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Miguel Niño-Zarazúa,<sup>1</sup> Laurence Roope,<sup>2</sup> and Finn Tarp<sup>1</sup>

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**Keywords:** global interpersonal inequality, inequality, inequality measurement

**JEL classification:** D31, D63, E01, O15

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# Global interpersonal inequality

## Trends and measurement\*

Miguel Niño-Zarazúa<sup>†</sup>, Laurence Roope<sup>‡</sup> and Finn Tarp<sup>§</sup>

### ABSTRACT

This paper discusses different approaches to the measurement of global interpersonal inequality. Trends in global interpersonal inequality during 1975-2005 are measured using data from UNU-WIDER's World Income Inequality Database. In order to better understand the trends, global interpersonal inequality is decomposed into within-country and between-country inequality. The paper illustrates that the relationship between global interpersonal inequality and these constituent components is a complex one. In particular, we demonstrate that the changes in China's and India's income distributions over the past 30 years have simultaneously caused inequality to rise domestically in those countries, while tending to reduce global interpersonal inequality. In light of these findings, we reflect on the meaning and policy relevance of global vis-à-vis domestic inequality measures.

Keywords: global interpersonal inequality, inequality, inequality measurement

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## 1 Introduction

Since the turn of the century, income inequality has become one of the most prominent political issues of our time. The World Economic Forum's Global Risks 2013 report identified 'global income disparity' as the global risk most likely to manifest itself over the next ten years. Issues of taxation and redistribution were central to the debate in the 2012 US presidential elections and in a number of recent general elections in Europe. There has also been significant interest in the economic literature in the level of, and trends in, various concepts of global inequality. The earliest of these papers were predominantly focused on either 'within-country' inequality, as in Cornia and Kiiski (2001) or 'between-country' inequality (see, for example, Boltho and Toniolo 1999; Firebaugh 1999, 2003; Melchior, Telle and Wiig 2000). Much of the impetus for these studies came from concerns as to what impact the recent era of globalization may

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have had on inequality (see, for example, Richardson 1995; Wood 1995 and Williamson 1999, and also UNDP 1999, which explicitly called for policies to mitigate rising inequality caused by economic globalization).

To quote Milanovic (2002:52), a direct implication of globalization is ‘that national borders are becoming less important, and that every individual may, in theory, be regarded simply as a citizen of the world’. The literature on global inequality trends began to focus on estimating levels of ‘global interpersonal inequality.’ In this approach, the global distribution of income of all the citizens of the world is constructed from national accounts and/or survey data.<sup>1</sup> Inequality is subsequently measured, based on this global interpersonal distribution of income. Notable contributions in this area have been made by Korzeniewicz and Moran (1997); Chotikapanich, Valenzuela and Rao (1997); Schultz (1998); Milanovic (2002, 2005); Bourguignon and Morrisson (2002); Dickhavoc and Ward (2002); Bhalla (2002); Dowrick and Akmal (2005); Sala-i-Martin (2006); and Atkinson and Brandolini (2010). See also Anand and Segal (2008) for a critical review of this strand of literature.

This study adds to the body of literature on trends in global interpersonal inequality which, for convenience, we will refer to hereafter simply as ‘global inequality.’ Most of the aforementioned studies consider trends in global inequality only up to the mid 1990s, and none beyond the year 2000. In this paper, using the most recent version of UNU-WIDER’s World Income Inequality Database (WIID), we estimate global inequality levels, and their within-country and between-country components, at ten-year intervals, between 1975 and 2005.

Having more recent estimates of global inequality levels is clearly valuable in its own right. However, the years following 2000 are of particular interest for a study on global inequality trends. This was the period immediately leading up to the global financial crisis. A number of studies argued that high levels of inequality were part of the cause of the financial crisis, and of financial crises generally. Stiglitz (2012), for example, has discussed a ‘...two-way relationship between inequality and economic fluctuations...’ and found that ‘Inequality can contribute to volatility and the creation of crises, and volatility can contribute to inequality.’ Berg and Ostry (2011) found that longer spells of growth are robustly associated with more equal income distributions. In the context of the sub-prime mortgage crisis, which precipitated the global financial crisis, Rajan (2010:43), argues that ‘growing income inequality in the United States...led to political pressure for more housing credit. This pressure created a serious fault line that distorted lending in the financial sector.’

Not all economists are of the same view. Acemoglu (2011), for example, argues that it is more plausible that the financial crisis and high levels of inequality, especially at the top-end of the income distribution, were common outcomes arising from lack of regulation of financial practices. Bordo and Meissner (2012) provide another dissenting view, arguing that credit booms heighten the probability of a banking crisis but finding no evidence that increased inequality leads to credit booms. Atkinson and Morelli (2011), in a long-run empirical investigation on both the impact of economic crises on inequality and of the impact of inequality on the probability of crises, obtain inconclusive results. It is not our intention to weigh into these controversies in this paper. Suffice to say that better knowledge of global inequality levels and trends in the

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<sup>1</sup>Actually some studies have focused on income and others on consumption. We use the term ‘income’ loosely for now but will discuss some of the issues arising from the important distinction between the two in Section 3.

run up to the crisis is invaluable for any research as to what, if any, role inequality may have played in causing the crisis.

As indicated above, analyzing the impact of the financial crisis on subsequent inequality is another active area of research. Given the global nature of the crisis, research into its impact on *global* inequality might be regarded to be an important aspect of such research. Knowledge of pre- and post-crisis global inequality levels is clearly an essential requirement for studies of this kind too.

A number of previous studies have drawn attention to the fact that changes in India's and (especially) China's income distributions, are likely to have a very pronounced impact on global inequality trends. Most obviously, the sheer size of their populations gives them significant weight in any calculation of global inequality. In this paper, we pay particular attention to the impact of India and China on the level and evolution of global inequality over the period from 1975 to 2005. We do so with a focus also on the changes in domestic inequality that have taken place in these countries. We conduct a counterfactual analysis, in which India and China's populations grew as they actually did over the period of analysis, but their levels and distributions of incomes remained as they were in 1975.

Strikingly, we find that the changes which occurred in India and China simultaneously resulted in spiralling domestic inequality, together with a pronounced dampening force on global inequality levels. This dampening force was substantial enough to cause global inequality to fall over the period of analysis, where it would otherwise have risen. The explanation for this apparent dichotomy lies in the fact that the increases in domestic inequality coincided with a remarkably prolonged period of extremely strong growth in these countries. By using Theil's decomposable 'mean log deviation' measure of inequality, together with our counterfactual analysis, we find that the changes in India and China resulted in an increase in the within-country component of global inequality, but that this was more than off-set by the accompanying decrease in the between-country component. Nevertheless, by conducting a further counterfactual analysis, we find that if India and China had been able to achieve the same rate of growth during 1975-2005 as they actually did, whilst avoiding increases in domestic inequality, this would have resulted in still lower levels of global inequality in 2005.

Overall, the picture that emerges from our study of the pre-crisis world in 2005 is one of widespread increases in domestic inequality together with reduced (though still very high) inequality between countries. Drawing on our results, we reflect on the likely evolution of global inequality if current trends continue.

The rest of the paper is organized as follows. In Section 2 we discuss the importance of measuring inequality in general. In Section 3 we discuss concepts and challenges involved in measuring global interpersonal inequality. In particular, we discuss the relationship between global interpersonal inequality and within-country and between-country inequality. In Section 4 we discuss some theoretical aspects of inequality measurement, with a particular focus on the Gini coefficient and the mean log deviation. In Section 5 we describe the data and discuss some of the empirical challenges and techniques. In Section 6 we provide our estimates of trends in global interpersonal inequality, and its within-country and between-country components, with particular reference to the impact of China and India. We also conduct the synthetic counterfactual analyses described above relating to India and China, to estimate their effect

on global distribution. In Section 7 we do some sensitivity analysis on our main results. In Section 8 we discuss our main findings, with particular reference to previous studies. Concluding remarks on the implications of our study are offered in Section 9.

## 2 The importance of inequality measurement

There are many reasons why one might have a concern for inequality and wish to measure it. Perhaps the most obvious reason is that high levels of inequality are deemed to be socially unfair. Since the time of ancient societies, scholars have been concerned about the possible negative effects of inequality on peace and prosperity. In his dialogue with Adeimantus, and reproduced in Plato's *Republic* (1901:422), Socrates was already aware of the pervasive effects of indiscriminate wealth in deteriorating peace and order. Also, under the influence of Plato, Aristotle (1954:1379a) saw in inequity a source of conflict and anger. In that context, the state was seen as fundamental to ensure peace and prosperity through the procurement of justice and social equality (Plato 1901).

Classical economists, from Adam Smith and David Ricardo to Karl Marx, were concerned about the effects of unfair distribution of income on factors of production, and social classes. These were, of course, discussions in the domain of normative principles. Others have also argued for the significance of inequality of opportunity as an obstacle for progress and development. Dworkin (1981a, 1981b), for example, argued that egalitarians should seek to equalize resources rather than outcomes. Roemer (1993, 1998) introduced a model which separated the determinants of the welfare outcomes a person experiences into circumstances and effort. He argued that individuals should only be held responsible for the latter. In contrast to effort, a person has no choice with respect to the circumstances of the environment he is born into. In Roemer's (1993, 1998) framework, an equal-opportunity policy is an intervention which 'levels the playing field' by ensuring that equal outcomes in achievement accrue to individuals who have expended the same amount of effort.<sup>23</sup> Whilst inequality of opportunity is beyond the scope of this paper, its importance for the analysis of inequality is undeniable.

With the rise of development economics theory, the concerns of inequality were linked to the development process, giving an emphasis to the trend of increasing inequality as countries transited from agrarian to industrial societies; see Lewis (1954); Kuznets (1955).

More recently, and following the neoclassical paradigm of the Solow growth model (Solow 1956), there has been a particular focus on the relationship between inequality and economic growth. The first empirical studies of the relationship between growth and inequality found an unambiguous detrimental impact of inequality on growth. For example, Alesina and Perotti (1996) found that income inequality, by fuelling social discontent, increases sociopolitical insta-

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<sup>2</sup>For further philosophical and normative discussion of equality of opportunity and related issues see Arneson (1989); Cohen (1989); Fleurbaey (2008); and Rawls (1971).

<sup>3</sup>There have also been some recent empirical attempts to measure inequality of opportunity. For example, drawing on Roemer's (1993, 1998) distinction between circumstances and effort, Bourguignon, Ferreira and Menéndez (2005) have decomposed earnings inequality in Brazil into a component due to unequal opportunities and a residual term. They found that around a quarter of total inequality was due to differences in observable circumstances. In another recent study, Checchi and Peragine (2010) proposed a methodology for decomposing total inequality into 'ethically acceptable' and 'ethically offensive' components and, in an application to data from Italy, found that inequality of opportunity accounts for around 20 per cent of total inequality.

bility. They found, furthermore, that this instability leads to reduced investment, by creating uncertainty in the politico-economic environment. As a consequence, income inequality and investment, an important engine of growth, are inversely related.<sup>4</sup> A review by Benabou (1996:13) finds that ‘These regressions, run over a variety of datasets and periods with many different measures of income distribution, deliver a consistent message: initial inequality is detrimental to long-run growth.’

In contrast, Forbes (2000) found that in the short and medium term, an increase in a country’s level of income inequality has a significant positive relationship with subsequent economic growth. Still other studies have found more nuanced relations between inequality and growth.<sup>5</sup> Barro (2000), for example, found that higher inequality tends to retard growth in poor countries but promote growth in richer countries. Banerjee and Duflo (2003), on the other hand, found the growth rate to be an inverted U-shaped function of net changes in inequality, in which any changes in inequality are associated with reduced growth in the subsequent period. The lack of consensus and the importance of the topic will ensure that the debate rages on.

In our introduction we drew attention to possible links between high levels of inequality and financial crises. High levels of inequality have also been blamed for, among many other things, political instability (Alesina and Perotti, 1996), crime (Kelly, 2000), corruption (You and Khagram, 2005), and poor health (Wilkinson and Pickett, 2006). Such issues are typically complex and multi-faceted, with possible reverse causality. Again, a fuller consideration of these issues is beyond the scope of this paper, but it is clear that good measurement of inequality is essential for any such empirical analyses.<sup>6</sup>

Some of the discussion above may seem more obviously applicable to domestic, ‘within-country,’ inequality. However, as the world becomes increasingly inter-connected, it is natural that relations between global inequality and global levels of growth, health, corruption, political stability, crime and so on will increasingly be of interest. Both domestic and global inequality are important in these regards and this paper is concerned with each of them. In order to clarify precisely what we are and are not analysing in this paper, various concepts of inequality are discussed in the next section.

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<sup>4</sup>For a discussion on the effects of redistributive and fiscal policies on growth see Alesina and Rodrik (1994) and Perotti (1996).

<sup>5</sup>It was in that context that the empirical work of Caselli et al. (1996) and Islam (1995) introduced the General Method of Moments proposed by Holtz-Eakin, Newey and Rosen (1988) and Arellano-Bond (1991) to tackle issues of inconsistency from individual effects and endogeneity found in cross-country studies of the relationship between inequality and growth.

<sup>6</sup>There might also be good reasons to measure other concepts of income inequality, not directly related to the present study. For example, one might wish to conduct an empirical analysis of ‘convergence’ theory, which predicts that per capita incomes across countries should converge over time. But note that, as explained in the next section, this is not the same thing as ‘between-country’ inequality.



### 3 Concepts and challenges in global interpersonal inequality measurement

#### 3.1 Within-country, between-country, and global inequality

Milanovic (2005) provided a useful framework, subsequently extended by Anand and Segal (2008), for distinguishing between different concepts of inequality.<sup>7</sup> Keeping to this framework we can define four concepts of inequality. ‘Concept zero’ is inequality among countries, where countries are ranked according to their total income, and every country receives an equal weight. We are not concerned with this concept of inequality in the present study but it is the concept which would be most appropriate if one wished to analyse, for example, relations between countries’ total incomes and their power on the world stage.

‘Concept one’ is inequality among countries, where countries are ranked according to their average per capita income, and every country receives an equal weight. This is not the focus of this study either, but is the most suitable concept for analyzing certain economic questions, such as whether ‘convergence’ theory appears to stand up empirically.

‘Concept two’ is what we refer to throughout this paper as between-country inequality. This is what the inequality among all the individuals in the world would be if each person received the average per capita income for his country.

‘Concept three’ inequality is global interpersonal inequality (or global inequality), the inequality inherent in the actual global distribution of income, of all the citizens of the world.

In this study we focus on ‘Concept two’ and ‘Concept three’ inequality. We also consider the ‘within-country’ component of global inequality but stop short of defining it as a new concept. This refers to the level of global inequality which is not attributable to between-country inequality. This is a more involved concept than it might appear at first glance and, as discussed in the next section, can only be appropriately measured using a very specific class of inequality measures.

#### 3.2 Income inequality and consumption inequality

Thus far we have used the term ‘income’ rather loosely. It is important to distinguish between ‘income’ and ‘consumption’ inequality. It is well-known that, in general, income inequality is likely to be considerably higher than consumption inequality. The reason is quite straightforward. The lowest quantiles of a distribution based on consumption typically take a greater share of the ‘consumption pie’ than the corresponding quantiles of income do. Conversely, the highest quantiles usually get a higher share of the ‘income pie’ than they do of consumption. Based on their analysis, Deininger and Squire (1996) have suggested adding 6.6 per cent to Gini coefficients based on expenditure to make them more comparable with income Ginis. In this study we focus on income inequality.<sup>8</sup>

<sup>7</sup>This subsection closely follows the discussion in Anand and Segal (2008).

<sup>8</sup>In order to increase our sample of country-year observations, we do resort to using expenditure data in places, but make adjustments. This procedure is described in Section 5.

### 3.3 Inequality at market exchange rates and at PPP

The measurement of global inequality requires an appropriate set of exchange rates to convert the various national currencies into a common numeraire. The natural choice, and that adopted in most of the literature and in this paper, is to convert national currencies into purchasing power parity (PPP). In this paper, for example, all currencies are converted into 2005 US\$ at PPP. In theory, one dollar at 2005 PPP enables one to purchase the same quantity of goods and services in any country and is an equivalent amount to that which US\$1 would have purchased in the US in 2005.

The same does not apply when incomes are converted to a common numeraire, such as US\$, using market exchange rates. This is because market exchange rates are determined only by the relative prices of traded goods across countries. The relative price of untraded goods—such as housing, transport, and education—is typically considerably lower in developing countries. Evaluating incomes in developing countries at market prices therefore tends to understate incomes in terms of purchasing power and would be expected to lead to exaggerated measures of both global inequality and between-country inequality.

Constructing consistent PPP conversion factors is a considerable undertaking. It requires finding comparable ‘baskets of goods’ to compare purchasing power across countries. Yet purchasing habits and patterns differ across countries, as do the kinds of goods that are available. The two most commonly used methods are the Geary-Khamis (GK) and the Eltetö-Köves-Szulc (EKS) methods.<sup>9</sup> Anand and Segal (2008) provide an excellent discussion of the relative merits of the different methods, in the context of global inequality measurement, and come down in favour of the EKS method. The 2005 US\$ PPP conversion factors used in this study are those estimated by, and obtainable from, the World Bank. Their more recent PPP estimates use the EKS method and the full details of their construction is described in World Bank (2008).

## 4 Inequality measures

Of central importance to any study on inequality is the selection of the index used to measure it. The choice of the index embodies fundamental normative judgements that are important to be aware of and which should be made explicit. The most widely used measure of inequality is the Gini coefficient.

It is defined graphically with respect to the Lorenz curve, which depicts the cumulative share of, e.g., income or consumption expenditure, corresponding to the cumulative population share. In a uniform, completely equal, income distribution the corresponding Lorenz curve is a 45 degree line, known as the line of equality. The Gini coefficient is the area which lies between the line of equality and the actual Lorenz curve, divided by the total area under the line of equality.

More formally, suppose that  $\{(X_k, Y_k) : k \in \{0, 1, \dots, n\}\}$  are the known points on the Lorenz curve, ordered so that  $X_{k-1} < X_k$  for all  $k \in \{1, \dots, n\}$ , so that  $X_k$  is the cumulative proportion of the population for  $k \in \{0, 1, \dots, n\}$ ,  $X_0 = 0$  and  $X_n = 1$ ;  $Y_k$  is the cumulative

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<sup>9</sup>Another method, known as the ‘Afriat’ method was developed by Dowrick and Quiggin (1997) though is less widely used.

proportion of income (or consumption expenditure) for  $k \in \{0, 1, \dots, n\}$ ,  $Y_0 = 0$  and  $Y_n = 1$ . Then the Gini coefficient can be approximated as follows:<sup>10</sup>

$$Gini \approx 1 - \sum_{k=1}^n (X_k - X_{k-1})(Y_k + Y_{k-1}) \quad (1)$$

When there are  $n$  equal intervals on the cumulative proportion of the population, equation (1) can be simplified as:

$$Gini \approx 1 - \frac{1}{n} \sum_{k=1}^n (Y_k + Y_{k-1}) \quad (2)$$

The popularity of the Gini index is largely due to its attractive intuitive geometric interpretation, taking values between 0 and 1, with 0 reflecting perfect equality and 1, perfect inequality. The Gini also has some normatively appealing characteristics. It satisfies the Pigou-Dalton transfer principle whereby, *ceteris paribus*, a transfer of income from a better-off individual to a less well-off individual must lead to a reduction in inequality. It also satisfies a population invariance principle, which enables consistent comparison of populations of different sizes.

In the present context, one of the main drawbacks of the Gini coefficient is that it is not decomposable into within-country and between-country inequality components.<sup>11</sup> In contrast, the Theil L measure, which belongs to the family of generalized entropy measures, is additively decomposable, with population share weights. It is also known as the mean log deviation (hereafter, MLD), because it gives the mean deviation of logged income. Suppose that, in a group of  $N$  individuals,  $Y_i$  is the income belonging to individual  $i \in \{1, \dots, N\}$  and  $\bar{Y} = \frac{1}{N} \sum_{i=1}^N Y_i$ . The MLD can then be expressed as:

$$MLD = \frac{1}{N} \sum_{i=1}^N \ln\left(\frac{\bar{Y}}{Y_i}\right) \quad (3)$$

As Anand and Segal (2008:85) point out, of the various inequality indices which have been used to measure global inequality in the literature, the MLD is the only measure which ‘has a consistent interpretation of its between- and within-group components.’ In this study we use both the Gini coefficient (mainly on account of its popularity and for the sake of comparability with other studies) and the MLD (mainly due to its decomposability). As noted above, use of any inequality measure embodies certain normative judgements. It should be stressed that each of these measures implicitly adopts one particular judgement that not everyone may support. They satisfy a ‘scale invariance’ property, in which a proportional increase in all incomes must leave inequality unchanged. That is, they belong to the class of ‘relative inequality’ measures. Relative inequality measures have been by far the most widely used in empirical studies but a strong case can also be made for attaching some importance to absolute differences in income. Indeed Kolm (1976) went as far as describing the relative inequality approach as ‘rightest.’

<sup>10</sup>In this computation the Lorenz curve is approximated on the intervals between known points  $(X_k, Y_k)$  and  $(X_{k+1}, Y_{k+1})$  as a straight line.

<sup>11</sup>For a discussion on decomposable income inequality measures, see Bourguignon (1979).

Conversely, the ‘absolute inequality’ approach, of demanding that inequality is unaffected by an increase of the same absolute amount to all incomes, was described by Kolm (1976) as ‘leftist.’ Experimental evidence (see for example Amiel and Cowell 1992, 1997) has shown support for both these approaches and for intermediary ‘centrist’ positions. See also Atkinson and Brandolini (2010), who re-examine these and other key concepts underlying the welfare approach to measuring income inequality, with particular reference to global inequality.

## 5 Data and empirical issues and techniques

### 5.1 Data compilation

The analysis in this paper is conducted using the latest version of the WIID, which contains repeated cross-country information on Gini coefficients and income (or consumption) quantiles for 156 countries, spanning the period 1950-2008. It is the most comprehensive and complete database of worldwide distributional data currently available.

As is to be expected with a secondary database of this scale, the data originate from many different sources. The various household surveys and other sources from which the WIID is compiled differ in many important respects. Some of the differences are conceptual. For example, some surveys are based on income and others on consumption. Among those data which refer to income, some are before tax and some are after tax. The surveys also differ in coverage; some are national, others are focused solely on rural or on urban areas and others still exclude certain groups, such as the self-employed. Some surveys take the household as the unit of analysis and others the individual. Importantly, the data also differ with respect to their quality and reliability. In its latest incarnation, all country-year observations are assigned a quality rating ranging from 1 to 4, where 1 denotes the highest quality and 4 the lowest. A score of 1, for example, means that the underlying concepts are known and the survey is judged as sufficient according to a number of criteria.<sup>12</sup>

The focus in this study centres on four specific years at ten year intervals - 1975, 1985, 1995 and 2005. In each of the years analysed, there is an inevitable trade-off between using data as close as possible to the desired years, while maintaining as high a coverage as possible of the global population at those times. The compromise adopted was to choose these four years and to include observations within a maximum of five years of each data point - with a preference, naturally, for observations as close to each of these years as possible.<sup>13</sup> So, for example, the 2005 observations actually come from 2000-10, but are concentrated around 2005 as much as possible.

As well as favouring data close to the four specified years, all other things being equal, we had a number of other preferences. Our inequality estimates are ultimately built up from quantile share data. In order to obtain more precise estimates, we had a preference for data based on deciles or, better still, the lower nine deciles plus the top two vingtiles, rather than quintile shares. Since it is a study on global interpersonal inequality, we also had a preference for

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<sup>12</sup>For further information on the WIID database, including details of the quality criteria, see the WIID User Guide and Data Sources, downloadable from [<http://website1.wider.unu.edu/wiid/WIID2c.pdf>].

<sup>13</sup>We regarded five years as an absolute cut-off in this respect. If there were only observations more than five years from the desired country-year, these were not used.

those data in which the person, rather than the household, was the unit of analysis. Naturally, we preferred data based on surveys with a more representative coverage of the entire population and those in which the quality of the data is deemed to be highest.

We had one final important preference. As highlighted in Section 3.2, our focus is on global income (rather than expenditure) inequality. Of the 3,013 country-year observations in the WIID database with quantile share data, 85 per cent are income based. Naturally, all other things being equal, we used income data rather than expenditure data. Nevertheless, ignoring the consumption based data completely would have dramatically reduced the coverage of the desired countries and years. Where no suitable income-based data were available but we had data on expenditure, we used the expenditure data and adjusted it as described in the following subsection.

A number of additional adjustments to the data could certainly be entertained to account for the various other conceptual and coverage issues discussed above. However, no more were made and in this regard we plead a similar defence to Milanovic (2002:56) who, faced with comparable issues, wrote that, ‘...no adjustments to the surveys were made first, because information on sources of the bias survey-by-survey is unavailable, and second, even if we had information regarding omission of certain population categories, it is simply beyond the scope of knowledge of any single researcher to make meaningful corrections for such a great and varied number of surveys.’

Before turning to the adjustment procedure, we note that, finally, where there was seemingly nothing to choose between more than one source for a given country-year, we took an average of the quantile shares from these different sources. At the end of the process we were left with 64, 90, 125 and 104 country-year observations in 1975, 1985, 1995 and 2005 respectively. This provided us with a sample which covers 78 per cent of the world’s population in 1975, 87 per cent in 1985, 94 per cent in 1995 and 88 per cent in 2005. The full list of country-year observations for each of the respective years is outlined in Tables 10 to 13 in the Appendix.

## 5.2 Converting consumption quantile shares into income quantile shares

Deininger and Squire (1996), in the context of their dataset, suggest adding 6.6 Gini points to Gini coefficients based on consumption to obtain the corresponding income Gini coefficients. In this study, as described in the following subsection, all our inequality estimates are made directly using quantile share data. This clearly requires a different approach to that of Deininger and Squire (1996), but it might be regarded as being in a similar spirit.

We began, starting with the full WIID database, by comparing the average quantile shares for income with the corresponding quantile shares for consumption. However, in order to ensure that we were comparing like with like as far as possible, we focused only on those country-years for which there are income and consumption data in exactly the same year. Where there was a choice of sources for a given country-year’s income or consumption data, we had a preference for instances where the sources for the income and consumption data were the same. This was in order to minimize differences due to other factors, such as different survey designs. The average shares per quantile for consumption and for income, and the average differences between them, are displayed in Table 1.

Table 1: Converting consumption quantile shares to income quantile shares

Quantile	1	2	3	4	5	6	7	8	9	10	11
Avg Consumption share (%)	2.46	3.59	4.72	5.51	6.76	7.79	9.64	11.52	16.10	15.91	16.00
Avg Income share (%)	1.71	2.82	3.85	4.70	5.87	7.02	8.89	11.06	16.25	18.41	19.44
Adjustment (% points)	-0.75	-0.77	-0.86	-0.82	-0.89	-0.78	-0.75	-0.45	0.16	2.50	3.44

*Note : Quantiles 1 to 9 are the bottom 9 deciles. Quantiles 10 and 11 are the top two vingtiles*

*Source : see text*

As expected, the lowest quantiles for consumption have a higher share than the corresponding quantiles for income, while the highest quantiles for consumption have a lower share than the corresponding quantiles for income. Where we had consumption-based quantile data for a given country-year, the shares were adjusted by the amounts indicated in Table 1.<sup>14</sup>

Also note that the income Gini coefficients (as reported in the WIID database, not as calculated by us) based on the sample of country-years with which we performed the analysis above, are on average 7.8 points higher than the corresponding consumption Ginis. Since Deininger and Squire (1996)'s database is an important source for the WIID, it is perhaps not surprising that this figure is in the same ball park as their figure of 6.6. Indeed 6.6 lies within the 95 per cent confidence interval of our estimate of 7.8.

### 5.3 Estimating global inequality indices from country quantile data

Thus far we have discussed the collation of income-based quantile share data, at the country level, for each of the countries and years indicated. These quantile shares are sufficient for evaluation of domestic inequality, using relative inequality measures. However, estimating global inequality requires constructing a global distribution of income, using country-level quantile data. To do this, we need to consider both the number of individuals and the income per capita within each of the country-level quantiles. The number of individuals per country-quantile were calculated based on population data from a number of sources.<sup>15</sup> The income levels per capita, per country-quantile, were calculated based on GDP data. GDP for the various country-years, in 2005 US\$ at PPP, were obtained from the World Bank's databank.<sup>16</sup>

<sup>14</sup>In a few exceptional cases, where the adjustment took some of the bottom quantiles' shares below zero, these were instead simply taken to be zero and an equivalent subtraction taken from the top quantile.

<sup>15</sup>The main sources were: (1) United Nations Population Division. World Population Prospects, (2) United Nations Statistical Division. Population and Vital Statistics Report (various years), (3) Census reports and other statistical publications from national statistical offices, (4) Eurostat: Demographic Statistics, (5) Secretariat of the Pacific Community: Statistics and Demography Programme, and (6) U.S. Census Bureau: International Database.

<sup>16</sup>In most cases we were able to obtain GDP values, in 2005 USD PPP, directly from the databank. There are a few exceptions. We made an estimate for Serbia and Montenegro in 1995, based on the Montenegro portion for 1997. For Belarus 1985 we used the 1990 value as an estimate. For Bulgaria 1975 we used the 1980 value as an estimate. For the Czech Republic 1985 we used the 1990 value as an estimate. For Kazakhstan 1985 we used the 1990 value as an estimate. For Kyrgyz Republic 1985 we used the 1986 value as an estimate. For Lithuania 1985 we used the 1990 value as an estimate. For New Zealand 1975 we used the 1977 value as an estimate. For Poland 1985 we used the 1990 value as an estimate. For the Russian Federation 1985 we used 1989 as a (possibly very poor) estimate. For Slovenia 1985 we used the 1990 value as an estimate. For Switzerland 1975 we used the 1980 value as an estimate. For Turkmenistan 1985 we used the 1987 value as an estimate. For Ukraine 1985 we used the 1987 value as an estimate. For Uzbekistan 1985 we used the 1987 value as an estimate. The Jamaican values for 1975, 1985 and 1995 are based on data no longer available on the World Bank's website: <http://data.worldbank.org/>

As in the majority of previous studies, we made the simplifying assumption that all individuals in the same country-quantile-year have the same income.<sup>17</sup> As is well recognized, this approach should be expected to bias the inequality estimates downwards and the resulting estimates should be interpreted as being lower bounds. As Milanovic (2002) has discussed, there are some reasonable grounds for taking this rather conservative approach. In particular, we do not in general know the upper and lower bounds for the individual-level incomes in each country-quantile. A degree of guesswork is therefore required in any smoothing exercise. Like Milanovic (2002), we prefer to take the cautious approach of estimating minimum levels of inequality. Anand and Segal (2008) suggest that studies which follow this approach should consider the sensitivity of the resulting estimates to different degrees of inequality, particularly the maximum possible degree of inequality, within country-quantiles. We discuss this issue in Section 7.

Formally, the methodology used to construct the global income distribution is as follows. Let  $y_{q,t}^c$  be the average per capita income in quantile  $q \in \{1, \dots, Q\}$  of country  $c \in \{1, \dots, C\}$  in year  $t \in \{t_1, \dots, t_T\}$ . As discussed above, domestic inequality in a given country-year is estimated under the assumption that all individuals in the same quantile have the average per capita income for that country-year-quantile; the world distribution of income in year  $t$  is then constructed by compiling all such available country-quantile data in year  $t$ . In any given country, year and quantile, there will be a corresponding number of individuals  $n_{c,q,t}$ . In year  $t$  then the global income distribution will contain  $Q$  quantiles for each country  $c$ , each with a number of individuals  $n_{c,q,t}$  who are assumed to have an income of  $y_{q,t}^c$ . Of course it is quite possible that at time  $t$  more than one country-quantile will have the same average per capita income, i.e. that  $y_{q,t}^c = y_{\hat{q},t}^{\hat{c}}$  for some  $c, \hat{c} \in \{1, \dots, C\}$  and  $q, \hat{q} \in \{1, \dots, Q\}$  such that either  $c \neq \hat{c}$  or  $q \neq \hat{q}$ . In that case, the total number of quantiles in the global income distribution in year  $t$  would be less than the sum of all country-quantiles,  $QC$ . For the purposes of this subsection, when we refer to a country contributing a ‘quantile’ to the global income distribution in year  $t$ , we use the term loosely, recognising that the effect of including the country’s quantile data might actually be to enlarge the size of an existing quantile in the global income distribution we are constructing, rather than creating a new one.

### 5.3.1 Counterfactual analyses

Without loss of generality, it will be helpful in what follows to refer to China as country 1 and India as country 2 and, since we are working in each country with nine deciles and two vingtiles,  $Q = 11$ . Since we focus on analysing four particular years, we also have that  $T = 4$ ;  $t_1 = 1975$ ,  $t_2 = 1985$ ,  $t_3 = 1995$  and  $t_4 = 2005$ .

In order to elucidate our counterfactual analyses, it is helpful to begin by considering China and India’s contributions towards (our construction of) the actual global income distribution in 2005. China’s contribution is the inclusion of 11 ‘quantiles’ of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{1,q,2005}$  individuals, each with an income of  $y_{q,2005}^1$  take their place in the

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<sup>17</sup>There are some notable exceptions. Bhalla (2002) and Sala-i-Martin (2006) have constructed smooth within-country distributions and based their global inequality figures on these estimates. Davies et al. (2008) also constructed smooth within-country distributions, in the slightly different context of estimating the global distribution of household wealth.

global income distribution. Similarly, India's contribution is the inclusion of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{2,q,2005}$  individuals, each with an income of  $y_{q,2005}^2$  are included in the global income distribution. The remainder of the actual global income distribution in 2005 is constructed similarly; for every  $c \in \{3, \dots, C\}$ , there is a contribution of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{c,q,2005}$  individuals, each with an income of  $y_{q,2005}^c$  are included in the global income distribution.

In the first counterfactual analysis, we consider what inequality levels would have arisen in the following circumstances. Suppose that India's and China's incomes per capita and distribution of incomes (i.e. domestic quantile shares) had remained unchanged from 1975 to 2005, at 1975 levels. The populations in these countries are assumed, however, to have grown as they actually did. This amounts to the following. In constructing the counterfactual global income distribution in 2005, China's contribution is the inclusion of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{1,q,2005}$  individuals, each with an income of  $y_{q,1975}^1$  take their place in the global income distribution. Similarly, India's contribution to the counterfactual distribution is the inclusion of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{2,q,2005}$  individuals, each with an income of  $y_{q,1975}^2$  are included in the global income distribution. All other countries contribute to the counterfactual distribution in 2005 exactly the same as they contribute to the actual income distribution in that year; for every  $c \in \{3, \dots, C\}$ , there is a contribution of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{c,q,2005}$  individuals, each with an income of  $y_{q,2005}^c$  are included.

In our second counterfactual analysis, we investigate what global inequality levels would have resulted in the following situation. Suppose that China and India had been able to grow their incomes per capita at the same rate as they actually did over 1975-2005, yet while also maintaining the same quantile shares as in 1975. Again, the populations are assumed to have grown as they actually did. In constructing this counterfactual global income distribution for 2005, China's contribution is the inclusion of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{1,q,2005}$  individuals are included in the global income distribution, each with an income given by:

$$\frac{(n_{1,q,1975})(y_{q,1975}^1)}{\sum_{q=1}^{11} (n_{1,q,1975})(y_{q,1975}^1)} \cdot \sum_{q=1}^{11} (n_{1,q,2005}) (y_{q,2005}^1).$$

Similarly, India's contribution is the inclusion of 11 'quantiles' of data, such that for each quantile  $q \in \{1, \dots, 11\}$ ,  $n_{2,q,2005}$  individuals are included in the global income distribution, each with an income given by:

$$\frac{(n_{2,q,1975})(y_{q,1975}^2)}{\sum_{q=1}^{11} (n_{2,q,1975})(y_{q,1975}^2)} \cdot \sum_{q=1}^{11} (n_{2,q,2005}) (y_{q,2005}^2).$$

As in the previous counterfactual scenario, all other countries contribute to this counterfactual distribution in 2005 exactly the same as they contribute to the actual income distribution in 2005.



## 6 Results

The analysis described in the previous section provides some interesting results. The overall findings are summarized in Table 2 below.

Table 2: Global Interpersonal Inequality Estimates

Inequality Measure	1975	1985	1995	2005
Gini	0.727	0.702	0.704	0.681
MLD	1.314	1.136	1.074	0.981
<i>MLD within-country component</i>	<i>0.254</i>	<i>0.232</i>	<i>0.335</i>	<i>0.381</i>
<i>MLD between-country component</i>	<i>1.060</i>	<i>0.905</i>	<i>0.740</i>	<i>0.600</i>
Source: authors' estimates				

The overall headline is that global interpersonal inequality has fallen during 1975 to 2005, from 0.727 to 0.681 according to the Gini coefficient, and from 1.314 to 0.981 according to the MLD index. This decline has, for the most part, occurred fairly steadily over this time period. With just one exception, both inequality measures register a decline in global interpersonal inequality from each decade to the next. The one exception is that, according to the Gini coefficient, global interpersonal inequality remained almost unchanged between 1985-95.

A clue to what has driven the changes in inequality is apparent from an examination of the within-country and between-country components of the MLD index. Apart from a slight decrease over 1975-85, within-country inequality has increased steadily over the period of analysis, from 0.254 to 0.381. *Ceteris paribus*, this would, naturally, be expected to lead to an increase in overall global interpersonal inequality over time. However, this dynamic has been more than offset by a dramatic reduction in between-country inequality over the same period; this has fallen from 1.060 to 0.600.

The changes that have occurred in within-country and between-country inequality are substantial and, since they have occurred in opposite directions, have led to a considerable change in the composition of global interpersonal inequality. It can be inferred from the results in Table 2 that in 1975, the within-country component of global interpersonal inequality was just 19.3 per cent. By 2005, this had more than doubled to 38.8 per cent.

We now turn to our results for the counterfactual scenario in which we assumed that India's and China's populations grew as they actually did, but their incomes per capita and distribution of incomes remained at 1975 levels. These results are presented in Table 3.

Table 3: Counterfactual scenario where India's and China's populations grew as they actually did during 1975-2005 but with no change in incomes per capita or distribution

Inequality Measure	1975	2005
Gini	0.727	0.764
MLD	1.314	1.449
<i>MLD within-country component</i>	<i>0.254</i>	<i>0.272</i>
<i>MLD between-country component</i>	<i>1.060</i>	<i>1.177</i>
Source: authors' estimates		

It is clear from Table 3, that in this counterfactual scenario, global interpersonal inequality would have instead increased during 1975-2005 from 0.727 to 0.764, using the Gini coefficient, and from 1.314 to 1.449 using the MLD index. An examination of the decomposition of the MLD index reveals that the increase that would have occurred in this counterfactual scenario, would have been driven by increases in both between-country and within-country inequality, with the ‘between’ component playing a slightly bigger role. China and India were low-income countries in 1975. If their incomes per capita had remained unchanged during the subsequent 30 years, a period in which mean world incomes soared, an increase in between-country inequality would, in light of their large populations, have been very much expected. The fact that the within-country component of inequality would have increased even had India’s and China’s income distributions remained unchanged highlights the fact that increases in domestic inequality over the period of analysis have certainly not been confined to these countries. However, the lion’s share of the overall observed net increase in within-country inequality is indeed due to them.

Combining the results from Table 2 and Table 3, it is clear that the changes that took place between 1975 and 2005 in India’s and China’s income distributions have had a very pronounced dampening effect on global interpersonal inequality. What is interesting, is that this is despite the fact that there were dramatic increases in both India’s and China’s domestic inequality over this same period. China’s inequality increased from 0.279 in 1975 to 0.485 in 2005, according to the Gini coefficient, and from 0.130 to 0.429 according to the MLD index. India’s Gini coefficient increased from 0.402 in 1975 to 0.509 in 2005 and its MLD index increased from 0.269 to 0.474. The explanation for this dichotomy lies, of course, in the dramatic growth which occurred in both countries over this timeframe, taking them from poor countries to middle-income countries.

The picture overall then is largely that the very changes to China’s and India’s domestic income distributions which have caused both huge growth, but also spiralling domestic inequality, have in fact caused global interpersonal inequality to fall, when it would otherwise have risen. So the changes that have occurred in these two countries have been simultaneously ‘good for inequality’ and ‘bad for inequality,’ depending on which income distribution one feels is the more relevant one.

As indicated in the previous section, we performed one further ‘counterfactual’ scenario. We considered what would have happened, with respect to global interpersonal inequality, if India and China had been able to grow their per capita incomes at the same rate as they actually did over 1975-2005, while maintaining the same quantile shares as in 1975. The results of this analysis are presented in Table 4.

Table 4: Counterfactual scenario where India and China grew as they actually did during 1975-2005 but with no change in domestic inequality

Inequality Measure	1975	2005
Gini	0.727	0.662
MLD	1.314	0.872
<i>MLD within-country component</i>	<i>0.254</i>	<i>0.272</i>
<i>MLD between-country component</i>	<i>1.060</i>	<i>0.600</i>
Source: authors’ estimates		

Our results suggest that in this scenario, global interpersonal inequality would have fallen

even further by 2005; to 0.662 according to the Gini coefficient, and to 0.872 according to the MLD index. Needless to say, this further fall in inequality, relative to what actually happened, would have been driven exclusively by there being a much smaller level of within-country inequality than that which actually emerged, and this is confirmed by the decomposition of the MLD index in Table 8. This serves to emphasize the point that the increases in domestic inequality in India and China have certainly not been ‘good’ for global interpersonal inequality per se. They have only been ‘good’ to any extent that they have been an unavoidable side effect of high economic growth that has led to a marked reduction in between-country inequality. It would certainly have been better still for global interpersonal inequality if the same growth could have been achieved in these countries without associated increases in domestic inequality.

We have seen that when the changes that occurred in China and India during 1975 to 2005 are controlled for, the remaining net increase in the within-country component of global inequality is much more modest. However, within individual countries, there have been both significant increases and significant decreases in domestic inequality during the period of analysis. Our attention now turns to some of these countries. In particular, it is of interest to see whether any obvious trends emerge, either with respect to geographic region or with respect to mean incomes or growth in mean incomes.<sup>18</sup> Tables 5 through to 8 display the Gini coefficients, GDP per capita and growth in GDP per capita (over the full period) for those countries for which we have data in both 1975 and 2005. The four tables are divided into four very loosely defined ‘geographic’ regions: Latin America and the Caribbean, Africa and the Middle East, Asia, Europe and North America.<sup>19</sup>

Table 5: Ginis and GDP per capita in Latin American and Caribbean countries in 1975 and 2005

Country	Gini		% Increase in Gini	GDP per capita		% Growth in GDP per capita
	1975	2005		1975	2005	
Argentina	0.361	0.477	32	9462	10833	14
Brazil	0.578	0.532	-8	6161	8509	38
Colombia	0.513	0.551	7	4574	7305	60
Costa Rica	0.453	0.460	2	5650	9042	60
El Salvador	0.445	0.483	9	4817	5702	18
Guatemala	0.439	0.524	19	3313	4062	23
Jamaica	0.516	0.543	5	6565	7083	8
Mexico	0.557	0.493	-11	8295	12191	47
Panama	0.447	0.524	17	6223	9167	47
Peru	0.571	0.502	-12	6203	6387	3
Uruguay	0.446	0.472	6	6440	9683	50
Venezuela	0.402	0.463	15	12183	9924	-19
<i>Average</i>	<i>0.477</i>	<i>0.502</i>	<i>5</i>	<i>6657</i>	<i>8324</i>	<i>25</i>

Source: authors’ estimates

<sup>18</sup>To be clear, by ‘obvious’ trends we mean just that. An in depth study of the complex interactions between inequality, geography, mean incomes and growth is well beyond the scope of the present study.

<sup>19</sup>The ‘Average’ rows at the bottom of Tables 9-12 require careful interpretation. Simple averages of the domestic Ginis and the average domestic GDP per capita are reported, as are the percentage increases in these averages over the period. Ginis and GDP per capita for the region as a whole and their percentage increases are not reported.

Table 6: Gini and GDP per capita in African and Middle Eastern countries in 1975 and 2005

Country	Gini		% Increase in Gini	GDP per capita		% Growth in GDP per capita
	1975	2005		1975	2005	
Cote d'Ivoire	0.529	0.500	-5	2686	1666	-38
Egypt	0.435	0.378	-13	1687	4491	166
Malawi	0.519	0.444	-14	639	645	1
Nigeria	0.498	0.489	-2	1574	1750	11
Tunisia	0.496	0.462	-7	3387	7182	112
Zambia	0.519	0.557	7	1773	1158	-35
Iran	0.560	0.439	-22	9759	9228	-5
Israel	0.360	0.408	13	13984	23340	67
Jordan	0.406	0.444	9	2277	4334	90
Turkey	0.470	0.455	-3	5907	11465	94
<i>Average</i>	<i>0.479</i>	<i>0.458</i>	<i>-5</i>	<i>4367</i>	<i>6526</i>	<i>49</i>

Source: authors' estimates

Table 7: Gini and GDP per capita in Asian countries in 1975 and 2005

Country	Gini		% Increase in Gini	GDP per capita		% Growth in GDP per capita
	1975	2005		1975	2005	
Australia	0.317	0.275	-13	18183	32523	79
China	0.279	0.485	74	409	4115	906
Indonesia	0.427	0.448	5	1016	3102	205
Republic of Korea	0.390	0.319	-18	4284	22783	432
Philippines	0.452	0.467	3	2424	3051	26
Thailand	0.417	0.444	6	1694	6675	294
India	0.402	0.509	27	849	2209	160
Nepal	0.510	0.521	2	570	954	67
Pakistan	0.350	0.369	5	1065	2145	101
Sri Lanka	0.389	0.456	17	1313	3550	170
<i>Average</i>	<i>0.393</i>	<i>0.429</i>	<i>9</i>	<i>3181</i>	<i>8111</i>	<i>155</i>

Source: authors' estimates

Some obvious trends do emerge from Tables 9 to 12. As expected, domestic inequality has been generally rising between 1975 and 2005. Africa and the Middle East is the only one of our loosely defined regions in which the average country from our sample has seen a decline in inequality. Within each region, there is considerable variation with respect to levels of, and changes in, inequality. For example, in Europe, Bulgaria's Gini has increased by 87 per cent, while Greece's has fallen by 18 per cent; in Latin America, Argentina's Gini has increased by 32 per cent, while Brazil's has fallen by 8 per cent; in the Middle East, Israel's Gini has increased by 13 per cent, while Iran's has decreased by 22 per cent and in Asia, China's Gini has increased by 74 per cent, while Korea's has decreased 18 per cent. The latter comparison is an interesting one. China and Korea have both been extraordinarily successful with respect to growth in mean incomes over the period studied, yet have had very different experiences with respect to changes in domestic inequality. An in-depth study of the relationships between mean incomes

Table 8: Gini's and GDP per capita in European and North American countries in 1975 and 2005

Country	Gini		% Increase in Gini	GDP per capita		% Growth in GDP per capita
	1975	2005		1975	2005	
Austria	0.292	0.293	0	17555	33626	92
Belgium	0.265	0.286	8	17898	32189	80
Bulgaria	0.169	0.316	87	5921	9809	66
Canada	0.325	0.330	2	20374	35033	72
Denmark	0.272	0.237	-13	18390	33193	80
Finland	0.222	0.275	24	15501	30708	98
France	0.345	0.310	-10	17550	29453	68
Germany	0.319	0.306	-4	17592	31115	77
Greece	0.398	0.326	-18	14809	24348	64
Hungary	0.224	0.302	35	9628	16975	76
Ireland	0.299	0.326	9	11339	38896	243
Italy	0.383	0.361	-6	15406	28280	84
Netherlands	0.276	0.295	7	20030	35104	75
Norway	0.313	0.290	-7	21411	47626	122
Portugal	0.372	0.363	-2	10057	21369	112
Spain	0.324	0.372	15	14693	27392	86
Sweden	0.235	0.254	8	19329	32703	69
Switzerland	0.336	0.309	-8	29274	36964	26
UK	0.233	0.361	55	16625	32958	98
USA	0.357	0.411	15	22396	42516	90
<i>Average</i>	<i>0.298</i>	<i>0.316</i>	<i>6</i>	<i>16789</i>	<i>31013</i>	<i>85</i>

Source: authors' estimates

and inequality and growth in mean incomes and changes in inequality are not our intention. Nevertheless, some interesting correlations do emerge from the data in Tables 9 to 12. These are displayed in Table 9.

Table 9: Correlations between inequality, GDP per capita and growth

	Correlations		
	1975 Gini & GDP per cap	2005 Gini & GDP per cap	% Inc in Gini & Growth in GDP per cap
Latin America & Caribbean	-0.306	-0.435	-0.215
Africa & Middle East	-0.357	-0.487	0.028
Asia	-0.376	-0.867	0.705
Europe & North America	0.316	-0.036	0.018
Total Sample	-0.564	-0.801	0.356

Source: authors' estimates

Overall, higher Gini coefficients appear quite strongly negatively correlated with levels of GDP per capita, and the strength of the correlation is higher in 2005 than it was in 1975. This pattern holds in each of our individual regions, apart from Europe and North America. Overall, and somewhat in contrast, there is a modest positive correlation between the increase in Gini coefficients and growth in GDP per capita. However, this pattern is not consistent across regions and is mainly driven by Asia, in which there is a strong positive correlation. In fact,

this correlation disappears completely when China is omitted.<sup>20</sup> Omitting China has relatively little impact, however, on the correlations between Gini and GDP per capita levels; without China the overall correlations for 1975 and for 2005 become -0.607 and -0.798 respectively.

## 7 Sensitivity analysis

We are aware of some of the potential sources of error in our estimates of global inequality, including sampling error, measurement error and, as discussed by Anand and Segal (2008), assuming a single PPP price level for each country. There is also the issue of the extent to which assuming equal incomes within country-quantiles is likely to bias the inequality measures downwards.

Anand and Segal (2008:90) have argued that ‘Sensitivity analysis should be undertaken to assess the possible impact of these errors and assumptions, even if there is insufficient information to estimate statistical confidence intervals...’ They also illustrate in some detail why ‘The standard errors estimated in the literature do not address these concerns.’ We broadly agree with Anand and Segal (2008). With respect to the difficulties involved in estimating statistical confidence intervals, we would perhaps even go as far as to argue that such a task is impossible. There is simply too much uncertainty regarding the sizes and directions of some of the biases. We will discuss some of the issues in turn and then consider their possible net impact.

### 7.1 Sampling error and bias

There are well-established techniques for estimating the standard errors arising from a sample not being representative of the population under study. The difficulty in the present context, as pointed out by Anand and Segal (2008), is that we are not dealing with a random sample of the global population. Rather we are dealing with a constructed sample, based on many different national surveys, each with their own sampling variance. Estimating the sampling variance of the resulting distribution is a difficult problem and a solution is not easily apparent.

A related issue is the extent to which our results are likely to suffer from sample selection bias. Given the nature of household surveys, one might expect this to impart a downward bias on our estimates, since it is rare for very high earners to be surveyed. However, we make this conjecture somewhat tentatively and without a method for estimating the extent of this potential bias. Moreover, any such bias needs to be considered in tandem with possible biases arising from measurement error, as discussed next.

### 7.2 Measurement error

Measurement error is likely to arise from a number of sources, notably the quantile share data from the various surveys and the GDP data measured in US\$ PPP. Indeed measurement error in the latter might itself arise from either the raw GDP calculations or the estimation of the PPP conversion rates. Measurement error in the population data is a further possibility.

Anand and Segal (2008) argue that since the responses from those who are surveyed are likely to be noisy, this would bias the variance of the responses upwards which might cause

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<sup>20</sup>Indeed it becomes slightly negative, falling to -0.031 overall and to -0.280 in Asia.

measured inequality to be overstated. This is a reasonable argument. However, as Anand and Segal (2008) also point out, surveys are also likely to suffer from underreporting of the incomes of the rich and from undersampling of both the richest and the poorest. These dynamics would be expected to bias inequality in the opposite direction.

Now, if the GDP data are biased upwards (respectively, downwards) for low-income countries, or downwards (respectively, upwards) for high-income countries, measured global inequality will be biased downwards (respectively, upwards), due to the resulting impact on the between-country component of inequality.

If population sizes are biased upwards (respectively, downwards) in lower-income countries, or downwards (respectively, upwards) in higher-income countries, this will tend to bias measured global inequality upwards (respectively, downwards), due to the resulting impact on both the between-country and within-country components of inequality. Unfortunately, however, the direction and size of biases resulting from measurement error in the GDP data and of country population sizes are very difficult to predict. Overall, given the multitude of surveys and the various uncertainties involved, it is unfortunately not at all clear what even the direction of the net bias due to measurement error should be expected to be, let alone its size. This is certainly an area for future research enquiry.

### **7.3 Assuming a single PPP price level for each country**

Further biases are likely due to the necessary evil of assuming a single PPP price level for each country-year. This issue has been discussed by Aten and Heston (2010) and Anand and Segal (2008). In short, if prices faced by individuals are positively correlated with incomes, as is often the case, the assumption of a single PPP price level will tend to bias measured inequality upwards.<sup>21</sup> On the other hand, economies of scale tend to favour the better off, who are more likely to be able to buy in bulk. This may result in a negative correlation between prices and incomes and a downward bias on measured inequality. The overall direction of the net bias even at a given country-level is difficult to predict; estimating the overall effect of such biases globally appears an almost insurmountable task.

### **7.4 Assuming equal incomes within quantiles**

As we have discussed, in this source of error at least, there is no doubt about the direction of the bias. Assuming equal incomes within country-quantiles certainly biases our inequality measures downwards and indeed, ignoring the various other sources of bias discussed above, we might consider our various inequality estimates to be lower bounds.

Anand and Segal (2008:88) have suggested that studies which take our approach should construct an upper bound for within-country inequality, by considering how high inequality would be if the distribution within income intervals were assumed to be maximally unequal. We agree that this is a nice idea. However, it is a more challenging problem that it might, at first sight, appear. The main difficulty stems from the fact that we do not, in general, know the upper- and lower-income bounds within each quantile. So, for example, inequality would increase if the income of the poorest individual in the second quantile decreases as far as is

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<sup>21</sup>It is well known that incomes are often higher in expensive regions.

possible, whilst remaining in the second quantile. Inequality will also increase if the income of the richest person in the poorest quantile increases as far as is possible, while remaining in the first quantile. Unfortunately, however, we do not know where the cut-off point between the two quantiles is.

If there were just two quantiles, it might be relatively straightforward to evaluate the optimal (counterintuitively, with respect to maximizing inequality) cut-off point between the quantiles but the complexity of the problem increases as the number of quantiles increases. Consider the following. As the upper bound to the first quantile decreases, this tends to decrease the amount of inequality that can arise within the first quantile and increase the inequality that can arise within the second quantile. However, with more than two quantiles, we also need to choose a cut-off point that bounds the top of the second quantile from the bottom of the third quantile. The truly optimal bound for the top of the first quantile (with respect to maximizing inequality) can then be expected to depend on where the optimal upper bound to the second quantile lies - and so on. A solution to this problem is not readily apparent to us and it perhaps represents an interesting topic for future research.

## 8 Discussion

Our overall estimates of global inequality levels lie broadly in the same ball park as those of previous studies. For example, Dowrick and Akmal (2005) reported Ginis of 0.698 in 1980 and 0.711 in 1993, Sala-i-Martin (2006) found Ginis of 0.660 in 1980 and 0.637 in 2000, Bhalla (2002) reported Ginis of 0.686 in 1980 and 0.651 in 2000, Bourguignon and Morrisson (2002) found a Gini of 0.657 in both 1980 and 1992 and Milanovic (2005) reported Ginis of 0.622 in 1988 and 0.641 in 1998.

Our estimates lie towards the upper end of the existing literature, closest to Dowrick and Akmal (2005). This is likely to be partially related to the manner in which we have adjusted for data which are reported as consumption quantiles rather than income quantiles. As we have discussed, this imparts an (intentional) upward impact on our global inequality measurements.

Our analysis of the impact of China on global interpersonal inequality is consistent with that of Sala-i-Martin (2006), who found that without China, global inequality would have risen from 0.620 to 0.648 from 1970 to 2000, whereas in fact it actually decreased.

Our analysis of trends in within-country and between-country inequality and of the impact of India and China seem at least partially consistent with that of Bourguignon and Morrisson (2002). They found that between 1970-92, global income inequality, as measured by the MLD index, increased slightly from 0.823 to 0.827. Whilst we found that global income inequality decreased between 1975 and 1995, our within-country and between-country components moved in the same directions as theirs. (Their within-country component increased from 0.304 to 0.332, while their between-country component decreased from 0.518 to 0.495).

Bourguignon and Morrisson (2002:738) also found that ‘...the relatively poor growth performances of China and India until late in the 20th century’ was one of the main ‘disequalizing forces’ while ‘China’s outstanding growth performance in the last decade or two of the period’ was one of the main ‘equalizing forces.’ Whilst we consider a much shorter period of analysis (which starts much later but also finishes later), our results as to the impact of China and India



are consistent with theirs.

There are also some notable points of divergence in our results. For example, Milanovic (2002) found that inequality, as measured by the Gini index, increased from 0.63 in 1988 to 0.66 in 1993. Moreover, this increase was driven more by differences in mean incomes between countries than by inequalities within countries. Although we do not consider these exact years, these results do seem somewhat at odds with our findings for 1985-95, especially with respect to the trends in within-country and between-country inequality; as discussed at length in Section 3, we find that within-country inequality increased considerably over this period, while between-country inequality decreased substantially.

## 9 Conclusions

Using the most up-to-date and complete database of worldwide distributional data presently available, we have estimated global interpersonal inequality levels and their trends during the period from 1975 to 2005. This is the first study to provide a comprehensive picture of global inequality levels prior to the financial crisis of 2007-08.

As in previous studies, the global inequality figures estimated in this paper represent very high levels indeed. This is especially so in light of the fact that our figures might be considered, as we have discussed, to be lower bounds of the true values. Generally speaking, we live today in a very unequal world. Global inequality figures are much higher than domestic levels in even the most unequal countries of Latin America and sub-Saharan Africa. The dynamic which causes this is clear from our decomposition of global inequality into within-country and between-country components. The latter component is still the dominant factor in global inequality. This is due to the dramatic growth in China and India that accompanied dramatic increases in inequality in those countries, and which in turn resulted in a net decrease in global inequality. Strong but above all, more 'inclusive' growth in developing countries, especially populous ones, remains a potent tool for reducing global interpersonal inequality.

However, the general trend towards increasing domestic inequality should be a matter for concern, not just for nation states, but also for those concerned with global equity and stability. If current upward patterns of inequality continue in large emerging markets such as China and India, with dramatic growth but also large increases in domestic inequality, in not too many years time this will lead to increases in both the within-country and between-country components of global inequality.

A major challenge for both future research and for policy makers in the years ahead will be to find ways of achieving strong growth without allowing inequality to spiral to dangerous levels. It may be instructive to learn from the experiences of countries such as the Republic of Korea which have somehow managed to achieve this.

Finally, it is worth reflecting on the fact that there are other dimensions to inequality than the income-based focus in this study and others we have referred to. Some are likely to be strongly correlated with income but others perhaps less so. Bourguignon and Morrisson (2002:728), for example, have found that 'health disparities are probably not much larger today than they were in the early 19th century...', despite dramatic increases in income inequality. This may or may not be the case across other important dimensions of wellbeing such as education,

easy access to clean water and so on. Greater knowledge in these domains would clearly be of significant value.

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## 10 Appendix

Table 10: Countries covered in 1975

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Argentina, Australia, Austria, Barbados, Belgium, Botswana, Brazil, Bulgaria, Canada, China, Colombia, Costa Rica, Cote d'Ivoire, Denmark, Ecuador, Egypt, El Salvador, Fiji, Finland, France, Gabon, Germany, Greece, Guatemala, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Republic of Korea, Malawi, Malaysia, Mexico, Morocco, Nepal, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Panama, Peru, Philippines, Portugal, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Trinidad & Tobago, Tunisia, Turkey, UK, USA, Uruguay, Venezuela, Zambia

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Table 11: Countries covered in 1985

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Algeria, Argentina, Australia, Austria, Bahamas, Bangladesh, Belarus, Belgium, Bolivia, Botswana, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Czech Republic, Denmark, Dominican Republic, Ecuador, El Salvador, Ethiopia, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Republic of Korea, Kyrgyz Republic, Latvia, Lesotho, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mexico, Moldova, Morocco, Nepal, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Rwanda, Sierra Leone, Slovak Republic, Slovenia, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Trinidad & Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, UK, USA, Uruguay, Uzbekistan, Venezuela

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Table 12: Countries covered in 1995

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Albania, Algeria, Argentina, Armenia, Australia, Austria, Bahamas, Bangladesh, Belarus, Belgium, Bolivia, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Central African Republic, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Fiji, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Guyana, Honduras, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Republic of Korea, Kyrgyz Republic, Lao, Latvia, Lesotho, Lithuania, Luxembourg, Macedonia, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Rwanda, Senegal, Serbia & Montenegro, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Suriname, Swaziland, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Trinidad & Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, UK, USA, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia

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Table 13: Countries covered in 2005

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Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bangladesh, Belarus, Belgium, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Burkina Faso, Cambodia, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Georgia, Germany, Greece, Guatemala, Guinea, Haiti, Honduras, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Jordan, Kazakhstan, Republic of Korea, Kyrgyz Republic, Lao, Latvia, Lithuania, Luxembourg, Macedonia, Madagascar, Malawi, Mali, Mauritania, Mexico, Mongolia, Mozambique, Nepal, Netherlands, Nicaragua, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Senegal, Serbia and Montenegro, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Tunisia, Turkey, Uganda, Ukraine, UK, USA, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia

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