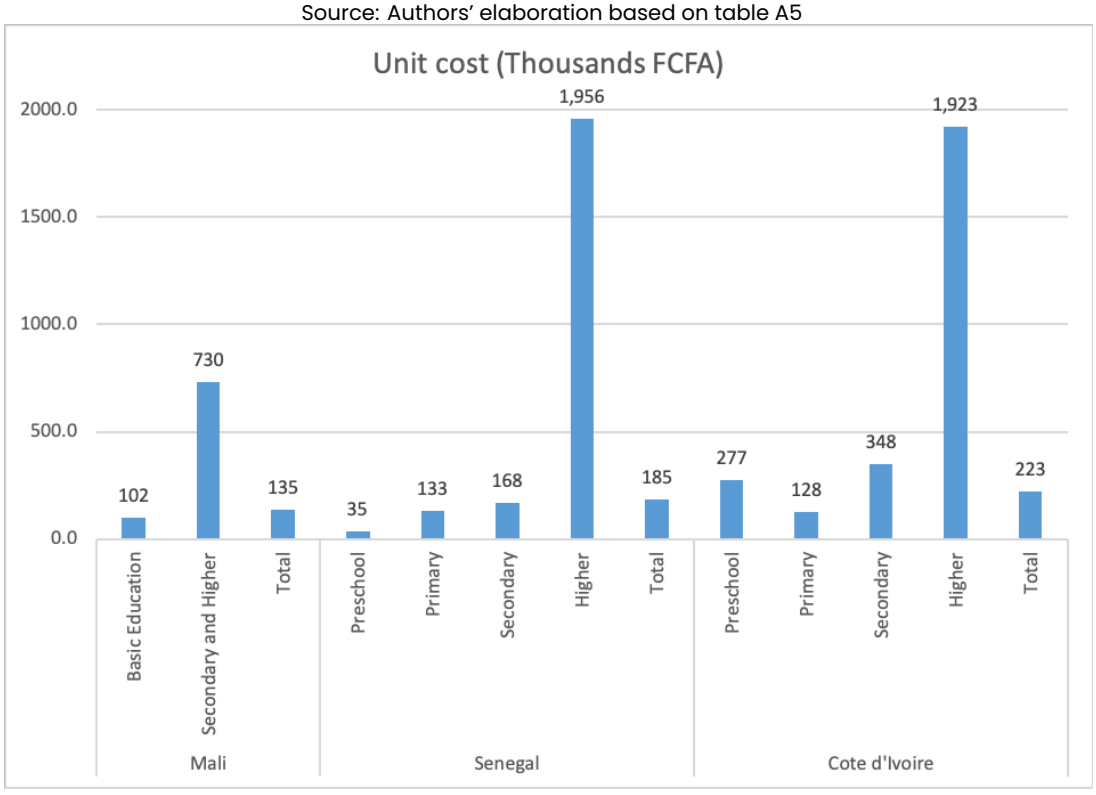
Source: General tax codes, authors

Harmonized category	Category collected from official documents	
	Senegal	Cote d'Ivoire
Preschool	Preschool	Preschool
Primary	Elementary	Primary
Secondary	Middle and general secondary	General secondary 1
	-	General secondary 2
	Technical and professional training	Professional and technical formation (sec. + post. sec.)
Tertiary	Tertiary	Tertiary

unit cost is significantly higher in Cote d'Ivoire and Senegal compared to Mali. The difference goes from 30 to 80 thousands FCFA representing between 22% and 65% of Mali's unit cost. This unit cost is considered as the monetary equivalent of the benefit for Cote d'Ivoire and Senegal. In Mali, this unit cost will be adjusted by the probability for the household to use public education service (Table A5). This probability is estimated by the ratio of the number of users provided by the household survey and the administrative data for a given education level[12]. The comparison across education level in the three countries shows in furthermore a positive correlation between unit cost and the level of education (Figure 12). The higher is the education level, the higher is the unit cost.

Figure 12: Unit cost of education public service

Source: Authors' elaboration based on table A5



[12]The probability is estimated at 64.3% for fundamental education level and 16.7% for secondary and higher education level

3.4. Calibration

3.4.1. From survey income to market income

Since direct taxes on (formal) wages are withheld by the employer in all three countries, the wage income collected by the survey corresponds to the concept of ”disposable” wage income. As a result, it is necessary to compute for each individual his or her ”market” wage income. This is done by simulating the direct tax rules ”backwards”.

3.4.2. From survey income aggregate to national accounts aggregates

The three household samples used in this study are representative at the national level. This in principle implies that properly weighted income and consumption aggregates computed using survey data should be equal to corresponding national accounts aggregates for each country in the year of the survey. There are however at least three sets of reasons why this might not be the case. The first reason is related to sampling and non-response bias, in particular at the top of the income distribution. Indeed, rich households are more difficult to reach and are more likely to decline to participate to the survey. As a result, they are under represented in the sample. Second, incomes at the individual or household level are likely to be underestimated, either because individuals do not remember all their sources of income, or because they are inclined to omit or hide some income sources, or because the design of questionnaires does not allow to properly report and measure all income sources. A third reason is related to the fact that aggregate income concepts include some income (e.g. undistributed profits) that are not reported in household surveys. A number of techniques have been developed to try and correct for all these sources of underestimation and bias (see for instance Alvaredo et al. (2016)). Here, for lack of more informed assumptions, we simply rescale all income components in order to match official national accounts aggregates of household income. This rescaling assumption leaves income distribution between households unchanged.

4. Simulation results

4.1. Targeting fiscal aggregates

As presented in section 2.2, the OpenFisca platform is a tax-benefit calculator that allows simulating fiscal incidence either for individuals (or households) with given characteristics or for a full sample of households. When the household sample is representative at the national level, weighted fiscal aggregates simulated by the calculator should correspond to fiscal accounts data. For instance, the weighted sum of income taxes paid by each individual (or household) should be equal to the fiscal receipt of the income tax. However, depending on the assumptions of the model (see above), some discrepancies are to be expected. This is for instance the case for indirect taxation since the current models simulate the taxation of final

consumption goods only and not that of intermediate goods[13]. Some of these discrepancies can be seen in Table 17 where fiscal receipts from national accounts are reported ("actual") as well as simulated receipts to asses how they perform in terms of targeting. Two versions of simulated aggregates are reported: one takes the household data as given ("direct"), while the other provides aggregates obtained once the data has been rescaled ("inflated") as explained in section 4.2.2.

Numbers in table 17 indicate that the ability of the model to simulate fiscal aggregates for direct taxation (personal income taxes and social security contributions) is acceptable when household incomes and consumption have been inflated. For instance, in Cote d'Ivoire, actual income taxes in 2014 were 395.6 billion FCFA and the "inflated" simulated aggregate is 326.9 billion FCFA. In the case of Senegal, the inflated simulation "overshoot" the actual numbers: for instance the "inflated" simulated aggregate is 270.4 billion FCFA while the actual number of 238.1 billion FCFA. Results for Mali are much less satisfactory which is consistent with the fact that the EMOP survey omits many income sources and probably underestimates formal wages (see section on Data).

As explained above, the case of indirect taxation is different. The current version of the microsimulation model does not account for indirect taxes paid on intermediate consumption. As a result, one expects to obtain much smaller simulated aggregates than actual aggregates. This is indeed the case in all three countries for custom duties. However, when using the inflated version of the data, the microsimulation model "overshoots" VAT receipts in Mali and Senegal by more than 20%. This can be explained by the fact that the model does not account for the fact that some goods are sold on informal markets and evade the payment of VAT.

Table 17: Targeting fiscal aggregates

Source: IMF, OECD, Ministry of finance and Economy, authors' elaboration

	Mali			Senegal			Cote d'Ivoire		
	Actual	Direct	Inflated	Actual	Direct	Inflated	Actual	Direct	Inflated
Total tax revenue	711	256	449	1128	680	1181	3118	1196	1392
Direct taxes & SSC	144	27	68	334	265	378	1187	446	638
|Personal Income	58	7	38	238	162	270	396	179	327
|Social Security (SSC)	87	20	30	95	103	107	384	267	311
|Corporate Income	113	NI	NI	114	NI	NI	319	NI	NI
|Other Direct	50	NI	NI	47	NI	NI	89	NI	NI
Indirect taxes	566	229	381	794	415	803	1931	750	753
|VAT	282	208	346	519	342	662	733	559	562
|Import Taxes	112	21	35	195	73	141	490	191	191
|Excise taxes	16	NI	NI	80	NI	NI	33	NI	NI
|Other Indirect	156	NI	NI	141	NI	NI	675	NI	NI

4.2. Fiscal incidence

As explained above, the microsimulation model simulates different sets of income in each country. Following the CEQ framework, we focus on 4 main income concepts: market income, disposable income, consumable income and final income.

We first report inequality indicators of each income concept for each country. The comparison

[13] This will be included in a future version of the model.

of these indicators provides both a global view of the progressivity or regressivity of each fiscal system and a more specific diagnostic of the distributional impact of the three main components of the fiscal system: direct taxes, indirect taxes, and public spending.

Figure 13 presents the Gini coefficient and the income shares of the bottom 40% and of the top 10% for each income concept. Results are relatively similar across countries and can be summed up as follows:

- the distributional impact of fiscal systems is overall slightly progressive but very small,
- direct taxation is slightly progressive,
- indirect taxation is regressive,
- public spending is progressive.

More precisely, the data indicates that the fiscal system reduces the Gini coefficient by 1 to 3 points overall. Direct taxation contributes to that reduction in Senegal and Cote d'Ivoire but not in Mali. Instead, indirect taxation appears highly regressive as it increases the Gini coefficient by up to 5 points in Mali. However, public spending compensates for that effect as it reduces the Gini coefficient by 4 points in Senegal, 3 points in Cote d'Ivoire and 6 points of Gini in Mali. Results using income shares are similar.

Figure 13: Fiscal and public spending incidence

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations based on table A7, A8 and A9

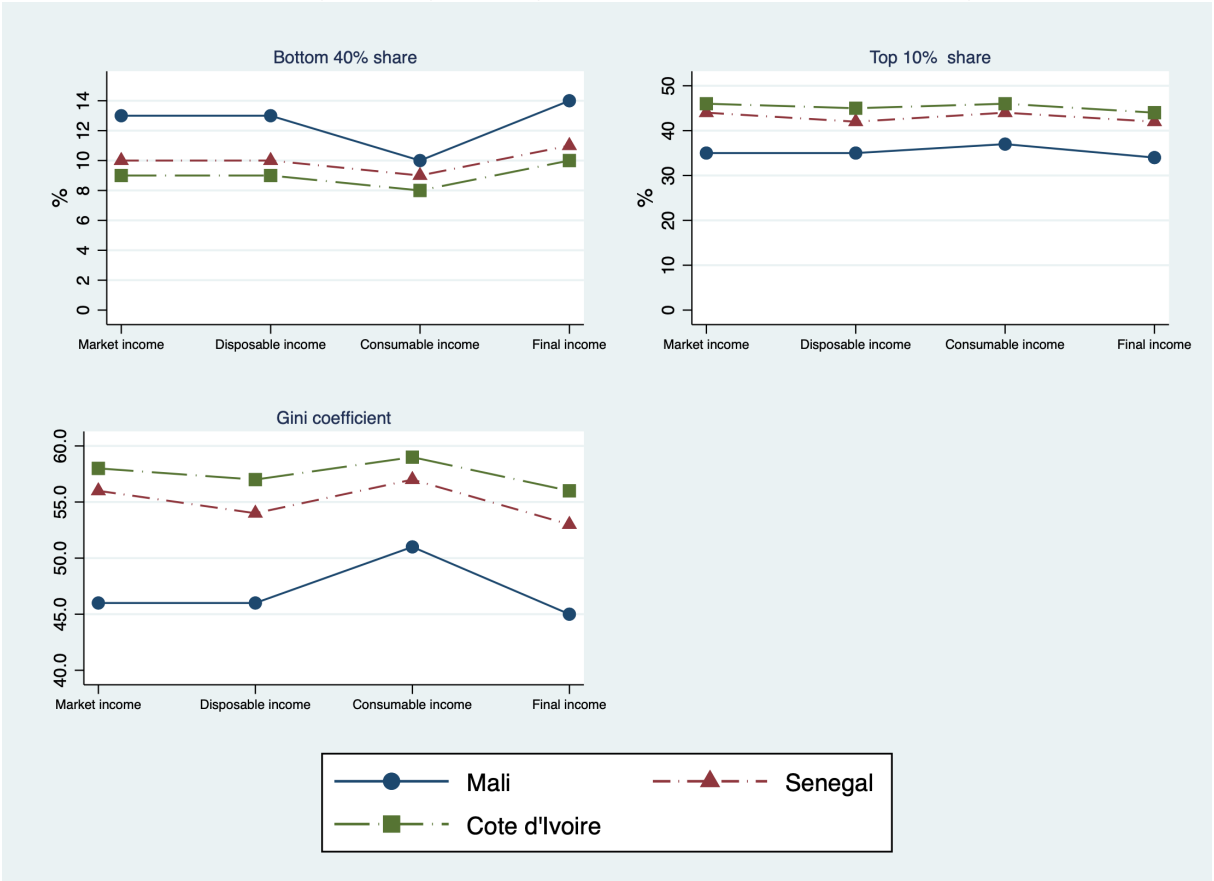
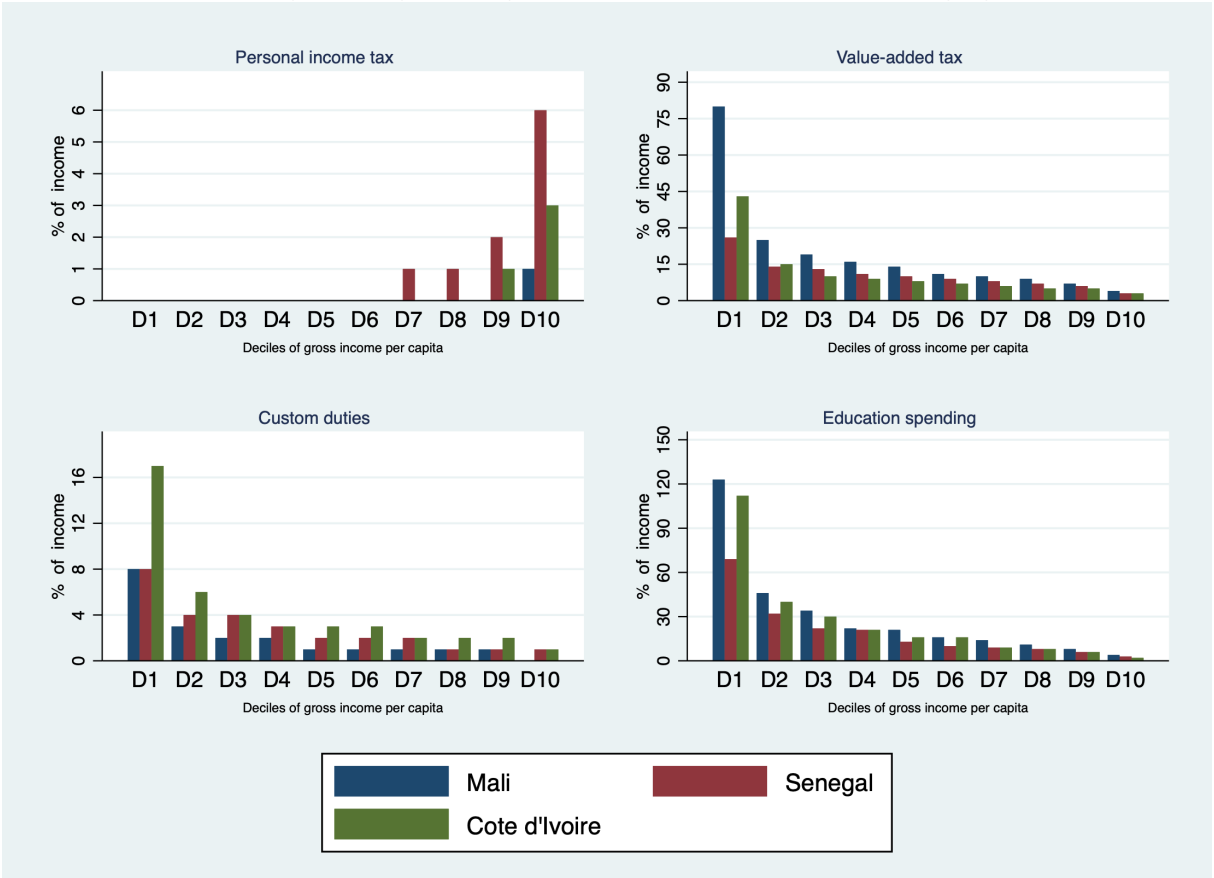


Figure 14 reports the incidence of the main fiscal instruments (PIT, custom duties, VAT, education spending) for each decile of per capita market income[14]. Results are consistent with those of the CEQ analysis and can be summed up as follows:

- the incidence of the PIT is progressive in the three countries but some difference are worth highlighting: in Senegal, the top 4 deciles have a positive incidence in Senegal, while only the top 2 deciles in Cote d'Ivoire and the top 10% in Mali.
- Both the VAT and custom duties are regressive with higher rates of incidence for poorer deciles. This seems to be specially the case for Mali where the incidence of VAT is 27% for the second poorest decile while it is only 5% for the top decile[15].
- Public spending in education is progressive in all 3 countries, more so in Mali and Cote d'Ivoire than in Senegal. The incidence of education spending can be explained by different factors. The reason why it appears more progressive in Mali might be related to the fact that primary education represents a higher share of public education spending than in the other two countries (see table 13).

Figure 14: Fiscal and public spending incidence by decile

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations based on table A10, A11, A12 and A13



[14] Incidence is equal to the ratio of the amount of tax paid (or benefit received) to market income.

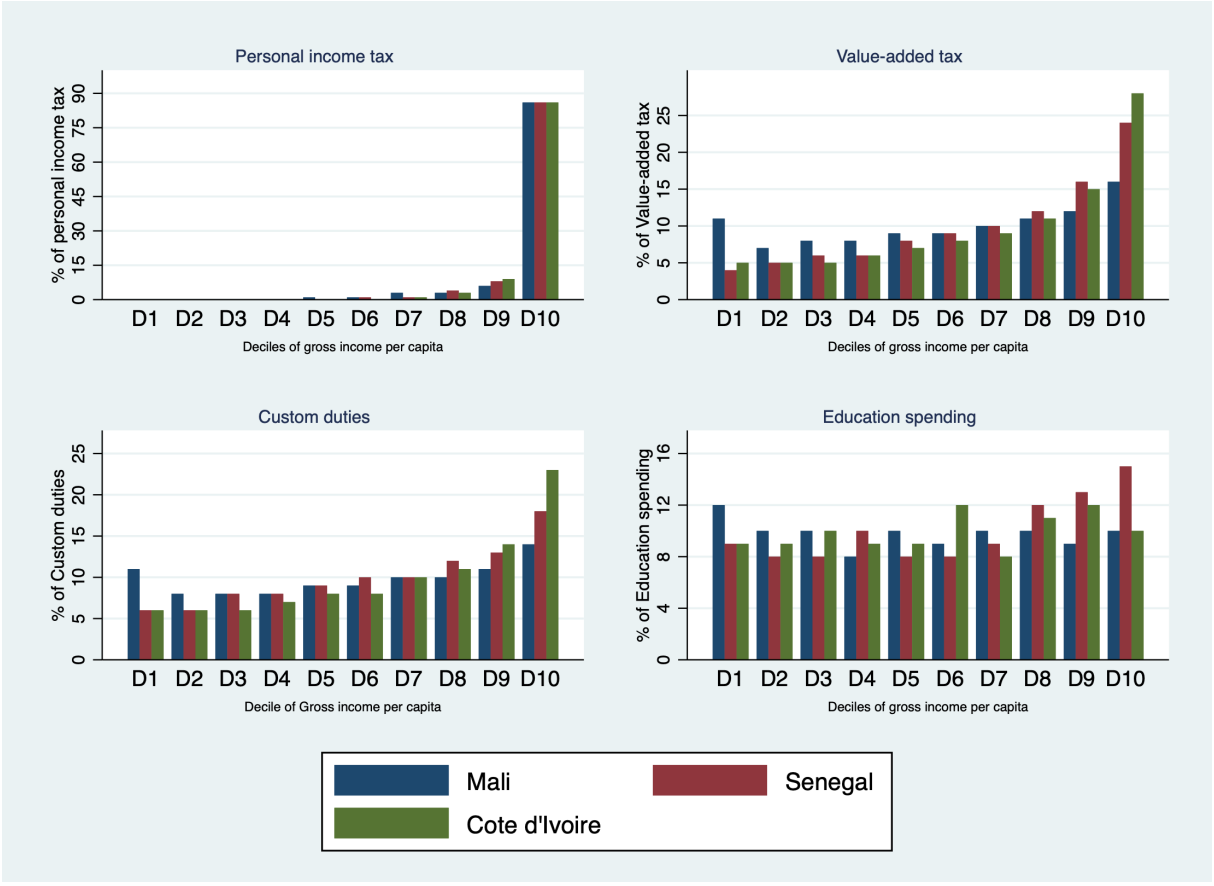
[15] We do not comment on the values for the bottom decile where the issue of zero incomes mentioned in the data section may lead to overestimate the rates of incidence.

Figure 15 reports the concentration shares of the main fiscal instruments (PIT, custom duties, VAT, education spending) for each decile[16]. Results can be summed up as follows:

- In all 3 countries, the top 10% contribute 86% of the fiscal income of PIT.
- Concerning indirect taxes, the contribution of the top 10% varies from 14% in Mali to 23% in Cote d'Ivoire for custom duties, and from 16% in Mali to 28% in Cote d'Ivoire for VAT.
- The concentration shares of education spending are relatively uniform across deciles in Cote d'Ivoire and Mali and slightly skewed towards the top decile in Senegal which gets 15% of total education spending. This could be related to the fact that Senegal spends a higher share of public education spending on tertiary education than the other two countries (see Table 13).

Figure 15: Fiscal and public spending concentration shares

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations based on table A14, A15, A16 and A17

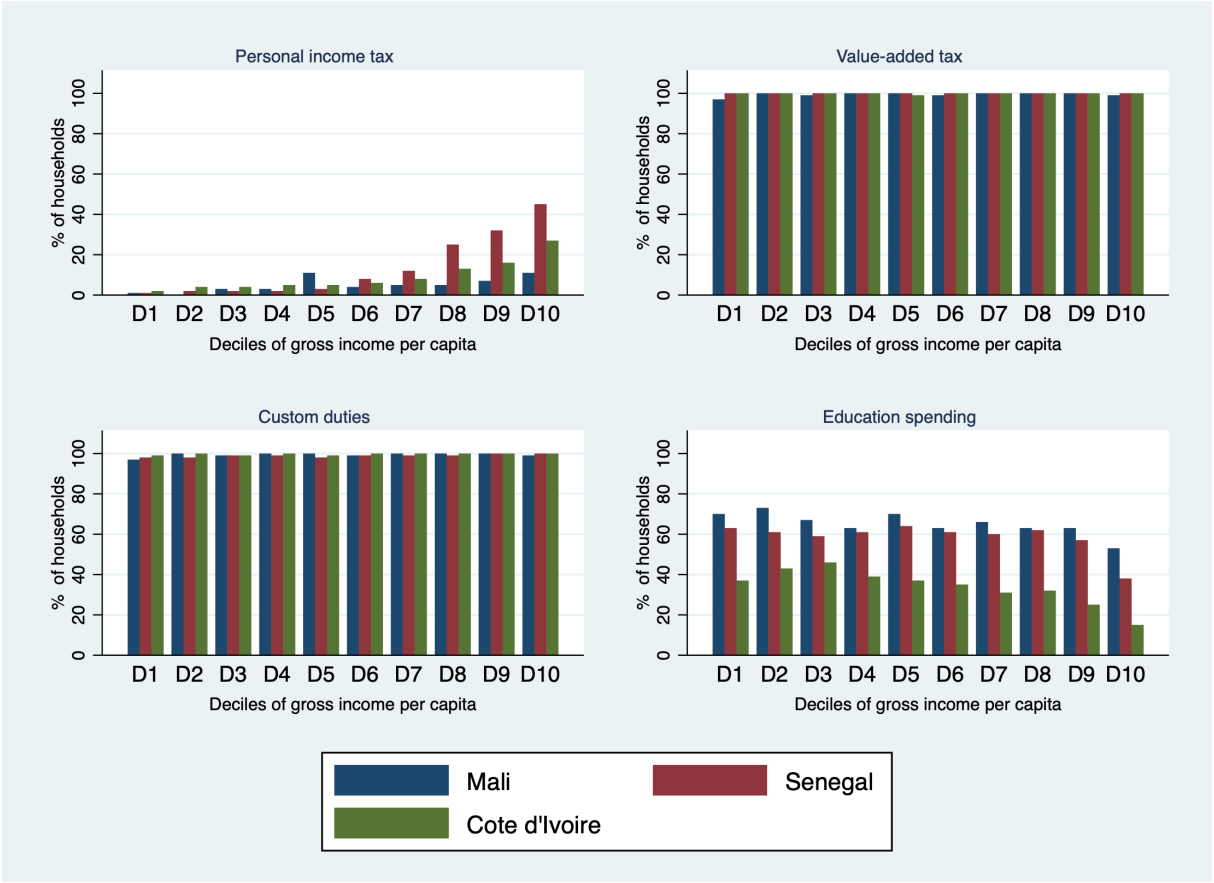


[16] Concentration shares are equal to the ratio of the amount of tax paid (or benefit received) by each decile to the total fiscal income (or cost). The sum of concentration shares is equal to 100%.

Figure 16 reports the proportion of taxpayers (or beneficiaries) in each decile. Not surprisingly, the proportion of PIT taxpayers is close to zero for the bottom decile and increases steadily with income, indirect taxes are paid by all households across the distribution, and the proportion of beneficiaries of public education decreases slightly with income. One result stands out: in all 3 countries the proportion of PIT taxpayers in the top decile is relatively low. Across countries, it varies from a dismal 11% in Mali to 45% in Senegal. This result helps explain why the redistributive impact of direct taxation is small.

Figure 16: Taxpayers and beneficiaries of in-kind transfers

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations based on table A18, A19, A20 and A21



4.3. Discussion

The main results described above are consistent with those obtained in other CEQ case studies (Lustig, 2018): fiscal systems are redistributive overall, direct taxes are progressive, indirect taxes are regressive, and public spending is progressive.

Two results stand out however. First, the degree of regressivity of indirect taxes is very high. While indirect taxes are expected to be regressive with respect to income (since they are raised on a higher share of income for poorer households), at least 4 features of indirect taxation are expected to be progressive and thus have a mitigating impact on the regressive "character" of indirect taxes. These features are:

- VAT is not raised on goods sold in informal markets.
- VAT is not raised on own consumption.
- Food products and "basic necessities" are exempted from VAT (See Table 9).
- Social goods are exempted from taxes on imports (See Table 9).

Since the location of purchase is unknown, we cannot account for the first feature but the last 3 features are accounted for in the model. However, they do not seem to weight enough to make indirect taxes progressive.

The second striking result is the low proportion of PIT taxpayers in the top decile which can explain the small redistributive impact of direct taxation which is revealed both in the CEQ analysis and in the incidence analysis. The low proportion is related to the share of formal wage workers in each country. It is possible that the model results underestimate the proportion of PIT taxpayers since individuals outside the formal sector also have the possibility of declaring their incomes to the administration. They are unlikely to be many, however.

These results point to a few general policy recommendations:

- PIT should be made more progressive by increasing the number of its taxpayers.
- VAT exemptions should be reexamined to insure that their impact is progressive.
- Public spending in education should be increased.

5. Conclusion

In the context of the "Collect More, Spend Better" Agenda, it is important to understand how existing tax and benefit fiscal systems impact poverty and income distribution in aid recipient countries. Using country specific tax benefit calculators and recent household survey data, this paper attempts to address this question by analysing and comparing the incidence of benefit, tax and public spending in three western African countries: Cote d'Ivoire, Mali and Senegal.

The analysis allows providing some answers to the questions raised in the introduction.

- Who pays direct and indirect taxes and who benefits from transfers and public spending?

  - Formal wage workers pay the bulk of direct taxation; they belong mainly to the top decile of the income distribution.
  - Indirect taxes are paid by all households, including the poorest deciles.
  - Public spending in education benefits households from all the deciles of the income distribution.
  - Social transfers beneficiaries represent a very small number of households
  - Results are similar across countries
- What is the global impact of tax and benefit systems on inequality?
  - The distributional impact of existing fiscal systems is slightly progressive but small.
- Which tax instruments will allow raising domestic resources while achieving poverty and inequality reduction?
  - The PIT is progressive. In order to increase receipts while achieving poverty and inequality reduction, it should be extended to a much higher proportion of top decile households.
  - Indirect taxation is regressive, VAT exemptions should be examined at the country level.
  - Public spending is progressive. Raising public expenditure in the primary sector should allow increasing quality while maintaining that progressivity. However, higher education should not be sacrificed.
- How do country characteristics interact with tax and benefit system parameters to determine the incidence of tax benefit systems?
  - The low proportion of PIT taxpayers in Mali - and its related low redistributive power- can be explained by the small number of formal wage workers in Mali.
  - The higher redistribution achieved through education spending in Mali can be explained by the high share of spending going to the primary level compared to Senegal and Cote d'Ivoire.

Two last important points concern the data used in the microsimulation models. As mentioned, the data comes from three representative household surveys collected in 2011 in Mali and Senegal and 2014 in Cote d'Ivoire. In order to compare results across countries and allow for the possibility of cross-simulations[17], it is important to make the data as comparable as possible: ideally, income and consumption constructs should be strictly identical across countries. This is unfortunately not the case since National Statistical Offices use widely different questionnaires designs both on the income and the expenditure side (see section 2.3)[18]. This is a source of concern. First, carrying out cross country analysis entails a huge effort of harmonization between surveys. Second, even after this huge effort, the comparison remains problematic because the process of harmonization is imperfect. This calls for significant changes in the process of data collection in aid recipient countries. While not

[17] This is not undertaken here and is left for future work.

[18] This problem is also found within countries when surveys collected in different years use different questionnaire designs, which is unfortunately often the case

all household surveys can be made identical, the objective of comparison across countries should be given more importance when designing questionnaires.

A second point concerning to data relates to the quality of the data collected. Household survey collection is a difficult task. Yet, household survey data is key to analyse different types of policy questions in particular related to poverty and income distribution. More efforts and resources should be invested in the collection of good quality household survey data at the national level.

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Appendix

Table A1: Tax on securities income

Source: General tax codes, authors

Categories	Senegal	Mali	Cote d'Ivoire
Dividends	10%	10%	10% to 15%
Interests from Bank saving account	8%	9%	1% to 13.5%
Other securities income	16%	18%	18%

Table A2: Official sources exploited on Education sector

Country	Main official documents exploited	
	Government spending	Number of users
Mali	IMF Country Report No. 13/44, February 2013, pp 10	Annuaire statistique 2011 UNESCO 2015, Rapport de l'Etude Diagnostique de la question enseignante en republique du Mali, bureau de Bamako.
Senegal	Ministère de l'Education nationale (2012) Rapport national sur la situation de l'éducation, pp. 110 et ANSD (2015) Situation économique sociale du Sénégal en 2012, pp. 84	Ministère de l'Education nationale (2012) Rapport national sur la situation de l'éducation, pp. 110 et ANSD (2015) Situation économique sociale du Sénégal en 2012, pp. 84
Cote d'Ivoire	UNESCO's National Education Accounts	Annuaire statistique 2014-2015

Table A3: Amount of synthetic tax in Cote d'Ivoire (art. 77)

Source: Cote d'Ivoire general tax codes, authors

Range of turnover (FCFA)		Amount of tax (FCFA)
Lower bound	Upper bound	
-	5,000,000	-
5,000,001	6,000,000	491,400
6,000,001	7,000,000	573,300
7,000,001	8,000,000	655,200
8,000,001	9,000,000	737,100
9,000,001	10,000,000	819,000
10,000,001	11,000,000	900,000
11,000,001	12,000,000	982,000
12,000,001	13,000,000	1,064,000
13,000,001	14,000,000	1,146,600
14,000,001	15,000,000	1,228,500
15,000,001	16,000,000	1,310,000
16,000,001	17,000,000	1,392,000
17,000,001	18,000,000	1,474,200
18,000,001	19,000,000	1,556,100
19,000,001	20,000,000	1,638,000
20,000,001	21,000,000	1,719,900
21,000,001	22,000,000	1,801,800
22,000,001	23,000,000	1,883,700
23,000,001	24,000,000	1,965,600
24,000,001	25,000,000	2,047,500
25,000,001	26,000,000	2,129,400
26,000,001	27,000,000	2,211,300
27,000,001	28,000,000	2,293,200
28,000,001	29,000,000	2,375,100
29,000,001	30,000,000	2,457,000
30,000,001	32,000,000	2,480,000
32,000,001	34,000,000	2,640,000
34,000,001	36,000,000	2,800,000
36,000,001	38,000,000	2,960,000
38,000,001	40,000,000	3,120,000
40,000,001	42,000,000	3,280,000
42,000,001	44,000,000	3,400,000
44,000,001	46,000,000	3,600,000
46,000,001	48,000,000	3,760,000
48,000,001	50,000,000	3,920,000

Table A4: Number of consumption items by category

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' elaboration

Category	Mali	Senegal	Cote d'Ivoire
Food	21	54	128
Other	14	6	12
Combustible	3	5	7
Education	3	5	11
Equipment	32	56	48
Ceremonies	2	2	2
Info & communication	4	6	8
Dwelling and related charges	9	8	3
Health	5	9	9
Textile/footwear/jewelry	4	5	8
Transport	3	4	5
Water/electricity	2	5	7
Total	102	165	248

Table A5: Unit cost of education public service by country- Mali, Senegal and Cote d'Ivoire

Source: authors' elaboration based on administrative data

Country	Harmonized category	Spending (billions FCFA)	Number of users (millions)	Unit cost (Thousands FCFA)	Adjusted Unit cost (Thousands FCFA)
Mali	Basic Education	183.0	1.8	101.6	65.4
	Secondary and Higher Education	73.0	0.1	730.0	121.7
	Total	256.0	1.9	134.7	75.3
Senegal	Preschool	1.4	0.0	34.9	_
	Primary	189.8	1.4	133.2	_
	Secondary	141.2	0.8	168.0	_
	Higher	103.8	0.1	1956.3	_
	Total	436.2	2.4	184.9	_
Cote d'Ivoire	Preschool	22.2	0.1	276.8	_
	Primary	373.2	2.9	128.0	_
	Secondary	338.0	1.0	348.1	_
	Higher	171.1	0.1	1922.5	_
	Total	904.5	4.1	223.1	_

Source: General tax codes, authors

Table A6: Tax on property income

	Senegal			Mali			Cote d'Ivoire		
Category	Theorical fiscal population	Taxation basis	Taxation rules (amount expressed in FCFA)	Theorical fiscal population	Taxation basis	Taxation rules	Theorical fiscal population	Taxation basis	Taxation rules
Tax on rental income	Individuals whose rental income exceeds 3 millions FCFA.	Rental income after reduction of charges	Same as tax on wages	Individuals with rental income	Gross rental income including charges	* 15% for buildings in hard and semi-hard * 10% for buildings built with banco	Individuals with rental income	Gross rental income including charges	3%
Overall land contribution	Individuals whose rental income is lower than 3 millions FCFA.	Rental income after reduction of charges	i. 1 to 1 800 000: 8% ii. 1 800 001 to 2 100 000: 10% iii. 2 100 001 to 2 400 000: 12% iv. 2 400 001 to 3 000 000: 14%	–	–	–	–	–	–
Tax on built properties	Owner of built proprieties	Market value	5%	–	–	–	Owner of built proprieties	Market value	i. 3% when: - One building occupied as main dwelling - Only one secondary residence for personal use - Built properties remained vacant for 6 months ii. 9% otherwise

Tax on unbuilt properties	Owner of built proprieties	Market value	5%	–	–	–	Owner of unbuilt proprieties such as urban buildings, At least 100 hectares of exploitation of hevea, cocoa, coffee, bananas, etc.	Market value	i. 1.5 % ii. Regarding agricultural properties, a flat tax: - Hevea 7 500 FCFA/ha - Cacao, Coffee, Banana, Pineapple, coconut, 5 000 - etc. (see art 165)

Figure A1: Population structure by gender and area of residence

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' calculations

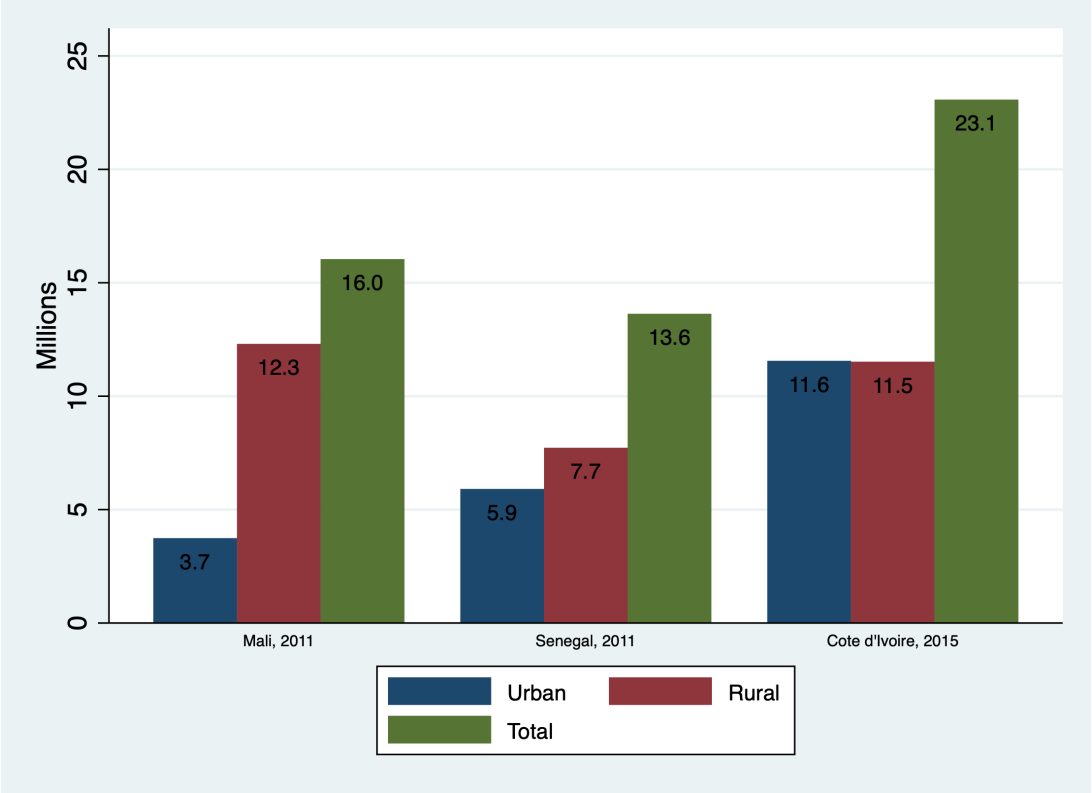
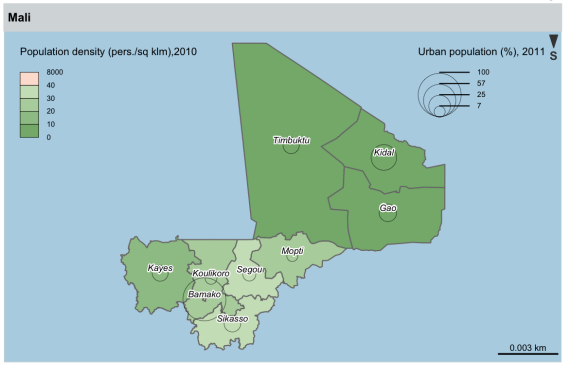
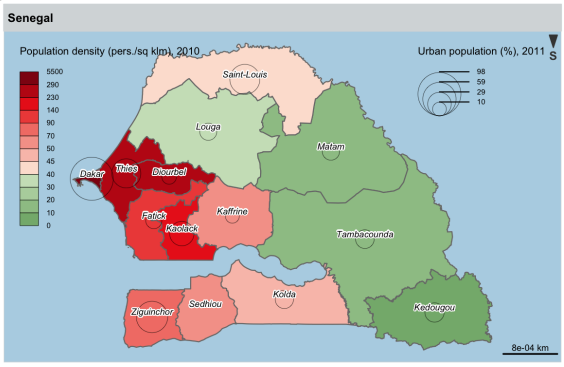
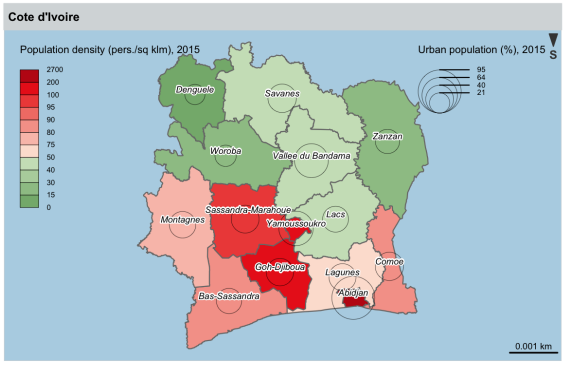


Figure A2: Population density and share of population in capital city

Source: Gridded Population of the World V4 (UN adjusted values), EMOP-2011, ESPS-2011, ENV-2014, authors' elaboration







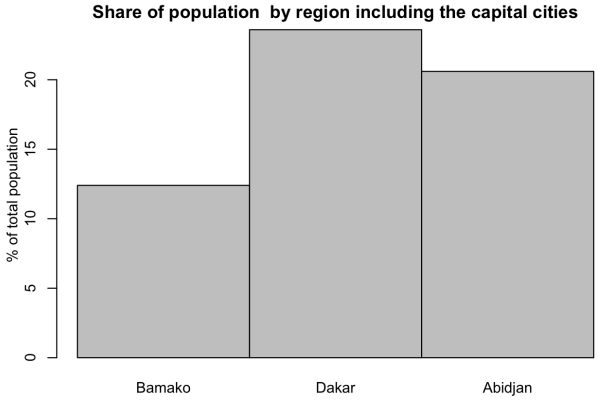


Figure A3: Population structure by age and by gender

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' elaboration

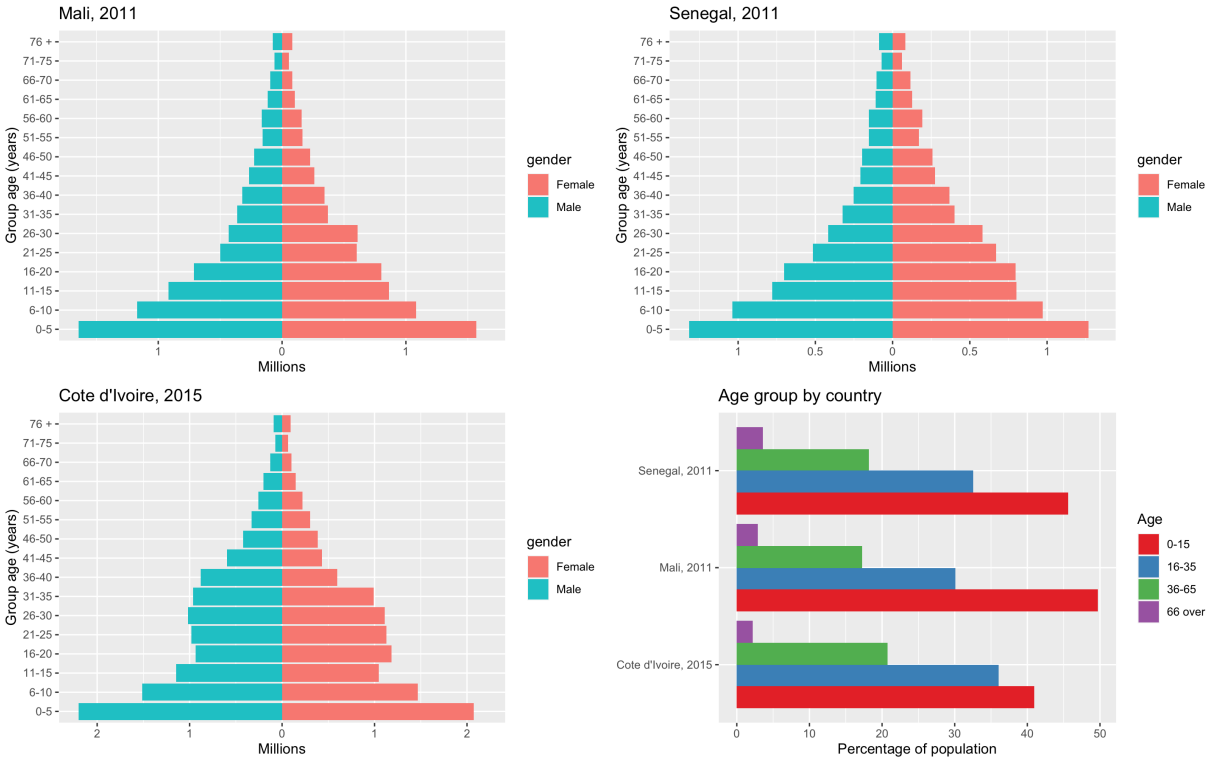


Figure A4: Education level of population

Source: EMOP-2011, ESPS-2011, ENV-2014, authors' elaboration

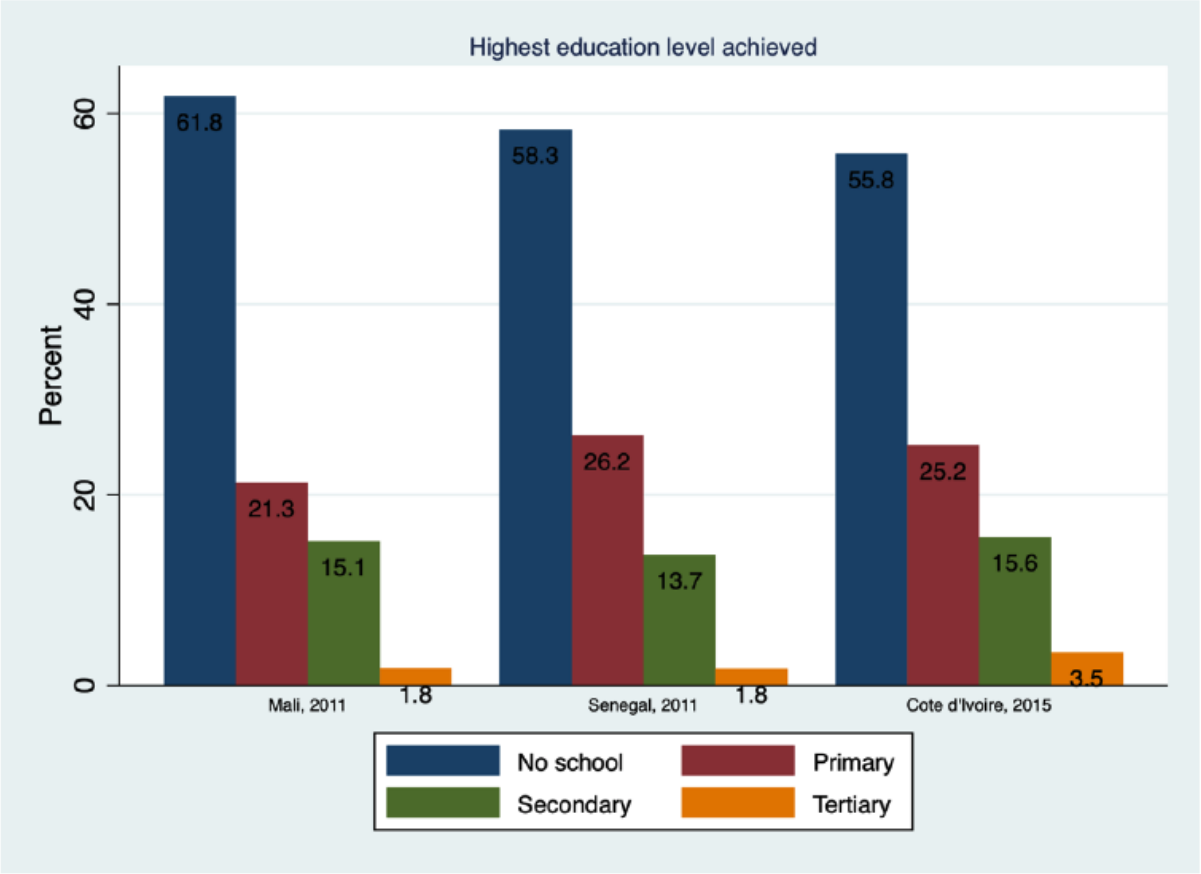


Figure A5: Household structure

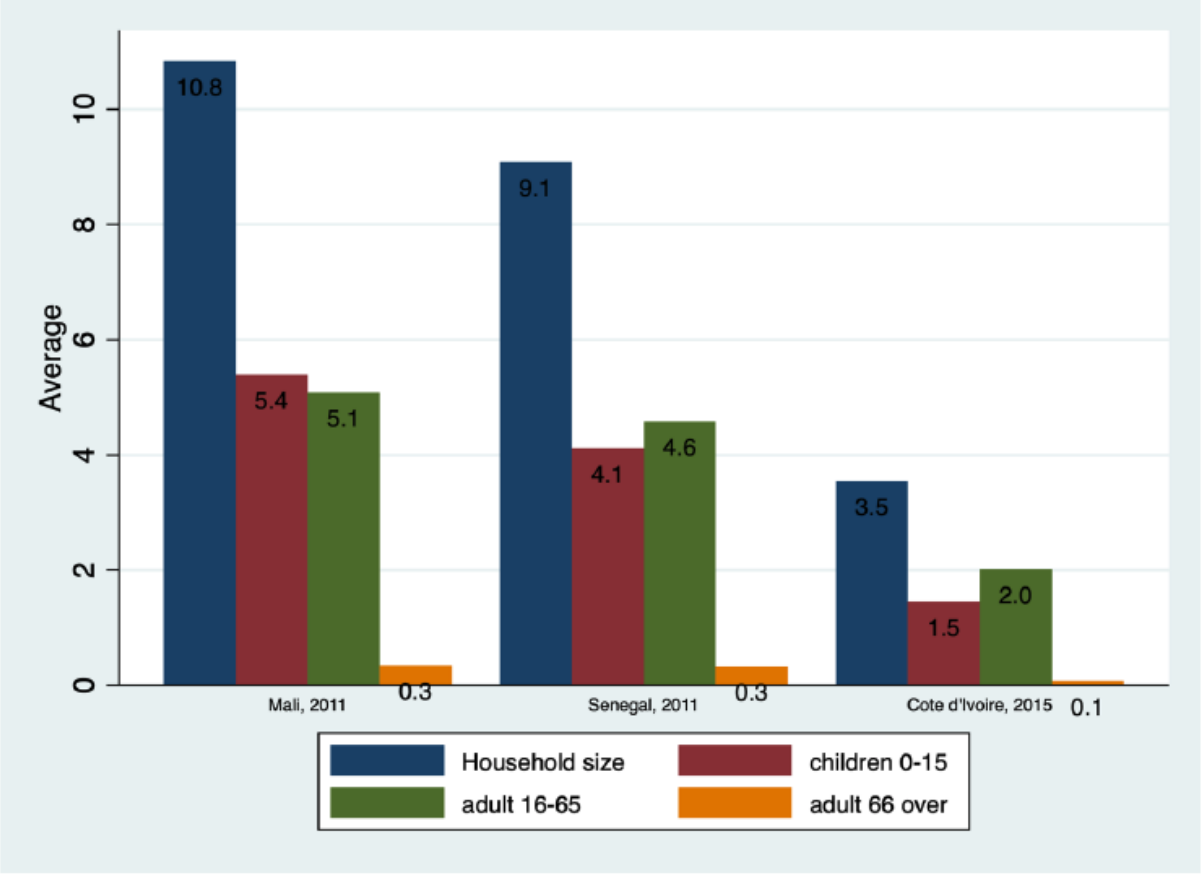


Table A7: Bottom 40% share by income concept

	Market income	Disposable income	Consumable income	Final income
Cote d'Ivoire	0.09	0.09	0.08	0.10
Mali	0.13	0.13	0.10	0.14
Senegal	0.10	0.10	0.09	0.11

Table A8: Gini by income concept

	Market income	Disposable income	Consumable income	Final income
Cote d'Ivoire	0.58	0.57	0.59	0.56
Mali	0.46	0.46	0.51	0.45
Senegal	0.56	0.54	0.57	0.53

Table A9: Top 10% share by income concept

	Market income	Disposable income	Consumable income	Final income
Cote d'Ivoire	0.46	0.45	0.46	0.44
Mali	0.35	0.35	0.37	0.34
Senegal	0.44	0.42	0.44	0.42

Table A10: Incidence of personal income tax by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%
3	0.0%	0.0%	0.0%
4	0.0%	0.0%	0.0%
5	0.0%	0.0%	0.0%
6	0.0%	0.0%	0.0%
7	0.0%	0.0%	1.0%
8	0.0%	0.0%	1.0%
9	1.0%	0.0%	2.0%
10	3.0%	1.0%	6.0%

Table A11: Incidence of custom duties by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	17.0%	8.0%	8.0%
2	6.0%	3.0%	4.0%
3	4.0%	2.0%	4.0%
4	3.0%	2.0%	3.0%
5	3.0%	1.0%	2.0%
6	3.0%	1.0%	2.0%
7	2.0%	1.0%	2.0%
8	2.0%	1.0%	1.0%
9	2.0%	1.0%	1.0%
10	1.0%	0.0%	1.0%

Table A12: Incidence of value-added taxe by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	43.0%	80.0%	26.0%
2	15.0%	25.0%	14.0%
3	10.0%	19.0%	13.0%
4	9.0%	16.0%	11.0%
5	8.0%	14.0%	10.0%
6	7.0%	11.0%	9.0%
7	6.0%	10.0%	8.0%
8	5.0%	9.0%	7.0%
9	5.0%	7.0%	6.0%
10	3.0%	4.0%	3.0%

Table A13: Incidence of education spending by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	112.0%	123.0%	69.0%
2	40.0%	46.0%	32.0%
3	30.0%	34.0%	22.0%
4	21.0%	22.0%	21.0%
5	16.0%	21.0%	13.0%
6	16.0%	16.0%	10.0%
7	9.0%	14.0%	9.0%
8	8.0%	11.0%	8.0%
9	6.0%	8.0%	6.0%
10	2.0%	4.0%	3.0%

Table A14: Concentration shares of personal income tax by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%
3	0.0%	0.0%	0.0%
4	0.0%	0.0%	0.0%
5	0.0%	1.0%	0.0%
6	0.0%	1.0%	1.0%
7	1.0%	3.0%	1.0%
8	3.0%	3.0%	4.0%
9	9.0%	6.0%	8.0%
10	86.0%	86.0%	86.0%

Table A15: Concentration shares of custom duties tax by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	6.0%	11.0%	6.0%
2	6.0%	8.0%	6.0%
3	6.0%	8.0%	8.0%
4	7.0%	8.0%	8.0%
5	8.0%	9.0%	9.0%
6	8.0%	9.0%	10.0%
7	10.0%	10.0%	10.0%
8	11.0%	10.0%	12.0%
9	14.0%	11.0%	13.0%
10	23.0%	14.0%	18.0%

Table A16: Concentration shares of value-added tax by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	5.0%	11.0%	4.0%
2	5.0%	7.0%	5.0%
3	5.0%	8.0%	6.0%
4	6.0%	8.0%	6.0%
5	7.0%	9.0%	8.0%
6	8.0%	9.0%	9.0%
7	9.0%	10.0%	10.0%
8	11.0%	11.0%	12.0%
9	15.0%	12.0%	16.0%
10	28.0%	16.0%	24.0%

Table A17: Concentration shares of education spending tax by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	9.0%	12.0%	9.0%
2	9.0%	10.0%	8.0%
3	10.0%	10.0%	8.0%
4	9.0%	8.0%	10.0%
5	9.0%	10.0%	8.0%
6	12.0%	9.0%	8.0%
7	8.0%	10.0%	9.0%
8	11.0%	10.0%	12.0%
9	12.0%	9.0%	13.0%
10	10.0%	10.0%	15.0%

Table A18: Personal income taxpayers by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	2.0%	1.0%	1.0%
2	4.0%	0.0%	2.0%
3	4.0%	3.0%	2.0%
4	5.0%	3.0%	2.0%
5	5.0%	11.0%	3.0%
6	6.0%	4.0%	8.0%
7	8.0%	5.0%	12.0%
8	13.0%	5.0%	25.0%
9	16.0%	7.0%	32.0%
10	27.0%	11.0%	45.0%

Table A19: Custom duties payers by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	99.0%	97.0%	98.0%
2	100.0%	100.0%	98.0%
3	99.0%	99.0%	99.0%
4	100.0%	100.0%	99.0%
5	99.0%	100.0%	98.0%
6	100.0%	99.0%	99.0%
7	100.0%	100.0%	99.0%
8	100.0%	100.0%	99.0%
9	100.0%	100.0%	100.0%
10	100.0%	99.0%	100.0%

Table A20: Value-added taxpayers by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	100.0%	97.0%	100.0%
2	100.0%	100.0%	100.0%
3	100.0%	99.0%	100.0%
4	100.0%	100.0%	100.0%
5	99.0%	100.0%	100.0%
6	100.0%	99.0%	100.0%
7	100.0%	100.0%	100.0%
8	100.0%	100.0%	100.0%
9	100.0%	100.0%	100.0%
10	100.0%	99.0%	100.0%

Table A21: Education spending beneficiaries by decile

Decile	Cote d'Ivoire	Mali	Senegal
1	37.0%	70.0%	63.0%
2	43.0%	73.0%	61.0%
3	46.0%	67.0%	59.0%
4	39.0%	63.0%	61.0%
5	37.0%	70.0%	64.0%
6	35.0%	63.0%	61.0%
7	31.0%	66.0%	60.0%
8	32.0%	63.0%	62.0%
9	25.0%	63.0%	57.0%
10	15.0%	53.0%	38.0%

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