TECHNICAL ASSISTANCE REPORT

REPUBLIC OF ARMENIA

Personal Income Tax and Social Security Contribution Gaps Estimation Based on Operational Audits

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Contents

Abbreviations and Acronyms

AMD	Armenian Dram is the currency of Armenia
CD	Capacity Development
CIT	Corporate Income Tax
CRM	Compliance Risk Management
FAD	IMF Fiscal Affairs Department
GDP	Gross Domestic Product
GPFP	Global Public Finance Parthership
IMF	International Monetary Fund
NACE	Nomenclature statistique des Activites economiques dans la Communaute Europeenne (Statistical nomenclature of economic activities in the European Community)
PIT	Personal Income Tax
SRC	Armenia State Revenue Committee
SSC	Social Security Contribution
STX	IMF Short Term Expert
TIN	Taxpayer Identification Number
VAT	Value Added Tax

Preface

In response to a request from the Armenia State Revenue Committee (SRC), a capacity development (CD) mission team comprising Mr. Soren Pedersen (FAD) and Mr. Tobias Gabel Christiansen (FAD short-term expert), carried out a duty-station based mission during the period December 16, 2024 – January 3, 2025. The purpose of this mission, financed by the Global Public Finance Partnership (GPFP), was to estimate Personal Income Tax (PIT) and Social Security Contribution (SSC) gaps based on operational audits for the income years 2020-2023. This is a follow up mission of a scoping mission in September 2024 that examined the feasibility of measuring the PIT/SSC gaps.

During the mission in September 2024, it became evident that the SRC possesses extensive data on audit results related to withholding PIT and SSC, along with detailed taxpayer characteristics.

Prior to the mission to measure PIT/SSC gaps, SRC had provided the required data consisting of PIT/SSC returns from employers for income year 2020-2023. The report's findings are based on the data provided by the SRC.

The IMF team expresses its sincere appreciation to SRC for the excellent cooperation and the excellent support provided before this mission. The team particularly acknowledges the excellent support provided by Mr. Arsen Sarikyan, Head of Development and Administration Strategy Programs Department and his staff. The IMF team would also like to credit SRC for the extremely comprehensive material they have made available for the analyses.

This report represents the final version of the draft report that was submitted to Mr. Ashot H. Muradyan, Deputy Chairman and Mr. Arsen Sarikyan, Head of Development and Administration Strategy Programs Department, on January 3, 2025. It consists of an Executive Summary and the following sections: (I) Introduction (II) Key Findings; and (III) Next Steps.

Executive Summary

This mission, financed by the Global Public Finance Partnership (GPFP), estimated the personal income tax (PIT) and social security contribution gap in Armenia in collaboration with State Revenue Committee's (SRC) staff based on a bottom-up approach using data from SRC's operational audits (2020-2023).[1] The average yearly PIT gap across 2020-2023 is estimated to be 14.5 billion AMD or 3.8 percent of potential PIT liability. The average yearly SSC gap across 2020-2023 is estimated to be 0.6 billion AMD or 1.6 percent of potential SSC liability. These estimates represent compliance gaps in PIT and SSC associated to registered corporations and dependent workers included in their payrolls. Compliance gaps associated to non-registered businesses and/or informal workers are out of our scope.

For the years 2020, 2021, 2022 and 2023, the PIT gap is estimated at 2.6 percent, 3.1 percent, 3.8 percent, and 5.5 percent of potential PIT liability and the SSC gap is estimated at 2.8 percent, 1.5 percent, 0.7 percent, and 1.8 percent of potential SSC liability respectively.[2] The larger variation in the SSC gap results compared to the PIT gap is due to the significantly fewer corrections of SSC, which increases the uncertainty of the results.

The PIT gap represents 0.2 percent of the average GDP from 2020 to 2023, while the SSC gap accounts for 0.003 percent of the average GDP over the same period. For the years 2020, 2021, 2022 and 2023, the PIT gap was estimated to be 0.1, 0.2, 0.2 and 0.3 percent of GDP, respectively. The SSC gap is estimated to be 0.002-0.003 percent of GDP in all years covered.

In absolute terms, the PIT gap is estimated to be 24.1 billion AMD in 2023, while it was estimated to be 8.9 billion AMD in 2020, 10.8 billion AMD in 2021, and 14.4 billion AMD in 2022. The SSC gap is estimated to be 0.5 billion AMD in 2020, 0.5 billion AMD in 2021, 0.3 billion AMD in 2022, and 1 billion AMD in 2023 in absolute terms.

The PIT gap as a percentage of potential PIT is also increasing when the largest corporations are excluded, with figures of 0.6 percent in 2020, 1.4 percent in 2021, 2.8 percent in 2022, and 4.1 percent in 2023. Excluding the largest corporations likely provides a more accurate estimate of the PIT gap. Due to the limited number of large companies, the associated tax gap entails more uncertainty. Excluding these companies can reduce 'noise' and provide a more accurate tax gap.

As the next step, it is recommended that the SRC adopts the methodology and continues to carry out the PIT/SSC gap estimation in 2025 and the coming years. After following the work of the IMF team data analysts in the SRC are now equipped to perform this analysis using the provided R code and detailed instructions. SRC can also seek IMF capacity development (CD) for an assisted self-assessment measure of the PIT/SSC gap.

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[1] This analysis measures the PIT/SSC compliance gap, i.e., the policy gap and payment gap are excluded. For simplicity, "gap" and "compliance gap" will be used indistinguishably in this report.

[2] Potential PIT liability is the sum of self-reported PIT and the estimated PIT gap. Similarly, potential SSC liability is the total of self-reported SSC and the estimated SSC gap.

Recommendations

Estimate the PIT/SSC gap in the coming years		Due data
1	SRC should adopts the methodology and continue to carry out the PIT/SSC gap estimation in the coming years. Data analysts in the SRC can perform this analysis using the provided R code and detailed instructions. Alternatively, the SRC can seek IMF capacity development (CD) for an assisted self-assessment measure of the PIT/SSC gap based on operational audits in the winter 2025/2026.	January 2026

I. Introduction

1. The Chairman of the Armenian State Revenue Committee (SRC) asked for IMF assistance to measure the Personal Income Tax (PIT) and Social Security Contributions (SSC) gaps. This request was confirmed at the 2024 IMF-World Bank Spring Meetings.

2. The Armenian PIT and SSC systems operate within a framework that includes a well-established withholding tax system by employers.[3] The final PIT/SSC is withheld by the employer, reported electronically, and paid to the SRC on a monthly basis.[4] [5] Employers, also known as Tax Agents, provide a wide range of information in their reports, including names and unique identifiers of their employees.

3. This mission team estimated the PIT/SSC gap in collaboration with SRC staff based on a bottom-up approach using tax returns from Tax Agents for 2020-2023. During an IMF mission in September 2024, it became evident that the SRC possesses extensive data on audit results related to withholding PIT and SSC, along with detailed taxpayer characteristics.[6] This information enables more granular tax gap estimates and helps identify specific issues within sectors, company size etc.

4. Using operational audits to estimate a tax gap needs to account for the non-random selection of audited corporations. Without correction for cases not selected randomly, the PIT/SSC gap would be overestimated. This bias, known as "Sample Selection Bias," arises from the non-random selection of cases. The method devised by the economist (and Nobel Prize laureate) James J. Heckman is utilized to correct for Sample Selection Bias.[7]

5. The PIT/SSC gap estimates are based on comprehensive audits conducted by the SRC. Comprehensive audits cover all aspects of the taxpayer including PIT and SSC.[8] Taxpayers chosen for an audit each year will also have their unaudited tax returns from previous years reviewed. The number of

[3] IMF. *Republic of Armenia: Technical Assistance Report on Personal Income Tax: Policy Review and Introduction of a Universal Declaration*. January 2023: https://www.imf.org/en/Publications/CR/Issues/2023/01/30/Republic-of-Armenia-Technical-Assistance-Report-on-Personal-Income-Tax-Policy-Review-and-528760

[4] This encompasses various forms of income such as salaries, benefits, bonuses, temporary disability compensation, and maternity leave compensation. As of 2024, the rate of the personal income tax in Armenia is 20 percent and applies to all forms of compensation, regardless of the amount involved.

[5] Apart from PIT, employers are also responsible for deducting social security payments. As at 2024 the rate for these payments stands at 5 percent for income up to 500,000 AMD (approximately $1,309) and 10% deducted 25,000 AMD for income exceeding this threshold. It's important to be aware that there's a maximum salary limit for social security payments, currently capped at 1,125,000 AMD per month (equivalent to 15 times the minimum monthly wage of 75,000 AMD).

[6] IMF. *Republic of Armenia: Technical Assistance Report-Personal Income Tax and Social Security Contribution Gaps*. January 2025.

[7] James J. Heckman (1979). “Sample Selection Bias as a Specification Error”. Econometrica. vol. 47(1), pp. 153-161.

[8] The audits includes all PIT regulations and all sections of the tax return.

tax returns audited and the assessed amounts are shown in table 1[9][10] Most of the assessed PIT and SSC relate to audits where taxpayers agreed to the findings and adjusted their tax returns accordingly.

Table 1. Number of audits and assessed amounts.

	2020	2021	2022	2023
Number of audits	2,656	2,373	2,044	1,262
PIT assessed amounts	1 billion AMD	1.3 billion AMD	900 million AMD	1.4 billion AMD
SSC assessed amounts	6 million AMD	21 million AMD	12 million AMD	125 million AMD

6. Thematic audits and thematic inspections are not used to estimate the PIT/SSC gap. Thematic audits are unannounced audits that aim to uncover unregistered workers. No PIT adjustments are reported during thematic audits. Instead, penalties of 250,000 AMD for each unregistered worker are imposed. Moreover, the risk criteria used to select thematic audits are not available, making the Heckman method inappropriate. Thematic inspections were introduced in 2022 and consist of desk-type audits selected on the same criteria as thematic audits.

7. The estimates presented in this report represent compliance gaps in PIT and SSC associated to registered corporations and dependent workers included in their payrolls. Compliance gaps associated with non-registered businesses and/or informal workers are not included because thematic audits and thematic inspections are not suitable for the Heckman method as explained above. This leads to an underestimation of the total tax gap.

8. In order to estimate the PIT/SSC gap for non-registered workers, other methods must be applied. At the conclusion of the mission, SRC stated that they had utilized the so-called labor input method, which compares employment statistics from the Labor Force Survey with SRC's own employment statistics, as recommended during the scoping mission in September 2024. SRC reported that their findings were consistent with those presented in this report.[11] See Annex II for more details on

[9] It is important to note that approximately 75 percent of the audits conducted between 2020 and 2022 cover a period of 10 months or more. However, some audits may only cover a shorter period, such as 3 months. This report does not adjust for these variations in its estimations.

[10] The percentage of companies audited was 3.5%, 3.3%, 3.0%, and 2.8% in 2020 through 2023, respectively. In contrast, the percentage of revenues audited was significantly higher, at 55.8%, 55.7%, 53.6%, and 50.5% over the same period. For example, in 2023 1,262 companies were audited (Table 1). The 1,262 companies that were audited reported a total of approximately 210 billion AMD in PIT. That amounts to 50.5% of total PIT of 413 trillion AMD in 2023.

[11] The IMF team did not assess the labor input method used by SRC.

the method mentioned here as well as other methods that can be used to capture non-registered employment.

9. The PIT/SSC gaps for 2020-2023 were estimated using the Heckman Sample Selection model. The Heckman method is a two-stage procedure. In the first stage, it estimates the probability that a company is selected for audit. This is done using a probit model and 30 summed risk scores and risk rankings used by the SRC to target PIT/SSC audits.[12] [13] The second stage models the audit outcome (i.e., PIT/SSC uncovered) using company characteristics (i.e., lines from the tax return, sector, number of employees etc.) and a regressor that accounts for the selection process (see Annex I for more details).

10. The Heckman two-step estimator's suitability in estimating the PIT/SSC gaps depends on audit practices. Narrowly focused audits may miss undisclosed taxes, leading to an underestimated PIT/SSC gap. When audits target specific sectors or types of firms, reliable estimates become challenging due to increased extrapolation. Additionally, some noncompliance may remain undetected by auditors, potentially underestimating the PIT/SSC gap.

11. SRC conducts comprehensive audits on tax agents, making the Heckman model an appropriate choice. The comprehensive audits as well as the rigorous data available in SRC provide a solid basis for applying the Heckman model to measure the PIT/SSC gap.

12. PIT/SSC gaps based on operational audits were estimated for four consecutive years. These estimates cover the latest available audit data for the income years 2020, 2021, 2022, and 2023. The estimates based on audits from 2023 are more uncertain due to the lower number of audits, partly because the SRC is still auditing 2023 returns.

[12] In a probit model the outcome is binary (0 or 1) – in this case whether a company has been audited or not.

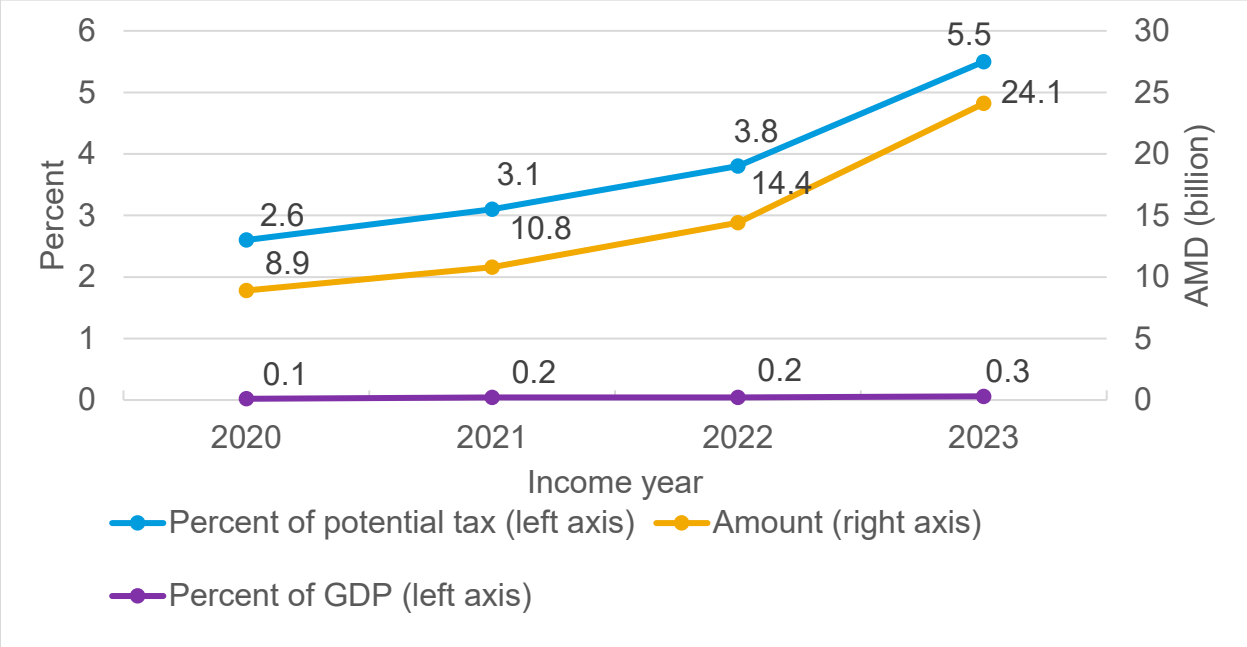
[13] SRC provided access to five summed risk scores and risk rankings (i.e., taxpayers ranked from high to low based on risk) for PIT, CIT, and VAT for the income years 2019–2023. While SRC provided access to the risk scores, the underlying details of these scores were not made available. The underlying details are not disclosed to prevent taxpayers from evading audit selection. However, the risk scores are sufficient for the Heckman model to work.

II. Key Findings

A. PIT gap results

13. The average yearly PIT gap across 2020-2023 is estimated to be 14.5 billion AMD[14] or 3.8 percent of potential PIT liability (Figure 1). The PIT gap corresponds to 0.2 percent of average GDP across 2020-2023. The PIT gap estimates are based on a Heckman model using operational audits conducted for the income years 2020, 2021, 2022 and 2023. A total of 4,098 comprehensive audits, covering all aspects of the company and carried out by the SRC over the four-year period, were used to estimate the Heckman model. The results have been adjusted to account for the non-random selection of operational audits, addressing what is known as "sample selection bias."

Figure 1. Estimated PIT Gap (2020-2023)



Source: IMF calculations based on data from SRC.

14. The PIT gap in 2023 is estimated to be 24.1 billion AMD[15] or 5.5 percent of potential PIT liability (Figure 1). The PIT gap corresponds to 0.3 percent of GDP in 2023.

15. The PIT gap was 8.9 billion AMD in 2020 or 2.6 percent of potential PIT liability. In 2021 the PIT gap was 10.8 billion AMD or 3.1 percent of potential PIT, and in 2022 the PIT gap was 14.4 billion

[14] Measured in 2020-prices.

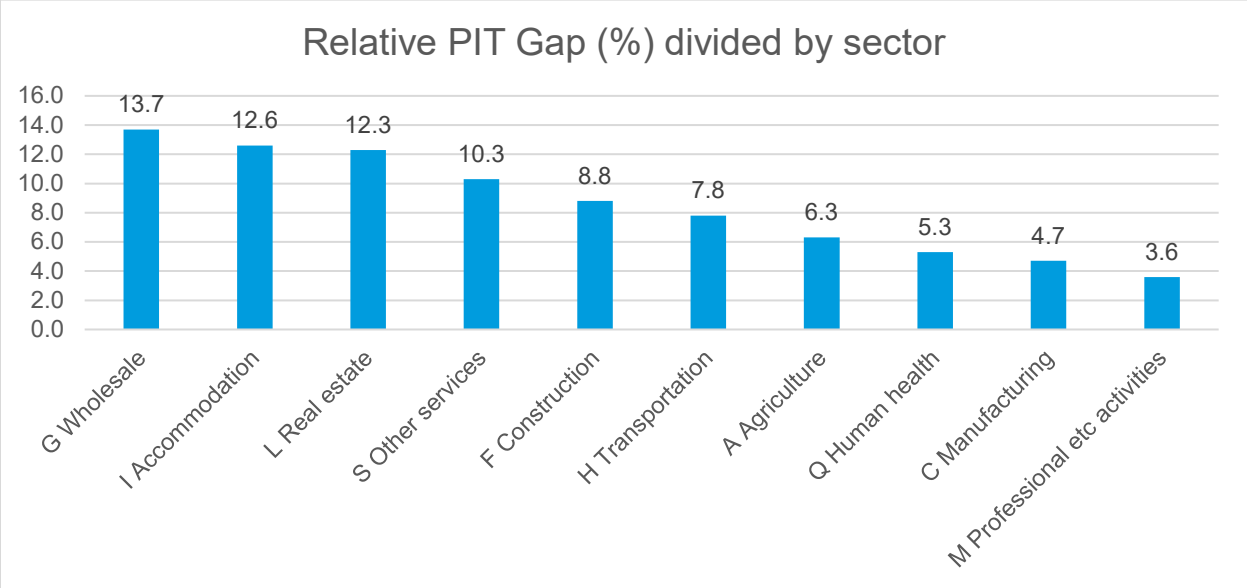
[15] Measured in 2020-prices.

AMD or 3.8 percent of potential PIT. The PIT gap has increased from 2020 to 2023 but remains relatively low compared to the CIT gap.[16]

16. The increase in the relative and absolute gap is driven by an increase in the number of newly established firms that have relative higher relative PIT gaps compared to older firms (see Figure 4). From 2020 to 2023, the number of PIT-liable firms grew from 65,193 to 87,854. The PIT gap for firms less than five years old was 1.6 billion AMD (3.3 percent of potential PIT) in 2020 and 12.6 billion AMD (13.2 percent of potential PIT) in 2023. This indicates that newly established firms contributed 11 billion AMD of the 15.2 billion AMD increase in the PIT gap over this period, accounting for 72% of the total increase.

17. The PIT gap in percent of total PIT is highest in the sector "Wholesale" (Figure 2).[17] As seen in Figure 2, the second-highest relative PIT gap is in the "Accommodation" sector. The lowest relative PIT gap among the top-10 sectors is found in the "Professional, Scientific and Technical Activities" sector.

Figure 2. PIT gap in percent of total PIT by top-10 sectors [18] (average across 2020-2023)



Source: IMF calculations based on data from SRC.

18. The PIT gap is large in corporations with few employees (Figure 3). It amounts to 31.98 percent of potential tax for corporations with 0–5 employees. The PIT gap declines as the number of employees increases and amounts to 0.25 percent for corporations with more than 100 employees. This indicates that collusion between employers and employees is more prevalent in smaller corporations,

[16]The average CIT gap in Armenia was estimated at 26.4-35.2 percent of potential CIT liability for 2020-2022.https://www.elibrary.imf.org/view/journals/019/2024/076/019.2024.issue-076-en.xml

[17] Sector classification follows NACE coding (Nomenclature statistique des Activites Economiques'-Statistical classification of economic activities in the European Community).

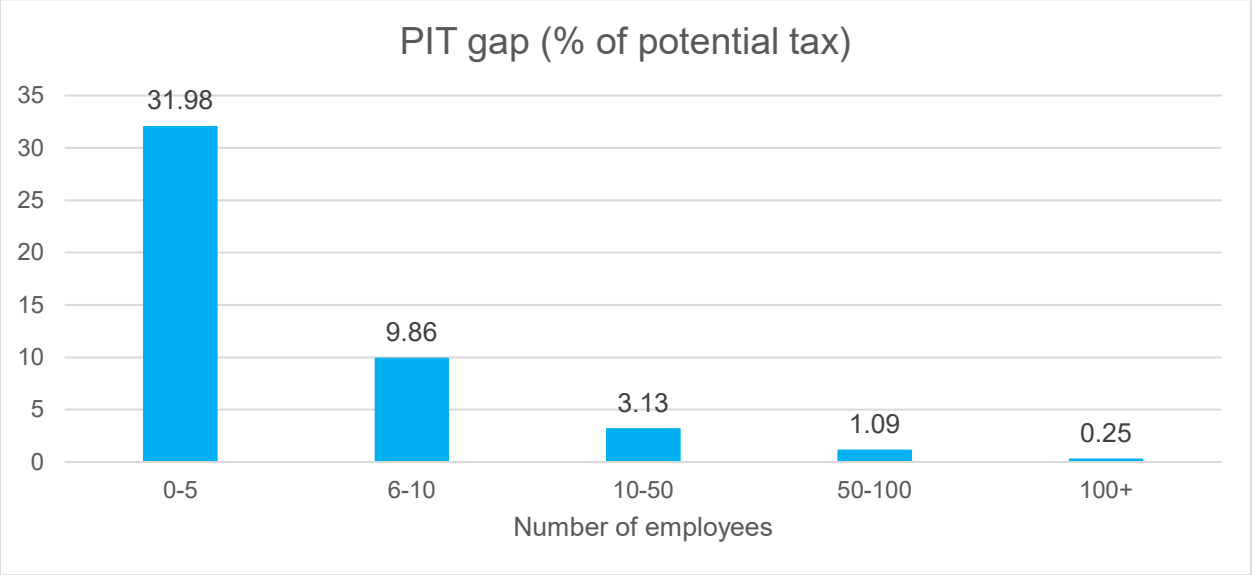
[18] This sector is considered the primary sector for a corporation if they operate in more than one sector. Sector codes are self-reported by Corporations. The chart only displays the top 10 sectors due to space limitations.

while it is less problematic in larger corporations. Similar patterns are observed in Norway.[19] Kleven et al (2016) argues in a theoretical paper that collusive tax evasion is very hard in large firms.[20]

19. The PIT gap is larger in younger corporations (Figure 4). It amounts to 13.96 percent of potential tax in corporations that are 0–2 years old, while it is 2.34 percent in corporations older than 20 years.

20. It is important to examine the reasons for non-compliance more closely in high-risk sectors such as the human health, construction and transporting sectors and in corporations with few employees. It will give valuable information for a compliance improvement plan to understand if non-compliance is due to deliberate evasion, lack of knowledge of the tax law or complicated legislation.

Figure 3. Relative PIT gap by size (average across 2020-2023)

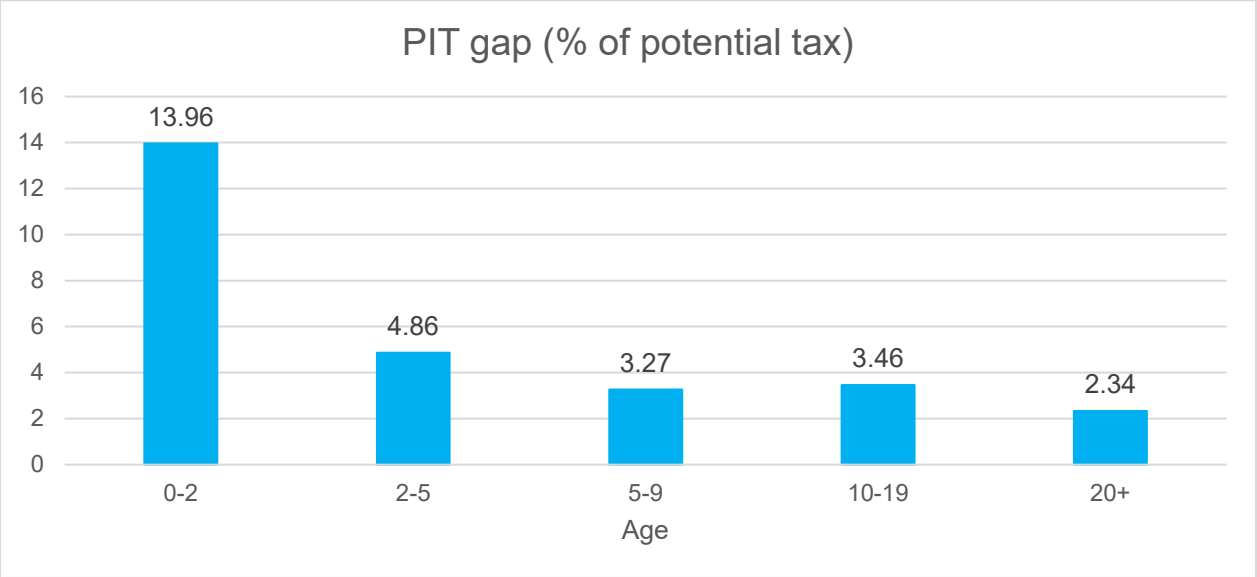


Source: IMF calculations based on data from SRC.

[19] Marie Bjørneby, Annette Alstadsæter, Kjetil Telle (2018) "Collusive Tax Evasion by Employers and Employees: Evidence from a Randomized Field Experiment in Norway". CESifo Working Paper No. 7381.

[20] Henrik Jacobsen Kleven, Claus Thustrup Kreiner, Emmanuel Saez (2016) "Why Can Modern Governments Tax So Much? An Agency Model of Firms as Fiscal Intermediaries". Economica (2016) 83, 219–246.

Figure 4. Relative PIT gap by age (average across 2020-2023)



Source: IMF calculations based on data from SRC.

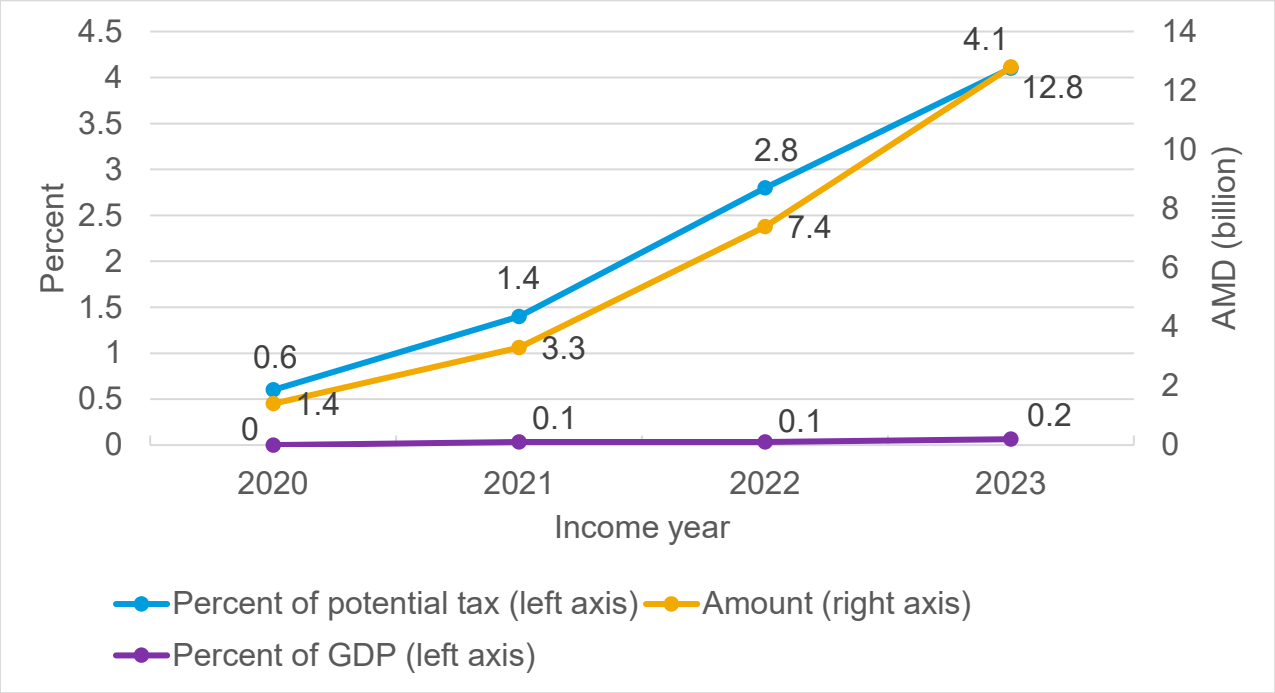
21. Using a Heckman model that excludes the largest corporations, the PIT gap in 2023 is estimated to be 12.8 billion AMD or 4.1 percent of potential PIT (Figure 5). The estimated PIT gap corresponds to 0.2 percent of GDP in 2023.[21]

22. Excluding the largest corporations likely provides a more accurate estimate of the PIT gap. Due to the limited number of large companies, the associated tax gap entails more uncertainty. Excluding these companies can reduce 'noise' and provide more accurate tax gap estimate but comes at the cost of reducing the population for which the tax gap is estimated.[22] To balance the influence of outliers and still account for most of the population, the top 0.1 percent largest companies, measured by average number of employees, were excluded before estimating the Heckman model and making predictions. The PIT gap remains similar after excluding the largest corporations.

[21] Measured in 2020-prices.

[22] The IRS CIT gap methodology excludes Large Businesses from the scope of the Heckman methodology.

Figure 5. PIT gap: Excluding large corporations (2020-2023)



Source: IMF calculations based on data from SRC.

B. SSC gap results

23. The average yearly SSC gap across 2020-2023 is estimated to be 0.6 billion AMD[23] or 1.6 percent of potential SSC liability.[24] The SSC gap corresponds to 0.0 percent of average GDP across 2020-2023.

24. The SSC gap in 2023 is estimated to be 1 billion AMD or 1.8 percent of potential PIT liability (Figure 6). The SSC gap corresponds to 0.0 percent of GDP in 2023. The SSC gap estimates are also based on a Heckman model using operational audits conducted for the income years 2020, 2021, 2022 and 2023.

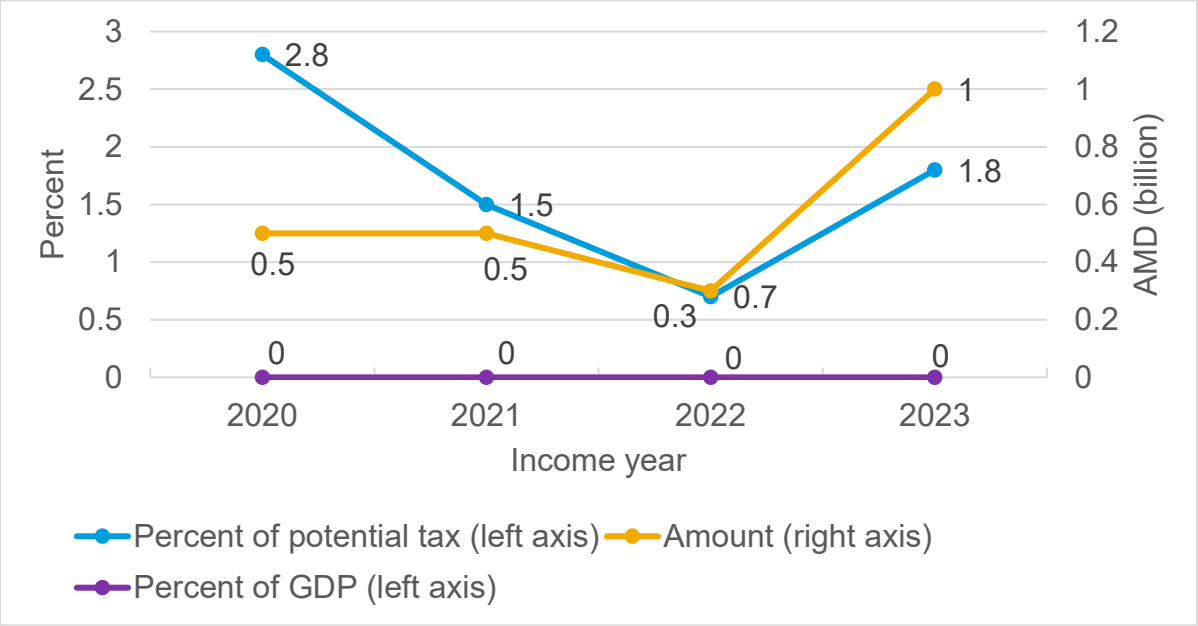
25. The SSC was 0.5 billion AMD in 2020 or 2.8 percent of potential SSC liability (Figure 6). In 2021 the SSC gap was 0.5 billion AMD or 1.5 percent of potential PIT, and in 2022 the SSC gap was 0.3 billion AMD or 0.7 percent of potential SSC.

26. The SSC gap indicates that social security contributions are not a significant compliance problem. The SSC gap remains consistently low throughout the period.

[23] Measured in 2020-prices.

[24] The estimates of SSC gaps are associated with greater uncertainty, as significantly fewer companies have been found with errors in the controls of SSC compared to PIT.

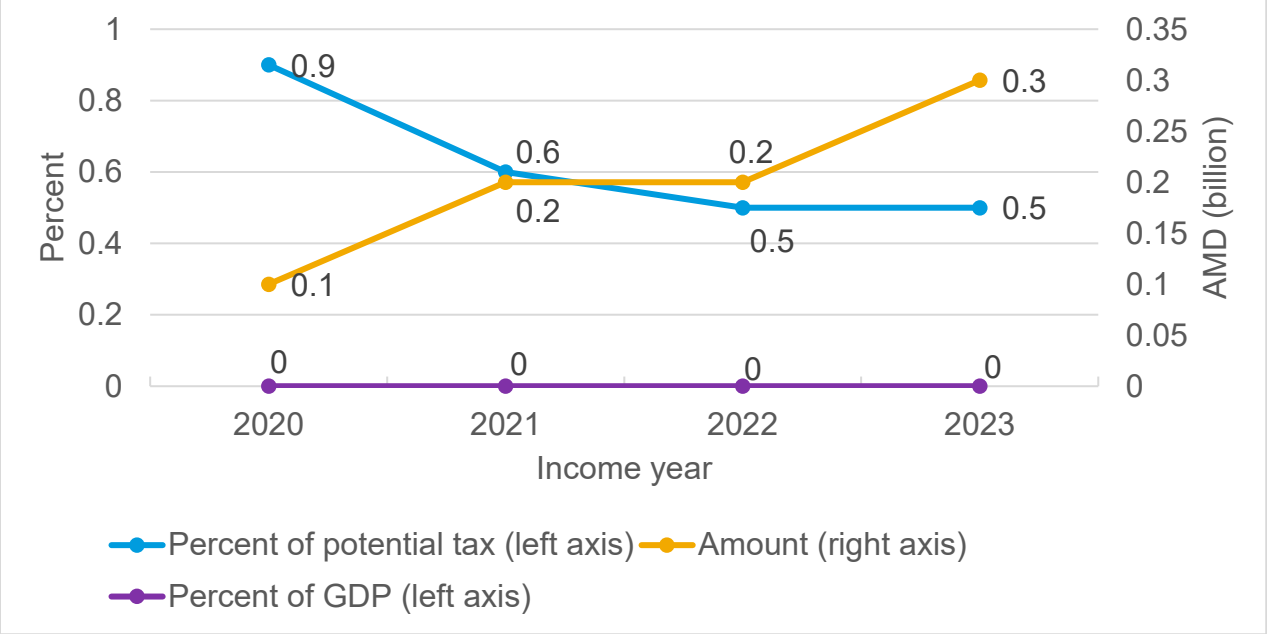
Figure 6. SSC gap (2020-2023)



Source: IMF calculations based on data from SRC.

27. Using a Heckman model that excludes the largest corporations, the SSC gap in 2023 is estimated to be 0.3 billion AMD and 0.5 percent of potential PIT (Figure 7). The estimated SSC gap corresponds to 0.0 percent of GDP in 2023.

Figure 7. SSC gap: Excluding large corporations (2020-2023)



Source: IMF calculations based on data from SRC.

III. Next Steps

A. Set up a team of data analysts and apply the developed model

28. Based on the previous IMF mission to measure the CIT gap in March 2024, it was recommended that SRC appoints 2-3 data analysts with responsibility to compile future tax gap estimations. To sustain the CIT/PIT/SSC gap models, it is crucial that SRC invests in data analytics. It was recommended that at least 2-3 individuals be trained in data analytics. This will enable SRC to independently conduct tax gap analysis on various taxes based on operational audits developed by IMF missions in 2024.

29. It was also recommended that the appointed team should invest around 80 percent of their time on data analytics. It is important to invest sufficient time to be able to perform good data analytics. The team should learn the necessary programming tools to be able to carry out tax gap analysis.

30. SRC addresses the PIT/SSC gaps in the process of implementing a personal income tax declaration. High-quality data from employers are crucial, especially if they are preprinted on the personal tax declaration form. Tackling the tax gaps identified in this report will enhance the quality of data used in the personal income declaration form.

B. Recommendation

31. If, after taking the recommended steps above, SRC is not able to carry out the estimation in 2025 when the relevant data is available with its own resources, they could seek IMF assistance for an assisted self-assessment of the CIT/PIT/SSC Gaps. This approach will help the SRC to develop the required data analytical skills to use the model in the future and become self-sufficient.

Annex I. Supplementary Material

Tax gap estimates from non-random risk-based audits are prone to sample selection bias due to the selection process being influenced by the perceived risk of non-compliance. Put differently, the audited companies are not representative of the general population of companies since they are selected as being more prone to risk of tax non-compliance based on several indicators. Hence the tax gap estimate based purely on such operational risk-based audits does not reflect that of the general population. A common approach to account for this is through the Heckman 2-step estimator.[25] The Heckman 2-step estimator corrects for sample selection bias by estimating both the selection process and the level of non-compliance (i.e., the tax uncovered from audit) in the same model. Following Wooldridge (2010)[26] the Heckman 2-step estimator is given by an outcome equation and a selection equation:

$$Y_i = X_i\beta + u_i \qquad (1)$$

$$S_i = 1[Z_i\delta + v_i > 0] \qquad (2)$$

Here equation (1) is the outcome equation, where Y_i measures the tax uncovered from audit and X_i is company characteristics (i.e., lines from the CIT return, sector, number of employees etc.)[27]. Next, equation (2) is the selection equation, where S_i is an indicator of audit, with $S_i = 1$ denoting company i was audited and $S_i = 0$ denoting company i was not, while Z_i are factors that determine whether a company is audited or not.[28] This includes 30 summed risk scores and risk rankings used by the SRC to target audits.[29] Importantly, the value of Y_i is only observed if company i was selected for an audit ($S_i = 1$). Finally, u_i and v_i are independent of X_i and Z_i, with $v_i \sim N(0,1)$ and $E(u_i|v_i) = \gamma v_i$.[30]

What we are interested in estimating is $E[Y_i|X_i]$. However, since Y_i is observed only when $S_i = 1$, what we can estimate is $E[Y_i|X_i, S_i = 1]$. Using equation (1) and (2) this can be rewritten as:

$$E[Y_i|X_i, S_i = 1] = X_i\beta + E[u_i|v_i > -Z_i\delta] = X_i\beta + \gamma\lambda(Z_i\delta) \qquad (3)$$

Here $\lambda(\cdot) = \phi(\cdot)/\Phi(\cdot)$ where $\phi(\cdot)$ and $\Phi(\cdot)$ are the probability density function (pdf) and cumulative distribution function (cdf) of a standard normal distribution, respectively. The form of $\lambda(\cdot)$ follows from the assumption that $v_i \sim N(0,1)$ and it is labeled the inverse Mills ratio. Equation (3) presents a way to consistently estimate β. Following Heckman (1979) we can consistently estimate β and γ by regressing Y_i on X_i and $\lambda(Z_i\hat{\delta})$ using OLS, where $\hat{\delta}$ is obtained by estimating equation (2) using a probit model. Once an estimate of β has been obtained using the 2-step Heckman estimator, it can be used to construct an

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[25] James J. Heckman (1979). Sample Selection Bias as a Specification Error. *Econometrica*. vol. 47(1), pp. 153-161.

[26] Jefrey M. Wooldridge (2010). Econometric Analysis of Cross Section and Panel Data. The MIT Press

[27] A total of 12 variables are used. These variables correspond to the 12 variables selected as the most important variables in a LASSO model developed to predict audit adjustments. In addition, PIT risk scores and PIT risk rankings are included.

[28] Data to estimate PIT/SSC gap stems from the CIT returns.

[29] In total five summed risk scores and risk rankings (i.e., taxpayers ranked from high to low based on risk) for PIT, CIT, and VAT for the income years 2019–2023 are used in the selection model.

[30] We only require v_i to be normally distributed. It is sufficient to assume that the conditional expectation of u_i given v_i is linear, which does not require u_i to be normally distributed.

estimator of the unconditional expectation of non-compliance (not conditioning on $S_i = 1$), given by $E[\widehat{Y_i|X_i}] = X_i\hat{\beta}$.[31] This can be applied to obtain predicted values of non-compliance for all companies in the population, and thereby the overall PIT/SSC gap. Table A2 presents an estimate of the selection and outcome models using all data on CIT returns and operational audits from 2020, 2021, 2022, and 2023. The selection model obtains an R^2 of 0.77 which indicates that the selection model fits the data well.[32] Turning to the outcome model, it obtains an R^2 of 0.03. Ideally, we aim for this value to be as high as possible. However, due to the considerable diversity among companies and audit adjustments, reaching this goal is challenging. Interestingly, the coefficient on the inverse Mills-ratio is insignificant (IMR in Table A2), indicating limited sample selection bias.

Two important points need to be highlighted. First, when using the Heckman 2-step estimator to predict non-compliance instead of inferring causal relationships, the accuracy of predictions depends on how well the selection model and the outcome model explain the data. Second, it is best to avoid using the same variables in both models. Doing so makes the outcome model's identification rely on the non-linearity of the inverse Mills-ratio, which can cause unstable results due to high multicollinearity. To prevent this, the selection model should include at least one variable that determines whether a company gets audited but doesn't affect non-compliance levels (known as an exclusion restriction).[33] However, finding such a variable can be tricky if audits are solely based on estimated non-compliance. In this context, we use 10 summed risk scores and 10 risk rankings for VAT and CIT as exclusion restrictions. In other words, these are used to predict whether a company undergoes an audit, but not used to predict the PIT uncovered from audit in the second step.

[31] Standard errors are wrong when manually estimating the 2-step Heckman estimator. Correct standard errors can be obtained using bootstrap.

[32] This is McFadden's Pseudo R^2

[33] In other words, exclusion restriction means that there must be at least one variable appearing with a non-zero coefficient in the selection equation but not in the equation of interest.

Table 2. Regression results

Selection Model			Outcome model		
Variables	**Coefficients**	**Std. Error**	**Variables**	**Coefficients**	**Std. Error**
Intercept	-1.696***	0.029	Intercept	159721.456	182885.606
PIT score 2019	0.002***	0.000	UnjustPayTotalAmountIncomeSum	-0.061	0.058
PIT score 2020	0.000	0.000	RentalTotalAmountIncomeSum	-0.002	0.039
PIT score 2021	0.002***	0.000	PropertyTotalAmountIncomeSum	0.003*	0.002
PIT score 2022	-0.002***	0.000	UnjustPayIncomeTaxAmountSum	0.532	0.397
PIT score 2023	-0.002***	0.000	PercentIncomeTaxAmountSum	0.003	0.002
PIT ranking 2019	-0.096***	0.007	EmployeesAvg	79.889	278.843
PIT ranking 2020	0.000***	0.000	Age	13124.904**	5834.049
PIT ranking 2021	0.000***	0.000	InsuranceTotalAmountIncomeSum	-0.013	0.009
PIT ranking 2022	0.000***	0.000	OthertaxbaseSum	-0.012***	0.002
PIT ranking 2023	0.001***	0.000	RentalIncomeTaxAmountSum	0.037	0.396
CIT score 2019	0.000	0.000	UnjustPayNoRecipientsIncomeSum	-13.217	4.529
CIT score 2020	0.001***	0.000	HoursworkedSum	0.160	0.184
CIT score 2021	0.001***	0.000	PIT score 2019	-508.051*	290.910
CIT score 2022	0.000***	0.000	PIT score 2020	-8.770	348.234
CIT score 2023	0.023***	0.000	PIT score 2021	-25.695	425.310
CIT ranking 2019	0.000***	0.000	PIT score 2022	16.391	278.431
CIT ranking 2020	0.000*	0.000	PIT score 2023	-504.825	816.632
CIT ranking 2021	0.000***	0.000	PIT ranking 2020	-3.534***	0.948
CIT ranking 2022	0.000***	0,000	PIT ranking 2021	-1.658*	0.899
CIT ranking 2023	-0.020***	0,001	PIT ranking 2022	-4.864***	1.380
VAT score 2019	0.003***	0,001	PIT ranking 2023	1476.673	972.816
VAT score 2020	0.000	0,000	IMR	-126813.376*	70104.080
VAT score 2021	0.002***	0,000			
VAT score 2022	0.003***	0,000			
VAT score 2023	0.001	0,000			
VAT ranking 2019	-0.258***	0.028			
VAT ranking 2020	0.000***	0.000			
VAT ranking 2021	0.000***	0.000			
VAT ranking 2022	0.000***	0.000			
VAT ranking 2023	-0.001***	0.000			
Includes Sector dummies	No			Yes	
Number of observations	306,666			9,532	
R^2	0.77			0.03	

Source: IMF calculations based on data from SRC. Note: [1)] In 2020-prices. Re-audits are discarded. Only corporations with a reported PIT return. The outcome model also includes sector dummies. Standard errors are computed using bootstrap, with resampling done at the TIN-level. For the selection model R^2 corresponds to McFadden's Pseudo R^2. ***, **, * denotes p < 0.01, p < 0.05, p<0.10.

Annex II. Other Methods to Estimate PIT Gap

IMF's Technical Notes and Manuals by Thackray et al. (2021) titled "*The Revenue Administration Gap Analysis Program. An Analytical Framework for Personal Income Tax Gap Estimation*" lists a number of methods that can be used to estimate the PIT gap.[34] Some of methods are more suited to capture non-registered taxpayers than others. Some of the different methods available to measure the PIT/SSC gaps was also presented in the scoping mission in September 2024 that examined the feasibility of measuring the PIT/SSC gaps.

Typically, in the literature including Thackray et al. (2021) there is a distinction between direct and indirect methods. Another way of describing the methods is by top-down or bottom-up approaches. Direct methods of measuring the PIT gap are based on contact with or observation of persons and/or firms. Direct methods can typically be described as bottom-up methods. The direct methods are "random audits", "risk-based audits" and "questionnaire surveys".[35] Using indirect methods analysts try to measure the "traces", so to speak, which the non-registered taxpayers leave in different statistics. Indirect methods can also be described as top-down methods. Indirect measures cover the "consumption income method" developed by Pissarides and Weber (1989), the "labor input method" and "discrepancies in national accounts". Below are the methods described a little more in detail.

Random audits

Random sampling is a method used to select taxpayers for audit, where each member of the population has a probability of being audited. This approach ensures that the sample is representative of the entire population. The selected sample undergoes a thorough audit, and auditors record the adjustments made. These adjustments are then scaled by the ratio of the sample to the population to estimate the compliance tax gap.

Questionnaire surveys

In questionnaire surveys respondents are either asked directly if he or she has carried out activities in the shadow/underground economy in a given period of time or indirectly by asking "do you know someone who has carried out activities in the shadow/underground economy".[36] This method has especially been used in Scandinavia, cf. Pedersen (2003).[37]

Consumption income method

Through consumer surveys, it is possible to compare individual income and expenditure over a specific period. These surveys provide detailed information on the population's incomes and consumption. Typically, consumption is measured by asking a random sample of the population to meticulously record their consumption over a period of, for example, 14 days, and to also disclose their various incomes, taxes paid, and savings. In the original article Pissarides and Weber (1989) compare the relationship

[34] Mick Thackray, Sarah Jennings, and Martin B. Knudsen (2021): *The Revenue Administration Gap Analysis Program. An Analytical Framework for Personal Income Tax Gap Estimation*. TNM/2021/009.

[35] Risk-based audits are used to measure the PIT gap in this report so they will not be discussed further here.

[36] "A beloved child has many names".

[37] Søren Pedersen (2003), *The Shadow Economy in Germany, Great Britain and Scandinavia. A measurement based on questionnaire surveys*. Study no. 10 from The Rockwool Foundation Research Unit.

between food expenditure and reported income among employees and the self-employed.[38] They assume that employees report income accurately due to third-party reporting/tax withholding. It is then possible to estimate the fraction of income spent on consumption. Pissarides and Weber (1989) then assumes the propensity to consume is identical across taxpayers. For a given level of reported income it is then possible to calculate the food expenditure of the self-employed. If this is higher than for employees, it is interpreted as under-reporting of income.

As mentioned in the scoping mission, most self-employed taxpayers, including sole proprietors, are subject to corporate income tax (CIT) according to Armenian tax legislation. As a result, the methodology developed by Pissarides and Weber (1989) building on Household Consumption survey data is not suitable for estimating the PIT/SSC gap.

Labor input method

The extent of the shadow/underground economy can also be measured by looking at the difference between employment according to SRC's records compared with employment in other, independent studies like Labor Force Surveys.

The Labor Force Survey (LFS) conducted by the Statistical Committee of the Republic of Armenia (ARMSTAT) aligns with the International Labor Organization (ILO) guidelines for labor data collection, ensuring that the information gathered is reliable and comparable. The LFS plays a critical role in providing insights into employment trends, sectoral analysis etc.

SRC records the number of employees and hours worked from PIT returns. This data facilitates the comparison between tax registry records and LFS data, and thereby the estimation of the PIT/SSC gap at a sectoral level.[39]

In the scoping mission in September 2024 SRC was recommended to apply the labor input method. As mentioned earlier at the conclusion of this mission to estimate the PIT/SSC gaps, SRC stated that they had utilized the labor input method and came up with similar results as in this mission.

Discrepancies in national accounts

The magnitude of the shadow/underground economy can be assessed in national accounts by examining various discrepancies and residuals. Typically, this involves comparing the total estimate of the national accounts - which encompasses most of the shadow/underground economy - with estimates derived from specific segments of the primary statistics, including tax data that only represent the formal part of the economy.

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[38] Christopher A. Pissarides, Guglielmo Weber. "An expenditure-based estimate of Britain's black economy". *Journal of Public Economics.* Volume 39, Issue 1, June 1989.

[39] Søndergaard, J. (2023): "Undeclared Danish Labor: Using the labor input method with linked individual-level tax data to estimate undeclared work in Denmark", *Journal of Economic Behavior & Organization*, 214:708-730 has developed the labor input method further by combining labor force survey data with tax administration data on employment at an (anonymized) individual level.

National accounts measure both incomes and expenditures; however, these figures originate from different statistical sources, leading to discrepancies. Thus, it's essential to reconcile these figures in line with established accounting principles.

During the scoping mission in September 2024, the SRC presented PIT/SSC gap estimates produced by both the SRC and MoF based on their own calculations of the PIT/SSC gap.

Both the SRC and MoF have assessed the PIT/SSC gap by examining discrepancies between national accounts statistics and SRC data. Wages and salaries are derived from the output and value added in the national accounts, and potential tax withholding from employers is calculated based on these estimated wages and salaries. The PIT/SSC gap is defined as the difference between the potential tax calculated from national accounts and the taxes reported to the SRC. SRC/MoF's findings were fluctuating around 1 percent of GDP with MoF estimates slightly higher than SRC estimates.

SRC/MoF results are somewhat higher than those estimated in this report based on operational audits of around 0.1-0.3 percent of GDP (Figure 1).

Annex III. Materials Left with Armenia State Revenue Committee

- R-code used to clean data for PIT/SSC.
- R-code used to make tax gap estimates for PIT/SSC.
- Powerpoint presentation with key findings.
- CSV-file with tax gaps.