**Appendix 1: Detailed account of the AETR formulas for wage income, SSCs, capital income, and consumption**

Table A.1 introduces various AETR formulas developed by Mendoza et al. (1994), Carey and Tchilinguirian (2000), Carey and Rabesona (2003), and Author’s own (2020). The first three works present the AETR formulas for labor income, capital income, and consumption. The author further divides labor income into wage income and SSCs to calculate separate AETRs. This study follows the author’s approach, emphasizing that the two taxes represent different sources (progressive vs. proportional) of labor taxation.

While diverse in their specific details, all these formulas employ the same broad methodology for measurement. Namely, they calculate the tax burden by adding all relevant tax payments from OECD revenue statistics and dividing them by the respective tax bases drawn from OECD national account statistics (<https://stats.oecd.org/>). All the tax, income, and consumption items used in these formulas are described in Table A.2, following OECD’s standard definitions (Carey and Rabesona 2003, 34; Carey and Tchilinguirian 2000, 8).

Mendoza and colleagues presented their AETR formulas in an influential study of tax burden in OECD countries (Mendoza et al. 1994). Their formula for aggregate labor income includes \**W* as the wage portion of the household income tax payments, along with items 2000 (total SSCs) and 3000 (other taxes on payroll and workforce). For the present study, these payments were separated into the wage and SSC parts, while being divided by the same income base of *W* and 2200 (SSCs paid by employers). The formula for capital income consists of \*(*OSPUE+PEI*), the non-wage portion of the household income tax payments, as well as items 1200, 4100, 4400 that indicate corporate income taxes and other property taxes. These payments are divided by *OS* (net operating surplus) to produce the final estimate of capital tax burden. Finally, the AETR for consumption is calculated by dividing the sum of 5110 (general taxes on goods and services) and 5121 (excise taxes) by *CP* (private final consumption) and *CG-CGW* (government non-wage consumption), along with other minor adjustments to the denominator (Carey and Rabesona 2003).

Carey and Tchilinguirian (2000) presented alternative AETRs by modifying certain assumptions embedded in Mendoza et al.’s original formulas. Their most significant revision relates to the assumption regarding self-employment income. Mendoza et al. considered this income to be part of household capital income (*OSPUS+PEI*), rather than household wage income. Carey and Tchilinguirian criticized the concept by asserting that the self-employed may pay at least some proportion of their income to themselves. The authors therefore devised a proxy for the self-employment wage payment (*WSE*), assuming that the self-employed pay themselves the average employee’s wages or salary, minus social security payments. This redefined portion of wage income as well as item 2300 (SSCs paid by the self-employed) appear in the AETR formulas for wage income and SSCs, as part of the income tax base (the denominator) and the realized tax payments (the numerator). By the same rationale, the two items drop off from the capital’s AETR formula because they belong to neither the capital income base nor the household capital tax payments. Meanwhile, Carey and Rabesona (2003) introduced revised baseline AETR models by not breaking with Mendoza et al.’s assumption concerning self-employment. Their primary concern was that the introduction of *WSE*, while theoretically justified,may create a serious empirical problem because *WSE* is estimated based on an unrealistic assumption that the average income of the self-employed is equivalent to that of all dependent employees. This could further distort the tax data if the reported number of the self-employed is very high and also unreliable. Besides this major disagreement, Carey and Tchilinguirian (2000) and Carey and Rabesona (2003) added various revisions to Mendoza et al.’s formulas. Refer to their original works for further details of these changes.

 “Author I” and “Author II” presented another set of formulas for wage income, SSCs, and capital income that revised the work of Carey and Tchilinguirian (2000) and Carey and Rabesona (2003). While incorporating all major tax and income items that these formulas developed, Author I followed Carey and Tchilinguirian’s assumption that self-employment income was part of the household wage income, while Author II built on Carey and Rabesona’s assumption that it was still part of the household capital income. In addition, both of Author’s formulas expanded the capital tax base by adding *OSPUE* and *PEI* to the denominator of the capital AETR. This addressed the problem of asymmetry observed in all previous capital formulas: while the numerator covers all capital tax payments from incorporated enterprises to unincorporated household businesses, the denominator covers only the incomes from incorporated enterprises (as expressed by *OS*). By introducing *OSPUE* and *PEI* into the denominator, Author made the capital tax base more symmetric to the actual payments.

Moreover, notice that all the wage, SSCs, and capital formulas listed in Table A.1 specify “net” effective tax rates by using net income data (such as *OSPUE* and *OS*) and other items (such as *α, β,* ) that are derived from the net data. Empirical studies, however, have found that nominal data tend to produce more reliable results than net data in cross-country tax research (Carey and Rabesona 2003, 132; Carey and Tchilinguirian 2000, 10–11). Following this guidance, Author I and Author II produced nominal AETRs by replacing all the aforementioned income and tax items with their gross versions (Author’s own 2020). It is true that Mendoza et al., Carey and Tchilinguirian, and Carey and Rabesona presented nominal versions of their capital formulas. However, their approach was simply to replace *OS* with *GOS* (gross operating surplus), thereby leaving *OSPUE, β,* and in their net versions. With respect to the labor income formulas, they did not provide any gross versions at all.

Regardless of these advantages and shortcomings associated with existing AETR formulas, it is important to note that no comprehensive empirical analysis has yet been conducted to evaluate their actual performance in empirical estimation. It is therefore reasonable to utilize all the formulas when gauging the degree of tax burden across different tax categories. More specifically, in this study, I produced composite tax burden measures by averaging out all the AETR figures in unweighted forms. In so doing, it was generally preferred to use nominal rather than net versions of the AETRs. In case some formulas provide only net versions, these formulas were used along with other nominal formulas for the same tax category. This way, the AETRs for wage income and SSCs are calculated by using the five net formulas from Table A.1 and the two nominal formulas presented by Author I and Author II. Capital tax burdens were calculated using the nominal versions of the five formulas in Table A.1. In addition, items 5125, 5212, and 6100 in Carey and Rabesona’s capital AETR formula were all dropped because they constituted only fractions of the capital tax payments and yet produced too many missing data across the sample countries. Finally, consumption tax burdens were calculated using the three formulas drawn from Mendoza et al., Carey and Tchilinguirian, and Carey and Rabesona. Here again, Item 5212 from Carey and Rabesona’s formula was dropped because it constituted only a fraction of the consumption tax payments and yet produced all missing data for Japan and Korea.

Table A.1: AETR Formulas

|  |  |  |
| --- | --- | --- |
| AETR | Tax Categories | Formulas |
| Mendoza et al. (1994) | Wage Income ($τ\_{w}$), SSCs ($τ\_{s}$) | $τ\_{w}=\frac{τ\_{h}\*W}{W+2200}$, $τ\_{s}=\frac{2000+3000}{W+2200}$ |
| Capital ($τ\_{k}$) |  |
| Consumption ($τ\_{C}$) |  |
| Carey and Tchilinguirian (2000) | Wage Income ($τ\_{w}$), SSCs ($τ\_{s}$) | $τ\_{w}=\frac{\left.τ\_{h}\*\left(W-2100+WSE-α2400\right)\right.}{WSSS+WSE+2300}$, $τ\_{s}=\frac{\left.2100+2200+2300+α2400+3000\right.}{WSSS+WSE+2300}$ |
| Capital ($τ\_{k}$) |  |
| Consumption ($τ\_{C}$) |  |
| Carey and Rabesona (2003) | Wage Income ($τ\_{w}$), SSCs ($τ\_{s}$) | $τ\_{w}=\frac{\left.τ\_{h}\*\left(W-2100-α2400\right)\right.}{WSSS+3000}$, $τ\_{s}=\frac{\left.2100+2200+α2400+3000\right.}{WSSS+3000}$  |
| Capital ($τ\_{k}$) |  |
| Consumption ($τ\_{C}$) |  |
| Author I (2020) | Wage Income ($τ\_{w}$), SSCs ($τ\_{s}$) | $τ\_{w}=\frac{\left.τ\_{h}\*\left(W-2100+WSE-α2400\right)\right.}{WSSS+WSE+2300+3000}$, $τ\_{s}=\frac{\left.2100+2200+2300+α2400+3000\right.}{WSSS+WSE+2300+3000}$  |
| Capital ($τ\_{k}$) |  |
| Author II (2020) | Wage Income ($τ\_{w}$), SSCs ($τ\_{s}$) | $τ\_{w}=\frac{\left.τ\_{h}\*\left(W-2100-α2400\right)\right.}{WSSS+3000}$, $τ\_{s}=\frac{\left.2100+2200+α2400+3000\right.}{WSSS+3000}$ |
| Capital ($τ\_{k}$) |  |

Table A.2: Tax and Income/Consumption Items used in the AETR Formulas

|  |  |  |  |
| --- | --- | --- | --- |
| Items | Descriptions | Items | Descriptions |
| *α* | The share of wage-related income in personal income | 2300 | SSC paid by the self-employed |
| *β* | The share of non-wage income in personal income | 2400 | SSC, unallocated |
| *CG* | Government final consumption | 3000 | Taxes on payroll and workforce |
| *CGW* | Government final wage consumption | 4000 | Total property tax |
| *CP* | Private final consumption | 4100 | Recurrent taxes on immovable property |
| *OS* | Net operating surplus | 4400 | Taxes on financial and capital transactions |
| *OSPUE* | Unincorporated business net income (net mixed income) | 5110 | General taxes on goods and services |
| *PEI* | Interest, dividends, and investment receipts | 5121 | Excise taxes |
| *WSE* | Proxy for the wages for the self-employed | 5122 | Taxes on profits from fiscal monopolies |
| *WSSS* | Total compensation of employees (including employers’ contributions to social security and to pension funds) | 5123 | Customs and import duties |
|  | AETR for personal income | 5125 | Taxes on investment goods |
| *W* | Wages and salaries for employees | 5126 | Taxes on specific services |
| 1200 | Corporate income tax | 5128 | Other consumption-related taxes |
| 2000 | Total social security contributions (SSC) | 5200 | Taxes on use of goods and performances |
| 2100 | SSC paid by employees | 5212 | Taxes on moto vehicles paid by others |
| 2200 | SSC paid by employers |  |  |

**Appendix 2: Cases, the coverage, and the data sources**

1. Cases: 21 countries

Japan, Korea, and 19 OECD countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the UK, and the US)

2. Coverage: 1995-2018

For Japan and Korea, some data extended to cover earlier years back in1980.

3. Data sources

1> Total taxation as % of GDP: OECD database (<https://stats.oecd.org/>).

2> Top statutory tax rates for personal and corporate income: OECD database (<https://stats.oecd.org/>). The historical data for Korea were collected from the tax rate clauses of the Corporate Tax Acts of Korea and the Income Tax Acts of Korea, available online from the government website (http://www.law. go.kr/). The historical data for Japan were collected from Ishi (2001, pp. 82, 173).

3> VAT: OECD. 2018. *Consumption Tax Trend 2018*. Paris: OECD. The historical data for Korea were collected from Na (1997, pp.180-182), and those for Japan were collected from Cabinet Office (2018, p.67), Ishi (2001, pp.324-339), and *Nippon Times* (Oct. 8 2019). The US data was calculated by averaging out all state-level VAT rates provided by Tax Policy Center (https://www.taxpolicycenter.org/statistics/state-sales-tax-rates).

4> The marginal effective tax rates of for one-earner and two-earner families with 167% and 67% of the average gross wage earnings: OECD database (<https://stats.oecd.org/>).

5> The tax burden as measured with AETRs and the GDP ratios: The tax and income/consumption data used to calculate these figures were directly collected from OECD Revenue Statistics and OECD National Accounts Statistics (<https://stats.oecd.org/>), except for the following cases.

* *OSPUE* (unincorporated business net income): This item was calculated by subtracting gross mixed income (*GMI*) by consumption of fixed capital (*CFC*) at the household level. For Australia, Canada, Germany, and Ireland where the household-level data were missing, alternative data were drawn from the household and non-profit institutions (NPI) level. Also notice that the OECD database did not provide the *GMI* and *CFC* data for Korea. These data were therefore collected from an alternative source, KOSIS (<https://kosis.kr/index/index.do>), run by the Korean government.
* *PEI* (interest, dividends, and investment receipts): The OECD database did not provide the household-level data for Australia, Austria, Canada, Germany, Ireland, and Switzerland. These data were replaced by the household and NPI level data. Meanwhile, the *PEI* data for Korea were all missing. These data were substituted with those from KOSIS (<https://kosis.kr/index/index.do>).
* *W* (wages and salaries for employees), *WSSS* (total compensation of employees (including employers’ contributions to social security and to pension funds), *OS* (operating surplus), and *GOS* (gross operating surplus) were all missing for Korea. These data were substituted with those from the KOSIS.
* All historical data for Japan, which were not covered by the OECD database, were collected from National Account for household (2003) from the Cabinet Office (<https://www.esri.cao.go.jp/en/sna/data/kakuhou/files/2003/17annual_report_e.html>). Those for Korea were drawn from KOSIS.

4. Missing data

1> Total taxation as the percentage of GDP: The data for Australia in 2018 was missing.

2> Top statutory rates for personal and corporate income: The personal income data for the 1995-1999 period were missing in all countries except for Japan and Korea.

3> VAT: The Australian data for 1995-1999, 2001-2004, and 2006 were missing. The US data were also missing for 1995-2000. For all other countries, the VAT data for 1996-2004 and 2006 were missing, except for Japan and Korea which reported no missing data.

4> The marginal effective tax rates of for one-earner and two-earner families with 167% and 67% of the average gross wage earnings: The data for 1995-1999 were missing for all countries.

5> Tax burden as measured with AETRs and the GDP ratios:

* Australia: The AETR data for consumption were missing for 1995-1997. All data were missing for 2018.
* Austria: All wage, SSCs, and capital income data were missing for 1995-1998.
* Canada: All AETR data for consumption were missing. All other data, except for the GDP-ratio for consumption, were missing for 2016-2018.
* Greece: All data were missing for 2018.
* Japan: All data, except for the GDP-ratio for consumption, were missing for 2018.
* Korea: The AETR data for consumption was missing for 2018.
* Spain: All data, except for the consumption data, were missing for 1995-1997.
* Switzerland: All data, except for the consumption data, were missing for 1995.