Income Distribution and Structural Transformation: Empirical Evidence from Developed and Developing Countries

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The process of structural transformation forms the very basis of economic growth and development. This paper analyses the implications of alternate patterns of structural change for changes in the overall distribution of income within an economy. An empirical analysis is carried out based on evidence from seventy-eight developing and transition economies and developed countries. The estimated results from a fixed effects panel data model, indicate the existence of substantial differences as well as important similarities between developed and developing country experience with respect to structural change and associated changes in income inequality.

Keywords: Income distribution, Inequality, Informal sector, Institutions, Panel data, Structural change

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I. Introduction

In recent years, there has been a great deal of interest in issues related to the distribution of income. In the era of globalization, with

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reforms being the mantra everywhere, existing economic structures within countries are undergoing rapid change. This paper explores how the distribution of income within countries is likely to be affected with economic transformation. We seek to identify a general result, if any, relating alternate *patterns* of structural change to changes in the overall distribution of income.

The importance of the underlying process of structural change in explaining observed changes in income distribution was highlighted in the seminal contribution of Kuznets (1955) and subsequently, in the vast literature on the Kuznets curve. As such the idea is not new. However, at the current conjuncture, given the observed patterns of structural change in developed and developing countries, several interesting questions can be raised anew.

Drawing on the historical development experience of developed countries like USA, UK, and Germany, Kuznets (1955) argued that overall income inequality is likely to rise as industrial transformation gets underway. Historically these countries experienced declining shares of agriculture in aggregate output and employment along with growing importance of the industrial sector. Once industrial transformation was well under way, the service sector became increasingly important (see Johnston (1970) for a survey of these issues). This pattern of development is associated with increasing inequality in the initial stages, with the transfer of labour from a low-wage-, low-inequality-, agricultural sector to a relatively higher-wage-, higher-inequality- industrial sector.

However, the experience of developing countries differs from this classic pattern in several important respects. While the share of agriculture in aggregate output has declined, this has been accompanied by growing importance of the service sector, rather than the industrial sector. Unlike the post-war trend in Western European countries, a large segment of the labour force in developing nations moved directly from agriculture to the service sector (see UNCTAD 1988; Nayyar 1994).

Currently, the share of services in output and employment is high and rising in both developed and developing countries alike. However, service-orientation followed industrialization in developed nations, while preceding it in poor countries. Thus two strikingly different patterns of structural change are associated with the same phenomenon, viz., rising share of services in output and employment.

Several questions arise in this context. As structural change leads to service-orientation, rather than industrial transformation, what are the likely consequences for change in income inequality? Given deep inherent differences in structural characteristics between developed and developing countries, service orientation should lead to different distributional outcomes in the two country groups. Is this borne out by empirical evidence?

For a deeper understanding of these issues, we examine evidence on structural change and income inequality for a group of seventy-eight developed, developing and transition economies over the period 1980 to 2005. Data on inequality is selected from the latest WIDER (WIID2c) database and a panel data set constructed, closely following the recommendations in Atkinson and Brandolini (2001) regarding compilation of time series data on income distribution.

Apart from structural change, the estimated panel data model incorporates an important insight from the political economy literature, underscoring the importance of past levels of inequality and the role of institutions in affecting economic outcomes (see *e.g.*, Acemoglu and Robinson 2001, 2002). The outcome of high 'initial' inequality ultimately depends on factors like whether or not bottom income groups are able to launch effective, organized protest against the richer classes. The success or absence of such 'social revolutions' are determined by the quality of economic and political institutions in the economy. Lack of effective redistributive policies in Latin America, Africa, and low and middle-income countries in parts of Asia has been attributed to low institutional quality in these countries. In contrast, the high quality of institutions that have historically shaped the evolution of economic policies in the OECD countries have contributed to eventual lowering of inequality in these nations (Chong and Calderon 2000).

We also use income per capita, as a measure to control for differences in countries' levels of development in our empirical model. Per capita income is a summary measure that bears a correlation with broad structural characteristics as well as with the myriad dimensions of development, including literacy and health indicators of the population and indicators of access to basic amenities. All of these affect quality of the workforce, especially in terms of its overall skill composition. Together with the quality of economic and political institutions, this has an important influence on labour market outcomes like the wage structure and relative shares of employment in the formal and informal sectors of the economy, which in turn affect the overall distribution of income.

In what follows, we specify our basic model, relating it to the existing literature and outline our empirical strategy and sources of data (Section II); this is followed by analysis of results (Section III) and presentation of the main conclusions that emerge from the analysis (Section IV). The

Appendix at the end contains detailed description of the data (especially the data on income inequality) and the methodology used to select the final sample of countries.

II. The Framework of Analysis

A. The Literature

The standard models used in the literature to explore the relation between income inequality and structural change stem from the literature on the "Kuznets Curve." A vast literature explores the empirical validity of the inverted-U shaped relation between inequality and per capita income using data on developed and developing countries (see Bruno *et al.* (1998) and Kanbur (2000), for surveys of this literature). A selection of these studies include Ahluwalia (1976), Anand and Kanbur (1993), Bourguignon and Morrisson (1990), Chenery and Syrquin (1975), Deininger and Squire (1998), Jha (1996), Ogwang (1994), Papanek and Kyn (1986), Paukert (1973), Ram (1995), and Sundrum (1990).

These studies differ mainly with respect to the functional form used to test the Kuznets curve relation, the measure of inequality used, the countries included in the data set and the determinants of inequality (other than per capita income) considered. For example, Ahluwalia (1976) uses the share of income of various population percentiles as a measure of inequality and the logarithm of per capita income and its square as the relevant functional form. Chenery and Syrquin (1975) and Bourguignon and Morrisson (1990) use the same inequality measures, and per capita income and its square as the functional form. Papanek and Kyn (1996) and Sundrum (1990) use both the Gini coefficient and the income share of the poorest 40% as inequality measures and the Ahluwalia functional form. Ram (1995) measures inequality with the Gini and Theil indices and employs both the Ahluwalia, and Bourguignon and Morrisson functional forms. Anand and Kanbur (1993) adopt an alternate form to estimate the inverted-U relation, consisting of per capita income and its inverse and Deininger and Squire (1998) also use this.

The most common empirical methodology used in this literature is cross-country regression with a measure of income inequality (*e.g.*, Gini coefficient or ratio of the cumulative income share of the richest 20% to the poorest 40% of the population) as the dependent variable and with per-capita GDP (y) and the square of per-capita GDP (y^2) as independent variables. That is, estimating an equation of the form,

$$\text{Inequality} = \alpha + \beta.y + \gamma.y^2 + \varepsilon.$$

A positive (and statistically significant) coefficient for 'y' (*i.e.*, $\beta > 0$) and a negative (and statistically significant) coefficient for 'y^2' (*i.e.*, $\gamma < 0$), is taken as confirmation of an inverted U-shaped relation between income inequality and per-capita incomes.

The idea that changes in income inequality is affected by structural change was formalized in Anand and Kanbur (1993), who derive the exact functional specification for testing the Kuznets curve relation for alternative inequality measures. They also derive the exact condition for the existence of a turning point in the relation between inequality and per capita income and test the implied restriction using cross-section data. In their empirical model, income inequality (measured by the Gini coefficient) is a function of the level of per capita income and its inverse.

B. The Model

Our empirical model for estimating the relation between income inequality and structural change differs from that used in the above literature in an important respect. We explicitly include sectoral output shares, as explanatory variables. The main reason being that this formulation brings out more clearly, the distributional implications of *alternate* patterns of structural transformation.

To see this point clearly consider that per capita income (y) in a three sector economy (the three sectors being Agriculture 'A,' Industry 'I,' and Services 'S'), can be expressed as a *weighted average* of sectoral per capita incomes y_A, y_I, and y_S, the weights n_A, n_I, and n_S being the share of total population N in each sector:

$$y = n_A.y_A + n_I.y_I + n_S.y_S, \tag{1}$$

where, $y = (Y_A + Y_I + Y_S)/N$;
$y_A = (Y_A/N_A)$, $y_B = (Y_B/N_B)$, $y_S = (Y_S/N_S)$;
$n_A = (N_A/N)$, $n_I = (N_I/N)$, $n_S = (N_S/N)$
$(N_A + N_B + N_S) = N$ and Y_A, Y_I, Y_S = Aggregate Sectoral Output

From the simple identity in (1) above it is clear that change in per capita income of any given magnitude may be associated with several alternate, underlying patterns of structural change, involving different relative changes in sectoral output and employment shares. Given this, suppose we regress an inequality measure on per capita income and that the variable is statistically significant. In this case the coefficient of per capita income indicates that structural change does affect income distribution, however it does not reveal exactly which kind of structural change is associated with the observed change in income distribution.

Anand and Kanbur (1993) explicitly show that in a two-sector economy, with non-overlapping sectoral distributions, the Gini coefficient (which belongs to the Lorenz class of indices of income inequality) can be expressed as a function of per capita income. Per capita income, in turn, is a weighted average of sectoral per capita incomes (as shown in (1) above). Taking this one step further, we can express sectoral per capita incomes as functions of sectoral output shares and express the Gini coefficient as a function of sectoral output shares.

In our formulation the Gini coefficient is expressed as a general function of sectoral output shares, including quadratic as well as interaction terms in these variables.

The model we estimate is:

$$\begin{aligned} G_{it} = {} & \alpha_i + \beta_1 X_{AGRit} + \beta_2 X_{INDit} + \beta_3 (X_{AGRit})^2 + \beta_4 (X_{INDit})^2 + \beta_5 (X_{AGRit} * X_{INDit}) \\ & + \beta_6 X_{PCYit} + \beta_7 (X_{PCYit})^2 + \beta_8 (X_{AGRit} * .X_{INEQi}) + \beta_9 (X_{INDit} * .X_{INEQi}) \\ & + \delta_1 (X_{AGRit} * DC) + \delta_2 (X_{INDit} * DC) + \delta_3 (X_{AGRit})^2 * DC \\ & + \delta_4 (X_{INDit})^2 * DC + \delta_5 (X_{AGRit} * X_{INDit}) * DC + \delta_6 (X_{PCYit} * DC) \\ & + \delta_7 (X_{PCYit})^2 * DC + \delta_8 (X_{AGRit} * .X_{INEQit}) * DC \\ & + \delta_9 (X_{INDit} * .X_{INEQit}) * DC + \varepsilon_{it} \end{aligned} \tag{2}$$

where, G=Gini Coefficient

X_{AGR}=share of agriculture in aggregate output (percentage)

X_{IND}=share of the industrial sector in aggregate output (percentage)

X_{PCY}=per capita real income

X_{INEQ}=a measure of initial inequality or inequality at the beginning of the period

DC=Dummy Variable which takes the value 1 for developed countries and is zero otherwise;

In our model the sectoral output share variables capture the effect of alternate patterns of structural change on inequality. Apart from this we also control for per capita income and its square, to control for differences in countries' overall levels of development. We attempt to capture the influence of political economy-related factors on inequality, by allowing the marginal effect of an 'agriculture-service transition' to depend upon past or 'initial' levels of inequality. 'Initial inequality,' a time invariant variable, would be dropped by a fixed effects transformation along with the country-specific, time invariant 'fixed effect.' As such it is included as an interaction term in the model.

Additionally, a dummy variable for developed countries is included, to control for differences in factors like institutional quality that differ significantly between developed and developing countries. All estimated coefficients are interacted with a developed country dummy (DC), which takes the value one for developed countries and is zero otherwise. As DC is time invariant variable it would also be dropped by a fixed effects transformation, allowing for the inclusion of only interaction terms.

The interpretation of estimated coefficients and nature of the relation between inequality and the included explanatory variables is further discussed below.

C. The Inequality-Structural Change Relation

The model postulates that controlling for countries' levels of development, income inequality depends upon the shares of agriculture and industry in aggregate output. The coefficients of these variables have an interesting interpretation. We consider three sectors, agriculture (AGR), industry (IND), and services (SER), with X_{AGR}, X_{IND}, and X_{SER} denoting the share of each sector in aggregate output (in percentage terms), so that,

$$X_{AGR}+X_{IND}+X_{SER}=100 \tag{3}$$

Expressing the Gini coefficient, G as a function of sectoral output shares, *i.e.*,

$$G=f(X_{AGR},\ X_{IND},\ X_{SER}) \tag{4}$$

amounts to,

$$G=f(X_{AGR},\ X_{IND},\ (100-X_{AGR}-X_{IND})) \tag{5}$$

Holding X_{IND} constant and reducing X_{AGR} by one percentage point, amounts to increasing X_{SER} by one percentage point, so as to satisfy the identity in (3).

So $\partial Gini/\partial X_{AGR}$ in model (2) above captures the distributional implications of an 'agriculture-service transition,' the kind of structural change experienced mainly by developing countries, which is of little interest in the context of developed countries. It measures the change in inequality associated with a one percentage point *decrease* (say) in the share of agriculture and an offsetting, one percentage point *increase* in the share of services in total output, with the share of industry held constant (such that the shares of the three sectors always add up to 100). Per capita income levels are also held constant, so the changes in sectoral output shares and employment shares must offset each other exactly so that the level of per capita income remains unchanged. In effect this model helps us identify the implications of changes in the sectoral *composition* of output on overall inequality. Analogously, $\partial Gini/\partial X_{IND}$ captures the distributional implications of an industry-service transition of the kind experienced by developed countries after industrial transformation had taken place. That is, the model in (2), essentially treats services as a residual sector, adjusting passively to changes in the shares of the other two sectors. An alternate formulation with shares of agriculture and services as explanatory variables (including quadratic and interaction terms as in (2) above) would treat industry as the residual sector and allow us to estimate the implications of an agriculture-industry transition. This highlights the past experience of developed countries and is likely to be relevant in the future context of developing countries as it spells out the distributional implications associated with industrial transformation, which is yet to take place in a number of low and middle income countries.

In the model in (2) above the distributional implications of an agriculture-service transition would be estimated as follows:

$$\partial Gini/\partial X_{AGR}|_{DC=0}=\beta_1+2\beta_3 X_{AGRit}+\beta_5 X_{INDit}+\beta_8 . X_{INEQi}$$
(for developing and transition economies (*i.e.*, for $DC=0$))

$$\partial Gini/\partial X_{AGR}|_{\mathrm{DC}=1}=(\beta_1+\delta_1)+2(\beta_3+\delta_3)X_{AGRit}+(\beta_5+\delta_5)X_{INDit}+(\beta_8+\delta_8)X_{INEQi}$$
(for developed countries (*i.e.*, for $DC=1$))

For both country groups, this marginal effect is a function of two sets of factors: the sectoral structure of the economy (as captured by the parameters β_1, δ_1, β_3, δ_3, and β_5 and δ_5) and past levels of inequality (captured by the parameters β_8 and δ_8).

The magnitude and sign of the estimated coefficients of the output share variables above are expected to be influenced by factors like income inequality within each sector, sectoral population shares and also the distribution of the workforce across the formal and informal segments in each sector, as the difference between formal and informal wages can often be significant. In case β_1 and β_3 are of opposite signs that would indicate the existence of a turning point in the relation between inequality and the sectoral share of agriculture in aggregate output.

Assuming that inequality is lowest in the agricultural sector it is expected that β_1 and β_3 will be negative, *i.e.*, any transition involving a fall in the share of agriculture (and a corresponding increase in the share of services) would result in increasing inequality. The extent of increase would depend upon past inequality levels. High level of initial inequality is likely to reflect absence of strong democratic institutions and mechanisms ensuring redistribution. Income inequality in the non-agricultural sector is likely to be higher in such economies. So it is likely that higher the level of initial inequality, greater the marginal increase in inequality with a fall in agriculture and a corresponding rise in the relative share of the non-agricultural sector. In contrast, low initial inequality is likely to be the outcome of sound redistribution policies and increase in inequality is likely to be less in such cases.

Per capita income and its square are also included as regressors. Since we have controls for sectoral output shares as well, the per capita income variable is expected to pick up the effects of other indicators of economic development. Of these an important characteristic likely to influence the distribution of income, is the size the informal sector. The informal sector is typically non-unionized and characterized by low and flexible wage conditions (see *e.g.*, Cole and Sanders 1985; ILO 1995, 1998; Agenor 1996; Ihrig and Moe 2000). Differences between developed and developing countries in this respect are particularly sharp. Studies show that on average, between sixty to seventy percent of the labour force in developing economies operate in the informal sector (Marjit and Acharyya 2003). In transition economies also the share of the informal sector may be as high as fifty percent of official GDP. In contrast, in developed countries the average share of the informal sector is only around ten percent and can be as low as four to five percent in developed market economies like Switzerland, USA, and the UK (Lacko 2000; Gerxhani 2004). It can be argued therefore that the size of the informal economy declines with development and rising per capita incomes.

With rising incomes per capita and reduction in the size of a relatively low-wage, low-inequality segment of the economy, overall inequality could increase initially and then, with growth and development as the formal economy becomes predominant and absorbs the bulk of the labour force, inequality may even decline. A quadratic term for per capita income is included to allow for a turning point in this relation. That is, the sign of β_6 (coefficient of X_{PCY}) is expected to be positive, while β_7 coefficient of $(X_{PCY})^2$ may actually be negative giving rise to a Kuznets curve type of a relation between inequality and structural change. This argument would apply mainly for developing and transition economies. Among developed countries, the size of the informal economy is likely to be uniformly low across countries. In fact, as per the Kuznets' curve hypothesis, these countries being in the mature phase of development, should experience falling inequality with rising per capita incomes, as such a turning point in the relation is not expected.

However, differences in per capita incomes across countries do not simply reflect differences in size of the informal economy. It also captures differences in a number of developmental characteristics affecting the quality and skill level of the workforce. This is also likely to give rise to an inverted U-shaped pattern of change in inequality with development and increase in per capita incomes. For instance, to the extent that development creates enabling conditions like skill formation for labour market participation, it can be expected that inequality would widen, reflecting a widening skilled-unskilled wage gap. However, with further development and rise in per capita incomes, a wider segment of the workforce would gain access to skills, driving down the skill premium and *ceteris paribas*, overall inequality would tend to fall.

In general, observed structural and institutional characteristics differ significantly especially between developed and developing countries. The developed country dummy is expected to capture the difference in the inequality-per capita income relation between the two the country groups arising due to these underlying differences in development characteristics.

D. The Data

The model in (2) is estimated using an unbalanced panel data set (details in the Appendix). The uneven number of observations per country being a compulsion, given the constraints related to data on income distribution. Variable averages over time are not used to construct a balanced panel, as this would smoothen the data, reducing variance, thereby reducing efficiency of the estimates.

We have an unbalanced panel including 78 countries, with an unequal number of observations over time for each country spanning the decades of the 1980s, 1990s, up to 2005. The data on income distribution (the dependent variable, *Gini*) for this paper is taken from the latest version of WIID2 (WIID2c, updated and revised in May, 2008) of the UNU/WIDER World Income Inequality Database (WIID), currently the most exhaustive compilation of secondary data, which subsumes all existing data sources on income inequality.[1] Two estimates of Gini coefficients are available in the WIID database; to check robustness of our results, both measures are used in our regressions.

The explanatory variable initial inequality (X_{INEQ}) is measured as the first time series observation on Gini coefficients available for each country. Data on the other variables, viz., value added in agriculture (X_{AGR}), industry (X_{IND}) and services (X_{SER}) as percentage of GDP and per capita income (X_{PCY}) (in constant 2000 dollars and in purchasing power parity terms) are from World Bank (2007). Further details regarding the criteria for country selection and the final dataset appear in the Appendix.

E. Methodological Issues

Standard panel data estimators, the fixed and random effects estimators are used and the choice between the two alternatives made on the basis of the Hausman specification test. In general, given the nature of our exercise, we expect the unobserved country-specific effect to be correlated with the included explanatory variables and thus, the fixed effects model to be appropriate in our case. For, unobserved, time invariant, country-specific factors such as historical conditions (factors like whether or not the country had a colonial past) tend to influence the evolution of socio-political institutions, thereby affecting aggregate economic outcomes significantly. So in this case it is reasonable to expect that the country specific, time invariant 'fixed' effect would be correlated with the regressors.

Given that our empirical strategy relies on the fixed effects model (subject to the Hausman specification test), one advantage is that this model utilizes only the 'within' variation (within country, over time variation) in the dataset. So that for each country, the estimator essentially uses the over time variation for the respective country and discards all of the between variation. This would tend to reduce the effects of dif-

[1] Such as Deininger and Squire (1996) and its latest (2004) update as well as the WIID1 database *etc.*

ferences arising due to availability of uneven number of time series observations across countries. Further, panel data techniques with an unbalanced panel are not any different from techniques used for a balanced panel — the time demeaned data has to be appropriately calculated, allowing for the unequal number of time periods available per country.

The main problem with an unbalanced panel is that of attrition or the reason for missing data. Typically attrition can be a serious problem in micro level panel datasets pertaining to individuals or firms. In this case, with country level data, it seems reasonable to assume that the reason there is missing data is not systematically related to the idiosyncratic error which captures unobserved, time-varying random factors. Moreover, the fixed effects model allows attrition to be correlated with the unobserved country specific factors (Wooldridge 2002).

We begin by testing for differences in average inequality levels, *ceteris paribus*, between developed and developing countries. This is done on the basis of a test for the joint significance of *all* the dummy interaction terms.

We have seen above that $\partial Gini/\partial X_{AGR}$ is a function of the shares of output in the agriculture and services sectors and of initial inequality. As such it is to be evaluated at appropriate values of these variables. We evaluate these partial effects using *average* variable values for the year 2000 for developed and developing countries in the sample. Average share of industry is comparable between the two country groups (at around thirty percent). However, compared to developing nations, in the industrialized nations on average, the share of agriculture is significantly *lower* (about two percent, compared to over ten percent for developing countries), share of services *higher* (nearly seventy percent, compared to about fifty-five percent for developing countries), initial inequality *lower* (Gini coefficient is just under thirty percent, compared to over forty percent for developing countries) and per capita incomes *higher* (about twenty thousand dollars, compared to about twelve thousand dollars for developing countries).

The main difference between developed and developing countries in our sample relates to the shares of agriculture in value added and to the levels of initial inequality, on average. The average share of industry between the two country groups is very similar. However, this figure masks the reality that relatively low share of industry in developed nations represents a mature economy where industrial transformation is complete and a declining share of industry is giving way to rising share of services. In contrast, in developing countries, low industry share in most cases signifies that the process of industrial transformation is yet to get underway and the share of agriculture is still high.

To evaluate and test the significance (on the basis of t tests) of the partial effects we estimate re-parameterised models, regressing the dependent variable on explanatory variables measured as differences from the values at which the partial effects are evaluated. This exercise allows us to evaluate the likely effects of structural change on inequality in low and high inequality developing countries and contrast this with the outcome for low and high inequality developed countries.

For example, in model (3) below, the coefficients of X_{AGRit} and $(X_{AGRit} * DC)$ capture the marginal effect of an agriculture-service transition on income inequality in a developing (β_1) and developed country $(\beta_1+\delta_1)$ respectively, evaluated at sample averages of *developing* countries. Variables with subscript *LDC* indicate average developing country values for the year 2000 — *e.g.*, Ind_{LDC}=average share of industry for the developing economies in the sample in 2000. The coefficients of X_{INDit} and $(X_{INDit} * DC)$ capture the impact of an industry-service transition, while those of X_{PCYit} and $(X_{PCYit} * DC)$ capture the marginal effect of a change in per capita income on inequality, evaluated at developing country averages.

$$
\begin{aligned}
G_{it}= & \alpha_i+\beta_1 X_{AGRit}+\beta_2 X_{INDit}+\beta_3(X_{AGRit}-Agr_{LDC})^2+\beta_4(X_{INDit}-Ind_{LDC})^2 \\
& +\beta_5(X_{AGRit}-Agr_{LDC}) * (X_{INDit}-Ind_{LDC})+\beta_6 X_{PCYit}+\beta_7(X_{PCYit}-Pcy_{LDC})^2 \\
& +\beta_8(X_{AGRit}-Agr_{LDC}) * (X_{INEQi}-Ineq_{LDC}) \\
& +\beta_9(X_{INDit}-Ind_{LDC}) * (X_{INEQi}-Ineq_{LDC})+\delta_1(X_{AGRit} * DC) \\
& +\delta_2(X_{INDit} * DC)+\delta_3(X_{AGRit}-Agr_{LDC})^2 * DC+\delta_4(X_{INDit}-Ind_{LDC})^2 * DC \\
& +\delta_5(X_{AGRit}-Agr_{LDC}) * (X_{INDit}-Ind_{LDC}) * DC \\
& +\delta_6(X_{PCYit} * DC)+\delta_7(X_{PCYit}-Pcy_{LDC})^2 * DC \\
& +\delta_8(X_{AGRit}-Agr_{LDC}) * (X_{INEQi}-Ineq_{LDC}) * DC \\
& +\delta_9(X_{INDit}-Ind_{LDC}) * (X_{INEQi}-Ineq_{LDC}) * DC+\varepsilon_{it}
\end{aligned}
\tag{3}
$$

In our model the extent of change in inequality associated with structural change, depends on the relative sizes of the sectors and on the level of initial inequality. We try to isolate the impact of each of these factors separately in two steps. First, we hold initial inequality equal to zero and test whether the quadratic and interaction terms involving output shares are statistically significant. Thereafter, we allow initial inequality to be positive, while the share of the 'other' sector goes to zero (*i.e.*, in the above case, we evaluate $\partial Gini/\partial X_{IND}$, allowing it to depend on initial inequality and only on the share of industry, but not agriculture, by dropping the interaction term involving sectoral output shares). In each case we test for statistical significance of the quadratic and interaction terms using t (for one tailed hypotheses) and F tests for nested models.

III. The Results

In what follows we present the main results from the estimated fixed effects panel data models. Two models were estimated, each with Gini coefficients as dependent variable and sectoral output shares, per capital incomes and initial inequality as explanatory variables. In each case the Hausman specification test was significant, bearing evidence of correlation between the unobserved, country specific fixed effect and the regressors — so the fixed effects models was preferred to the random effects model. To check robustness of the results, the regressions were run using two alternate measures of Gini coefficients available in the WIID dataset — similar results were obtained in each case. The estimated results are presented in Table 1 while details of joint tests and results from reparameterised models used to evaluate the marginal effects are presented in detail in Box 1, 2, 3, and 4. The inclusion of interaction terms in the model often results in high correlation between explanatory variables and as in case of multicollinearity may lead to insignificant t statistics for individual coefficients; so we also rely on F tests for joint significance and t tests for linear restrictions for drawing conclusions from our estimated results.

Our results indicate evidence of a Kuznets curve type, inverted-U shaped relation between per capita income and income inequality for developing countries. However, no such relation holds for the developed countries in the sample (see Table 1 and Box 1 for details). This is in line with what we had expected.

For developing countries the marginal effect of an increase in per capita income is estimated as:

$$\partial Gini/\partial X_{PCY}|_{DC=0}=\beta_6+2\beta_7 X_{PCYit}$$

We hold output shares of two of the three sectors constant, as we consider an increase in per capita income levels, so the entire increase in per capita income is due to expansion of the third sector, *not included*

TABLE 1
RESULTS OF FIXED EFFECTS REGRESSION

Dependent Variable: Gini Coefficient				
Explanatory Variables ↓	Col (1)		Col (2)	
Constant	42.562***	(5.703)	5.273	(15.099)
X_{AGR}	-0.535	(0.437)	-0.082	(0.599)
X_{IND}	-1.023***	(0.359)		
X_{SER}			-0.581	(0.403)
$(X_{AGR})^2$	0.006	(0.004)	0.004	(0.007)
$(X_{IND})^2$	0.008**	(0.004)		
$(X_{SER})^2$			0.008**	(0.004)
$(X_{AGR} * X_{IND})$	0.010	(0.007)		
$(X_{AGR} * X_{SER})$			0.007	(0.011)
$(X_{AGR} * .X_{INEQ})$	-0.002	(0.005)	-0.010	(0.008)
$(X_{IND} * .X_{INEQ})$	0.006**	(0.003)		
$(X_{SER} * X_{INEQ})$			-0.006**	(0.003)
X_{PCY}	0.002***	(0.001)	0.002**	(0.001)
$(X_{PCY})^2$	0.000***	(0.000)	0.000***	(0.000)
$(X_{AGR} * DC)$	2.360	(2.332)	5.564**	(2.216)
$(X_{IND} * DC)$	-0.633	(0.855)		
$(X_{SER} * DC)$			5.989***	(0.798)
$((X_{AGR})^2 * DC)$	0.005	(0.032)	0.005	(0.046)
$((X_{IND})^2 * DC)$	-0.026***	(0.007)		
$((X_{SER})^2 * DC)$			-0.027***	(0.007)
$((X_{AGR} * X_{IND}) * DC)$	-0.028	(0.025)		
$((X_{AGR} * X_{SER}) * DC)$			-0.027	(0.032)
$((X_{AGR} * X_{INEQ}) * DC)$	-0.050	(0.059)	-0.134*	(0.073)
$((X_{IND} * X_{INEQ}) * DC)$	0.086***	(0.020)		
$((X_{SER} * X_{INEQ}) * DC)$			-0.086***	(0.020)
$(X_{PCY} * DC)$	-0.002***	(0.001)	-0.002***	(0.001)
$((X_{PCY})^2 * DC)$	0.000***	(0.000)	0.000***	(0.000)
Nob	647		647	
R^2 within	0.2034		0.2054	

Note: The dependent variable in the above regression is the Gini coefficients calculated by T. Shorrocks and G. H. Wan of WIDER; Figures in parentheses are robust standard errors; ***, **, * indicate statistical significance at 1%, 5%, and 10% levels respectively.

as an explanatory variable in the model. For developing nations, inequality increases with an increase in per capita income till it reaches a level of about six and half thousand dollars. Thereafter inequality declines with further increase in income per capita. This result holds no matter which two output share variables are included as regressors.

Evaluating $\partial Gini/\partial X_{PCY}|_{DC=0}$ at average per capita income levels for

Box 1

MARGINAL IMPACT OF CHANGE IN PER CAPITA INCOMES ON INEQUALITY

Marginal effect of change in per capita incomes on inequality can be estimated from a regression of Gini coefficients on per capita incomes (X_{PCY}) and shares of any two sectoral output shares (*e.g.*, agriculture (X_{AGR}), industry (X_{IND})) (including quadratic and interaction terms and interaction terms with a developed country dummy variable (DC) and with countries' initial inequality levels (X_{INEQ})), as:

$$\partial Gini/\partial X_{PCY}|_{DC=0}=\beta_6+2\beta_7 X_{PCY} \text{ (for developing countries)}$$

$$\partial Gini/\partial X_{PCY}|_{DC=1}=(\beta_6+\delta_6)+2(\beta_7+\delta_7)\ X_{PCY} \text{ (for developed countries)}$$

For **developed countries** we cannot reject the null $\partial Gini/\partial X_{PCY}|_{DC=1}=0$. The coefficients $(\beta_6+\delta_6)$ and $2(\beta_7+\delta_7)$ are jointly insignificant.

For **developing countries**, we reject the null $\partial Gini/\partial X_{PCY}|_{DC=0}=0$. $\beta_6>0$ and $\beta_7<0$ at the 1% level of significance, with the turning point at $X_{PCY}=\$$ 6686.4.

The value of $\partial Gini/\partial X_{PCY}$ for **developing countries**:

(a) evaluated using <u>developing country</u> averages (overall effect): 0.001** (0.0004)

(a) evaluated using <u>developed country</u> averages (overall effect): -0.005*** (0.001)

(Figures in parentheses are robust standard errors; ***, **, * indicate significance at 1%, 5% and 10% levels respectively)

developing countries in the sample reveals that the marginal effect is positive and highly significant[2] — inequality *increases* by 0.1 percentage point with every hundred dollar increase in per capita real income (Box 1). The turning point in the relation is evident when the marginal effect is evaluated using developed country average per capita incomes. At substantially higher per capita income levels, the sign of $\partial Gini/\partial X_{PCY}|_{DC=0}$ is negative and inequality actually decreases by half a percentage point with every hundred dollar increase in per capita real incomes.

Given that sectoral output share variables are held constant as we

[2] All reported results are based on statistically significant variables at standard levels of significance (1% or 5% or 10%).

Box 2

MARGINAL EFFECT OF AGRICULTURE-INDUSTRY TRANSITION ON INEQUALITY

Marginal Effect of Agriculture-Industry Transition is estimated from a regression of Gini coefficients on shares of agriculture (X_{AGR}), industry (X_{SER}), and per capita incomes (X_{PCY}) (including quadratic and interaction terms and interaction terms with a developed country dummy variable (DC) and with countries' initial inequality levels (X_{INEQ})), as:

$$\partial Gini/\partial X_{AGR}\,|_{DC=0} = \beta'_1 + 2\beta'_3\, X_{AGRit} + \beta'_5\, X_{SERit} + \beta'_8\, X_{INEQi}$$

(for developing countries)

$$\partial Gini/\partial X_{AGR}\,|_{DC=1} = (\beta'_1 + \delta'_1) + 2(\beta'_3 + \delta'_3)X_{AGRit} + (\beta'_5 + \delta'_5)X_{SERit} + (\beta'_8 + \delta'_8)X_{INEQi}$$

(for developed countries)

For **developing countries** we cannot reject the null $\partial Gini/\partial X_{AGR}\,|_{DC=0} = 0$. The coefficients β'_1, $2\beta'_3$, β'_5, and β'_8 are jointly insignificant.

For **developed countries,** joint tests show that $\partial Gini/\partial X_{AGR}\,|_{DC=0}$ is non zero and the coefficients $(\beta'_1 + \delta'_1)$, $2(\beta'_3 + \delta'_3)$, $(\beta'_5 + \delta'_5)$, and $(\beta'_8 + \delta'_8)$ are jointly significant at the 10% level. Joint tests show that $\partial Gini/\partial X_{AGR}\,|_{DC=0}$ is a function of X_{INEQ}:

(a) $(\beta'_1 + \delta'_1) > 0$ and significant at 5% level;
(b) we cannot reject the null $2(\beta'_3 + \delta'_3) = 0$;
(c) we cannot reject the null $(\beta'_5 + \delta'_5) = 0$
(d) $(\beta'_8 + \delta'_8) < 0$ and significant at 5% level

The value of $\partial Gini/\partial X_{AGR}$ for **developed countries**:

(a) evaluated using <u>developed country</u> averages (overall effect): -0.11 (insignificant)
   (i) when initial inequality levels = 0: 5.59** (2.129)
   (ii) when initial inequality levels > 0 and $X_{SER} = 0$: -1.25 (insignificant)

(b) evaluated using <u>developing country</u> averages (overall effect): -2.29** (1.156)
   (i) when initial inequality levels = 0: 5.70** (2.068)
   (ii) when initial inequality levels > 0 and $X_{SER} = 0$: -1.36 (insignificant)

(Figures in parentheses are robust standard errors; ***, **, * indicate significance at 1%, 5%, and 10% levels respectively) consider an increase in per capita incomes, it appears that the observed inverted U-shaped relation between income per capita and inequality for developing countries is driven by factors, other than structural change, that are systematically related to countries income levels.

Next we discuss the distributional implications of three alternate patterns of structural change for developing and developed countries.

We define an '**agriculture-industry transition**' as a fall in the share of agriculture and a corresponding rise in the share of industry in output, holding the share of services and per capita incomes constant. This is the classic pattern experienced by developed countries in the early phases of economic transformation; this process has not yet been witnessed on a large scale in the developing world. The marginal effect of this kind of transition on inequality is estimated as $\partial Gini/\partial X_{AGR}$ from the regression of Gini coefficients on shares of agriculture, services, and per capita incomes (Table 1, Col (2)). For developing countries our results indicate that with a transition of this kind, inequality does not increase at the margin (Box 2). In contrast to the result we expected, expansion of industry at the cost of agriculture is not associated with increasing inequality in developing nations.

Given the scope of this paper is to characterize the inequality-structural change relation in developed and developing countries, we do not go into a detailed examination of factors underlying the observed relation. In this context, Lee (2004) provides insights into one of the *channels via* which structural transformation, of the kind described above, is likely to affect the distribution of income by affecting labour market outcomes. Lee (2004) specifically examines the impact of long term changes in the industrial structure on a specific segment of the Korean labour force, viz., older males. In case of the Korean economy, a decline in the share of agriculture is seen to be associated with a falling labour force participation rate among older men. Clearly, an important area for future research would be to examine such channels and underlying processes linking structural change to income distribution *via* labour market outcomes in the context of developing nations.

The results are different for developed countries, as indicated by the joint significance of the dummy interaction terms (Box 2).

For developed countries the marginal impact of an 'agriculture-industry transition' is[3]:

[3] The δ's are coefficients of the developed country dummy interaction terms.

$$\partial Gini/\partial X_{AGR}|_{DC=1} = (\beta'_1 + \delta'_1) + 2(\beta'_3 + \delta'_3)X_{AGRit} + (\beta'_5 + \delta'_5)X_{SERit} + (\beta'_8 + \delta'_8)X_{INEQi}$$

Joint tests indicate that the sign and magnitude of $\partial Gini/\partial X_{AGR}$ depends on the level of initial inequality, but not on the size of the service sector in output (Box 2). There is no evidence of a turning point in the relation between inequality and share of agriculture — the quadratic term in output share of agriculture is insignificant.

Our results imply that at very low levels of initial inequality (for $X_{INEQi} = 0$), industrial expansion with falling share of agriculture, *reduces* inequality. The reduction in inequality can be substantial, over five percentage points, when evaluated at average sample values of X_{AGR} for developed or developing countries (Box 2). However, high levels of initial inequality counter this effect quite sharply. With one percentage point fall in share of agriculture and corresponding rise in that of industry (holding services share and per capita incomes constant), inequality *rises* by about two percentage points, when evaluated at high levels of initial inequality (developing country average values) (Box 2).

This is an important result, in countries where industrial transformation has already taken place, further rise in share of industry (with falling share of agriculture) will lower inequality further as long as 'initial' inequality is low (as for developed countries). Otherwise, if 'initial' inequality levels are high, rising share of industry at the cost of agriculture would lead to further rise in inequality. Our results indicate nothing inherent in the process of industrialization tends to exacerbate inequality, rather the key variable determining the outcome is past or historical levels of inequality.

We also examine the implications of an '**agriculture-service transition**,' defined as a fall in the share of agriculture and a corresponding rise in the share of services in output (holding the share of industry and per capita incomes constant). This has been witnessed across low income countries, where services (especially informal services) have served as a residual sector, absorbing a significant share of the labour force, often at very low wages. The marginal effect of this kind of structural change on inequality is estimated as $\partial Gini/\partial X_{AGR}$ from the regression of Gini coefficients on shares of agriculture, industry, and per capita incomes (Table 1, Col (1)).

For developed countries our results show that this kind of structural change does not have a significant impact on inequality. Whereas, for developing countries, the inequality implications are a function of the

Box 3

MARGINAL EFFECT OF AGRICULTURE-SERVICE TRANSITION ON INEQUALITY

Marginal Effect of Agriculture-Service Transition is estimated from a regression of Gini coefficients on shares of agriculture (X_{AGR}), industry (X_{IND}) and per capita incomes (X_{PCY}) (including quadratic and interaction terms and interaction terms with a developed country dummy variable (DC) and with countries' initial inequality levels (X_{INEQ})), as:

$$\partial Gini/\partial X_{AGR}|_{DC=0}=\beta_1+2\beta_3 X_{AGRit}+\beta_5 X_{INDit}+\beta_8 X_{INEQi}$$

(for developing countries)

$$\partial Gini/\partial X_{AGR}|_{DC=1}=(\beta_1+\delta_1)+2(\beta_3+\delta_3) X_{AGRit}+(\beta_5+\delta_5) X_{INDit}+(\beta_8+\delta_8) X_{INEQi}$$

(for developed countries)

For **developed countries** we cannot reject the null $\partial Gini/\partial X_{AGR}|_{DC=1}=0$. The coefficients $(\beta_1+\delta_1)$, $2(\beta_3+\delta_3)$, $(\beta_5+\delta_5)$, and $(\beta_8+\delta_8)$ are jointly insignificant.

For **developing countries**, joint tests show that $\partial Gini/\partial X_{AGR}|_{DC=0}$ is a function of X_{INEQ}: the null hypothesis $\beta_1=0$ and $\beta_8=0$ is rejected at the 13% level of significance and $\beta_8<0$. β_3 and β_5 are jointly insignificant.

The value of $\partial Gini/\partial X_{AGR}$ for **developing countries**:

(a) evaluated using developing country averages (overall effect): -0.16 (0.104) (significant at 13%)
   (i) when initial inequality levels=0: zero
   (ii) when initial inequality levels>0 and $X_{INDit}=0$: -0.49** (0.248)

(b) evaluated using developed country averages (overall effect): -0.27* (0.159)
   (i) when initial inequality levels=0: zero
   (ii) when initial inequality levels>0 and $X_{INDit}=0$: -0.58* (0.340)

(Figures in parentheses are robust standard errors; ***, **, * indicate significance at 1%, 5%, and 10% levels respectively)

level of initial inequality (Box 3).

For developing countries the marginal impact of an 'agriculture-service transition' is:

$$\partial Gini/\partial X_{AGR}|_{DC=0}=\beta_1+2\beta_3 X_{AGRit}+\beta_5 X_{INDit}+\beta_8 X_{INEQi}$$

Results from joint (F-tests) show that this marginal impact does not depend on the structure of the economy — ($\beta_1+2\beta_3$) and β_5 are not significantly different from zero. However, β_1 and β_8 are jointly significant and β_8 is negative and significant. So in developing economies, given the share of industry and level of per capita incomes, a falling share of agriculture with corresponding rise in share of services by one percentage point would *raise* overall inequality by half a percentage point (evaluated at sample average values for developing countries) (Box 3). The increase in inequality would be higher for countries where initial inequality is higher than the sample average.

Finally, we define an '**industry-services transition**' as a fall in the share of industry and a corresponding rise in the share of services in output, holding the share of agriculture and per capita incomes constant. This kind of structural change was observed in developed countries once industrial transformation had taken place and the service sector had become dominant. Our results indicate that this kind of transition has a statistically significant impact on inequality in both developed and developing countries (the dummy interactions are jointly significant as indicated by an F-test). The marginal effect of this kind of structural change is estimated from a regression of Gini coefficients on shares of agriculture, industry, and per capita incomes as follows:

for developing countries:
$$\partial Gini/\partial X_{IND}|_{DC=0}=\beta_2+2\beta_4 X_{INDit}+\beta_5 X_{AGRit}+\beta_8 X_{INEQi}$$

for developed countries:
$$\partial Gini/\partial X_{IND}|_{DC=1}=(\beta_2+\delta_2)+2(\beta_4+\delta_4)X_{INDit}+(\beta_5+\delta_5)X_{AGRit}+(\beta_8+\delta_8)X_{INEQi}$$

Our results show interesting similarities in the marginal effects for developed and developing countries (see Table 1, Col (1) and Box 4). For both country groups, $\partial Gini/\partial X_{IND}$ depends inversely on the relative size of the industrial sector and positively on initial inequality. The two main differences in results for these country groups are as follows. Firstly, for developing countries, there is evidence of a U-shaped relation between industry share and inequality — inequality declines with a rising share of industry (and falling services share, holding agriculture and per capita incomes constant), till it reaches a high of about 68%, thereafter inequality rises as industry share increases further. This is not observed for the industrialized countries. The declining inequality scenario is most likely to be operative for developing countries, where on average industry

Box 4

MARGINAL EFFECT OF INDUSTRY-SERVICE TRANSITION ON INEQUALITY

Marginal Effect of Industry-Service Transition is estimated from a regression of Gini coefficients on shares of agriculture (X_{AGR}), industry (X_{IND}), and per capita incomes (X_{PCY}) (including quadratic and interaction terms and interaction terms with a developed country dummy variable (DC) and with countries' initial inequality levels (X_{INEQ})), as:

$$\partial Gini/\partial X_{IND}|_{DC=0}=\beta_2+2\beta_4 X_{INDit}+\beta_5 X_{AGRit}+\beta_8 X_{INEQi}$$

(for developing countries)

$$\partial Gini/\partial X_{IND}|_{DC=1}=(\beta_2+\delta_2)+2(\beta_4+\delta_4)X_{INDit}+(\beta_5+\delta_5)X_{AGRit}+(\beta_8+\delta_8)X_{INEQi}$$

(for developed countries)

For **developing countries** we cannot reject the null $\partial Gini/\partial X_{IND}|_{DC=0}=0$, and the coefficients β_2, $2\beta_4$, β_5, and β_8 are jointly significant at the 1% level. Joint tests show that $\partial Gini/\partial X_{IND}|_{DC=0}$ is a function of X_{INDit}, X_{AGRit}, and X_{INEQ}:

(a) $\beta_2<0$ and significant at 1% level;
(b) $\beta_4>0$ and significant at 1% level; (a) and (b) implies a U-shaped relation between *Gini* and X_{INDit} with a turning point at $X_{IND}=67.8\%$
(c) $\beta_5>0$ and significant at 1% level;
(d) $\beta_8>0$ and significant at the 5% level;

The value of $\partial Gini/\partial X_{AGR}$ for **developing countries**:

(a) evaluated using developing country averages (overall effect): -0.11* (0.068)
 (i) when initial inequality levels=0: -0.54*** (0.143)
 (ii) when initial inequality levels>0 and $X_{AGR}=0$: -0.25** (0.097)
(b) evaluated using developed country averages (overall effect): -0.38*** (0.099)
 (i) when initial inequality levels=0: -0.59*** (0.161)
 (ii) when initial inequality levels>0 and $X_{AGR}=0$: -0.41*** (0.107)

For **developed countries** the null $\partial Gini/\partial X_{IND}|_{DC=1}=0$ is rejected and the coefficients $(\beta_2+\delta_2)$, $2(\beta_4+\delta_4)$, $(\beta_5+\delta_5)$, and $(\beta_8+\delta_8)$ are jointly significant at the 1% level. Joint tests indicate that $\partial Gini/\partial X_{IND}|_{DC=1}$ is a function of X_{INDit} and X_{INEQi}:

(a) $(\beta_2+\delta_2)<0$ and significant at 1% level;
(b) $(\beta_4+\delta_4)<0$ and significant at 1% level;
(c) We cannot reject the null $(\beta_5+\delta_5)=0$;
(d) $(\beta_8+\delta_8)>0$ and significant at 1% level.

Box 4
CONTINUED

The value of $\partial Gini/\partial X_{AGR}$ for **developed countries**:

(a) evaluated using developed country averages (overall effect): -0.069** (0.030) (significant at 13%)
  (i) when initial inequality levels=0: -2.74*** (0.569)
  (ii) when initial inequality levels>0 and X_{AGR}=0: -0.02** (0.009)

(b) evaluated using developing country averages (overall effect): 1.35*** (0.294)
  (i) when initial inequality levels=0: -2.86*** (0.671)
  (ii) when initial inequality levels>0 and X_{AGR}=0: 1.59* (0.392)

(Figures in parentheses are robust standard errors; ***, **, * indicate significance at 1%, 5%, and 10% levels respectively)

shares are typically well below fifty percent of aggregate output. Secondly in developing countries, the marginal effect is additionally a function of the share of agriculture, in contrast to the case for developed nations (Box 4).

In both country groups, inequality increases with falling share of industry and corresponding, rising share of services (holding shares of agriculture and per capita incomes constant). High levels of initial inequality in this case would have the opposite effect, tending to reduce inequality at the margin, for both country groups. In developing countries, a lower share of agriculture would also tend to reduce inequality at the margin, with an industry-service transition.

Evaluating the marginal effects for developing countries (using developing country average values) indicates, with one percentage point reduction in industry share and corresponding rise in share of services (holding shares of agriculture and per capita output constant), overall inequality would tend to *rise* marginally by about 0.1 percentage points. One reason the magnitude of this effect is so small is because, developing countries have relatively high shares of agriculture and high levels of initial inequality. Both these factors tend to dampen the increase or reduce inequality at the margin with an industry-service transition. However, in this case the marginal effect of industrial expansion dominates the other effects, so that $\partial Gini/\partial X_{IND}|_{DC=0}$ is negative. In the opposite scenario, likely to be observed in developing countries in the future, inequality would actually tend to *fall* at the margin, with expansion of industry at the cost of services (holding the share of agriculture and per capita incomes constant).

Evaluating the marginal effects for developed countries (at developed country average values) indicates that an industry-services transition has hardly any impact on overall inequality — a result that reflects the net effect of two factors (industry share and initial inequality) with opposing impacts on inequality. However, evaluating the same effect at higher levels of inequality (at developing country average values), indicates that for developed countries, one percentage point fall in share of industry and rise in share of services (holding agriculture share and per capita incomes constant) reduces overall inequality by 1.35 percentage points (Box 4). For developed countries therefore, the effect of initial inequality dominates at the margin.

Having characterized the distributional implications of alternate patterns of structural change we highlight the main conclusions that can be drawn from the estimated results, in the following section.

IV. Conclusion

In conclusion we summarize the central findings from our empirical exercise in light of the issues and questions raised at the beginning of the paper.

We have found substantial differences between developing and developed nations regarding the distributional implications of changes in income per capita and of agriculture-industry and agriculture-service transitions. Yet, despite these there are significant similarities in results with respect to the implications of industry-service transition. However the effects of industry-service transition is likely to be different in the two country groups as developed industrial economies are likely to experience falling shares of industry, with rising services share, while the opposite is likely to be the case in developing economies, in the future.

Considering the likely consequence of greater service orientation of the economy, we find that the distributional implications are likely to be different in developed and developing countries. In poorer countries experiencing service orientation at the expense of agriculture, inequality is likely to rise in the process, the rise in inequality being sharper for countries with historically higher levels of inequality. This indicates that in developing countries, especially in countries where historically inequality levels are high, distribution of service incomes is very unequal, especially when compared to incomes from agriculture.

In developed countries, in contrast, greater service orientation occurs along with a shrinking share of industry and this is likely to lower inequality, especially in high inequality countries. Our results suggests that in developed nations, in the initial phases of the transition to services (when agriculture share is still relatively high and so is initial inequality), overall inequality declines with an industry-service transition. However, once the agriculture share has declined further and the economy is in the 'mature' phase of development with lower overall inequality levels, further decline in the share of industry and rise in services is unlikely to bring down inequality further.

Regarding the distributional implications of industrialization for developing countries, our results indicate that as long as industrial expansion occurs at the cost of agriculture, inequality does not rise. In case industrial expansion occurs at the cost of services, overall inequality is even likely to fall. This is an important result indicating that in poorer countries, industrialization is unlikely to worsen the distribution of income. It also indicates that in developing countries, the distribution of service incomes is relatively more unequal, even as compared to the industrial sector. Therefore, policies geared to encourage industrial expansion are likely to improve the distribution of income in developing countries.

With industrial expansion and falling share of agriculture in developed nations, inequality would fall in economies with historically low levels of inequality. However in developed societies with historically high levels of inequality, industrial expansion is likely to be unequalizing, whether it be at the cost of agriculture or services. This is in contrast to our results for developing countries, where industrial expansion at the cost of services may reduce inequality.

An important result we have is with regard to the influence of initial or past levels of inequality on the distributional implications of structural change. In case of a transition involving shrinking share of agriculture, high levels of initial inequality tends to raise inequality at the margin. This result holds for developing countries in case of an agriculture service transition and for developed countries with an agriculture industry transition.

Finally, regarding per capita incomes, our results indicate that, holding output shares of any two sectors constant, rising per capita incomes does not affect inequality in developed countries. This result is fundamentally different from the developing country case, where we find evidence of a Kuznets curve type inverted U-shaped relation between inequality and per capita incomes. Since structural change variables are controlled for, this relation is driven by other indicators of development and structural characteristics of developing economies, which results in widening inequality to begin with and thereafter falling inequality as development proceeds further. In the final analysis, there appears to be scope for further research, examining more closely the factors underlying the kind of inequality-structural relation in developed and developing countries characterized in this paper.

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Appendix

Description of Variables

The data on income distribution for this paper is taken from the latest version of WIID2 (WIID2c, updated and revised in May, 2008) of the UNU/WIDER World Income Inequality Database (WIID), currently the most exhaustive compilation of secondary data on income inequality which subsumes all existing data sources.[4] It provides a single, comprehensive secondary database on income inequality, closely following the standards prescribed in Atkinson and Brandolini (2001). Till date, few papers have used the latest revised version (WIID2c) of the data (earlier versions of the data, *e.g.*, WIID2.0 and WIID2b are used in Jantti and Sandstorm 2005; Jakobsson 2006; Kocherlakota and Pistaferri 2008). In constructing the panel dataset we have closely followed the recommendations in Atkinson and Brandolini (2001) as well as the Canberra Group recommendations and other guidelines in WIID (2007), as we tried to ensure time consistency of the estimates as well as comparability across a large number of developed and developing countries.

We have ensured that the inequality measure used (Gini coefficients) are based on households as the basic income sharing units, while the unit of analysis is the individual. Individual incomes are calculated from household level data either on a per capita basis (*i.e.*, household income divided by number of members) or by introducing adjustments based on an equivalence scale (*i.e.*, taking into account factors like age

[4] Such as Deininger and Squire (1996) and its latest (2004) update and the WIID1 database *etc.*

composition of household *etc.*, in calculating individual incomes from household data).

For income based Gini coefficients we have chosen measures based on disposable incomes. For countries where income data was not available, we have taken measures based on consumption, rather than simply expenditure, as consumption includes non-monetary items in addition to monetary expenditures incurred.[5] Dummy variables were used to control for differences in estimates arising due to measurement issues.

The WIID inequality data are given a quality rating on a scale of 1 to 4, with 1 representing the highest quality rating, given to data for which underlying concepts for constructing the inequality index are clearly known and for which the concepts of income used and quality of the underlying survey conform to a set of reasonable criteria documented in WIID (2007, pp. 13-14). We have ensured that the inequality measures included in our database have a high quality rating of either 1 or 2. In light of the caveats laid down in Atkinson and Brandolini (2001), we desisted from using data with quality rankings of 3 or 4.

In addition to the above criteria we have ensured that for each country, the inequality measures included cover all age groups, all population groups and all geographical regions within each country. Finally, for each country we tried to include, as far as possible, data from the same source to ensure comparability over time. Wherever estimates from different sources had to be combined, we included only those with the same population, age, and geographical coverage, based on household data as well as on similar equivalence scales.

Applying all these restrictions along with the quality rankings in the WIID dataset meant that for each country a number of observations had to be discarded. This reduced the time span that could be covered, as well as the number of countries that could be included in the final dataset. Finally we have an unbalanced panel including 78 countries, with an unequal number of observations over time for each country spanning the decades of the 1980s, 1990s, up to 2005.

Two estimates of Gini coefficients are available in the WIID database one ("gini") based on a method developed by T. Shorrocks and G.H. Wan of WIDER and the second ("reported Gini") is either based on the World Bank's POVCAL methodology or directly derived from secondary

[5] In general, for some countries (*e.g.*, mainly OECD and Latin American countries) inequality estimates are based on income, whereas for others (*e.g.*, a number of Asian and African countries) these are based on consumption.

sources (WIID 2007). To check robustness of our results, both measures are used in our regressions and similar results were obtained in each case.

We incorporated dummy variables for variables based on consumption, as well as for monetary disposable incomes, to check if average inequality estimates differed significantly. The dummies were used with the pooled data, in a pooled OLS regression, as well as in the fixed effects model, interacted with other included variables, but in each case the dummies were found insignificant and hence they were discarded in the final regression. One reason for this could be that there are only a small number of countries in the sample for which inequality estimates are based on consumption or monetary disposable incomes. *E.g.*, estimates for only 12 (Cambodia, Cote d'Ivoire, Egypt, Ghana, India, Indonesia, Jamaica, Nepal, Philippines, Sri Lanka, Vietnam, Kyrgyz Republic) of the 78 countries in the sample were based on consumption.

Initial inequality is measured as the first time series observation available for each country. With the dataset beginning at 1980, for the majority of the countries, it pertains to inequality at the beginning of the 1980s decade. For a few African countries and transition economies, observations are available only from the 1990s decade onward. For these countries the 'initial' inequality variable accordingly represents inequality in the 1990s decade. The upshot of this is basically, for many countries the initial inequality variable is not actually capturing long run effects or historical conditions, a factor that is likely to influence the estimated coefficients for this variable.

Data on the other variables, viz., value added in agriculture, industry and services as percentage of GDP and per capita income (in constant 2000 dollars and in purchasing power parity terms) are from World Bank (2007).

Country Selection

In constructing the panel dataset, we began with selection of countries on the basis of observations available on the dependent variable, Gini coefficients, from the WIID2c database. At first we only chose observations which adhered most closely to the Atkinson and Brandolini guidelines. That is we only included observations with highest quality rating (of 1) and where population and area coverage spanned the entire population (since we are looking at overall distribution of income, this would naturally be the most appropriate choice). Moreover the income earning unit chosen was the household, while the unit of analysis was the individual (in most cases this is calculated as per capita household income, while in some cases the calculation is based on appropriate equivalence scales). We did not impose any criteria with respect to income or consumption as the underlying concept for gini calculations. This is because we intended to include both developed and developing countries in the sample and in a number of developing countries (especially in Asia and Africa) inequality calculations are based on expenditure, rather than income data. Our strategy was to include dummy variables to control for systematic differences arising due to this. As suggested by Atkinson and Brandolini (2001), this would be better than introducing arbitrary, linear regression based corrections, which may enhance noise in the model by introducing measurement error.

However the first round of filtering yielded very few observations, especially for developing countries. Even major developing countries like India and China were completely left out by this criteria and mainly developed countries were being picked up. So we diluted the criteria by including data with lower quality rating (up to 2), while the other criteria with respect to coverage and unit of analysis remained unchanged.

In constructing a time series dataset for each country we tried to include data from the same source and ginis based on the same underlying concepts with respect to definition of income or consumption and unit of analysis (as per recommendation of WIID 2007). Very few observations were available for the decade of the 1960s and 1970s, so we had to start our analysis from 1980 onwards, as this ensured availability of data on Gini coefficients as well as other explanatory variables for the majority of the countries in our sample. Another consideration was that at least two observations should be available for each country (the minimum required to construct a panel dataset). To allow for maximum number of time series observations per country, in some cases we have included observations, even when the underlying income concepts are slightly different, *e.g.*, for Austria the observations for 1987 and 1994 are based on Monetary disposable income (which underestimates 'in kind' incomes), whereas the rest of the observations from 1995 to 2006 are based on disposable income, which corresponds exactly to the Canberra group recommendations laid down in WIID (2007).

The final list of countries selected include **23** developed countries including, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United

Kingdom, and United States; and **55** developing countries and transition economies including, Bangladesh, Bolivia, Botswana, Brazil, Cambodia, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, Jamaica, Jordan, Korea, Malaysia, Mexico, Nepal, Nicaragua, Nigeria, Panama, Paraguay, Peru, Philippines, Sri Lanka, Thailand, Turkey, Uganda, Venezuela, Vietnam, Albania, Armenia, Belarus, Bulgaria, Czech Republic, Estonia, Hungary, Kyrgyz Republic, Latvia, Lithuania, Macedonia FYR, Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, and Turkmenistan.

In an effort to include more countries in the sample we did not impose a separate time period related criteria. This meant we would not necessarily be having a balanced panel. We did not use over time averages to create a balanced panel as that would smoothen much of the variation in the data, reducing the efficiency of the estimators.

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