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Income Distribution and Growth: A Re-examination

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Abstract

This paper examines the relationship between the distribution of income and economic growth. A newly formulated data set is used to asses the potential bias in estimating the relation between income distribution and growth using data grouped over different populations and income concepts. Several possible groupings of the data are tested and it is found that the previous literature, which does not classify distributions, may incorrectly accept the null hypothesis of no relation. The data is further used to assess the impact of different types of income on growth rates by exploiting the hierarchical structure of the income definitions used in the surveys that produced the income distribution data.

1 Introduction

This paper examines the relationship between the distribution of income and economic growth. A newly formulated data set is used to asses the potential bias in estimating the relation between income distribution and growth using data grouped over different populations and income concepts. Several possible groupings of the data are tested and it is found that the previous literature, which does not classify distributions, may incorrectly accept the null hypothesis of no relation. The data is further used to assess the impact of different types of income on growth rates by exploiting the hierarchical structure of the income definitions used in the surveys that produced the income distribution data.

Interest in how income distribution and growth are related has its roots in Kuznets' (1955) hypothesis that as a country becomes more developed, the income distribution becomes more unequal and then as development continues, the income distribution again becomes more equal. Here we repeat the traditional test of the Kuznets hypothesis using univariate OLS regressions of Gini coefficients on the log of the level of GDP per capita, and find the results to be highly dependent upon the type of income distribution considered.

This paper goes on from Kuznets original idea to understand why the phenomenon of dual convergence, or non-convergence might take place. Heuristically, the idea is that many countries have highly skewed distributions of wealth. When wealth is concentrated in the hands of a few decision makers it may be in their interest to restrict growth for the entire economy in the same way that a monopolists restricts output of their produce. Obviously the best test of this hypothesis is to look at the relation between the share of wealth in the top percentiles of the distribution of wealth and growth rates.

However, data on the distribution of wealth is both scarce and unreliable. Since income is the flow from the stock of wealth, we consider measures of income distribution to be an acceptable proxy for the distribution of wealth. When we think of wealth as the stock of assets, the profit patterns of concentrated wealth imply a similarly concentrated distribution of personal income. Here we test for a relation between income share of the top decile of the population and ten year growth rates through standard OLS regression controlling for the level of per capita GDP. We are unable to reject the null hypothesis that the coefficient on the income share of the top decile of the population is zero in twelve of the nineteen regressions. We find that the sign of the coefficient on in the other seven regressions is highly dependent upon the population and income concepts used. We also identify acceptable ways of pooling the data across concepts to increase the power of the tests. Pooling across population codes is found to be acceptable in most cases, but pooling across income concepts is not. We then go on to identify which basic elements of income are most important in the relationship between income distribution and growth.

Virtually all of the previous work on income distribution suffers from the fact that the data are not comparable across income concepts, population coverage and sectoral coverage. A major contribution of this study is the creation of a data set that does classify distributions over income concept, population coverage and sectoral coverage. The data in this study has been updated and amplified from that used by Paukert (1973)[1] Jain (1975) and Fields (1989). The relation of this work to previous work in the field is presented in Section 2. The method for constructing the data set is presented in brief in Section 3 and amplified in the Data Appendix. The results for Kuznets hypothesis using this data are presented in Section 4, and the results of the test of the relation between income share of the top decile and growth rates are presented in Section 5.

2 Relation to the Literature

Because data on the distribution of wealth was essentially unavailable, we are looking at the relation between measures of the distribution of income and growth rates. This is the most general statement of a Kuznets type hypothesis. The standard test of this relation is an OLS regression of Gini coefficients on the log of the level of GDP per capita. We perform these test for comparability to previous literature[2]. However, we also look at *growth rates* not *levels*, and *income share* not *Gini coefficients*[3]. There is also an important conceptual difference because income share is the independent variable and growth rates are hypothesized to be dependent on income shares. The Kuznets hypothesis uses the *level* of development as the independent

[1]The Paukert data set is used in many subsequent studies. For example Ahluwalia (1976) and Persson and Tabellini (1991) among others.

[2]These results are presented in Section 4.

[3]These results are presented in Section 5.

variable, while a summary statistic of the *entire distribution* of income is dependent. So here the direction of causality is switched, one further level of dynamics is introduced by using growth rates instead of levels, and it is specifically the top of the income distribution that is of interest.

Most studies of the Kuznets hypothesis rely on cross sectional data. Measures of per capita income, expenditure, GNP or GDP have been used to proxy the level of development. For example Paukert (1973), Ahluwalia (1976) are well known studies of this relation.[4] The underlying assumption of these studies is that all countries follow the same growth path, therefore looking at inequality across levels of GDP is equivalent to studying the relation between inequality and growth. However, more recent empirical work in economic growth and development has called into question the idea that all countries in fact converge to the same growth path.[5]Here we do not rely on the assumption of convergence, precisely because the theory that is being tested is an attempt to shed light on why there might be non-convergence.

There are single country and regional studies of inequality and growth that do not rely on the assumption of a single common growth path. For example Adelman and Robinson (1978), Looney (1975), Schnitzer (1974) and several studies commissioned by the World Bank's research project on the Political Economy of Poverty, Equity and Growth, help to avoid the problem of comparing data from countries that are actually on different growth paths by focusing on one country or region at a time. These studies incorporate many aspects of the economic environment and do provide a more comprehensive picture of the specific relation between income distribution and growth. However they lack in that the information from different countries may not be compared easily.

Fields does a comprehensive analysis of the relation between inequality and growth using a compendium of data on inequality. Fields, unlike most other work in this literature, restricts his data to that coming from national household surveys. He also restricts the test statistics to those derived from within country correlations between Gini coefficients and actual growth rates, thus avoiding the asssumption that all countries are on the same growth path. Fields finds that there is no statistically significant relationship between inequality and the rate of economic growth.

[4]See Bigsten (1984) for a survey of this literature.

[5]See Abramovitz (1986) for a discussion of international non-convergence.

Ahluwalia also briefly addresses question of the relation between growth rates and inequality. The finding is also that there is no significant relationship between inequality and growth rates. However, there is an important conceptual difference between Ahluwalia and this paper. Ahluwalia posits that growth will affect the distribution of income, here the direction of causality switched. While the direction of causality is certainly not important when calculating correlation coefficients, it is important in deciding the appropriate measure of growth. Ahluwalia uses the growth rate for ten years *prior* to the year in which the income distribution measure was taken. However if it is income distribution that is affecting growth, then the appropriate measure is the growth rate *after* the income distribution measure was taken.

Both Ahluwalia and Fields find no significant relationship between growth rates and income inequality. Their findings are not surprising given the nature of the data.[6] The data analysis presented in Sections 4 and 5 restricts the data used to national surveys as in Fields, however we are able to use a wider variety of income concepts and population coverages than Fields. This analysis shows that different combinations of income concepts and population coverage offer regression coefficients differing in both sign and magnitude. It also shows that different elements of income have a different impact on growth.

3 The Data

The empirical literature on the Kuznets hypothesis has relied heavily on a few sources of income distribution statistics. Two widely used sources are Paukert and the World Bank Development Reports, neither of which provides clarification regarding the comparability of data. Often in this literature it is clearly stated that the distributions used are not comparable, and thus the results are suspect. This section explains the methods used to construct a data set that offers comparable statistics. This section explains some of the data definitions, while more detail on these methods is presented in the Data Appendix.

Sources

[6]While Fields does exclude data if the data was not derived from a national household survey, he does not classify the data according to income concept.

This data set was constructed using secondary sources.[7] These sources, listed in the bibliography, were collected and analyzed for information regarding the income distribution estimates that they provide. Each distribution was coded by country, year, sectoral coverage, population coverage, and primary source, as this information was available. The data were then cross checked to ensure that duplicate observations were not retained. The rules for choosing among duplicate observations are detailed in the Data Appendix.

Coverage

The sectoral coverage codes are listed in Table 1. The limited national (LNL) coverage was mainly used when there was an indication that particular areas of a country were not covered. For example in Panama there were certain "indigenous regions" that were unreachable, hence the limited national code was used. Furthermore, the codes for single urban area (U) and non-metropolitan area (NM) were only used for Panama. The metropolitan code was used when a single metropolitan area was covered. This was common for small countries with few metropolitan areas. Data from Sri-Lanka required their own coverage codes: estate (E), estate rural (ER), and (OR) non-estate rural. There is only one observation for these coverage codes, so they are not included in the analysis, however they are in the master data set. The Costa Rican data also required a unique code: urban, excluding the metropolitan area (U/M).

Population

The population codes are listed in Table 2. There are five codes that indicate that the distribution was calculated over groups of income earners, nine over individuals, and two over households then adjusted to a per capita unit distribution based on the number of people in the household. The household (HH) population code is the most common in the data set. This was used to cover any description of groups of people living together and sharing living expenses, unless the source indicated specifically that the concept of a family (FAM) was used. [8]

There were some types of population coverages that were not included in the data set, although the data was available in the secondary sources. The first is adult equivalent unit, and the others are either sex separated, race

[7] The sources that were used to construct this data set will be referred to as secondary sources, while the sources referenced by the secondary sources will be referred to as primary sources. A full bibliography of primary sources for the data is available from the author.

[8] The concept of family is explained in more detail in the data appendix.

separated, or limited adult age group distributions. Most of the adult equivalent unit distributions that were available were found in van Ginneken and Park (1984). However at the same time, von Ginneken et al.. included per capita or other distributions that were more comparable to data from other sources. Hence the adult equivalent unit observations were not gathered. The sex separated or limited adult age group distributions were excluded for similar reasons.

Income

Table 3 describes twenty income codes used in the master data set. Most of these definitions of the type of income covered build on the first six concepts listed in the table. In addition to these twenty concepts, there were many distributions for which the exact income concept was unavailable. This includes all of the Paukert data, and the Jain data, when no additional information was available. In the data set these are coded as "no income".

The Data

A series of successively smaller data sets on the distribution of income were formed beginning with a master data set which includes all the data gathered from the secondary sources and ending with a data set which includes only observations from national surveys of income distribution with population coverage, top decile and ten year growth rates included. Table 4 shows counts of the data used for analysis in Sections 4 and 5. Each cell indicates how many observations for each income concept, population code pair. Although it is not indicated in the table, the majority of the data lies in the 1960–1975 time period. The cells in Table 4 with fewer data points may be dominated by one country. For example FAM with income code 18, HH income code 19, HH income code 11, HH income code 8 are all heavily dominated by one country in each group. Also, the distribution over workers with no income specified only includes planned economies.

Table 4 also shows that many classifications do not have enough observations required for OLS regression. These data points are thus not included in the analysis of the Kuznets' hypothesis in Section 4. In Section 5 we test for acceptable ways of pooling the data so that we may take advantage of the information provided in these observations.

4 The Kuznets Hypothesis

The Kuznets hypothesis being tested is that there is a quadratic relation between the Gini coefficient and the log of the level of GDP per capita.

$$GINI = \alpha + \beta_1 \ln (GDP) + \beta_2[\ln (GDP)]^2$$

OLS regressions were performed on the nineteen classes of income distributions with enough observations. These results are presented in Table 5. Of these nineteen regressions only three produced β_1 and β_2 significantly different from zero at the 10% level for a two sided test. None of the remaining sixteen regressions produced significant coefficients for either β_1 or β_2. The classifications with significant coefficients were household disposable income, per capita income with no income specified, and net taxable income of tax units.[9]The nine observations for the household income code 18 regression fall in the time period 1965 - 1975, and include two observations from Bangladesh and Sweeden, and one each from Israel, West Germany, Spain, Turkey and the United Kingdom. The six observations from per capita income with no income specified are from Tunisia, Mexico, Honduras, Malaysia, Costa Rica and the United States. These represent a rather wide geographical coverage over the time period 1960–1975. The ten observations from the regression for net taxable income of tax units all come from planned economies, and thus can be viewed as distinct from those regressions including wider geographical and political coverage. The possibility the taxable income distributions behave differently is further supported by the pooling tests presented in Section 5.

Perhaps the more interesting results are the cases where the coefficients are not significantly different from zero. For example the available data include five classifications which don't specify what type of income is included; the population codes are economically active population, per capita, population, household and income recipient[10]. These data by enlarge come from the Paukert and Jain data sets. Both the household and income recipient classifications have more than 50 observations, and fail to reject the hypothesis of non-zero coefficients. In other words, the most general classifications

[9]Population code HH, income code 18; population code PC with no income code and population code TU, income code 20, respectively.

[10]EAP, PC, POP, HH, and IR respectively.

with many observations do not confirm the Kuznets hypothesis of incresing inequality in the initial stages of development, and decresing inequality thereafter. It is probably due to the generality of these data that other studies also do not support the Kuznets hypothesis.

If we drop the assumption of a quadratic relation between income inequality and ln(GDP) we do find more evidence for a negative relation between inequality and growth. We perform the following regression:

$$GINI = \alpha + \beta_1 \ln(GDP)$$

and find that of the nineteen classes examined there are nine regressions in which the coefficient on ln(GDP) is significant. These results are presented in Table 6. Three of these significant coefficients however are positive, suggesting that as inequality increases, so does GDP per capita. One of these regressions covers Australia, Canada and Japan, the second covers Belgium, Ireland and Australia and the third regression only covers Japan. Both the limited international coverage and the small number of observations may make these results suspect. The two very general classifications with many observations discussed above indicate a negative relation between inequality and growth for a wide range of countries, as do a number of other more limited regressions containing ten or less observations.

Overall, this analysis suggests that the presence of a significant quadratic relation is doubtful, even among the most general data. However that the relation between income inequality and growth is dependent on the range of countries and types of income being considered.

5 Growth and the Top Decile

Moving on from the analysis from the previous section, we proceed to investigate the relation between income accrued to the top decile of the population and growth rates. Here we perform the following regression for the nineteen available classes of data.

$$GR10 = \alpha + \beta_1\ DEC10\ + \beta_2\ GDP$$

Where GR10 is the ten year growth rate of per capita GDP from the year of the corresponding income distribution measure, DEC10 is income accrued to the top decile of the size distribution of income and GDP is the level of GDP per capita. β_1 is the main coefficient of interest representing the relation between growth and the share of income to the top decile. As is standard for neo-classical type growth models, we include the level of GDP per capita to account for decreasing rates of growth as GDP increases.

The results from these regressions, presented in Table 7, are somewhat more puzzling than those for the Kuznets hypothesis presented in Section 4. There are seven β_1 coefficients that are significantly different from zero at the ten percent level for a two sided test. Four of these coefficients are positive and three are negative. The presence of significant coefficients of both positive and negative signs suggests that the coverage and type of income considered are important factors in determining the effect of income shares on growth rates.

The effect of changing the income receiving unit can be seen by focusing on the five classes of distributions that do not specify what type of income is being considered, those marked "no income". Within these classes β_1 is significant and negative for the population coverage household, not significantly different from zero for economically active population, income recipient, and per capita, and the coefficient is significantly positive for the distributions with population coverage "population". Data that does not specify what type of income is included in the distribution is frequently used for tests of the Kuznet's and related hypotheses. These results suggest that even if the type of income being considered were not an issue, how the income receiving unit or population is defined may be important in determining how the distribution of income affects growth. However, below we find that pooling the data across population coverages, within income groups may be justified, and leads to a clear negative coefficient on DEC 10.

The two regressions that cover taxable income do not present this type of contradiction in the sign of the coefficients presented here, however below we find that they may not be pooled. These are the last two regressions presented in Table 7. Both of these regressions have few data points and are heavily dominated by data from one country, France. This may simply be a result of the particular tax and population structure in France. Both of these regressions suggest a positive relation between the income share of the top decile and growth rates. However it would be necessary to examine more closely exactly what income is included in taxable income in France, and the other three countries in this sample, to advance a plausible interpretation of these coefficients.

We also can see the effect of changing the definition of the type of income by focusing on the three classes of income distributions that covered family incomes. These are the second, third and fourth regressions presented in Table 7. The results cover the range from β_1 significant and positive, not significant, to significant and negative. The regression for family money income[11] has significantly positive β_1, and family total income[12] has significantly negative β_1, while for after tax total family income β_1[13] is negative, but not significantly different from zero. The major difference between total income and money income is that total income includes imputed rent on owner occupied housing. Of the three analogous regressions under the population coverage household, only β_1 for total income (money income, plus the imputed value of owner occupied housing) is significant. The coefficient is negative and there are many more observations. These results suggest that by decomposing income definitions into their various basic elements we may gain some insights into the differences across income definitions.

Obviously there is a problem with the power of many of these tests because the number of observations is small. This fact leads to the necessity of determining what pooling of the data may be done. Again here, as in the tests of the Kuznets hypothesis presented in Section 4, the fact that many of the coefficients are not significantly different from zero could be an important conclusion. However, for many cases this lack of significance may simply be due to the fact that there are few data points. Eleven of the nineteen regressions have ten or less than data points. Fourteen of nineteen cover ten or less countries.

One alternative to running separate regressions for each income code, population coverage pair is to explore the possibility of pooling data over one dimension or the other. Here we choose to pool over population coverages and then analyze the separate effects of inequality on growth.

We begin with three standard F-tests to determine if the data may be grouped across both income and population. The first test is the most general, and is rejected. The form for the other two general tests was limited based on information from a series of F-tests for pooling across income

[11]income code 5.

[12]income code 7.

[13]income code 18.

groups. This series of tests indicates that either income concept or population definition is an important factor in determining the effect of income distribution on growth. The statistical results are presented in Table 8.

Test 1

H_0: All observations may be pooled regardless of income or population definitions.

H_1: Each separate income concept, population code pair must be analyzed separately.

As indicated in Table 8, the null is rejected at the 1% level. The generality of this test however is somewhat of a drawback. It gives no indication of what income categories if any may be pooled across population definitions. The huge number of possible combinations of tests available, with up to twenty of each type of definition, makes it infeasable to test all combinations and permutations of pooled and unpooled classifications. Also there is no clear test for optimality among those hundreds of different schemes. Tests of pooling over population definitions reinforce the idea that the distributions covering taxable income may behave differently from the other distributions. These diagnostics led to the other two general tests, and also help to guide the analysis of the effect of different kernal elements of income in determing the role of income distribution in growth that is presented below

Test 2

H_0: For each income concept, all observations may be pooled regardless of population coverage.

H_1: Each separate income concept, population definition pair must be analyzed separately.

Here we find that for the majority of income concepts the null can not be rejected. It is also interesting to note that two of the three income concepts for which the null is rejected cover taxable income. These classes suffer from two problems relevant here. The first problem, mentioned in the Data Appendix, is that taxable income definitions vary widely both across time and across countries. Secondly these definitions also make it difficult to attribute any other population coverage than "tax unit". The population code "tax unit" is meaningless without reference to the particular tax rules in place at the time of the survey. For these reasons the gross and net taxable income definitions will not be included in the dummy variable analysis below.

The other income class for which the null is rejected, income class 12, is very closely related to disposable income. The null is rejected at the 5% level, but not the 1% level. There is no a priori reason to believe that the this income concept has properties different from other income concepts across population definitions. This leaves two interpretations, one is that Type II errors are being committed when imposing the restriction that the data in the other five income classes may be pooled, thus leading to biased estimates of the coefficients in regressions using those restrictions. The other interpretation is that there is a Type I error being commited here. Neither interpration is fully satifactory.

Two further general tests were conducted to be sure that it was not only these income concepts that could not individually be pooled over population definitions that were influencing the results in Test 1.

Test 3

H_0: *Excluding all income concepts for which Test 2 is rejected, all observations may be pooled regardless of population definition.*

H_1: *Each separate income concept, population definition pair must be analyzed separately.*

Test 4

H_0: *Excluding taxable income concepts, all observations may be pooled regardless of population definition.*

H_1: *Each separate income concept, population definition pair must be analyzed separately.*

Both of these test are also rejected, indicating that it is unlikely that big groups of observations may be pooled regardless of both income and population definitions. However, the results from Tests 2 indicate that it is not unreasonable to pool across population coverage by income code. Given this information we may begin to analyze the effect of different kernal elements of income on the relation between income distribution and growth.

Referring to Table 3, we can see that the first six income concepts are the basic elements of all the other concepts. These basic elements have been referred to as kernal elements of income. The idea that inequality based on different kernal elements contribute differently to the relationship between income and growth may be modelled using simple dummy variables to indicate if an observation includes each kernal element. We assume that the presence of a particular kernal definition has an additive effect on the degree of the relation. In other words no intercept dummy variables are used. As mentioned above, distributions covering taxable income have been eliminated. The regression imposes the restriction that population definition is unimportant in this context. Because income concept 12 offers a special case with reference to pooling across population code, the analysis is conducted both including and excluding income code 12. This leads to the following regression:

$$GR10 = \beta_0 + \beta_1 * DEC10 + \beta_2 * GDP + \sum_{i=1}^{6} d_i * DEC10$$

Where the d_i are dummy variables equal to 1 when the kernal element i as defined in Table 3 is included in the income concept. This analysis enables us to estimate the change in the effect of the income share of the top decile when different kernal elements of income are included. Rows 1 and 3 in Table 9 correspond to regressions excluding income code 12, and rows 2 and 4 exclude observations with income code 12. The results are similar with or without income code 12, but both are presented for completeness. In general, from all four regressions we can see that the effect of high share of income to the top decile is negative, and that the incremental effect of some or all of the kernal elements may be negligable.

The first two regressions indicate that some or all of the kernal elements may be irrelevant. For both regressions the hypothesis that the sum of the effect of the kernal elements wages, salary, imputed rent and transfer are significantly different form zero was not rejected. Various other test on combinations of kernal elements were performed, and results indicated that self employment income, investment income, and after tax income were the most important kernal elements. Hence the following two regressions, rows 3 and 4 in Table 9, were run. These regressions indicate that when the income distribution being considered includes self employment income, the negative effect of income share of the top decile is mitigated. At the same time however, if a large share of income including investment income is accrued by the top decile growth is slower. If the income distribution being measure includes various kernal elements and is net of taxes then again the negative effect of high shares of income to the top decile again is exacerbated.

These results roughly correspond to the findings in the previous section in that it is found that some elements of income are more important than others in measuring the effect of income distribution on growth. Here the data is pooled and the overall effect is seen to be negative particularly so investment income is included. When the data was not pooled, as in Table 7, those regressions indicating a positive relation between income and growth had very few observations.

Overall what is most clear from this exercise is that previous work on income distribution and growth that has not accounted for the differences in the population and income coverage of the data may be missing important elements of the data generation process. It is not surprising that much of the previous work finds no significant relationship between income distribution and growth rates given the lack of well specified data. Here an attempt is made to more clearly specify the data, but the cost is to reduce the number of observations and range of coverage available for analysis, or to risk biased estimates. In many cases where enough observations are available for analysis, there is still no significant relationship found between measures of income distribution and growth rates.

DATA APPENDIX

This appendix amplifies the brief description of how the data set was formulated given in the test. It has the same format as Section 3 of the text in that first the sources are discussed, then the codes for income, population and sectoral coverage and finally the data set itself is described in some more detail regarding number of observations.

Sources

Many of the secondary sources used referenced the same primary source. For example both Jain (1975) and Paukert (1973) use the same primary source and data for several European countries. The Jain data were more complete because they were decile distributions, and classified according to population and sectoral coverage. Hence the Jain data were retained, and the Paukert data were discarded in these instances. Occasionally the primary source and data were the same, but each secondary source provided complementary information regarding population coverage, sectoral coverage or income concept. In this case the information was combined to create a more complete observation.

Some secondary sources referenced the same primary sources, but did not give the same data. This situation can arise for three main reasons. First, often the same primary source contains data for many countries. This was common for United Nations documents in particular. The second reason that the same primary source is referenced is that some of the secondary sources used other secondary sources as primary sources. Jain used data from Schnitzer (1974) for example. This rarely led to duplication in the present data set since we have only included distributions that were presented in some kind of percentile format within the secondary source. Jain and others often used distributions that were given for discrete income classes to derive a percentile distribution.

The final case is when the same primary source is listed, and the same raw data may have been used, but different interpolations or corrections have been employed. This was a common problem with both Jain and van Ginneken and Park (1984). Jain re-estimated every distribution using an equation for the Lorenz curve suggested by Kakwani and Podder (1976). The Lorenz curve is the graph obtained by plotting cumulative income shares on cumulative population shares. Kakwani and Podder's formula for the Lorenz curve is:

$$\tau = a\pi^{\alpha}(\sqrt{2} - \pi)^{\beta}$$

Where

$$\tau = \frac{(F - F_1)}{\sqrt{2}}$$

and

$$\pi = \frac{(F + F_1)}{\sqrt{2}}$$

F is the cumulative population share and F_1 is the cumulative income share. The log form of this equation provides a linear relation which was estimated using ordinary least squares regression. The predicted values for $\ln(\tau)$ were then used to solve for estimates of F_1. It is these estimates of F_1 that are provided by Jain.

While the fit that Jain obtained was acceptable, his method may lead to a slight difference between his estimates and others using the same primary source. To retain comparability all other decile and quintile distributions were re-estimated for the analysis in Section 3 using the Kawani and Podder formula. Less complete distributions, for example those that only included the top five and top 1 percentiles, were not re-estimated because there were not enough data points within these distribution to give a reliable estimate of the entire distribution.

Van Ginneken and Park often included corrections to the data based national accounts or information regarding the survey methods used in the primary source. These duplicate observations, when the data does not appear to be the same, are treated as if they did not have the same primary source but are eliminated according to the methodology for choosing among observations for the same country, year, population coverage, sectoral coverage, and income concept is explained below.

In case of duplicate observations where the country, year, population coverage, sectoral coverage and income concept were the same, all estimates are retained in the master data set to maintain its completeness. Duplicate observations were ranked by reliability, and retained for analysis accordingly. Jain's or van Ginneken and Park's estimates were retained for analysis over other secondary sources.[14] Then decile distributions were retained over quintile or less complete distributions, and quintile distributions over less complete distributions.

This left two types of duplicate observations. There were several observations in which both duplicates came from Jain data, and there were a few duplicates between other sources. In these case the primary sources of the data were evaluated according to their reliability. Government or international institution sources were judged more reliable than private estimates because it is likely that the private estimates were actually derived from government surveys. Finally in case two private estimates had the same country, year, population coverage, sectoral coverage, income concept, and were of the same completeness, data from the primary source with the earliest publication date was selected. If domestic government or international institution sources were referenced, then domestic government publications were retained over international institution publications. If the duplicates were both from the same type of institution, then publication dates were as the criterion for selection. This methodology left no additional duplicate observations in the data set for analysis.

Population Coverage

The main issue in amplifying the population code definitions is the possible confusion over different types of household codings. Among these codings (HH, HH/SE,PCH, PCH/SE,SEHH) there are slight inconsistencies in the treatment of lodgers and boarders. Lodgers and boarders may also be treated inconsistently elsewhere. The household, excluding self-employed (HH/SE) code excludes households wherein the head of household is self employed. Self employed household (SEHH) indicates a distribution only over households wherein the head of household is self employed.

The code family (FAM) is to be distinguished from household (HH). Family (FAM) is meant to indicate that single person households were not included and that more than one family may share living accommodations and food expenses. When single person households were not included, occasionally a distribution for unrelated individuals (UNR) was available as well. If more than one family was sharing living accommodations and expenses this would be one household, but several families. Usually families are determined

[14] Both of these sources were fairly consistent in their methodology and clear about their primary sources. Also they both only included decile distributions.

by blood or marriage relations as well as sharing living accommodations and expenses. For this reason the family (FAM) code is more restrictive than the household code.

The codes per capita household (PCH) and per capita household, excluding self employed (PCH/SE) indicate distributions derived from household distributions by correcting for the size of the household. In this way a large household needs proportionately more income than a small household to be ranked equally on the income distribution scale.

The final code indicating that the distribution was taken over groups of people is the tax unit (TU) code. This code provides little comparability between countries because laws governing tax reporting units vary widely from country to country.

A similar problem arises in case the code income recipient (IR) was used, and the income code is either gross or net taxable income. Inconsistencies arise because tax laws vary so greatly across countries, and within one country over time. If income recipient is used, then it is individual recipients of this kind of income. For example, if the income code is 19, gross taxable income, then it is only a distribution over individuals with taxable income. If the income code is 1 or 2, wages or salaries only, then the distribution is over individual wage or salary earners, and the potential inconsistencies are not a problem. However some of the Jain data are coded as income recipient (IR), but no income code is given. In this case, the population may be assumed to be all individuals who earned income.

The code economically active population (EAP) is essentially like labor force participants, but also may include individuals who earn non-wage or salary income only, depending on the corresponding income concept. The code workers (WRK) differs from economically active population in that it usually only includes people who are employed to earn income. Both of these codes, however are still open to much interpretation.

Both the codes per capita (PC) and population (POP) refer to distributions of individual income over the entire population of the country. It is not clear why Jain makes the distinction in his coding. Data of this nature from other sources is always coded as per capita (PC), or if appropriate self employed per capita (SE) or per capita, excluding self employed (PC/SE). It is of course understood that most of these observations do not include minors who do not earn income, whereas the per capita household (PCH) and per capita household excluding self employed (PCH/SE) do include minors.

Income

Income codes 1 and 2 are essentially earned income. Income code 3 adds personal investment income, and imputed rent. It can be seen from Table 3 that the first six income codes are basic elements, or kernals, of the following 14. There are very few observations that include only one of these kernals.Income code 3 is essentially transfer income. The treatment of gifts and one time lump sum transfers such as legal settlements may also vary widely across data sources. Income code 6, imputed rent, is the rental value of owner occupied housing. It suffers from obvious measurement difficulties.

Data

The income data itself varies according to availability. For example all of the data that come from Jain consists of decile distributions, whereas some of the data from Schnitzer is just the income accrued by the top 1% or top 5% of the population. Each separate distribution is considered one observation. Hence although the master data set may include many observations within one classification of population coverage, sectoral coverage, and income concept, it still may be the case that there are not enough observations to run a regression using the top decile as the measure of income distribution.

The master data set has 922 observations. There are 138 classifications of population coverage, sectoral coverage and income concept represented and there are 98 countries represented. Eighty five duplicate observations where country, year, population coverage and sectoral coverage and income concept were the same, but the primary source was different, were droppped from the master data set according to the methodology described under *Sources* section. Three observations wherin the share of the first decile was negative, and 70 observations where population code was not specified were also dropped. The remaining 770 observations on income distribution were then merged with ten year per capita GDP growth rates. The growth rates were calculated from the widely used Summers-Heston data set on international macroeconomic variables. Each growth rate was calculated from the year of income distribution forward.

After merging with the Summers-Heston data set 136 observations lacked growth rates. Hence, the next data set has 634 observations with 115 different classifications according to population coverage, sectoral coverage and income concept for 77 countries, plus the growth data. Twenty-two observations were deleted because the fact that the Summers-Heston data did not cover 10 countries which had not yet been eliminated. The data in this set was further limited because of the limited time span of the Summers-Heston data. The longest time series of GDP data in the Summers-Heston data set is from 1950-1985, yet for some countries the data does not become available until as late as 1960. There were 26 observations deleted because the income data did not begin early enough, and 88 observations deleted because the ten-year growth rate was not available after 1975.

Of the remaining 634 observations, 443 had national coverage. Of those with national coverage 81 did not include the top decile in the distribution. The data set used in the analysis has 362 observations. All the observations in this data set are national in coverage and include the top decile as a measure of the distribution of income. It is reasonable to include only national surveys since the GDP levels and growth rates used are also national, hence the only hypothesis that it makes sense to test are those regarding the distribution of income over the entire nation, although other types of sectoral coverages have both the tenth decile and ten-year growth rate available. Gini coefficients were calculated from the final data set[15] using the new coordinate system proposed by Kakwani and Podder (1976).

[15]Twelve observations were not included for calculating the Gini coefficient as they did not include complete decile nor quintle distributions. The accuracy of the Kakwani and Podder method for computing Gini coefficients is compromised in these cases.

Table 1: Coverage Codes

NL	national	LNL	limited national
URB	urban	U	single urban area
AG	agricultural	E	estate
NAG	non-agricultural	ER	rural estate
RRL	rural	OR	non-estate rural
M	single metropolitan area	U/M	urban excluding metropolitan area
		NM	non-metropolitan area

Table 2: Population Codes

HH	household	HH/SE	household excluding self employed
IR	income recipient	POP	population
EAP	economically active population	TU	tax units
FAM	family	UNR	unrelated individuals
WRK	workers	FTW	full time wage earners
PC	per capita	PC/SE	per capita excluding self employed
PCH	per capita household	PCH/SE	per capita household excluding self employed
SE	self employed per capita	SEHH	self employed household

Table 3: Income Concepts

Income Code	Wages	Salary	Transfers	Self Employment Income	Investment Income	Imputed Rent	In Kind Income	Net of Taxes
1	x							
2		x						
3			x					
4				x				
5					x			
6						x		
7	x	x					x	
8	x	x		x	x		x	
9	x	x		x	x	x	x	
10	x	x	x				x	
11	x	x	x	x			x	
12	x	x	x	x	x		x	
13	x	x	x	x	x	x	x	
14	x	x					x	x
15	x	x		x	x		x	x
16	x	x	x	x			x	x
17	x	x	x	x	x		x	x
18	x	x	x	x	x	x	x	x
19	GROSS	TAX ABLE						
20	NET	TAX ABLE						x

Table 4: Observations by Income Code and Population Coverage.

POPULATION CODE ↓	INC OME	CON CEPT	→	→	→	→	→	→	→	→	→	→	→	→
	0	1	2	8	10	11	12	13	15	17	18	19	20	TOT
EAP	16						1							17
FAM	2						6	10		1	4	1	1	25
HH	87			5		4	11	26	1	9	9	4	1	157
HH/SE	1				1			1			1			4
IR	53	1	1				3					7	19	84
PC	6						1	2			1	2		12
PC/SE												1	1	2
PCH	2			1				3		1	3			10
PCH/SE							1							1
POP	18													18
SE												2	2	4
SEHH												1	1	2
STWRK	3													3
TU												11	2	13
UNR														
WRK	10													10
COL TOTAL	198	1	1	6	1	4	23	42	1	11	18	29	27	362

Table 5: Tests of the Kuznets Hypothesis. Prob > |t| in parentheses

Code Income	Obs.	Constant	LN(GDP)	LN(GDP)^2
EAP no income	16	1.0129 (0.770)	-0.0725 (0.934)	0.0026 (0.963)
FAM 5	6	1.7385 (0.695)	-0.3460 (0.739)	0.0222 (0.717)
FAM 6	4	0.9485 (0.646)	-0.0682 (0.990)	-0.0060 (0.879)
FAM 7	10	3.9093 (0.058)	-0.8281 (0.126)	0.0497 (0.170)
HH no income	87	0.3627 (0.605)	0.0825 (0.661)	-0.0082 (0.511)
HH 11	4	4.5161 (0.864)	-0.8289 (0.892)	0.0422 (0.906)
HH 14	9	0.7135 (0.432)	0.0199 (0.937)	-0.0058 (0.737)
HH 18	4	0.6158 (0.943)	-0.1407 (0.950)	0.0160 (0.915)
HH 5	11	5.4067 (0.614)	-1.2311 (0.624)	0.0757 (0.607)
HH 6	9	-4.667 (0.066)	1.4194 (0.045)	-0.0959 (0.042)
HH 7	26	0.3975 (0.755)	0.0548 (0.868)	-0.0053 (0.803)
HH 8	5	-21.4665 (0.255)	4.9223 (0.259)	-0.2754 (0.271)
IR no income	53	-0.4831 (0.747)	0.3938 (0.328)	-0.0322 (0.227)
IR 11	7	-4.9094 (0.784)	1.3042 (0.775)	-0.0781 (0.785)
IR 12	8	22.4284 (0.431)	-5.0571 (0.438)	0.2908 (0.437)
PC no income	6	-3.4499 (0.123)	1.0793 (0.079)	-0.0722 (0.068)
POP no income	18	-1.2050 (0.743)	0.5210 (0.615)	-0.0391 (0.589)
TU 11	10	28.8469 (0.334)	-6.4766 (0.338)	0.3692 (0.336)
TU 12	10	-11.8095 (0.068)	3.1276 (0.056)	-0.2016 (0.049)

Table 6: Tests of the Kuznets Hypothesis. Prob > $|t|$ in parentheses.

Code Income	Obs.	Constant	LN(GDP)
EAP no income	16	0.8541 (0.005)	-0.0319 (0.355)
FAM 5	6	0.1361 (0.281)	0.0314 (0.064)
FAM 6	4	1.2428 (0.003)	-0.0927 (0.008)
FAM 7	10	1.2958 (0.002)	-0.1012 (0.023)
HH no income	87	0.8202 (0.000)	-0.0410 (0.000)
HH 11	4	1.4214 (0.055)	-0.1057 (0.121)
HH 14	9	1.0104 (0.000)	-0.0648 (0.000)
HH 18	4	-0.2993 (0.160)	0.1016 (0.031)
HH 5	11	-0.1054 (0.788)	0.0636 (0.176)
HH 6	9	0.6710 (0.033)	-0.0309 (0.354)
HH 7	26	0.7134 (0.000)	-0.0276 (0.147)
HH 8	5	-0.9937 (0.079)	0.1712 (0.029)
IR no income	53	1.327 (0.000)	-0.0930 (0.000)
IR 11	7	-0.0212 (0.960)	0.0621 (0.265)
IR 12	8	0.3421 (0.557)	0.0135 (0.835)
PC no income	6	1.0492 (0.015)	-0.0677 (0.114)
POP no income	18	0.7707 (0.080)	-0.0382 (0.524)
TU 11	10	0.1647 (0.728)	0.0324 (0.552)
TU 12	10	1.1788 (0.002)	-0.1105 (0.009)

Table 7: Tests of the relationship between growth rates and income share of the top decile. Pob > $|t|$ in parentheses.

Code Income	Obs.	Constant	DEC10	GDP
EAP no income	16	0.7028 (.154)	-0.0020 (0.842)	-0.0001 (0.024)
FAM 5	6	-2.0184 (0.269)	0.1640 (0.088)	-0.0002 (0.008)
FAM 6	4	0.4055 (0.783)	-0.0003 (0.994)	0.0000 (0.912)
FAM 7	10	3.1230 (0.001)	-0.0637 (0.003)	-0.0001 (0.038)
HH no income	87	0.8361 (0.000)	-0.0089 (0.075)	-0.0000 (0.037)
HH 11	4	-1.1318 (0.075)	0.0471 (0.045)	0.0000 (0.446)
HH 14	9	0.7112 (0.235)	-0.0106 (0.520)	-0.0000 (0.433)
HH 18	4	-4.5551 (0.354)	0.2487 (0.254)	-0.0006 (0.354)
HH 5	11	0.5051 (0.190)	0.0167 (0.262)	-0.0001 (0.001)
HH 6	9	0.0482 (0.814)	0.0049 (0.434)	0.0000 (0.663)
HH 7	26	1.8274 (0.001)	-0.0303 (0.039)	-0.0001 (0.002)
HH 8	5	0.2722 (0.657)	0.0019 (0.949)	-0.0000 (0.887)
IR no income	53	0.2653 (0.232)	0.0037 (0.426)	-0.0000 (0.713)
IR 11	7	1.1997 (11.67)	0.0010 (0.765)	-0.0001 (0.001)
IR 12	19	0.6788 (0.000)	0.0006 (0.765)	-0.0001 (0.001)
PC no income	6	0.1549 (0.968)	0.0081 (0.929)	-0.0000 (-0.942)
POP no income	18	-0.1239 (0.665)	0.0122 (0.091)	0.0000 (0.791)
TU 11	11	-0.4359 (0.301)	0.0477 (0.004)	-0.0001 (0.001)
TU 12	10	2.3413 (0.028)	-0.0552 (0.158)	-0.0002 (0.010)

Table 8: Pooling Tests.

Hypothesis	Income Code	RSS restricted	RSS unrest.	Total Obs	No. of unrest. regres.	F-Stat.	D.F. numer.	D.F. denom.	alpha
T1	All	31.268	19.369	362	19	1.569	101	258	0.002
T2	0	18.493	15.940	198	6	1.198	23	172	0.253
T2	8	0.023	0.022	6	1	0.094	1	2	0.788
T2	11	n.a.	n.a.	n.a.	n.a.		0	0	
T2	12	0.814	0.187	23	2	4.084	9	11	0.016
T2	13	3.747	2.989	42	2	0.845	9	30	0.581
T2	17	0.083	0.081	11	1	0.068	2	6	0.935
T2	18	0.203	0.053	18	2	2.492	8	7	0.123
T2	19	0.277	0.054	29	3	4.132	13	13	0.008
T2	20	0.139	0.027	27	1	8.387	8	16	0.000
T3	All -19&20	29.757	23.379	306	7	4.078	19	284	0.000
T4	All -19&20 &12	28.666	22.565	283	6	3.714	19	261	0.000

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