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Was Kuznets right?

New evidence on the relationship between structural transformation and inequality

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Abstract: We examine the Kuznets postulate that structural transformation leads to higher inequality using comparable panel data for a large number of developing and developed countries for 1960–2012. Countries are in different stages of structural transformation, being either structurally under-developed, structurally developing or structurally developed. In contrast to the Kuznets hypothesis, we find that the movement of workers to manufacturing unambiguously decreases income inequality, irrespective of the stage of structural transformation that a particular country is in. We also find that the movement of workers into services has a positive impact on inequality across our set of countries at an early stage of structural transformation and a negative effect at a later stage, suggesting that the Kuznets postulate may apply more for services driven structural transformation than manufacturing driven structural transformation. Overall, our findings confirm the positive development effects that structural transformation relating to manufacturing may have in developing countries, not merely through higher growth but by reducing inequality as well. However, for many low-income countries, where the realistic possibility of structural transformation may be the movement of workers from agriculture to services, our findings suggest that inequality may increase with further structural transformation.

Key words: structural transformation, inequality, Kuznets, double dividend, manufacturing,services

JEL classification: O11, O14, P51

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1 Introduction

Structural transformation — the movement of workers from low productivity to high productivity activities and sectors — is an essential feature of rapid and sustained growth. The speed at which structural transformation occurs differentiates successful countries from unsuccessful ones (Kuznets and Murphy 1966). At the same time, since Kuznets' seminal (1955) piece, it is widely believed that structural transformation can lead to higher inequality, at least initially. Therefore, rapid structural transformation may entail a trade-off between growth and inequality, which may be called the developer's dilemma (Sumner 2017). As Kuznets argued, while inequality may increase at the early stages of structural transformation, beyond a certain level of structural transformation, inequality will decrease, giving rise to the famous inverted U-shaped relationship between income and inequality — the so-called Kuznets curve.

Several recent papers have looked at the relationship between structural transformation and economic growth (Duarte and Restuccia 2010, Herrendorf et al. 2014, McMillan et al. 2014, Diao et al. 2017, Haraguchi et al. 2017, Comin et al. 2018).[1] In this paper, we examine the inequality dimension of structural transformation. We re-examine the Kuznets postulate that at the early process of structural transformation, inequality increases as workers move from a sector with low average incomes and lower within-sector inequality — agriculture — to a sector with higher average income and higher within-sector inequality, such as manufacturing. We argue that both from conceptual and empirical standpoints, there are reasons to question the Kuznets view on the relationship between structural transformation and inequality. Firstly, from a conceptual point of view, a closer examination of the assumptions behind the Kuznets process makes clear that it is not obvious that a movement of workers from agriculture to manufacturing necessarily involves an increase in inequality. In contrast, the movement of workers from agriculture to services may have a different implication for inequality, as the assumptions that underlie the Kuznets argument on the positive effect of structural transformation on inequality is more likely to be true for the services driven structural transformation.

Secondly, as we will document later in this paper, in contrast to what was envisaged by Kuznets, for many developing countries, the movement of workers from agriculture even in the early stage of structural transformation has been primarily to services and not to manufacturing. Given that few countries outside of East Asia have seen a typical path of structural transformation that was witnessed originally among the advanced market economies where workers first moved from agriculture to manufacturing and then on to services, it is not clear whether the implications of structural transformation for increasing inequality may be the same for the many different types of structural transformation that we observe in the developing and developed world.

Our historical data from 1960–2012 shows three different stages of structural transformation. Firstly, there are a set of countries where the proportion of workers in agriculture is higher than any other sector for the most recent period for which we have the data; we call this set of countries 'structurally under-developed'. These are mostly low-income countries. Secondly, for a set of countries, mostly in

[1] A separate (and large) literature has looked at the validity of the so-called Kuznets curve- the inverted U shaped relationship between inequality and the level of per capita income — without finding an unambiguous support for the Kuznets curve hypothesis of inequality first increasing and then decreasing with economic development (e.g. Anand and Kanbur 1993a, 1993b; Roine and Waldenström 2015). However, this literature has focused on the growth–inequality relationship, while our interest in this paper is in the structural transformation–inequality relationship. One paper that looks at the effect of structural transformation on inequality is Angeles (2009). However, this paper does not differentiate between manufacturing and services driven structural transformation (by using total non-agricultural employment share as the core explanatory variable), which as we will show in this paper, have very different effects on inequality.

the middle-income category, the proportion of workers in services is higher than that in agriculture, though the share of workers in agriculture still higher than that in manufacturing. We call this set of countries 'structurally developing'. Finally, we have a set of countries, which are a mix of middle and high-income countries, where the share of workers in manufacturing is higher than that in agriculture. We call this set of countries 'structurally developed'.

In this paper, we examine the inequality implications of structural transformation for a range of low, middle and high-income countries from 1960 to 2012, allowing for the heterogeneity of the stages of structural transformation that we observe in the data. We also allow for the possibility that manufacturing driven structural transformation may have very different implications for inequality than services driven inequality. To examine the structural transformation-inequality relationship, we use two high quality data-sets, one for structural transformation and the other for income inequality. The data for structural transformation — that is, the share of workers in agriculture, manufacturing and services — comes from the Groningen Growth and Development Centre (GGDC) database,[2] supplemented by additional data for low income African countries provided by Mensah et al. (2018), which provides consistent annual data on sectoral employment for several low, middle and high countries from the 1950s onwards and the data for inequality comes from the most recent revisions to the World Income Inequality Database (WIID) which provides comparable inequality data over time for a large number of countries.[3]

Using the GGDC and WIID databases and panel data methods, we find that the Kuznets postulate *does not hold true* for manufacturing driven structural transformation. No matter at what stage of structural transformation a county may be in, manufacturing *unambiguously* decreases inequality — the marginal effect of an increase in manufacturing employment share on income inequality (as measured by the Gini) is always negative and statistically significant, at all levels of manufacturing employment share. In contrast, we find that the marginal effect of an increase in the share of workers in services is positive on inequality for structurally developing countries, and negative for structurally developed countries, a process which is more in line with the original Kuznets argument. Given that the bulk of the movement of workers from agriculture are going to services and not to manufacturing in many low-income countries, this suggests that the Kuznets argument holds with greater force in contemporary times, but not in the manner envisaged by Kuznets and other scholars.

The rest of the paper is in six sections. In the next section, we discuss the argument proposed by Kuznets on the relationship between structural transformation and inequality, known in the literature as the Kuznets process. In Section 3, we describe the patterns of structural transformation in our sample of countries. In Section 4, we provide descriptive evidence on the relationship between structural transformation and inequality. In Section 5, we discuss the econometric methodology. We present our results in Section 6. Section 7 concludes.

2 The Kuznets process

In his classic 1955 paper, Kuznets suggested that in the early phase of economic development, inequality will increase. At a later phase of economic development, as governments follow redistributive policies combining progressive taxation with welfare spending, inequality may decrease. The core of Kuznet's argument on the relationship between inequality and development is captured in the following paragraph extracted from his (Kuznet 1955: 7-8) paper:

[2] See https://www.rug.nl/ggdc/productivity/10-sector/.

[3] See https://www.wider.unu.edu/project/wiid-world-income-inequality-database.

> An invariable accompaniment of growth in developed countries is the shift away from agriculture, a process usually referred to as industrialization and urbanization. The income distribution of total population in the simplest model, may therefore be viewed as a combination of the total income distributions of the rural and urban populations. What little we know of the structure of the two component income distributions reveals that a) the average per capita income of the rural population is usually lower than that of the urban; b) inequality in the percentage shares within the distribution for the rural population is somewhat narrower than that in the urban population … Operating with this simple model, what conclusions do we reach? First, all other conditions being equal, the increasing weight of the urban population means an increasing share for the more unequal of the two component distributions. Second, the relative difference in per capita income between the rural and urban populations does not necessarily shift downward in the process of economic growth; indeed, there is some evidence to suggest that it is stable at best, and tends to widen because per capita productivity in urban pursuits increases more rapidly than in agriculture. If this is so, inequality in total income distribution should increase.

The Kuznets process of widening inequality with structural transformation (that is, movement of workers away from agriculture) can be described as composed of two sub-processes: (i) between sector inequality: a movement of the population from a sector characterised **by lower mean income** to a sector characterised by **higher mean income**, and (ii) within sector inequality: the movement of the population from a sector with **low within-sector inequality** to a sector with **higher within-sector inequality**. If both sub-processes work in the same direction — that is, if the movement of workers is from a sector with both a low mean and low variance in incomes to a sector with a higher mean and high variance in incomes, then structural transformation will unambiguously increase inequality. However, if the movement of workers is from a sector with low mean income but higher variance of income to a sector with a higher mean income but lower variance in income, then it is less obvious that inequality will necessarily increase.

Following Anand and Kanbur (1993a), we provide a diagrammatic exposition of the Kuznets process to make clear the contribution of between sector (or group) inequality and within sector (or group) inequality to overall inequality.[4] Let I be the overall measure of inequality in a given country and let x be the share of workers in the non-agricultural sector. For the sake of exposition, let us assume that there is only one non-agricultural sector, so that we do not make a distinction between the manufacturing and services sectors. Let the working population of the country be normalised to one. Define between-sector (or group) inequality as the inequality in the income distribution when a fraction x of the working population receives income u_1 and the remaining fraction, 1-x, receives income u_2 (where between-group inequality is defined as the value of the inequality measure when everyone in the sector receives the mean income of the sector). Following Kuznets, we can assume that the mean income of the non-agricultural sector is higher than that of the agricultural sector, that is, $u1 > u2$.

It is clear from between-group inequality must be zero at both $x=0$ and $x=1$, and must be positive elsewhere — that is, when all workers are either in the agricultural sector or in the non-agricultural

[4] This exposition depends on the assumption that the inequality measures we are considering is decomposable. Among the inequality measures available in the literature, the variance of log income and mean log deviation (which is Theil's second index) has such decomposition properties; see Robinson (1976) and Kanbur (2017).

sector, there can be no between-group inequality. However, in the range where x is higher than 0 but less than 1, inequality will first increase with increasing x, then fall (as captured in Figure 1). This is because with low x, there are more workers in the low- income sector (in our example, agriculture) than in the high-income sector, so that between sector income differences are considerable. However, once a larger proportion of workers are in the high-income sector, between-group inequality starts falling, till it reaches zero when all workers are in the high-income sector.

Now consider the behaviour of within-group inequality. Defining within-group inequality as the difference between overall inequality and between-group inequality, its movement with the increase in x will depend on the assumptions that one makes on within-group inequality in the non-agricultural sector versus the agricultural sector. If one assumes that there is higher within-group inequality in the non-agricultural sector than in the agricultural sector (as seem to be implied by Kuznets), then the within-group inequality component of overall inequality will strictly increase as x increases — that is, within-group inequality will increase with structural transformation (as shown in Figure 1).

The combination of the behaviour of between-group inequality and within-group inequality may lead to the well-known inverted relationship between structural transformation and inequality — in Figure 1, as x increases, there is an unambiguous increase in inequality; however, once a certain x is reached, if the between-group component dominates the within-group component, inequality will start declining.

The Kuznets process as described above does not differentiate between whether the movement of workers from agriculture is to manufacturing or services. Would the effects of manufacturing driven structural transformation be different than that for services driven structural transformation? Consider between group-inequality first. For this component to increase with structural transformation, mean income in the sector absorbing labour from agriculture has to be higher than the mean income prevailing in the agricultural sector. This assumption is likely to hold, no matter whether the labour absorbing sector is manufacturing or services as productivity in the manufacturing or services sector is expected to be higher than in agriculture, at least in the early part of industrialization when agriculture is likely to be characterised by surplus labour (Lewis 1954).[5]

Now consider within-sector inequality. This component of overall inequality may not necessarily increase with manufacturing driven structural transformation for three reasons. Firstly, the historical experience of successful industrialization among what are called the 'late industrialisers' — for example, China, Mauritius, South Korea, Singapore, and Taiwan — indicates that much of the early success in industrialization occurs in labour-intensive manufacturing, which is characterised by low within-sector inequality (Krueger 1980, World Bank 2017). Secondly, manufacturing activity tends to be factory based and in the formal sector (in contrast to the services sector, where a large part of economic activity is in the informal sector), where labour markets are characterised by minimum wages and other labour regulations. This is likely to lead to wage compression, and therefore, relatively low within-sector inequality. Finally, there may be a political channel through which within sector inequality may decrease with manufacturing driven structural transformation as the organised working class is likely to gain political strength over time in countries which witness rapid industrialization. This may lead to democratization that may encourage redistribution (Acemoglu and Robinson 2002).

However, a very different argument may apply to services driven structural transformation. A large of part of the employment created in the services may be self-employment in the poorly paid informal sector (such as household enterprises in the trade, hotels and restaurants sector), which may exist with

[5] Several studies document the much higher productivity of manufacturing and services than agriculture in low-income countries (e.g., Gollin et al. 2014).

well-paid jobs in the formal services sector (such as banking and finance). The lack of an organised working class in the informal services sector also does not allow workers to make demands of their employers for better wages or of the state for redistribution. This suggests that the Kuznets argument, which proposes that the move of workers from agriculture to non-agriculture will exacerbate the within sector component of inequality, is likely to hold more for the services sector than the manufacturing sector.

We illustrate the possibility of the within sector component of inequality falling with a movement of workers from agriculture to manufacturing in Figure 2. Here, the within group inequality component falls with an increase in x. As is clear from the figure, it is not obvious that inequality will necessarily increase at early stages of structural transformation — if the within-group component of inequality dominates the between-group component, inequality will *fall* with an increase in the number of workers in the non-agricultural sector.[6]

3 Stages of structural transformation

In this section, we categorise countries according to the stage of structural transformation that they are in. We describe the data we use in our analysis in the Appendix.

We categorise our countries by the different stages of structural transformation that they are in. A first set of countries are those where agriculture is still the largest sector in terms of the share of employment in the most recent time period available. In our sample, these countries are Burkina Faso, Cameroon, Ethiopia, India, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Tanzania, Uganda and Zambia. These countries are all in sub-Saharan Africa, with only India being the non-African country. We call these countries 'structurally under-developed'. The next set of countries are where more people are employed in the services sector than agriculture, with agriculture being the second largest sector. These countries are Bolivia, Botswana, Brazil, China, Colombia, Costa Rica, Egypt, Ghana, Indonesia, Lesotho, Morocco, Namibia, Philippines, Peru, Philippines, Thailand and South Africa. We call them 'structurally developing countries'. These countries span all three continents — Africa, Asia and Latin America. The final set of countries has more people employed in manufacturing sector than agriculture. These countries in the sample are Argentina, Chile, Hong Kong, Malaysia, Mauritius, Mexico, Singapore, South Korea, Taiwan, and Venezuela, as well as Denmark, France, Italy, Japan, Netherlands, Spain, Sweden, United Kingdom and United States. These countries are either in East Asia or Latin America (with the exception of Mauritius, which is in Africa), and the advanced market economies. We call these countries 'structurally developed'. We provide the list of countries by stage of structural transformation in Table A1.

In Figure 3, we provide the allocation of workers by stage of structural transformation, averaged over the entire period, 1960–2012. The broad sectors we look at are agriculture, manufacturing industry, non-manufacturing industry (mining, utilities, and construction) and services. Agriculture provides under 77 per cent of the employment for structurally underdeveloped countries, just over 43 per cent in structurally developing countries and around 13 per cent in structurally developed countries. For the period 1960–2012, Manufacturing provided an average of 4 per cent of employment in structurally underdeveloped countries, 11 per cent of employment in structurally developing countries and 20 per

[6] It should also be noted that the assumption of low within sector inequality that is being implicitly made of the agricultural sector in the Kuznets process may not be correct in many country contexts in Latin America, South Asia and sub-Sahara Africa, where the land distribution may be concentrated among a few land-owning elites.

cent of employment in structurally developed countries. Finally, services provided an average of 17 per cent of employment in structurally underdeveloped countries, with only under 0.6 per cent being business services. Business services employed 3 per cent on average in structurally developing countries while the total services share was 38 per cent. Services is provided 58 per cent of employment in structurally developed countries and business services' share was 8 per cent.

In Table 1, we provide the same information as in Figure 3, except now we do it by sub- periods. We see the very slow movement of workers in agriculture in structurally underdeveloped countries, from 81 per cent in 1960–79 to 69 per cent in 2000–12. These countries have also seen a slow increase in the share of employment in manufacturing from 4 per cent in 1960–79 to around 6 per cent in 2000–12. In the case of structurally developing countries, average share of employment in services overtakes employment in agriculture only in the period between 2000–12. Nevertheless, these countries have seen rapid decline in the share of employment in agriculture from 55 per cent in 1960–79 to 31 per cent in 2000- 12, as well as an increase in the share of employment in manufacturing from 10 per cent in 1970–79 to around 12 per cent in 2000–12. For structurally developed, the share of employment in agriculture was low to start with at 20 per cent in 1970–79. By the time we reach the period 2000-12, more workers are employed in non-manufacturing industry in these countries than in agriculture, and services at 69 per cent provide the largest employment by far. Here, we observe a fall in the share of employment in manufacturing over time.

A striking feature of structural transformation in our 48 countries is that the movement of employment from agriculture has been mostly to services (Figure 4). For structurally underdeveloped countries, there has been an increase in the movement of workers away from agriculture since the 1990s till the recent period, which is when several of these countries witnessed fairly strong growth (Arndt et al. 2016) (Figure 5). We observe a rapid and sustained movement of workers from agriculture to manufacturing and services in structurally developing countries over the entire period 1960–2012 (Figure 6). Finally, for structurally developed countries, the movement of workers from agriculture is mostly to services, with the movement of workers from agriculture to manufacturing falling over time (Figure 7).

A second striking feature of structural transformation has been that the shift of employment from agriculture to services has been accompanied by falling relative productivity of services to agriculture (Figure 8).[7] In contrast, the relative productivity of manufacturing to agriculture has increased till the 1970s, then showed a decline until 1980s, and is significantly higher than the relative productivity of the services sector since mid-1980s. This suggests that a services driven structural transformation has very different implications for overall productivity growth as compared to a manufacturing driven structural transformation (Herrendorf et al. 2014).[8] We also observe very different patterns of relative productivity movements over time across the three different country groups — consistent with the slow movement of workers from agriculture to manufacturing, manufacturing relative productivity levels are very similar to that of services in structurally underdeveloped countries (Figure 9). In contrast, for structurally developing countries, the relative productivity of manufacturing is significantly higher than that of services (Figure 10). For structurally developed countries, where agricultural productivity levels are high relative to what we observe in structurally underdeveloped and developing countries (see Gollin

[7] We measure sectoral productivity as the ratio of real value added to total employment in the sector. The data is obtained from the GGDC database.

[8] This observation is also supported by the cross-country analysis undertaken by Duarte and Restuccia (2010) who show that productivity catch-up in industry explain about 50 per cent of the gains in aggregate productivity across countries, whereas low productivity in services and the lack of catch-up explain economic stagnation in low-income countries.

et al. 2014), relative productivity differences across sectors become insignificant over time as more workers move out of agriculture (Figure 11).

In the previous section, we argued that one key assumption behind the Kuznets process — that the within-sector component of total inequality will increase at the early stages of structural transformation — may not necessarily hold if the movement of workers from agriculture is to manufacturing. We now provide some suggestive evidence to support our claim that manufacturing in the early stages of structural transformation may not be characterised by high within-sector inequality. To capture within-sector inequality manufacturing, we use the Theil measure of within industry pay inequality as calculated by the University of Texas Inequality Project (UTIP) using industry-specific wage data from the United Nations Industrial Development Organisation (UNIDO)'s industrial statistics database (see Galbraith et al. 2014). We present the relationship between manufacturing employment share and the Theil measure of within industry pay inequality by our country groups in Figure 12. We observe that for structurally developing and developed countries, within sector inequality in manufacturing decreases with increases in the manufacturing employment share (this is not the case for the structurally underdeveloped countries, where we see an U shaped relationship). Particularly for countries where the share of employment in manufacturing has been very high (at over 20 per cent) in certain periods such as Hong Kong, Malaysia, Mauritius and Taiwan, the decreases in within sector inequality can be explained by the fact that much of the increase in employment occurred in the labour-intensive manufacturing sectors (Krueger 1978; Riedel 1988)

What about within sector inequality in services? We do not have data on mean incomes by sub-sector in services to allow us to compute within sector inequality in services. However, using productivity as a proxy for mean incomes at the sub-sectoral level, we find clear differences in relative productivity levels across sub-sectors — the business services sub-sector which comprise finance, banking and information technology, is far more productive than all other services sub-sectors (Figure 13).

Overall, our analysis of the patterns of structural transformation suggests that different countries in Africa, Asia, Europe and North America and Latin America are in very different stages of structural transformation, both in the across-sector movement of workers as well as the behaviour of relative productivities over time at the sectoral level. We next discuss the implications of these different stages of structural transformation for inequality.

4 Patterns of structural transformation and inequality

Data for income inequality are taken from the standardized income inequality dataset (WIID) of the World Institute for Development Economics Research (WIDER). This dataset has been used extensively in the literature (see Ackland et al. 2013 and Roope et al. 2017), and is widely regarded as the most reliable data on inequality for developing (and developed) countries. We use Net Ginis, which measure net per capita income inequality in a country in a given year.

We first look at the overall relationship between manufacturing employment share and inequality, then by country group. In the overall sample as well as by country group, we see a clear negative relationship between manufacturing driven structural transformation and inequality (Figures 14 and 15).

We next look at the relationship between services employment share and inequality, for the overall sample and then by country group (Figures 16 and 17). We do not see a clear relationship in the overall sample, with a lack of precision in the fitted line estimated in the scatter plot. By country group, we seem to see a U-shaped relationship for structurally underdeveloped countries, a positive relationship for structurally developing and a negative relationship for structurally developed countries. Overall, the

scatter plots suggest that there is a negative relationship between manufacturing driven structural transformation and inequality and a lack of a clear relationship between services driven structural transformation and inequality. We now proceed to an econometric analysis of the relationship between structural transformation and inequality. We next discuss the econometric methodology that we will use in the analysis.

5 Methodology

Our paper has two core research questions: a) what are the effects of manufacturing driven structural transformation on income inequality, and do the effects differ by the path of structural transformation a country is in, and b) what are the effects of services driven structural transformation on income inequality, and how are they different from the effects of manufacturing driven structural transformation? To address these two research questions, we estimate the marginal impact of an increase in the shares of employment in manufacturing and services on inequality with the two following equations:

$$Gini_{it} = \beta_1 Manufacturing_{it} + \beta_2 Manufacturing_{it}^2 + \beta_3 Nonmanufacturing_{it} + \beta_4 Services_{it} + \beta_5 Services_{it}^2 + \beta_X X_{it} + \sigma_t + a_i + u_{it} \quad (1)$$

$$\begin{aligned} Gini_{it} = {} & \beta_1 Manufacturing_{it} + \beta_2 Manufacturing_{it}^2 + \beta_3 Developed * Manufacturing_{it} \\ & + \beta_4 Developing * Manufacturing_{it} + \beta_5 Developed * Manufacturing_{it}^2 \\ & + \beta_6 Developing * Manufacturing_{it}^2 + \beta_7 Nonmanufacturing_{it} \\ & + \beta_8 Services_{it} + \beta_9 Services_{it}^2 + \beta_{10} Developed * Services_{it} \\ & + \beta_{11} Developing * Services_{it} + \beta_{12} Developed * Services_{it}^2 \\ & + \beta_{13} Developing * Services_{it}^2 + \beta_{14} Developed_i + \beta_{15} Developing_i + \beta_X X_{it} \\ & + \sigma_t + a_i + u_{it} \end{aligned} \quad (2)$$

Where *i* denotes country, and t denotes period. Manufacturing, non-manufacturing and Services are the employment shares of country i in period t in these sectors.[9] Since we are interested in the marginal impact of manufacturing employment share on inequality, we control for the employment shares of the other sectors. *X* is a vector of other controls, which we discuss below, and σ_t and a_i are period and country dummies.[10]

We measure income inequality using the net per capita gini — that is, the level of income inequality in the country net of taxes and transfers. The net Gini allows us to capture the indirect effect that structural transformation may have on inequality through what we called the political channel — the demand for redistribution that may originate from the organised working class if there is an increase in the share of employment in manufacturing. However, it is not obvious if it should be the preferred

[9] Non-manufacturing comprises of utilities, construction and mining.

[10] Since the Gini coefficient is bounded by zero from below and one from the top, one concern would be that Least Squares may not be an appropriate econometric strategy, given that the dependent variable is censored. However, as Figure S1 in the Supplementary Materials shows, most values of the Gini lie between 0.3 and 0.6, with very few observations approaching zero or one.

measure of inequality over the gross Gini — which captures the direct effect of structural transformation on market inequality. We also use the gross Gini as an alternate dependent variable in our econometric analysis.

In Equation (1), we allow a non-linear effect of manufacturing and services employment shares on inequality — as suggested by the Kuznets postulate that inequality may first increase, then decrease with structural transformation (such a quadratic relationship between employment share and inequality would not be expected for non-manufacturing). In Equation (2), we allow for the effect of manufacturing employment share on inequality to differ by the stage of structural transformation a particular country is in, so we interact the manufacturing employment share with the dummies for whether the country is structurally developing or developed (the residual is if the country is structurally underdeveloped).

With respect to the control variables, we begin with a parsimonious sector of controls — these are per capita income, human capital, trade and government consumption (to capture the size of the government sector). Per capita income may have an independent effect on inequality (by providing more resources for redistribution) over and above through the effect of structural transformation on the level of economic development. Countries with higher levels of human capital are likely to see lower inequality as a higher supply of human capital would lead to lower wage inequality (Castello-Climent and Doménech 2014). At the same time, a larger supply of more educated workers may lead to the growth of more sophisticated service sector activities (such as business services), which may increase inequality. Trade may lower inequality by increasing the demand and wages for abundant low-skilled workers (Goldberg and Pavnik 2007). On the other hand, trade can increase inequality via trade induced technological progress that is biased towards skilled labour and capital (Wood 1994; Feenstra and Hanson 2003). Finally, the larger the size of the government, the lower may be inequality (Dabla-Norris et al. 2015).[11] In further robustness tests, which we discuss in Section S6 in the Supplementary Materials, we also include financial globalization and foreign direct investment as additional controls.

We estimate Equation 1 by panel fixed effects regressions to control for time-invariant country characteristics (such as the country's factor endowments) that may explain both the pattern of structural transformation and inequality.[12] We estimate Equation 2 by random effects first, as it contains time invariant dummy variables for structurally developing and developed countries that need to be estimated. Additionally, we also estimate Equation 2 using fixed effects regressions. Fixed effects regressions do not allow us to identify the impact of time invariant dummy variables on the dependent variable; however, we are able to examine how the impact of the shares of employment in manufacturing and services on income inequality differ amongst the country groups. We also include period dummies to control for common global shocks that may affect structural transformation and inequality.[13] We use five-year averaged data to take into account the infrequent nature of the data on income inequality. We have 389 observations for the 48 countries for the period 1960–2012 in the base model without controls and 364 observations in the augmented model with controls.

[11] Additional information on the control variables and the sources of data can be found in Supplementary Materials S3.

[12] For example, countries with more favourable endowments of unskilled labour may have both larger manufacturing sectors as well as lower inequality (see Wood 2017).

[13] For example, a boom in global commodity prices may lead to a rise in employment in primary commodity sectors coinciding with an increase in inequality as incomes increase in high rent natural resource intensive activities.

6 Results

We present the results of the set of panel regressions that aim to investigate the relationship between the manufacturing and services employment shares and income inequality in Table 2 and the marginal effects of manufacturing and services employment shares on inequality in Table 3.[14] Columns (I) and (II) present the estimates of equation (1) with and without our basic controls. Columns (III) and (IV) present the random effects estimates of equation (2), with and without basic controls, with country groups interacted with manufacturing employment share. Columns (V) and (VI) re-runs the same equation, and in the same sequence, using fixed effects.

We begin with a discussion of the effect of an increase in the share of employment in manufacturing on inequality. The fixed effect estimates in the first and second columns (Columns (I) and (II)) both suggest that an increase in manufacturing employment share decreases income inequality — the coefficient on the manufacturing employment share is negative and significant at 10 per cent level of significance or below. The significance of the squared manufacturing variable in Columns I and II suggests that there is a quadratic Kuznets-type relationship exists between manufacturing and inequality. With respect to other control variables, non-manufacturing, per capita income, human capital and government expenditure have no discernible effect on inequality.[15] Trade has a positive and significant effect on inequality in the RE estimates (Column IV), but not in the FE estimates.

Columns (III) and (IV) display the results of the random effects regressions that aim to distinguish any difference in the marginal impact of manufacturing on inequality between different country groups. We find some evidence of heterogeneity in the effects of manufacturing employment share on inequality by country group, with the effect of manufacturing employment share on inequality being lower in structurally developing and developed countries as compared to structurally underdeveloped countries (though the interaction terms between manufacturing and services employment shares and country group dummies are not statistically significant at the 10 per cent level or below).

We present the marginal effect of manufacturing on inequality derived from Columns (III) and (IV) of Table 2 in Tables 3 and 4 at different levels of manufacturing employment share and by country groups. We find that the effect of manufacturing employment share on inequality is negative and statistically significant, *irrespective* of the level of manufacturing employment share (Table 3). Even when manufacturing employment share is close to the maximum of any period average between country groups (23 per cent), it still has a negative impact on inequality. This is a remarkable finding as it suggests that manufacturing driven structural transformation will *unambiguously* decrease income inequality. Similarly, we find the effect of manufacturing employment share on inequality is negative and statistically significant for all country groups, for the relevant ranges of manufacturing employment share for each country group (Table 4).

We next turn to a discussion of the results on the effects of services driven structural transformation on inequality in Tables 2, 3 and 4. In Table 2, we find that an increase in the share of employment in services unambiguously increases inequality across all specifications — the coefficients on the share of employment in services is positive and statistically significant at the 1 per cent level (Columns I to VI). There is also a clear inverted U-shaped relationship between service employment share and inequality — the quadratic term on services is negative and significant in all specifications. This is also evident

[14] Descriptive statistics are presented in Supplementary Materials, Table S3.

[15] We also added a quadratic term for non-manufacturing as a robustness test, to see if adding the square of non-manufacturing changes the finding on the lack of significance of the coefficient on non-manufacturing employment share. When we do so, neither non-manufacturing employment and its square are statistically significant.

from Table 3, where the share of employment in services initially has a positive and significant effect on inequality, and then has a negative and significant effect, when the share goes past 45 per cent. We also obtain a similar finding when we disaggregate the results by country groups, with services driven structural transformation first increasing inequality, then decreasing it, across all country groups (Table 4).

Overall, our results suggest if the Kuznets postulate were to hold, it does not do so for manufacturing but does so for services. We next undertake a series of tests to see if our results are robust to alternate specifications and estimation methods, which are reported in Supplementary Material S6. We find no change in our main findings.

What may explain the surprising result we get for services driven structural transformation where it increases inequality initially, and then decreases it beyond a certain level of employment share in services? We had noted from Section III that a key growth sector in services as countries move from one stage of structural transformation to another was the business services sub-sector. We had also noted the large productivity difference between this sub-sector and other services sub-sectors. In order to examine whether business services has a different effect on inequality than non-business services, we estimate equations (1) and (2), with the employment shares of business and non-business services entered separately in the same regression. In Table 5, we present the marginal effect of business services on inequality by country group (detailed results are available in Supplementary Material Table S4). In the random effects estimates, we find that the business services significantly increases inequality in the structurally developing countries, while decreasing it for structurally developed countries (with no discernible effect on structurally underdeveloped countries). This is in accord with our intuition that the growth of the business services sub-sector leads to increases in within-sector inequality increases in the services sector as workers in the business services sub-sector (mostly professionals working in banking, finance and information technology) tend to be paid much better than workers in trade, restaurants and hotels, and other services sub-sectors (where a large proportion of employment is in the informal sector in the structurally underdeveloped and developing countries). However, for structurally developed countries, where productivity and income differences within services sub-sectors are not likely to be as high as in the other country groups, between sector inequality starting dominating within-sector inequality in the overall behaviour of inequality as most workers in the economy are now employed in the services sector (leading to the downward movement in the between-group component of inequality, as captured in Figure 1).

7 Conclusions

Structural transformation is at the core of the process of economic development. While a rapid pace of structural transformation can lead to sustained economic growth, it can contribute to growing inequality, as had been suggested by Kuznets. In this paper, we examine whether structural transformation leads to higher inequality. We first document the very different paths of structural transformation that different countries have followed in the past five decades. Countries show different paths of structural transformation, being either structurally under-developed, structurally developing or structurally developed. We then investigate whether these different paths of structural transformation have had differential impacts on inequality, using a panel of developing and developed countries for the period 1960–2012. In contrast to the Kuznets hypothesis, we find that the movement of workers to manufacturing unambiguously *decreases* income inequality, irrespective of the stage of structural transformation that a particular country is in. However, in the case of services driven structural transformation, we find that there is an inverted U-shaped curve between services employment share and inequality, with inequality first increasing with an increase in service employment

share and then decreasing. We also find some evidence of heterogeneity in the impact of services driven structural transformation on inequality, with inequality increasing in structural developing countries and decreasing in structurally developed countries. Thus, our findings suggest that the Kuznets postulate seems to apply more to services than to manufacturing driven structural transformation.

A large literature has previously documented the beneficial effects that manufacturing driven structural transformation can have on the economic development process through its positive effect on sustained economic growth and productive job creation (e.g., Rodrik 2013). In this paper, we establish another mechanism by which manufacturing can be beneficial to development — employment creation in manufacturing can reduce overall inequality as well. This suggests a *double dividend* of manufacturing driven structural transformation — through increased growth and reduced inequality. However, for the vast majority of low-income countries which would fall into the structurally underdeveloped category, there has been considerable debate on whether the prospects for a manufacturing driven structural transformation is likely, given the twin forces of globalization and labour saving technological change (Rodrik 2016; World Bank 2017). For these countries, if the realistic possibility of structural transformation is the movement of workers from agriculture to services, our findings suggest that inequality may increase with further structural transformation.

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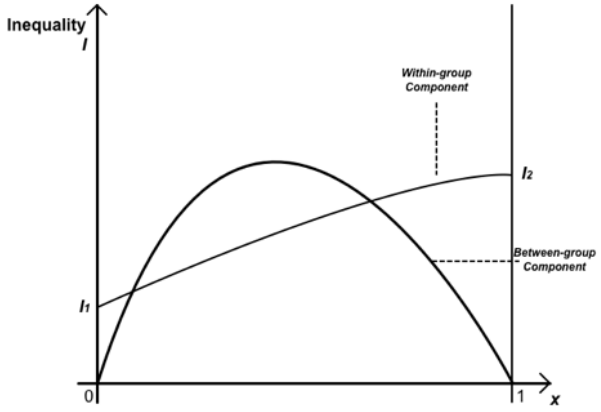
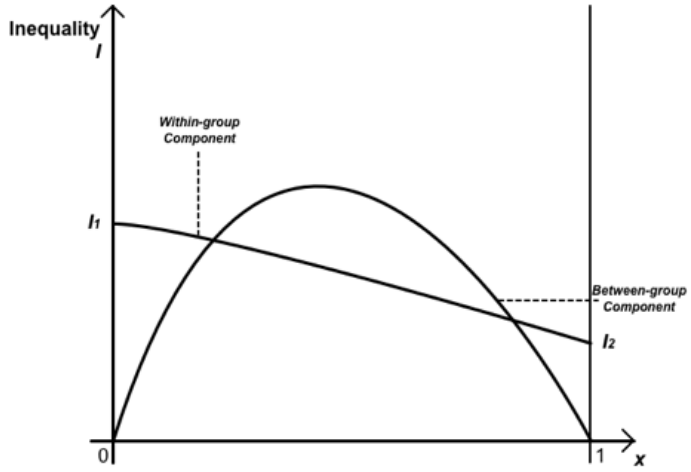
Figures and tables

Figure 1: The Kuznets process



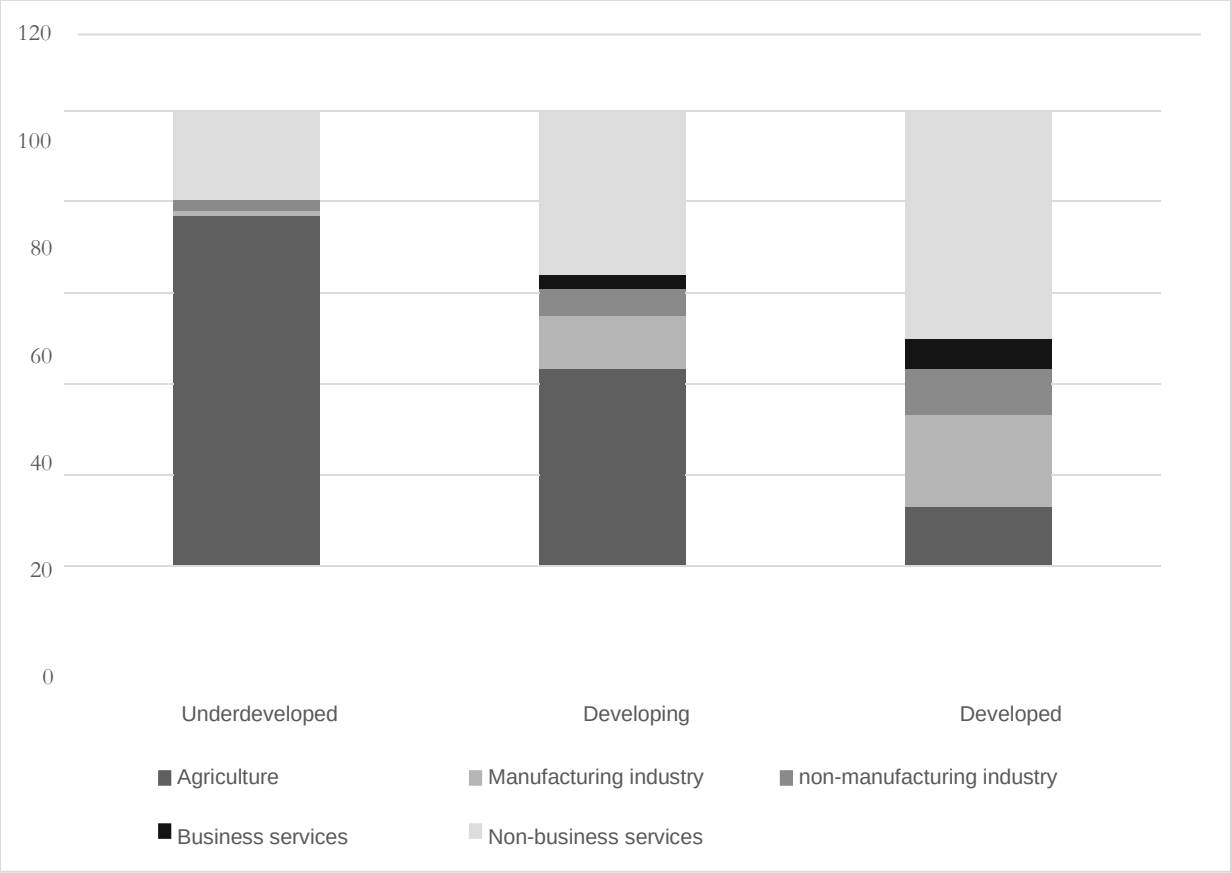
Source: adapted from Anand and Kanbur (1993a).

Figure 2: An alternate view of the Kuznets process



Source: adapted from Anand and Kanbur (1993a).

Figure 3: Share of employment by stages of structural transformation



Note: In percentages of total employment, unweighted averages.

Source: GGDC data and Mensah et al. (2018); authors' calculations.

Figures 4-7: Movement of workers from agriculture to manufacturing and services over time

Figure 4. All countries

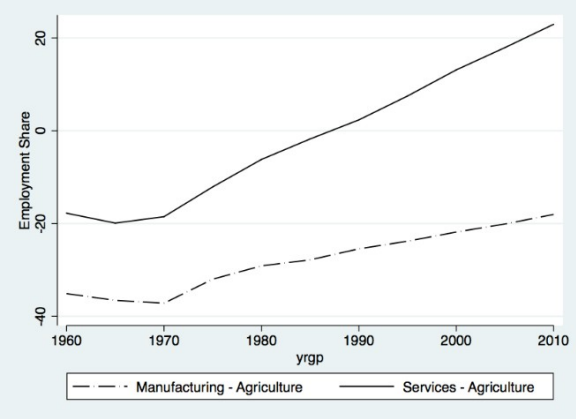


Figure 5. Structurally underdeveloped countries

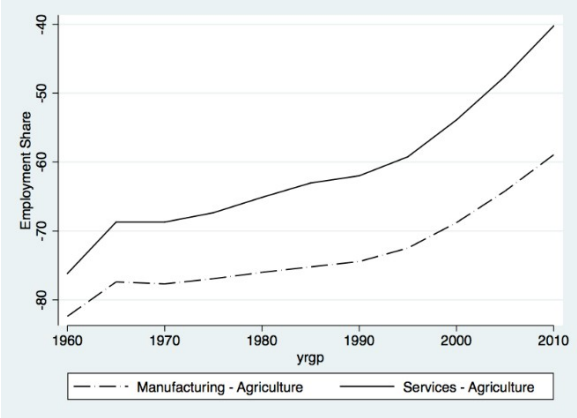


Figure 6: Structurally developing countries

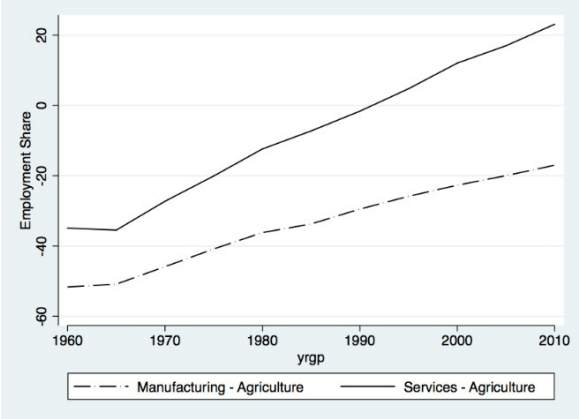
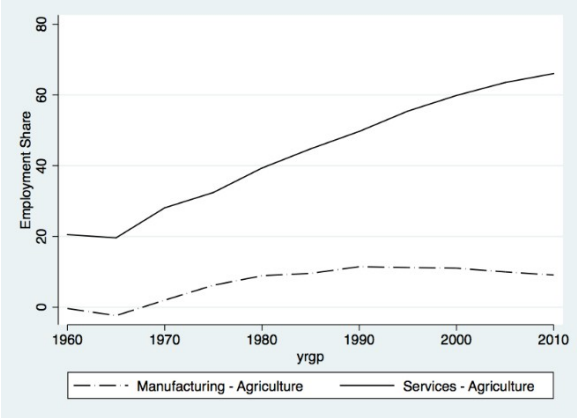


Figure 7. Structurally developed countries



Note: Manufacturing-Agriculture: Employment Share in Manufacturing — Employment Share in Agriculture, Manufacturing-Services: Employment Share in Services — Employment Share in Agriculture; unweighted averages.

Source: GGDC data and Mensah et al. (2018); authors' calculations.

Figures 8-11: relative productivity differentials over time

Figure 8: All countries

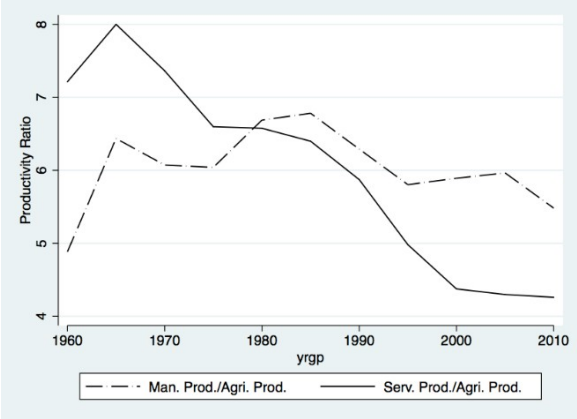


Figure 9: Structurally underdeveloped countries

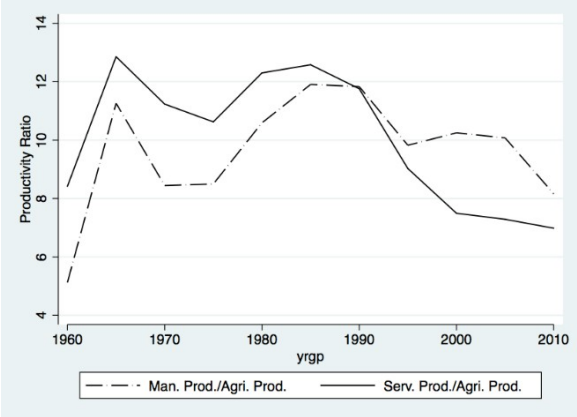


Figure 10: Structurally developing dountries

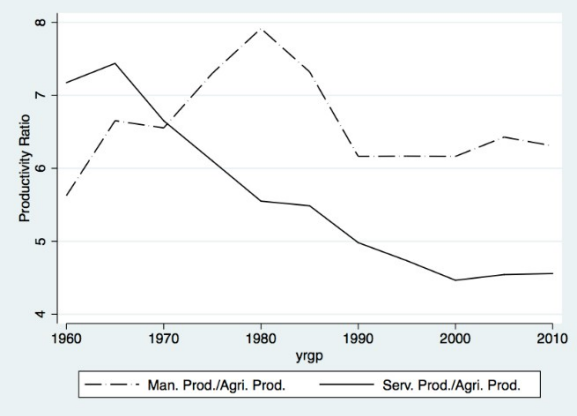
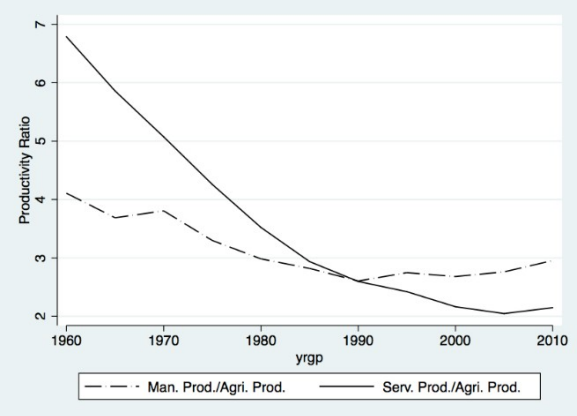


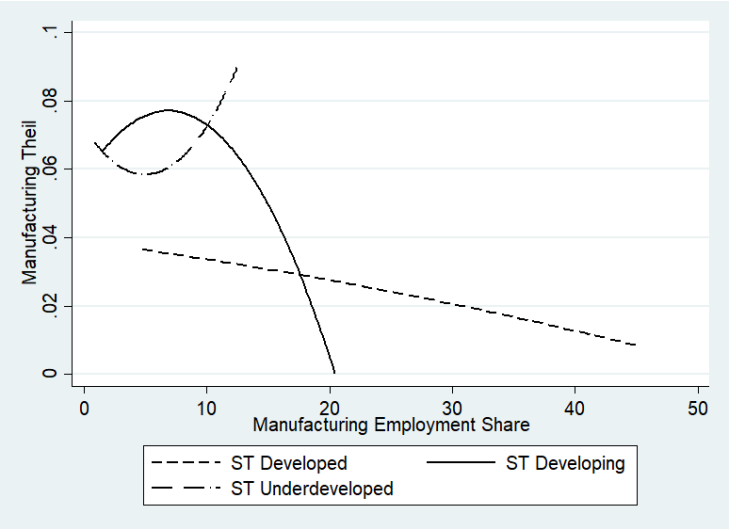
Figure 11: Structurally developed countries



Note: Manufacturing Prod./Agri Prod.: Real Value Added per Worker in Manufacturing as Ratio of Real Value Added per Worker in Agriculture; Services Prod./Agri Prod.: Real Value Added per Worker in Services as Ratio of Real Value Added per Worker in Agriculture; unweighted averages.

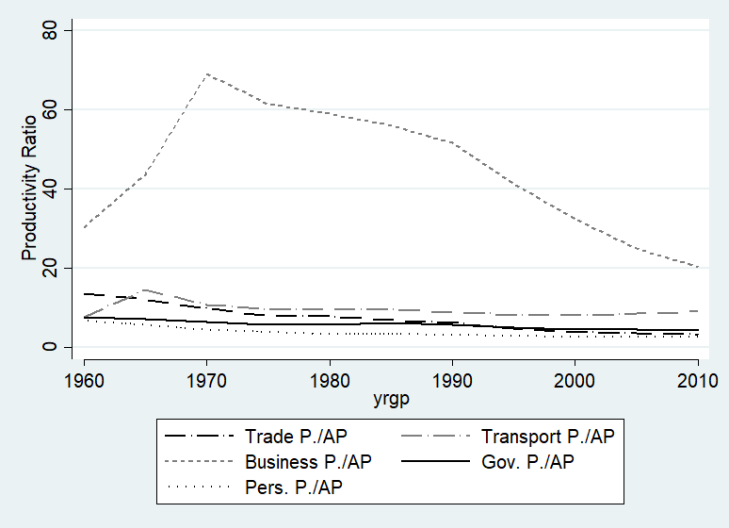
Source: GGDC data and Mensah et al. (2018); authors' calculations.

Figure 12: Structural transformation and within sector inequality in manufacturing



Source: https://utip.lbj.utexas.edu/data.html, authors' calculations.

Figure 13: Relative productivity within services sector over time, all countries



Note: Trade P./AP: Real Value Added per Worker in Trade Services as Ratio of Real Value Added per Worker in Agriculture; Transport P./AP: Real Value Added per Worker in Transport Services as Ratio of Real Value Added per Worker in Agriculture; Business P./AP: Real Value Added per Worker in Business Services as Ratio of Real Value Added per Worker in Agriculture; Govt P./AP: Real Value Added per Worker in Government Services as Ratio of Real Value Added per Worker in Agriculture; Pers. P./AP: Real Value Added per Worker in Personal, Social and Community Services as Ratio of Real Value Added per Worker in Agriculture; unweighted averages.

Source: GGDC data and Mensah et al. (2018); authors' calculations.

Figures 14-15: The relationship between manufacturing employment share and inequality

Figure 14: All countries

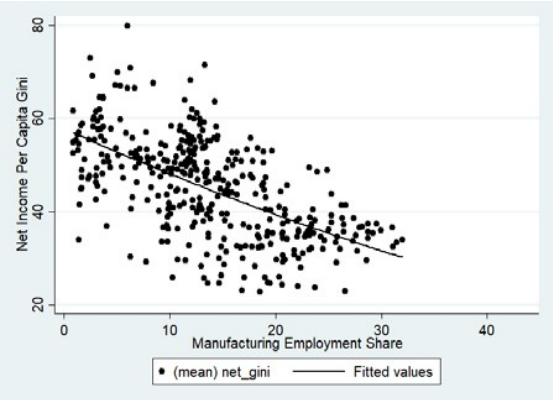
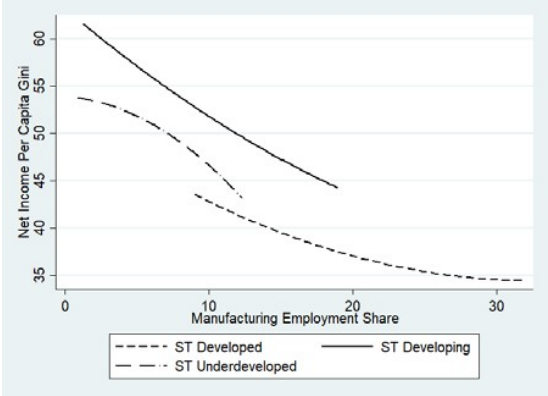


Figure 15: Different paths of structural transformation



Source: GGDC, Mensah et al. (2018) and WIID data; authors' calculations.

Figures 16-17: The relationship between services employment share and inequality

Figure 16: All countries

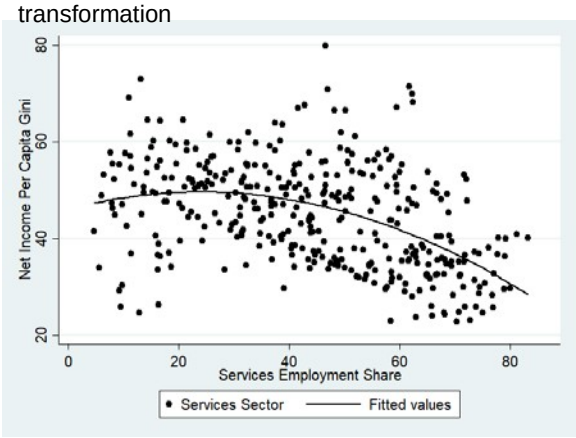
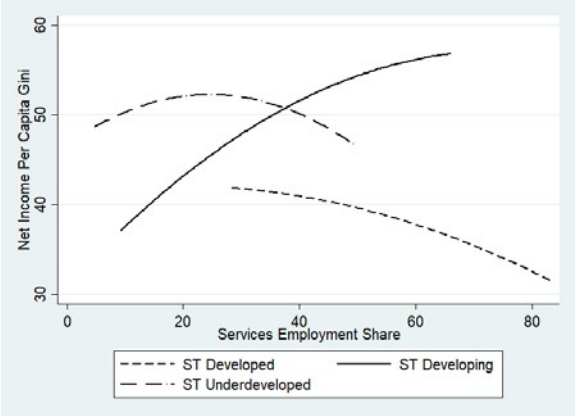


Figure 17: Different paths of structural transformation



Source: GGDC, Mensah et al. (2018) and WIID data; authors' calculations.

Table 1: Share of employment by stages of structural transformation over time

Country Group	Period	Agriculture	Manufacturing industry	Non-manuf. industry	Business services	Non-business services
Underdeveloped	1960–79	81.3	3.8	2.0	0.4	12.5
	1980–99	77.7	3.8	2.0	0.5	15.9
	2000–12	68.8	5.5	3.0	0.8	21.8
Developing	1960–79	55.1	10.0	6.5	2	26.5
	1980–99	41.3	11.3	7.8	3	36.6
	2000–12	31.2	11.5	8.1	5.3	43.9
Developed	1960–79	20.1	22.9	9.4	4.2	43.4
	1980–99	10.5	20.9	8.9	7.7	52
	2000–12	6.2	15.8	9.1	12	57

Note: In percentages of total employment, unweighted averages.

Source: GGDC data and Mensah et al. (2018); authors' calculations.

Table 2: Regression results

	I	II	III	IV	V	VI
	FE I	FE II	RE I	RE II	FE III	FE IV
Manufacturing	-0.745**	-1.051**	-3.451*	-4.064**	-3.853*	-4.545
	(0.323)	(0.456)	(1.784)	(1.965)	(2.176)	(2.963)
Manufacturing^2	0.008	0.012	0.189	0.215*	0.233	0.250
	(0.006)	(0.008)	(0.122)	(0.125)	(0.158)	(0.185)
Non-manufacturing	0.134	0.039	0.185	0.088	0.043	0.005
	(0.363)	(0.348)	(0.261)	(0.264)	(0.324)	(0.351)
Services	0.465	0.669*	0.935*	1.302**	0.822*	1.170*
	(0.292)	(0.339)	(0.518)	(0.624)	(0.557)	(0.845)
Services^2	-0.006**	-0.009**	-0.016**	-0.022**	-0.016	-0.020
	(0.003)	(0.003)	(0.007)	(0.009)	(0.008)	(0.011)
Ln GDP		0.311		1.012		0.330
		(1.667)		(1.447)		(1.702)
Human		1.224		-0.990		-0.002
Capital		(3.655)		(2.044)		(3.560)
Government		0.073		0.028		0.067
Expenditure		(0.055)		(0.048)		(0.053)
Trade		0.011		0.022*		0.013
		(0.020)		(0.011)		(0.021)
Developed			-11.449	-9.886		
			(8.434)	(9.566)		
Developing			-12.153	-7.197		
			(9.437)	(9.805)		
Manufacturing x Developed			1.995	2.222	2.987	3.414
			(1.954)	(2.109)	(2.351)	(3.107)
Manufacturing^2 x Developed			-0.170	-0.191	-0.224*	-0.238
			(0.123)	(0.125)	(0.159)	(0.185)

Manufacturing x Developing			2.520	2.603	3.909	4.331
			(2.052)	(2.264)	(2.588)	(3.333)
Manufacturing^2 x Developing			-0.190	-0.197	-0.260	-0.270
			(0.127)	(0.131)	(0.168)	(0.192)
Services x Developed			0.035	-0.014	-0.231	-0.376
			(0.784)	(0.925)	(0.858)	(1.265)
Services^2 x Developed			0.006	0.007	0.009	0.010
			(0.010)	(0.012)	(0.011)	(0.016)
Services x Developing			0.069	-0.318	-0.080	-0.437
			(0.796)	(0.876)	(0.860)	(1.079)
Services^2 x Developing			0.006	0.012	0.008	0.012
			(0.010)	(0.012)	(0.011)	(0.014)
Number of obs	389	364	389	364	389	364
R-squared (overall)	0.153	0.179	0.612	0.631	0.199	0.216
F	3.838	3.197			5.579	6.211
Wald chi^2			363.830	481.440		

Source: authors' estimates.

Table 3: Marginal effect of manufacturing and services employment share in FE II FE II — marginal effects of manufacturing FE II — marginal effects of services

Share of manufacturing, %	Dy/dx	Share of services, %	Dy/dx
1	-1.03**	15	0.39
5	-0.93**	25	0.21
10	-0.81**	35	0.003
15	-0.69***	45	-0.15
20	-0.57***	55	-0.34***
25	-0.45***	65	-0.52***
		75	-0.70***

Note: *, **, ***, indicate significance at 10%, 5%, 1% levels respectively.

Source: authors' estimates.

Table 4: Marginal effects by country groups in RE II

RE II Marginal effects of manufacturing RE II Marginal effects of services

Manuf. share, %	Underdev.	Developing	Developed	Services share, %	Underdev.	Developing	Developed
1	-3.63**	-1.42	-1.79**	15	0.66*	0.69*	0.85*
5	-1.91**	-1.28	-1.60**	25	0.23	0.50*	0.57*
10	0.24	-1.1***	-1.36**	35	-0.21***	0.31*	0.28
15	2.39	-0.92**	-1.12**	45	-0.64***	0.12	-0.01
20	4.55	-0.74	-0.88***	55	-1.07***	-0.08	-0.30**
25	6.71	-0.56	-0.64***	65	-1.50***	-0.27	-0.59**
				75	-1.93***	-0.46	-0.87**

Note: *, **, ***, indicate significance at 10%, 5%, 1% levels respectively.

Source: authors' estimates.

Table 5: Marginal effect of business services employment share

Random Effects		Fixed Effects Estimates	
Country Group	Dy/dx	Country Group	Dy/dx
Underdeveloped	3.90	Underdeveloped	2.74
Developing	0.81*	Developing	0.20
Developed	-0.67**	Developed	-0.72

Note: *, **, ***, indicate significance at 10%, 5%, 1% levels respectivelyin joint F-tests.

Source: authors' estimates.

Appendix

Data:

The data on structural transformation comes from the GGDC database of the University of Groningen (Timmer et al. 2015), with additional data from Mensah et al. (2018). The GGDC data is now widely used in the recent literature on structural transformation (see Diao et al. 2017 and Comin et al. 2018). There are 40 countries in the GGDC database, which includes annual disaggregated data on real value added and employment by sector from 1960 onwards to 2010 in most cases, with data available for a few countries till 2012. For our purpose, the GGDC data provides data on manufacturing industry and non-manufacturing industry (construction, mining and utilities) separately, as well as disaggregated data on services by type of sector (business services, government services, trade, hotels and restaurants, and so on). Table S1 in the Supplementary Material provides details of the ten sectors in the GGDC data. Employment is defined as 'all persons employed', including all paid employees, as well as self-employed and family workers.

The GGDC dataset has twelve African countries (including North Africa), nine Latin American countries, eleven Asian countries (including Japan) and the rest from Europe, and the United States.[16] We supplement the data on African countries with that provided by Mensah et al. (2018), who use the identical methodology as in GGDC data for eight more low and low- middle income sub-Saharan African countries.[17] Together, these two sources of sectoral employment cover 80 per cent of Africa's GDP.

A key strength of the employment data is that the source of the data is the population census, which ensures full coverage of the working population as well as a precise sectoral breakdown. The population census which tends to be quinquennial or decennial in most countries is supplemented by the labour force surveys and the business surveys to derive annual trends. The use of the population census also ensures that informal employment, which is important in many low and middle-income countries, is captured in the GGDC data. A feature of the data is the careful attention paid to intertemporal, international and internal consistency (Timmer and Vries 2009, Diao et al. 2017). This differentiates the quality of the data from other sources of employment data, such as the International Labour Organisation's ILOSTAT, which compiles data directly obtained from country sources without the consistency checks undertaken by GGDC (see Section S2 in Supplementary Materials).

[16] These countries are Botswana, Ethiopia, Ghana, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania, Zambia, Egypt and Morocco in Africa, China, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan, and Thailand in Asia, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Venezuela in Latin America, Denmark, Spain, France, Italy, Netherlands, Sweden and United Kingdom in Europe and the United States.

[17] These countries are Burkina Faso, Cameroon, Kenya, Lesotho, Mozambique, Namibia, Rwanda and Uganda.

Table A1. Stages of structural transformation

Structurally underdeveloped (13 countries)	Structurally developing (16 countries)	Structurally developed (19 countries)
Burkina Faso	Bolivia	Argentina
Cameroon	Brazil	Chile
Ethiopia	Botswana	Denmark
India	China	France
Kenya	Colombia	Hong Kong
Malawi	Costa Rica	Italy
Mozambique	Egypt	Japan
Nigeria	Ghana	Malaysia
Rwanda	Indonesia	Mauritius
Senegal	Lesotho	Mexico
Tanzania	Morocco	Netherlands
Uganda	Namibia	Singapore
Zambia	Peru	South Korea
	Philippines	Spain Sweden
	Thailand	Taiwan
	South Africa	United Kingdom
		United States
		Venezuela

Note: Structurally underdeveloped: share of employment in agriculture higher than in manufacturing or services; structurally developing: share of employment in services higher than in agriculture; structurally developed: share of employment in manufacturing higher than in agriculture.

Source: authors' estimates.

Supplementary material for 'Was Kuznets Right? New Evidence on the Relationship between Structural Transformation and Inequality'

S1: Description of data

Structural Transformation: Groningen Growth and Development Centre's (GGDC) 10-Sector Database provides annual employment data in 10 different sectors for 41 countries. Time spans for available data vary between countries, however most countries in the database have observations going as far back as 1960, and up to 2012. The 10 sectors, with their ISIC Revision 3.1 codes and definitions are:

Table S1: Description of sectors

ISIC 3.1 code	Sector Name	Description
AtB	Agriculture	Agriculture, Hunting and Forestry, Fishing
C	Mining	Mining and Quarrying
D	Manufacturing	Manufacturing
E	Utilities	Electricity, Gas and Water supply
F	Construction	Construction
G+H	Trade services	Wholesale and Retail trade; repair of motor vehicles, motorcycles and personal and household goods, Hotels and Restaurants
I	Transport services	Transport, Storage and Communications
J+K	Business services	Financial Intermediation, Renting and Business Activities (excluding owner occupied rents)
L,M,N	Government services	Public Administration and Defence, Education, Health and Social work
O,P	Personal services	Other Community, Social and Personal service activities, Activities of Private Households

Source: GGDC website.

Agriculture is the primary sector. The secondary industry sector can be divided into two groups: Manufacturing and non-manufacturing industry, which comprises of mining, utilities and construction. The tertiary services sector consists of trade, transport, business, government and personal services. The ISIC classification of manufacturing includes primary processed products, and employment in each category is defined as all persons engaged in labour, and hence encompasses self-employed and family workers both in formal and informal sectors.

S2: Alternate sources of employment data

There are two additional sources for data, apart from the GGDC database, on sectoral employment at the country level. The first is World Bank's World Development Indicators (WDI), which covers more countries than the GGDC. However, the WDI only reports total share of labour in agriculture, industry and services. The industry sector consists of mining, construction, public utilities and manufacturing, while the services sector consists of wholesale and retail trade and restaurants and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services. The WDI dataset does not break down industry employment data by manufacturing and non-manufacturing (mining, construction, utilities) and services employment by sub-sectors. The aim of our analysis is to

examine the impact of manufacturing as well as service sub-sectors on inequality. Since WDI does not offer information on sub-sectoral allocations of employment, we are unable to use the data they provide.

A second source of employment data is the International Labour Organisation's ILOSTAT database. ILOSTAT provides detailed information on the number of people working in each sector for majority of the countries since 1950s. The data is based mostly on labour force surveys and supplemented by censuses and other minor sources. However, even though ILOSTAT offers the largest sample size and time scale, comparability of this dataset is limited as concept definitions and population coverage differ between countries and over time. The frequency of the data collected also varies between countries and disregard all impacts of seasonality on the labour force. For these reasons, the GGDC 10-sector dataset is our preferred data source.

S3: Control variables

Economic Development: the natural logarithmic values of output-side gross domestic product (GDP) per capita at chained PPPs in 2011 US$ taken from the Penn World Table 9.0 are used to proxy economic development of countries.

Human capital: human capital index, based on years of schooling and returns to education is Dollars taken from the Penn World Table 9.0.

Government expenditure: government expenditure is the share of government consumption at current PPPs. Data is taken from the Penn World Table 9.0.

Trade: exports + imports as a ratio of GDP; data taken from the World Development Indicators.

Financial openness: Chinn-Ito index that measures the extent of de jure openness in capital account transactions. The value of the index goes from 0 (very closed) to 1(very open). Source: Chinn-Ito (2006).

Foreign direct investment (FDI): inward FDI as a ratio of GDP. Data is taken from the World Development Indicators.

S4: Fixed estimates of equation (2)

We present joint coefficients and significance by country groups in Table S2 when we estimate equation (2) using fixed effects. The results here are somewhat weaker than the random effects estimates, though we still obtain the finding that manufacturing driven structural transformation decreases inequality in structurally underdeveloped and developed country groups (the caveat here is that we are not able to control for invariant country group characteristics, so the results should be treated with caution).

Table S2: Joint coefficients and significance by country groups in FE IV

	Underdeveloped	Developing	Developed
Manufacturing	-4.545	-0.214	-1.131
Manufacturing2	0.250	-0.020	0.012
Services	1.170*	0.733	0.794
Services2	-0.020	-0.008**	-0.010*

Note: *, **, *** significance in 10, 5, 1% respectively in joint F-test.

Source: authors' estimates.

S5: Descriptive statistics

Table S3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min.	Max
Gini	389	44.51	10.74	22.69	79.81
Manufacturing	389	14.32	7.84	0.91	44.09
Non-manufacturing	389	7.15	3.32	0.32	15.95
Business dervices	389	5.03	4.32	0.03	20.74
Non-business services	389	39.50	15.63	4.28	69.11
Services (Total)	389	44.53	19.43	4.76	87.51
Trade	364	65.13	63.17	5.46	422.39
Government consumption	389	17.19	8.40	4.41	63.49
Human capital	389	2.16	0.65	1.03	3.70
Ln GDP	389	8.75	1.14	6.21	10.93
Financial openness	343	0.48	0.35	0	1
FDI	325	2.63	4.23	-1,67	39.02

Source: authors' estimates.

Table S4. Business and non-business services: detailed results

	I	II
	FE	RE
Business Services	2.740	3.899
	(3.094)	(2.482)
Non-business Services	-0.107	0.010
	(0.165)	(0.127)
Manufacturing	-0.475	-1.014***
	(0.401)	(0.309)
$Manufacturing^2$	0.003	0.013**
	(0.007)	(0.006)
Non-manufacturing	0.309	0.571**
	(0.293)	(0.254)
Ln GDP	0.790	1.080
	(2.060)	(1.703)
Human	-0.125	-1.370
Capital	(4.067)	(2.266)
Government	0.072	0.053
Expenditure	(0.065)	(0.054)
Trade	0.012	0.019**
	(0.016)	(0.008)
Developed		5.603
		(8.015)
Developing		1.453
		(8.256)

Business x Developed	-3.456	-4.568*
	(3.117)	(2.522)
Business x Developing	-2.538	-3.092
	(3.071)	(2.573)
Non-business x Developed	-0.037	-0.120
	(0.180)	(0.168)
Non-business x Developing	0.023	-0.022
	(0.248)	(0.247)
Number of obs	364	364
R-squared (overall)	0.51	0.61
F	4.494	
Wald chi2		470.61

Source: authors' estimates.

S6: Robustness tests

We undertake a series of tests to see if our results are robust to alternate specifications and estimation methods. First, we re-estimate equation (2) using the Mundlak (1978) approach, which involves including as additional explanatory variables the means of all time varying variables. Unlike the RE estimation method, the Mundlak approach allows for the possibility of correlation between the explanatory variables and the error term. However, unlike the FE method, the addition of the means of time-varying variables allows us to control for time- invariant unobserved heterogeneity. We present the results in Table S5 (Column I presents the results without controls and Column II presents the results with controls). We find that the quadratic relationships between inequality and manufacturing employment share and between inequality and services employment share that we observed in the FE and RE estimates are also evident in the Mundlak estimates. As before, an increase in the manufacturing employment share first decreases inequality, then after a certain level, decreases inequality. An increase in the services employment share first increases inequality, then decreases inequality. All the coefficient estimates on manufacturing and services employment shares and their squares are statistically significant at the 1 per cent level. Interestingly, several of the interaction terms between ST country group and manufacturing and services employment shares and their squares are statistically significant, indicated considerable heterogeneity in the relationship between manufacturing and services driven structural transformation on one hand and inequality on the other.[18]

We next include two more controls — financial globalization and foreign direct investment (FDI) — which may also affect inequality. Financial globalization can lead to a concentration of financial assets and liabilities in the high technology sectors, leading to increased demand and wages of high skilled workers relative to low skilled workers (Jaumotte et al. 2013; Dabla-Norris et al. 2015).[19] Foreign direct investment can lead to skill biased technological change, exacerbating wage inequality (Tsai 1995). We present the FE and RE estimates in Columns I and II of Table S6. We

[18] We also use Gross Gini instead of Net Gini as the dependent variable, and find no change in our findings — that manufacturing driven structural transformation unambiguously decreases inequality, and services driven structural transformation first increases, then decreases inequality

[19] We measure financial globalization using the widely used Chinn-Ito (2006) measure of de jure financial openness.

find that the sign of the coefficients on our key explanatory variables are the same as in Table 3, and remain statistically significant in the RE estimates for manufacturing employment share.[20]

We also account for the possibility of reverse causality in our estimates. It is plausible that a higher level of inequality leads to a smaller home market for manufacturing goods and high end services, and consequently, contribute to a lower level of manufacturing and services driven structural transformation. Such a mechanism, if it were to exist, would hold more in closed economies — in open economies, the size of the home market would not be a constraint to the expansion of the manufacturing and tradable services sectors via greater exports. To test for the possibility of reverse causality, we limit our sample to cases where trade as a ratio of GDP is less than 50 per cent (which is median value of trade/GDP in our sample). We present the FE and RE estimates in Columns III and IV of Table S6. We find that the signs of our key explanatory variables — manufacturing and services employment shares and their squares — are the same as their counterpart estimates in Table 3, and the coefficients on the key explanatory variables are statistically significant at 10 per cent or below. Therefore, our main findings remain robust to concerns of reverse causality (with the caveat that we are not able to directly address endogeneity in the absence of a credible set of instruments for manufacturing and services employment shares).[21]

We did two further robustness tests to see if our results are sensitive to alternate ways of classifying groups of countries. First, we estimated the marginal effects, separately for OECD and non-OECD countries. Second, we estimated the marginal effects, by low-, middle- and high-income countries (as in 2012). With respect to manufacturing driven structural transformation, we find that while its effect on inequality is negative for both OECD and non-OECD countries across all levels of manufacturing employment share, the marginal effects are significant (at the 1 per cent level) only for non-OECD countries. For services-driven structural transformation, while its effect on inequality is first positive and then negative for both OECD and non-OECD countries, the marginal effects are positive and significant at lower levels of service employment share only for non-OECD countries (but negative and significant for both OECD and non-OECD countries at higher levels of service employment share). Therefore, we obtain similar findings when we disaggregate the sample by income status, with the negative and positive effects of manufacturing and service employment shares on inequality particularly evident for low- and middle-income countries.

Table S5: Mundlak estimates

	I	II
Manufacturing	-4.36***	-4.92***
	(1.30)	(1.68)
Manufacturing^2	0.27***	0.28***
	(0.09)	(0.11)

[20] It should be noted that adding these two controls leads to a reduction in sample size from 364 observations in the model with full controls in Table 3 of the main paper to 313 observations, which may explain the lack of statistical significance of our main explanatory variables in the FE estimates. Further, there are other variables that are used in the literature to capture skill biased technological change such as R&D expenditures and information and capital technology (ICT) capital as a ration of total capital stock. However, data on the latter two variables are not available for most developing countries prior to the mid 1990s. Including these measures of technological change leads to an unacceptable reduction in sample size by more than half to around 170 observations.

[21] It should be noted that to implement an instrumental variable approach, we would need a minimum of four instruments, given that we have four explanatory variables — manufacturing and services employment shares and their squares — that we would have to instrument for.

Non-manufacturing	0.05	-0.01
	(0.19)	(0.23)
Services	0.97***	1.31***
	(0.35)	(0.44)
Sevices^2	-0.02***	-0.02***
	(0.01)	(0.01)
Ln GDP		-0.54
		(1.10)
Human Capital		3.51
		(2.83)
Government Expenditure		0.02
		(0.05)
Trade		0.01
		(0.02)
Developed	46.27	9.78
	(53.38)	(56.14)
Developing	29.64	24.33
	(21.01)	(24.02)
Manufacturing x Developed	3.72***	4.01**
	(1.39)	(1.75)
Manufacturing^2 x Developed	-0.26***	-0.27**
	(0.09)	(0.11)
Manufacturing x Developing	4.71***	4.82**
	(1.53)	(1.86)
Manufacturing^2 x Developing	-0.31***	-0.31***
	(0.10)	(0.11)
Services x Developed	-0.60	-0.82
	(0.58)	(0.70)
Services^2 x Developed	0.01*	0.02*
	(0.01)	(0.01)
Services x Developing	-0.26	-0.57
	(0.43)	(0.51)
Services^2 x Developing	0.01	0.02*
	(0.01)	(0.01)
Number of obs	389	364
R-squared (overall)	0.72	0.75
Wald chi2	206	233.66

Source: authors' estimates.

Table S6: Further robustness tests

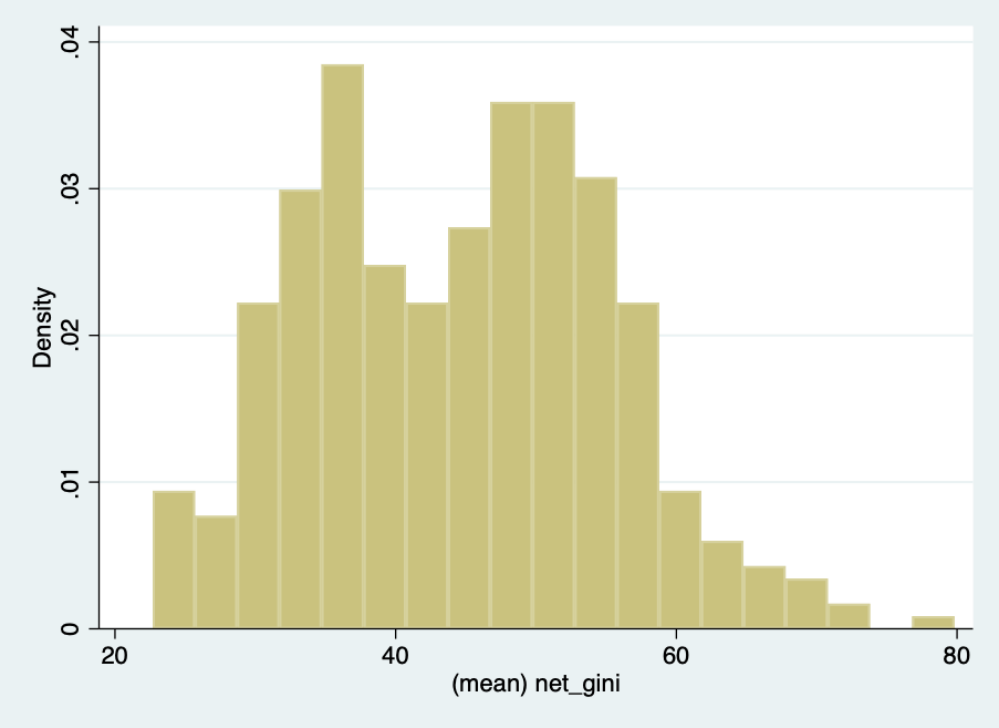
	Including financial globalization and FDI as controls		Restricting sample to cases where trade/GDP is less than 50%	
	I	II	III	IV
	FE	RE	FE	RE
Manufacturing	-1.494**	-3.635*	-1.376**	-6.961***
	(0.533)	(1.754)	(0.738)	(1.749)
$Manufacturing^2$	0.023**	0.189*	0.013*	0.342***
	(0.012)	(0.109)	(0.014)	(0.099)
Non-manufacturing	-0.577	-0.187	-0.085	0.468
	(0.414)	(0.249)	(0.441)	(0.411)
Services	0.704*	1.353**	0.682**	2.444**
	(0.361)	(0.602)	(0.319)	(0.411)
$Sevices^2$	-0.011**	- 0.022**	-0.013***	-0.041***
	(0.003)	(0.009)	(0.004)	(0.010)
Ln GDP	0.190	1.532	0.827	0.592
	(2.054)	(1.564)	(2.347)	(1.779)
Human Capital	2.395	-1.164	-2.679	-1.527
	(3.650)	(1.564)	(4.501)	(3.174)
Government Expenditure	0.093	-0.001	0.135	0.134
	(0.061)	(0.051)	(0.093)	(0.090)
Trade	-0.012	0.028**	0.221***	0.079
	(0.021)	(0.001)	(0.071)	(0.074)
Financial Openness	0.365	-1.445	--	--
	(1.433)	(0.077)		
Foreign Direct Investment	-0.090	-0..084	--	--
	(0.084)	(0.077)		
Developed	-	5.006	-	2.817
	--	(10.087)	--	(13.011)
Developing		1.636		7.169
		(11.745)		(9.224)
Manufacturing x Developed	--	0.738	--	5.171*
		(1.944)		(2.590)
$Manufacturing^2$ x Developed	---	-0.149	---	-0.322**
		(0.110)		(0.105)
Manufacturing x Developing	--	1.916	--	3.739*
		(11.749)		(2.216)
$Manufacturing^2$ x Developing	--	-0.171	--	-0.227**
		(0.119)		(0.112)
Services x Developed	--	0.176	--	-1.451
		(0.894)		(1.330)
$Services^2$ x Developed	--	0.004	--	0.029*
		(0.011)		(0.016)
Services x Developing	--	-0.644	--	-1.438*
		(0.871)		(0.742)

Services ^{2} x Developing	--	0.169	--	0.028**
		(0.011)		(0.011)
Number of obs	313	313	171	171
R-squared (overall)	0.418	0.688	0.277	0.478
F	4.38		40.53	
Wald chi2		316.59		6552.55

Note: *, **, ***, indicate significance at 10%, 5%, 1% levels respectively. Standard errors in parentheses. FE: Fixed Effects, RE: Random Effects.

Source: authors' estimates.

Figure S1: Histogram of net Gini



Source: authors' estimates based on WIID data.