Employment Structure and the Rise of the Modern Tax System

Online Appendix

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A.1 Data sources for distributional employment profiles

A.1.1 Cross-country

The cross-country database contains micro-data collected from 100 countries around the world to document changes in employment structure transformation in as many incremental stages over development as possible. I chose to focus on countries with at least 1 million citizens. The selection of a survey in a particular country had to satisfy three criteria. First, it must be nationally representative. Second, it must survey respondents in all forms of work arrangement as opposed to, for example, only salaried workers. Third, it must contain continuous information on all sources of income, instead of, say, only wage earnings.

Given these criteria, the preferred type is a living conditions survey. This type of survey will often dominate a labor force survey, for three reasons. First, the living conditions survey usually contains information on a broader range of income sources which, especially in the context of less-developed countries, can be quite important in order to construct the lower deciles of the country's income distribution. Second, it is not always clear what the underlying sample design is for the labor force survey, and it could potentially omit individuals which in the context of this study should be included in the survey, such as casual wage day laborers and household family workers; on the other hand, the scope of a living conditions survey is usually to assess the conditions of a nationally representative sample of individuals, which should include all the alternative work type patterns. Third, the sample size of a living condition survey is typically larger than that for a labor force survey, which does not have to imply better quality of data, but usually is due to sampling

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design which attempts to survey all geographical areas in the country. Basic health and demographics surveys are discarded, because they do not contain information on work arrangements and income.

The data collection effort resulted in 100 surveys, which are detailed in Table A.1, displaying for each country: the year of the survey; the per capita income group; the survey type; the coverage; the sample size; and, the original source. The income group corresponds to the World Bank classification of the country in the year of the survey. The micro data-base covers all levels of development: 20% of surveys from low-income countries; 28% from lower-middle income countries; 21% from upper-middle income countries; and, 31% from high-income countries. 93 out of the 100 data-sets are living condition surveys, 5 are labor force surveys, and the remaining 2 are censuses. In low and lower-middle countries, I obtain almost all surveys directly from the national statistics office, or the relevant government agency. In these countries, the average sample size is substantially larger than the corresponding Living Standards and Measurement Survey (LSMS) from the same country.

The construction of the employee variable is based on questions similar to the 'class of worker' question in the US Census. All cross-country surveys were chosen to ensure the highest possible international comparability. In particular, I discard all surveys where I cannot construct the employee classification based on a detailed and objective 'class of worker' question. In all surveys, I can distinguish between employees and employers. This removes the possibility that employers of large firms are counted as employees, in which case the comparison of employee versus self-employed would partially be confounded by a firm size comparison. In addition, I can systematically distinguish between employees and both family and non-family workers in household enterprises. I can also systematically distinguish between employees that work for a salary versus for in-kind payments. Finally, I can distinguish between casual daily wage laborers and 'regular' employees in the countries where seasonal work is arguably most prevalent. It is true, however, that I cannot systematically distinguish casual wage laborers, and non-regular wage earners more generally, from contract-based regular employees. .

I focus on calculating gross income from all sources in order to be conceptually consistent with the broadest possible income-definition in the tax code. This leads me to calculate four sources of income: wage income, self-employment income, capital income, and miscellaneous income (such as lottery receipts). Most importantly, I ensure that I can calculate both employee and self-employment income with precision. The most significant challenge is to calculate self-employment income in agriculture in less-developed countries. Agricultural earned revenue includes the value of crops sold to others. I do not attempt to create a monetary value of in-kind sales, as offering and receipt of in-kind goods and services

is not subject to tax. Agricultural capital revenue includes the sale of live-stock, income from rental of equipment, and share-cropping income. From this revenue I attempt to subtract costs, which include expenditure on inputs, wages paid out to workers, and new investments. In a limited number of countries, I do not observe any agricultural revenue for respondents that are self-employed in agriculture. These are most often contributing family workers on farms where the full output is consumed by the family. In this limited number of cases, I construct the income as the market value of the own-consumed output.
In all surveys, I exclude two sources: social transfers, and in-kind goods and services. I exclude social transfers because it falls outside the concept of taxable income. The monetary value of in-kind goods and services are sometimes included in taxable income, often on a presumptive basis. However, apart from the mentioned case above, I exclude this source of income because I cannot measure it consistently across all surveys. These sources of non-monetary income are plausibly too small in magnitude to overturn the decile-ranking of individual income if they were systematically included.
In 7 countries, I cannot calculate gross individual income with precision: Liberia, Ethiopia, Malawi, Mali, Burkina Faso, Cambodia and Kenya. In these countries, I lack information to calculate agricultural or non-agricultural self-employment income with meaningful precision. I instead calculate total individual expenditure, and use it as a proxy for total income. I do not attempt to locate the income tax exemption threshold in these 7 countries.
While I define the employee-status based on the respondent's primary job activity, I attempt to calculate income from all activities reported during the reference period. One issue is the allocation of income which is reported at the household, rather than individual, level. For sources of earned income that are not at the individual level, I assign equal portions to each economically active member of the household that reports having undertaken this activity during the reference period. For sources of non-earned income reported at the household level (e.g. property rental income), I assign an equal portion to each economically active member.
Whenever a country's tax code is based on annual amounts and the reference period in the country's survey module is not, I multiply the regular amount by the number of periods in the year – e.g. if wage income was reported monthly, I multiply it by the number of months that the wage income is reported to have been received during the past year. In the case where no periodicity exists, I assume that the flow was occurring during the whole year with the same pattern as during the reference period.
In every country survey, I limit the sample to the economically active population, following the definition of employment from the U.N. System of National Accounts. This definition is also used in Bicks, Fuchs-Schundeln, & Lagakos (2018), and in Feng, Lagakos, &

Rauch (2018), which study respectively how hours worked and unemployment vary with development. I code employment-type based on the primary job in the reference period. The primary job is often explicitly defined as the job in which the respondent spent most hours during the reference period. The reference period in the Luxembourg Income Study (LIS) is annual, while it is predominantly monthly in the remaining surveys. The extent to which the periodicity and the focus on the primary job introduce biases in the representativeness of my employment-categories is discussed in Appendix A.2.
The micro-database also contains variables on education, sector, and geographical location. The geographical location indicates whether a respondent lives in an urban area or not, based on the urban definition in the individual surveys (which may vary from country to country). I use variables to indicate three levels of education completion: not completed primary; completed primary but not high school; completed high school. I create four sectoral categories: agriculture; manufacturing ; services; and, public administration, based on the ISIC 4.4 classification.

A.1.2 Historical US time-series

The historical federal profiles in the US between 1950 and 2010 were constructed using the decennial Census samples, extracted from the IPUMS USA database. I exclude all respondents that are not active in the labor force during the reference period. I calculate the individual income distribution, based on the measure of gross income at the individual level. To construct the income distribution, I use the measure of total, pre-tax, personal income. Farm and non-farm business income, as well as wage income, are consistently recorded in every Census sample. I use the detailed 'class of worker' question, which allows me to assign unpaid family workers to the self-employed category. Consequently, the self-employed category includes employers, own account workers, self employed that are not incorporated, and self-employed that are incorporated. I apply individual weights to estimate the employee-share of every decile of the income distribution in every decade. The 1 percent sample of the 1940 Census does contain wage and salary income, but no business income nor farm income, which are required to construct a personal gross income distribution. Instead, I use the 1935-36 Study of Consumer Purchases. The primary sampling units were chosen to represent "the demographic, regional, and economic characteristics of the United States" (ICPSR, 2009). From these areas, a randomly selected group of approximately 700,000 families were screened in a first wave. The data-sample that I use is based on a random sub-sample of approximately 5,000 families who completed the first-wave 'labor force' component of the survey. The employee classification is based on 'status of employment' question, which is identical to the (non-detailed) 'class of worker'

question used in all US Censuses from 1950 onward. I code as an employee any individual respondent who reports being a "salaried worker/wage earner." I code as self-employed any respondent who reports being "self-employed", and any respondent who does not specify a type of work but declares to be working, is above age 20 and has substantial work-related income. I exclude all respondents that are employed on work-relief projects in their primary job. Total gross income only exists at the household level. Rather than try to assign income at the individual level within the household, I focus on the work-type of the head of household. I then rank individuals based on the reported total income, and estimate the employee-share in each income decile.

The 1935-36 survey marked a clear shift in focus of the surveys conducted by the Bureau of Labor Statistics. Indeed, the surveys carried out prior to the 1930s focused on measuring family income and expenditure patterns of the U.S. *employed* workers and their families and are therefore not relevant for my study. In order to construct additional historical profiles, I therefore use data from Lindert & Williamson (2016). This project estimates incomes in the U.S. between 1650 and 1870. The authors' approach to estimating income derives from combining information about income and labor force participation counts across occupation, space and time. This amounts to building 'social tables' across occupations within a given space-time frame. The data-collection attempts to capture all occupation categories in a given space-time by drawing on data from local tax assessments and occupational directories for 'registered' occupations, and local censuses for 'unregistered occupations'. The authors also collect data on property income by assuming rates of return on wealth estimates that vary across occupation-space-time, and combine this with earned income to derive measures of total income.

I construct a historical 1870 profile based on the data kindly provided by Peter Lindert. This cross-section builds upon the 1870 1 percent US Census sample delivered to the authors by IPUMS USA, which included sampling weights at the individual-level. This data-set is then merged with the authors' estimate of total income at the same level. I extend their analysis and classify all available occupation categories as either self-employed or employee. I use the detailed description of each occupation category to code employment-type. The measure of total income includes own labor earnings in agriculture and non-agriculture, farm and non-farm operating income, and property income. I apply the sampling weights initially provided by IPUMS USA. I estimate the employee-share in every decile of the individual gross income distribution, for the population that is active in the labor force.

I locate the Federal income tax exemption threshold. There was no Federal income tax in 1870. In all subsequent profiles, I use the historical IRS series which provide details on the nominal value of the standard deduction of a single filer.

US States time-series I construct the US States time-series using the same data and definitions as for the Federal time-series, combining Census data between 1950 and 2010 from IPUMS USA with the 1935 data from the Study of Consumer Purchases. I rank all respondents within a given state-year according to the reported total pre-tax personal income. I then apply person-weights and partition each state's income distribution into ten deciles of equal sample size. Within each decile, I estimate the conditional proportions of employees and self-employed to construct the employee-shares by income decile. I interpolate the variables between data-years using a natural cubic spline.
The tax-revenue sources by state and year are based on the historical series on the historical State Government Finances series. I construct the ratio of tax-revenue collected to aggregate total personal income, where the denominator is based on the BEA historical series. I use the state income tax calculator program from Bakija (2009). I thank Jon Bakija for kindly providing me access to the calculator, which is based on the legal tax codes from all states. I construct the income tax threshold for an individual earner who files under the status of being single and who claims the standard deduction. I also collect data on marginal rates from the calculator.

A.1.3 Historical Mexico time-series

As an additional within-country series, I focus on Mexico because it has variables of income and employee-jobs that are consistently defined over a long period of time, namely 1960-2010. The data is extracted from IPUMS International. The disadvantage of the Mexican data-sets is only earned income is measured consistently over this period - as opposed to total income, which further includes capital income and 'other' income. I use answers to the 'class of worker' question. The only inconsistency over time in this question is that the 2010 sample groups household assistants together with salaried workers, whereas in previous samples, these categories are separated. As such, I am over-estimating the true employee-share in the 2010 profile. There also exists a category for unpaid family workers, which I assign to the self-employment category. I construct the sample of respondents that are economically active, and use survey weights to construct individual earned income distributions in 1960, 1990, and 2010. For the years 1990 and 2010, I code the value of the exemption threshold from OECD's Personal Taxes database. For 1960, I use the historical archives of the Mexican Tax Authority (link).

A.2 Potential biases resulting from methodology

In this appendix section, I discuss the potential biases that can arise from the survey methodology and the measurement and construction of variables. I code employment

type based on the primary job in which the respondent spent the most hours during the reference period. Many individuals have many jobs at the same time (Banerjee and Duflo, 2007). This affects the representativeness of my estimates only to the extent that these jobs fall in different categories in my employment-classification. Most importantly, an individual who contributes on the family farm while being an own-account worker within the same reference period would be classified as 'self-employed' in both jobs. In surveys where the reference period is not yearly, there may be bias in the measure of employment structure if the employment type in the reference period is not representative of the entire year. There is strong seasonality in job-types in many developing countries. However, this introduces bias only to the extent that the jobs at different periods fall in different employment categories. Importantly, casual wage laborers during the harvest season are unlikely to be regular full-time employees in the non-harvest season, but rather own-account workers or contributing family workers.

A second potential source of bias stems from the inability to systematically separate casual wage work from contract-based wage-work. Specifically, due to survey-limitations, I potentially classify the group of casual workers that are not paid in-kind as employee when they should be self-employed. Since the transition over development involves a movement out of casual wage labor into contract-based wage labor, this mis-classification will lead me to under-state the true growth in employee-share along the development path.

Another potential source of bias arises from the possibility that self-employed misreport their true income in the surveys. This is unlikely to introduce a major bias in the main results, for three reasons. First, self-employed face much smaller incentives to mis-report income in survey data than in administrative tax data. U.S. evidence from matched survey-administrative data is consistent with this prediction (IRS, 2008). Second, models of tax evasion would predict under-reporting of income among self-employed locally around the exemption threshold and a decrease in employee-share further to the left of the threshold. This is not borne out in the data: instead, I observe a gradual increase in the employee-share over the full income distribution. Third, De Mel et al. (2008) show that recall error, which is more present when the reference period is not annual, lead self-employed to under-estimate their income. Both in the case of evasion and recall error, the true self-employed distributional profile would lie to the right of the observed one. A country's development may be associated with an increase in the enforcement ability to detect evasion under-reporting among self-employed and with a decrease in recall error due to changes in survey methodology or due to improvements in accounting tools and book-keeping. Both of these channels would thus generate *leftward shifts* of the employee-share profile, leading me under-estimate the *rightward shifts* in the employee-profile over development driven by the changes in employment-structure.

Finally, bias could be introduced from construcing the income tax base variable as the share of the individual income distribution which lies above the single-filer standard deduction (or allowance). This allows me to measure the tax base in a transparent way without making any behavioral assumptions that is comparable across countries and time. Notwithstanding, some tax systems allow allow taxpayers to further reduce their tax liability through specific deductions. If a significant number of filers makes use of these deductions, there is a wedge between my size of base and the 'effective' size of base. There exists no consistent evidence across countries at different levels of development on the extent to which the effective tax base is reduced through credits and deductions. The wedge is plausibly larger in more developed countries, simply because the potential wedge in less-developed countries is bounded above by the small size of my measured base. This would lead me to overstate the variation in base-size across development (Panel A, Figure 4), but understate the association between tax base-size and tax collection (Figure A.5).

A.3 Tax reform databases and case-studies

Reform databases

In several databases, I document that reforms to the nominal value of the threshold occur frequently. This guards against the concern that the increases in tax base over development are mechanical if the nominal threshold is never reformed but gradually decreases in the distribution due to income growth. The first database is Peter et al. (2010). The authors compile data on the complete national personal income tax schedules in 189 countries between 1981 and 2005, including the nominal value of the income tax exemption threshold. Their primary data-sources include tax summaries of international consultancies as well as publications and datasets of international organizations and public policy centers. Low income countries represent 36.5% of the sample, middle income countries represent 26%, and high income countries 37.5%. I code a reform as occurring if the nominal value of the exemption threshold changes by more than 10% between two years. I impose the 10% restriction to minimize the likelihood that changes to the threshold are automatic due to inflation-indexing of the tax scheduele. The average inflation rate since 1990 in developing (developed) countries since 1980 was 7.51% (3.34%) - making the 10% restriction conservative and leading me to under-estimate the frequency of (active) legislative reforms to the threshold. I find that reforms occur in 29.24% of the country-years. This reform intensity is more pronounced than reforms to any of a country's marginal income tax rates (there are 4.68 marginal rates in the average country-year tax schedule), which

occur in 23.94% of the country-year observations. 21.98% of threshold reforms lead to a reduction in the nominal value. I find similar results in two alternative databases. The IMF created a tax policy reform database covering 23 developed and developing countries over the past 40 years (Amaglobeli et al., 2018). In addition to the data-sources from Peter et al. (2010), this database also uses tax-related news published by the International Bureau of Fiscal Documentation. The developing countries in the database include Brazil, China, India, Mexico and Turkey. The IMF database does not contain information on the nominal threshold values, but one of the inclusion criteria for including a reform in the database is that it is deemed to "have the potential to mobilize significant resources." In the country-year panel data-set, the likelihood that a reform to the exemption threshold is observed is 27.54%. The share of threshold reforms which are decreases is 29.44%. Finally, there exists an OECD annual database of tax reforms, which includes a limited number of (rotating) selected developing countries. This database measures reforms to the income tax base, which includes the threshold but also tax credits and relief. Reforms to the personal income tax base occurred in 32.88% percent of the country-years.

China and India case-studies

I discuss additional findings related to the case-study of India and China's diverging personal income tax systems (Piketty and Qian, 2009). Tabulations from Banerjee and Piketty (2005) show that, between 1922 and 1992, the size of the income tax base in India was effectively constant, varying between 0.25% and 1.5%. This constancy was achieved through systematic upward revisions to the exemption threshold to keep track of top incomes' nominal growth (Ministry of Finance, 1971, 1986; Piketty and Qian, 2009). The tax base temporarily increased to 3.5% in the late 1990s, during the 'income growth paradox' when top incomes soared, but was quickly brought back to 2% in size through active threshold reforms. The Indian tax currently covers approximately 2.2% of the active workforce (Ministry of Finance, 2016). The Indian tax base has thus remained constantly narrow in size for over 90 years (1922 – 2016). In contrast, China's income tax base grew from 0.1% to approximately 20% between 1986 and 2008 (Piketty and Qian, 2009). This was achieved primarily through updating the nominal value of the exemption threshold at a slower pace than nominal income growth. This type of policy reform is arguably less salient than directly lowering the nominal value, but remains an important source of reform. Indeed, it has caused the personal income tax to currently raise 3.8% of GDP in taxes; moreover, the exemption threshold is regularly cited in public policy documents and national media outlets.

A.4 Employee share of income tax collection

In this appendix, I describe the procedure to collect data on the wage-salary share of personal income tax collection, focusing on actual taxes collected. There are two primary sources: OECD Revenue Statistics; and, national tax authorities' publications. I rely on OECD whenever possible, given its high level of data-quality. I use the fact that reported data contains a distinction between income taxes collected from wages and salaries and those that are not, based on the nature of the activity. For example, whenever a self-employed individual (activity) pays out a wage to herself (source) and pays taxes on it, this is counted as a tax on self-employment rather than a tax on wages. Whenever such a distinction is not available, I rely on income taxes that are withheld on employees as the measure for wage and salary taxes. I exclude data-points which do not distinguish between withholding on employee income and other withheld taxes. Given these selection criteria, I found information for 100 countries; whenever I could not find information for a country in the cross-sectional sample, I used information from a comparable country at a similar level of per capita income and in the same region. To the best of my knowledge, this data-collection is the most recent and most comprehensive in its country-coverage. Most prior studies that discuss the income tax collection composition use a common source that is 30 years old and covers a limited number of countries, namely the 1980 Government Finance Statistics Yearbook (including Newbury and Stern, 1987). The US historical data is collected from the IRS publication series 'Statistics of Income' (available online: link here). I include sources of income that have historically been taxed under the progressive tax schedule; this excludes dividends and capital gains which are often taxed on different tax schedules.

A.5 Convergence points in US states

In this appendix section, I adapt the regression technique used in Imbs and Wazciarg (2003) to quantify the relationship between the distribution of employee-share across income deciles and development. I use a non-parametric regression method that is locally robust and allows me to recover estimated coefficients.[1] I use the panel data in the US states sample and partition it into subsamples according to overlapping constant per capita income intervals of size $J = \$1,000$, with an overlap of size $\triangle = \$250$. For each subsample, and in each of the ten income-deciles, I run a state fixed effects regression of

[1] Other smoothing methods simply compute the mean of an outcome variable for subsamples of data centered around a value of the explanatory variable. This distinction is important because I am not only interested in the shape of the general relationship between employee share and per capita income, but also the sign and the statistical significance of the regression coefficient on per capita income within US states

the decile-specific measure of employee share on the log of per capita income.

$$E_{dst} = \alpha + \beta^d \, log \, y_{st} + \mu_s + \phi_t + \varepsilon_{st}$$

where E_{dst} is the employee-share in income decile d in state s at time t, $log \, y_{st}$ is the log of State real per capita income, μ_s and ϕ_t are state and year fixed effects, respectively. Separate slope coefficients, β^d, are estimated for each income decile d.

From each regression, I extract the estimated slope coefficient on income, and plot these (decile-specific) slope coefficients β^d together with the estimated 95% confidence interval against the per capita income midpoint of each estimation subsample. The resulting graphs are plotted in Figure A.1. The curves suggest that, at lower levels of per capita income, increases in income within a state are associated with growth in employee-share in all income deciles. However, the estimated $\hat{\beta}^d$ decrease with per capita income, and beyond a specific level of per capita income, the slope coefficients center around 0 and become insignificant, implying that growth of employee-share has come to a halt and the employee-share has reached a steady-state. I visually define this steady-state level of development as the smallest per capita income level beyond which β^d starts to become insignificant. I denote this the convergence point, and locate it on the panels for each of the ten income deciles. This 'convergence point' is precisely estimated, in the sense that the estimated $\hat{\beta}^d$ continue by and large to remain close to 0, and statistically insignificant, in subsequent subsamples after the slope-coefficient has first become insignificant. Importantly, the panels indicate that the convergence point in lower income deciles generally occurs at systematically later levels of development. This is suggestive of development 'stages': in the earliest stage, employee-share grows and converges at the top of the income distribution; over subsequent stages, employee-share grows, and converges, gradually further down the income distribution, in close relation to per capita income.

A.6 Evidence against redistributive targeting of the threshold

In this robustness check, I provide evidence to suggest that the exemption threshold is not set to target social assistance or anti-poverty in the income distribution. Governments define thresholds of income that are used as inputs in formulas to provide social assistance and anti-poverty relief. I use the national poverty line and the minimum wage values as proxies for the 'social redistribution' threshold. Using the IBFD tax summaries, I first show that only in 5% of countries in the cross-sectional sample does the tax code explicitly define the tax exemption threshold to be equal to, or a multiple of, either of these redistribution thresholds. These countries are: Mozambique, Bolivia, Paraguay,

Turkey, and Slovakia.

Notwithstanding, governments may implicitly maintain an association between the tax threshold and the social redistribution thresholds. To investigate this, I collect data on the value of the national poverty line and the minimum wage in all countries in the cross-sectional sample. I use harmonized data from ILO for minimum wage, but unfortunately there is no similar harmonized data for the national poverty line. I was able to collect relevant data in 88 of the 100 countries in my sample. Importantly, I collect the poverty line that is set by the national government, rather than the value of the international poverty line in local currency. If several poverty lines exist, I pick the one with the highest value – this decreases the likelihood of observing that the two thresholds are unrelated to each other.

The results are displayed in Figure A.2. The three panels separate countries into development groups: low and lower middle income; higher middle income; and, high income. I construct the ratio of the income tax exemption threshold to the minimum wage, and of the exemption threshold to the poverty line. In the left-hand graphs, the bars represent country-specific ratios using the minimum wage, while the right-hand graphs display the ratio using the poverty line. Finally, within each graph, I sort the countries by GDP per capita. I take the log of the ratio, as this allows me to display all country-ratios on the same graph. Therefore, a bar-value below 0 means that the exemption threshold is located below the minimum wage/poverty line in the specific country. There is no obvious, confounding trend which emerges from Figure A.3. Within all development groups, countries with similar per capita income, and hence similar size of tax base, display very large variation in the relative value of the tax threshold to the redistribution thresholds. The highest-income countries often locate both the poverty and the minimum wage thresholds above the tax exemption threshold, but there is otherwise no systematic systematic relationship between development and the relative location of tax and redistribution thresholds.

A.7 Evidence against sectoral targeting of the threshold

In this robustness check, I consider whether the location of the exemption threshold targets sectoral structure, rather than employment structure. I focus on the 'hard to tax' agricultural sector, and the 'easy to tax' sectors of manufacturing and public administration. I first consider whether the tax exemption explicitly targets any sector. Concretely, this is a primary concern for agriculture; I use the IBFD country-reports and report whenever agricultural income is exempt from income taxation. I do not take into account instances where tax codes allow self-employed to deduct costs specifically related to agricultural work

- for example, from the purchase of a tractor for farming. This is because my measure of the exemption threshold in all countries is the standard deduction. Aggricultural income is fully exempt only in 11% of low-income countries; 12% of middle-income countries; and, 5% of high-income countries.

As a second approach, I consider whether changes in sectoral distributional profiles over development could account for the movement in the exemption threshold. I create four sectoral categories in all the surveys: agriculture; manufacturing and construction; trade and services; and, public administration. I define these four categories in relation to the divisions of the ISIC 4.4 classification. The distributional profiles of agricultural employment, constructed similarly to the employee-profiles, are displayed in Figure A.3. There is a gradual shift leftward of a downward-sloping agricultural profile between low-income and middle-income countries, but virtually all agricultural work in these countries is concentrated among self-employed with no information trails. Moreover, the profile is effectively flat between middle income and high-income countries. Movement out of agriculture could therefore account for the expansion of the tax base, but only in a limited range of the development path, where it is fully confounded by movements out of self-employment. The sectoral profiles of 'easy to tax' sectors are displayed in Figure A.4. These profiles are conditional on employee-employment. The distributional profile of easily taxable sectors would have to be upward-sloping in the income distribution, and move leftward as the country develops, in order to be a confounding factor. This is not borne out in the observed profiles. The public administration profile is upward-sloping at some development levels, but the magnitude of the slope is quantitatively small, and there is no consistent leftward shift over development. The manufacturing distributional profile is largely flat in the income distribution, but features a level-shift upward and then downward across development.

A.8 Tax collection and income tax policies over development

Since I am introducing a novel tax policy instrument, I benchmark its association with tax collection (proxied for by income tax/GDP) against the top marginal tax rate. The top marginal rate is the main empirical proxy used in other theories of income tax growth. In Panel A of Figure A.5, I find a strongly significant and positive direct relationship between the size of the income tax base and tax collection, while controlling for the top rate; in contrast, I find no significant association between the top marginal tax rate and tax collection, once I control for the size of the tax base. To construct the left-hand side (right-hand side) figure, I first regress both income tax/GDP and income tax base (rate)

on the rate (base), and calculate residuals. I then group observations into fifty equal-sized (2 percentile-point) bins based on the tax base residuals (rate residuals), and scatter the means of income tax/GDP and tax base residuals (rate residuals) within each bin, adding back the sample mean of each variable to ease interpretation. In all figures, the solid line shows the best linear fit, estimated on the underlying cross-country data. In Panel B, I plot the association between income tax/GDP and income per capita, after regressing income tax/GDP on tax base (left-hand graph) or top rate (right-hand graph). The graphs therefore show how tax collection varies across development, after controlling for the variation in collection that is accounted for by the income tax base or top rate. I find that, once I control for the size of the base, there is no remaining association between income tax collection and development (left graph, Panel B). At the same time, there remains important variation in residual collection, at a given level of development. This is true in high-income countries, where additional factors beyond the size of the base contribute to differences in tax collection.

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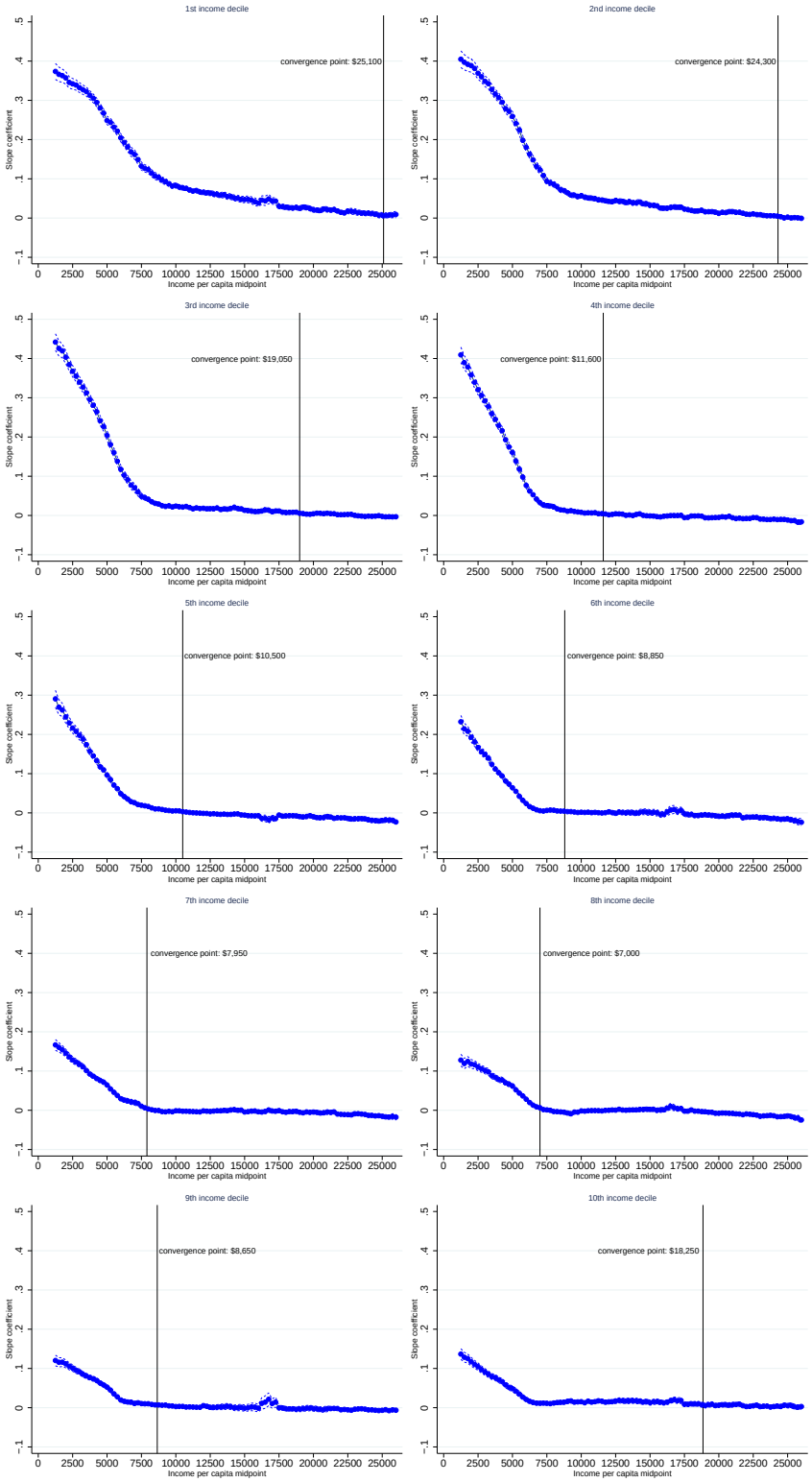
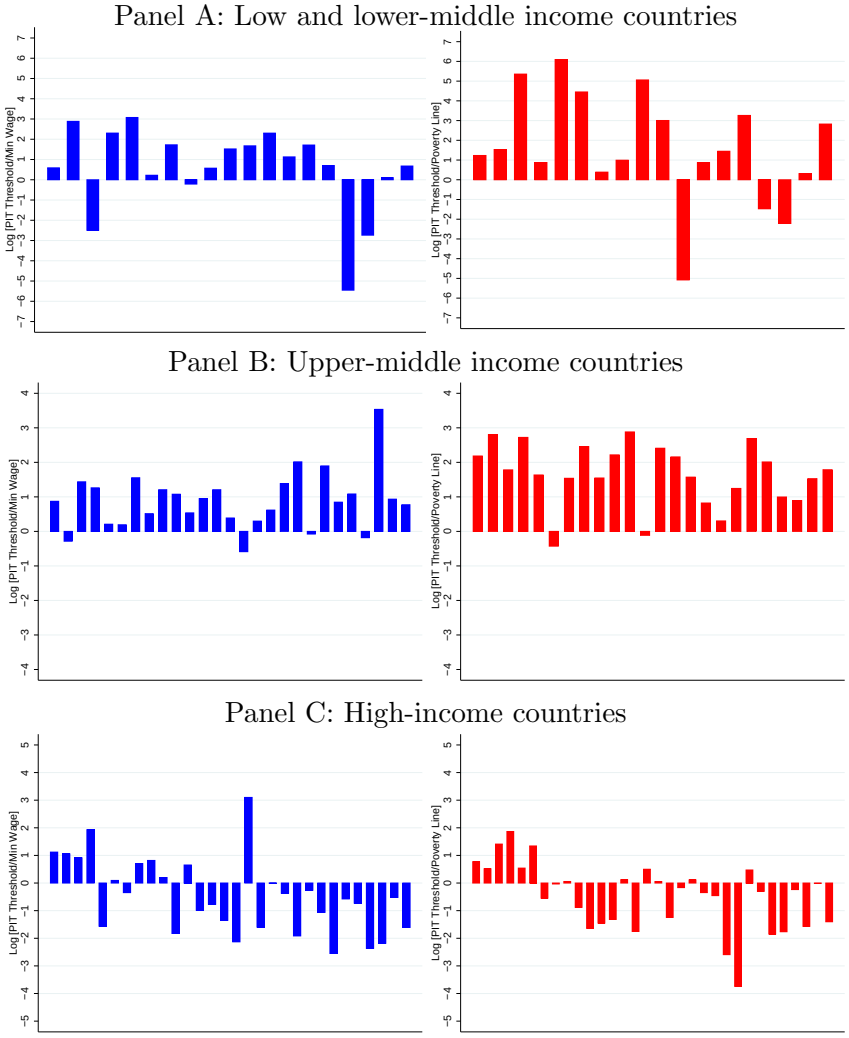
Figure A.1: Employee-share growth across income deciles



Notes: Each panel plots the estimated slope coefficients, and its 95% confidence interval, from within-state regressions of the employee-share in an income decile on log of per capita real income. The slope coefficients are estimated in sub-samples which differ by $250, and separately in the ten income deciles. The solid vertical line denotes the convergence point, which is the minimum per capita income beyond which the slope-coefficient starts to become insignificantly different from 0.

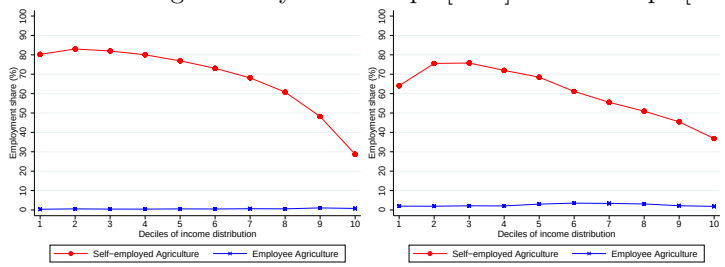
Figure A.2: Redistributive targeting



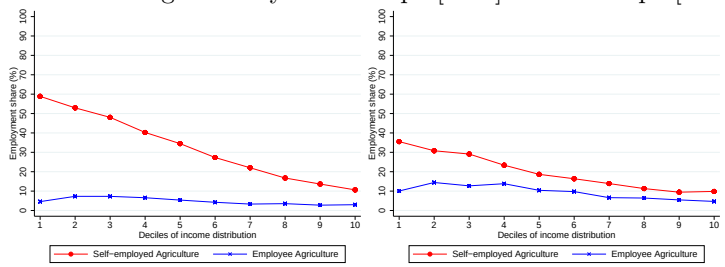
Notes: In every graph, a bar represents a country-observation from the cross-country micro-database. The three panels demark countries according to their per capita income group: low and lower-middle; upper-middle; high income. Within each graph, countries are ranked in ascending order of per capita income. Within each group, the left-hand graph shows the log of the ratio of the income tax exemption threshold to the minimum wage; the right-hand graph shows the log of the ratio of the income tax exemption threshold to the poverty line. All thresholds are expressed in annual and local currency.

Figure A.3: Distributional profiles of 'hard-to-tax' sectors

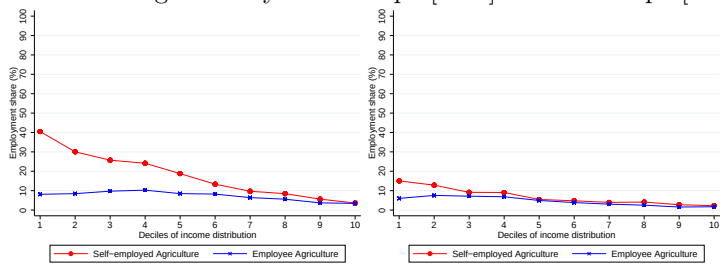
Profile for average country at $1065 pc [LHS] and $2226 pc [RHS]



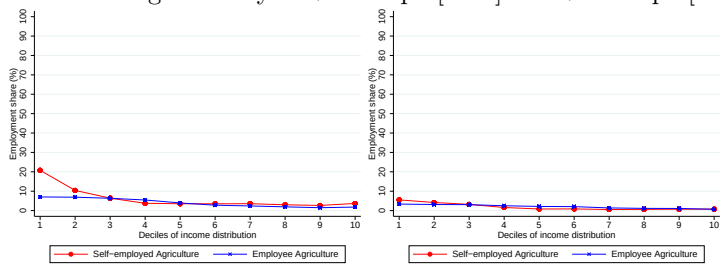
Profile for average country at $3239 pc [LHS] and $5796 pc [RHS]



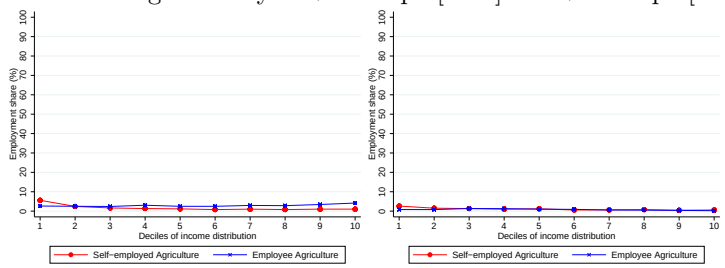
Profile for average country at $8826 pc [LHS] and $11257 pc [RHS]



Profile for average country at $17141 pc [LHS] and $27960 pc [RHS]



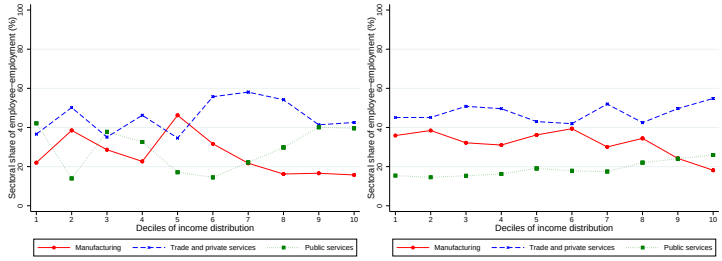
Profile for average country at $38224 pc [LHS] and $53878 pc [RHS]



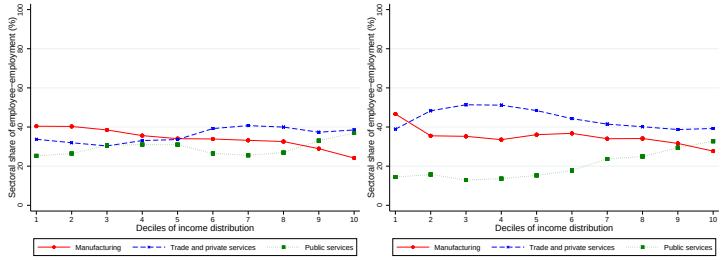
Notes: These figures plot the employment shares of self-employed agricultural workers and of employee agricultural workers, over deciles of the income distribution, for representative countries at different levels of per capita income. The share of each group is defined as the share of the total economically active workforce in the decile of the income distribution. To construct this graph, I partition the cross-country sample into ten groups of equal size, based on their level of per capita income. Note that I am limited to the group of countries where there exists sectoral data. Within each group, I calculate the unweighted average employment-share of agricultural self-employed and agricultural employee. I plot this average profile for every group, and indicate the average per capita income of the group. I use expenditure-side real GDP at chained PPPs in 2011 US$ from the same year as the country-survey year.

Figure A.4: Distributional profiles of 'easy-to-tax' sectors

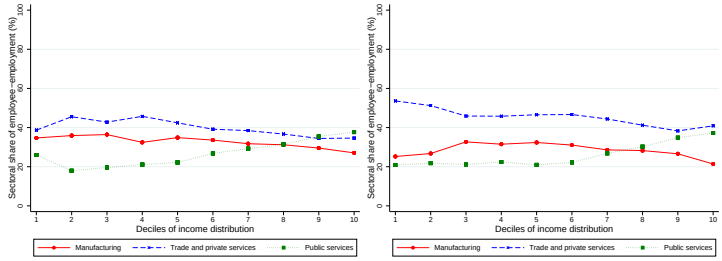
Profile for average country at $1065 pc [LHS] and $2226 pc [RHS]



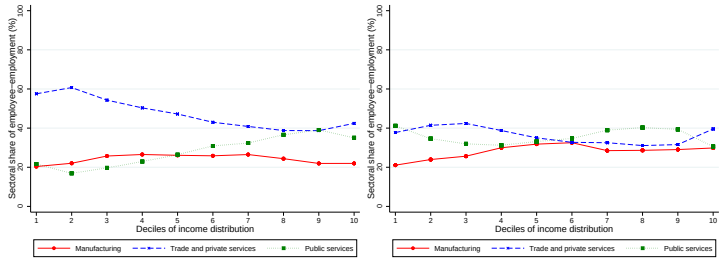
Profile for average country at $3239 pc [LHS] and $5796 pc [RHS]



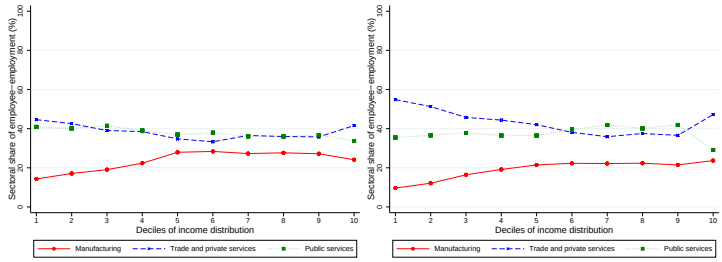
Profile for average country at $8826 pc [LHS] and $11257 pc [RHS]



Profile for average country at $17141 pc [LHS] and $27960 pc [RHS]



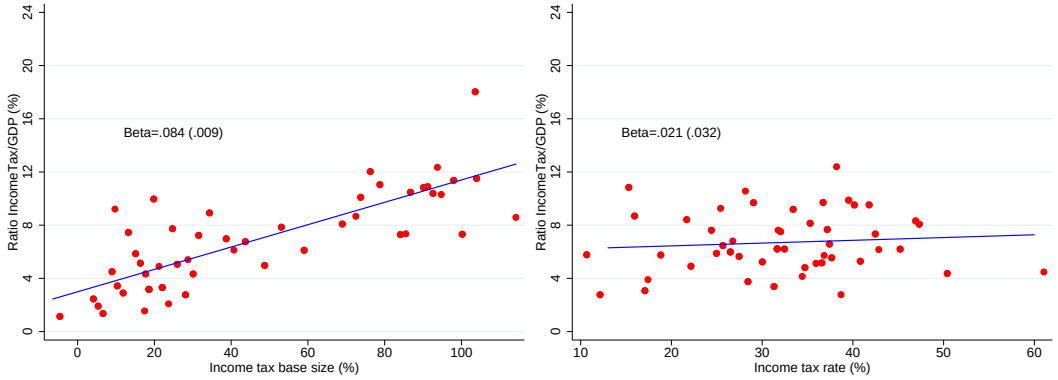
Profile for average country at $38224 pc [LHS] and $53878 pc [RHS]



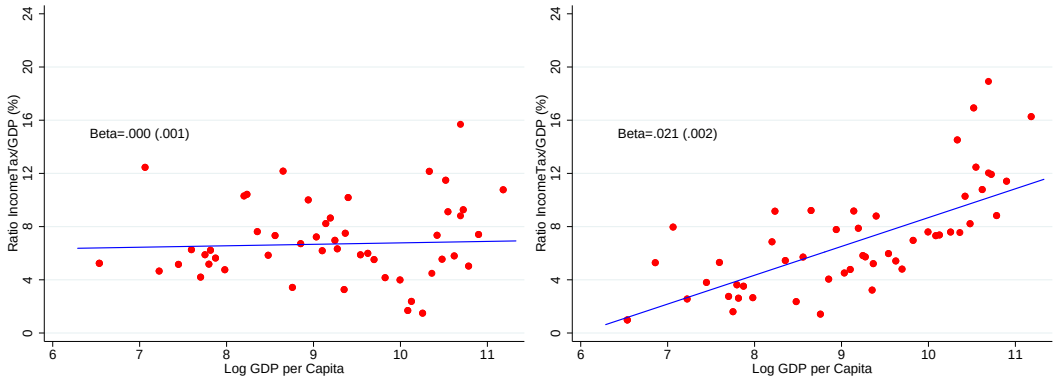
Notes: These figures plot the sectoral shares of employees over deciles of the income distribution, for representative countries at different levels of per capita income. Sectors are defined according to the ISIC classification. The share of each sector is defined as the share of the total employee workforce in the decile of the income distribution. To construct this graph, I partition the cross-country sample into ten groups of equal size, based on their level of per capita income. Note that I am limited to the group of countries where there exists sectoral data. Within each group, I calculate the unweighted average sectoral shares by income decile. I plot this average profile for every group, and indicate the average per capita income of the group. I use expenditure-side real GDP at chained PPPs in 2011 US$ from the same year as the country-survey year.

Figure A.5: Association between income tax policies, tax collection and development

Panel A: conditional association between income tax collection and base [LHS], rate [RHS]



Panel B: collection across development, conditional on tax base [LHS], rate [RHS]



Notes: All graphs use the 100 countries contained in the cross-country micro data-base (Appendix A.1). Panel A plots the conditional association between income tax to GDP and income tax base (top rate), controlling for to rate (income tax base). For example, to construct the right-hand side figure, I first regress both [income tax/GDP] on income tax base on the top rate, and calculate residuals. I then group observations into fifty equal-sized (2 percentile-point) bins based on the tax base residuals, and scatter the means of [income tax/GDP] and tax base residuals within each bin, adding back the sample mean of each variable to ease interpretation. Panel B plots the association between residual income tax and development, after regressing income tax on tax base (left-hand graph) or top rate (right-hand graph). In Panels A and B, the solid line shows the best linear fit, estimated on the underlying cross-country data.

Table A.1: Cross-Country Data Sources

Country	Year	Per Capita Income Group	Survey type	Coverage	Sample Size	Original source
Albania	2009	Upper Middle	Labor Force	National	18,997	Living Standards Measurement Survey
Argentina	2009	Upper Middle	Living Conditions	Urban	47,862	Multiple Indicator Cluster Survey
Australia	2014	High	Living Conditions	National	16,801	Luxembourg Income Study
Austria	2013	High	Living Conditions	National	5,102	Luxembourg Income Study (LIS)
Azerbaijan	1995	Low	Living Conditions	National	8,901	Survey of Living Conditions
Bangladesh	2010	Low	Living Conditions	National	19,664	Household Income and Expenditure Survey
Belgium	2000	High	Living Conditions	National	2823	Luxembourg Income Study (LIS)
Belize	1999	Lower Middle	Labor Force	National	15,167	Labour Force Survey
Bolivia	2007	Lower Middle	Living Conditions	National	16,130	National Household Survey
Brazil	2009	Upper Middle	Living Conditions	National	191, 810	National Household Survey
Bulgaria	2007	Upper Middle	Living Conditions	National	6,941	National Household Survey
Burkina Faso	2014	Low	Living Conditions	National	32,023	Multisectorial Household Survey
Cambodia	2009	Low	Living Conditions	National	31,959	Socioeconomic Survey
Cameroon	2007	Lower Middle	Living Conditions	National	51,836	National Household Survey
Canada	2013	High	Living Conditions	National	27,344	Luxembourg Income Study (LIS)
Chile	2009	Upper Middle	Living Conditions	National	90,610	National Socioeconomic Characterization Survey
China	2013	Upper Middle	Living Conditions	National	14,782	Luxembourg Income Study (LIS)
Colombia	2009	Upper Middle	Living Conditions	National	170,220	National Integrated Household Survey
Costa Rica	2009	Upper Middle	Living Conditions	National	19,594	National Multipurpose Household Survey
Czech Republic	2013	High	Living Conditions	National	7,653	Luxembourg Income Study (LIS)
Cote d'Ivoire	2008	Lower Middle	Living Conditions	National	59,699	Demographic and Health Surveys
Dem. Rep. of the Congo	2004	Low	Living Conditions	National	72,685	Household Living Conditions
Denmark	2013	High	Living Conditions	National	88,696	Luxembourg Income Study (LIS)
Dominican Republic	2009	Upper Middle	Living Conditions	National	30,430	National Multipurpose Household Survey
Ecuador	2009	Lower Middle	Living Conditions	National	78,865	National Employment Survey
Egypt	2010	Lower Middle	Living Conditions	National	34,069	Household Income, Expenditure and Consumption Survey
El Salvador	2014	Lower Middle	Living Conditions	National	20,361	National Multipurpose Household Survey
Estonia	2013	High	Living Conditions	National	6,576	Luxembourg Income Study (LIS)
Ethiopia	2010	Low	Living Conditions	National	18,864	National Socioeconomic Survey
Finland	2013	High	Living Conditions	National	11,112	Luxembourg Income Study (LIS)
France	2010	High	Living Conditions	National	14,440	Luxembourg Income Study (LIS)

Table A.1: Cross-Country Data Sources (continued)

Country	Year	Per Capita Income Group	Survey type	Coverage	Sample Size	Original source
Georgia	2010	Lower Middle	Living Conditions	National	4,811	Luxembourg Income Study (LIS)
Germany	2014	High	Living Conditions	National	14,915	Luxembourg Income Study (LIS)
Ghana	2010	Low	Living Conditions	National	62,042	Socioeconomic Panel Survey
Greece	2013	High	Living Conditions	National	6,115	Luxembourg Income Study (LIS)
Guatemala	2014	Lower Middle	Living Conditions	National	22,118	Luxembourg Income Study (LIS)
Honduras	2009	Lower Middle	Living Conditions	National	98,028	National Multipurpose Household Survey
Hungary	2014	High	Living Conditions	National	2,718	Luxembourg Income Study (LIS)
Iceland	2010	High	Living Conditions	National	4,133	Luxembourg Income Study (LIS)
India	2004	Low	Living Conditions	National	59,487	Luxembourg Income Study (LIS)
Indonesia	2011	Lower Middle	Living Conditions	National	111,824	National Socioeconomic Survey
Iraq	2011	Lower Middle	Living Conditions	National	176,042	Household Socioeconomic Survey
Ireland	2010	High	Living Conditions	National	3,508	Luxembourg Income Study (LIS)
Israel	2014	High	Living Conditions	National	11,770	Luxembourg Income Study (LIS)
Italy	2014	High	Living Conditions	National	6,258	Luxembourg Income Study (LIS)
Jamaica	2002	Lower Middle	Living Conditions	National	18,943	National Survey of Living Conditions
Japan	2008	High	Living Conditions	National	7,840	Luxembourg Income Study (LIS)
Jordan	2010	Upper Middle	Living Conditions	National	15,472	National Household and Income Survey
Kenya	2005	Low	Living Conditions	National	62,175	National Continuous Household Survey
Kosovo	2000	Lower Middle	Living Conditions	National	14,167	Living Standards Measurement Survey (LSMS)
Liberia	2014	Low	Living Conditions	National	18,089	National Household and Income Expenditure Survey
Lithuania	2008	Upper Middle	Living Conditions	National	15,837	National Household Budget Survey
Luxembourg	2013	High	Living Conditions	National	4,373	Luxembourg Income Study (LIS)
Malawi	2011	Low	Living Conditions	National	56,218	Integrated Household Survey
Mali	2014	Low	Living Conditions	National	37,175	Living Standards Measurement Study
Mexico	2011	Upper Middle	Living Conditions	National	17,682	Household Income and Expenditure Survey
Mongolia	2003	Low	Labor Force	National	49,948	National Labor Force Survey
Morocco	2009	Lower Middle	Living Conditions	National	10,769	Household and Youth Survey
Mozambique	2014	Low	Living Conditions	National	9,128	Household Budget Survey
Namibia	2009	Upper Middle	Living Conditions	National	44,614	Household Income and Expenditure Survey
Netherlands	2013	High	Living Conditions	National	23,935	Luxembourg Income Study (LIS)
Nicaragua	2014	Lower Middle	Living Conditions	National	9,250	Household Income and Expenditure Survey
Niger	2011	Low	Living Conditions	National	3,859	National Survey on Household Living Conditions
Nigeria	2011	Lower Middle	Living Conditions	National	23,289	General Household Survey Panel

Table A.1: Cross-Country Data Sources (end)

Country	Year	Per Capita Income Group	Survey type	Coverage	Sample Size	Original Source
Norway	2013	High	Living Conditions	National	23,993	Luxembourg Income Study (LIS)
Pakistan	2001	Lower Middle	Living Conditions	National	75,519	Household Integrated Economic Survey
Palestine	2011	Lower Middle	Living Conditions	National	25,947	Expenditure and Consumption Survey
Panama	2010	Upper Middle	Population and Housing Census	National	314,118	National Census
Papua New Guinea	1996	Lower Middle	Living Conditions	National	8,660	Living Standards Measurement Survey
Paraguay	2009	Lower Middle	Living Conditions	National	18,419	Permanent Household Survey
Peru	2009	Upper Middle	Living Conditions	National	95,199	National Household Survey
Poland	2013	High	Living Conditions	National	39,993	Luxembourg Income Study (LIS)
Puerto Rico	2005	High	Population and Housing Census	National	35,416	Puerto Rico Community Survey
Romania	1997	Lower Middle	Living Conditions	National	35,995	Luxembourg Income Study (LIS)
Russia	2013	High	Living Conditions	National	6,079	Luxembourg Income Study (LIS)
Rwanda	2000	Low	Living Conditions	National	32,679	Integrated Household Living Conditions Survey
Serbia	2007	Upper Middle	Living Conditions	National	17,375	Living Standards Measurement Survey (LSMS)
Sierra Leone	2003	Low	Living Conditions	National	23,022	Integrated Household Survey
Slovakia	2009	High	Living Conditions	National	4,704	Luxembourg Income Study (LIS)
South Africa	2012	Upper Middle	Living Conditions	National	7,105	Luxembourg Income Study (LIS)
South Korea	2006	High	Living Conditions	National	13,178	Luxembourg Income Study (LIS)
Spain	2013	High	Living Conditions	National	10,728	Luxembourg Income Study (LIS)
Sri Lanka	2008	Lower Middle	Labor Force	National	66,381	Labor Force Survey
Sudan	2009	Lower Middle	Living Conditions	National	48,845	National Baseline Household Survey
Sweden	2005	High	Living Conditions	National	11,607	Luxembourg Income Study (LIS)
Switzerland	2013	High	Living Conditions	National	7,961	Luxembourg Income Study (LIS)
Taiwan	2013	High	Living Conditions	National	23,474	Luxembourg Income Study (LIS)
Tajikistan	2007	Low	Living Conditions	National	1,503	Living Standards Measurement Survey (LSMS)
Timor Leste	2007	Lower Middle	Living Conditions	National	9,094	Living Standards Measurement Survey (LSMS)
Tunisia	2009	Upper Middle	Living Conditions	National	50,371	National Survey on Household Standard of Living
Turkey	2011	Upper Middle	Labor Force	National	37,121	National Household Budget Survey
Tanzania	2010	Low	Living Conditions	National	20,559	National Panel Survey
Uganda	2011	Low	Living Conditions	National	13,618	National Panel Survey
Ukraine	2010	Lower Middle	Living Conditions	National	10,428	National Budget Survey
United Kingdom	2013	High	Living Conditions	National	20,002	Luxembourg Income Study (LIS)
United States	2013	High	Living Conditions	National	63,859	Luxembourg Income Study (LIS)
Uruguay	2009	Upper Middle	Living Conditions	National	132,559	Permanent Household Survey
Venezuela	2006	Upper Middle	Living Conditions	National	166,506	Permanent Household Survey
Zambia	2014	Lower Middle	Living Conditions	National	11,921	Living Conditions Monitoring Survey