Preferences, Purchasing Power Parity, and Inequality: Analytical Framework, Propositions, and Empirical Evidence

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Abstract

This paper makes analytical, methodological and empirical contributions to the literature on purchasing power parity. Purchasing power parities are required in a host of cross-country welfare comparisons, such as poverty rates and gross domestic product. The subject has recently generated much interest in the wake of the release of the final results of the 2011 International Comparison Program. This paper introduces a preference-based analytical framework that departs from the conventional Balassa-Samuelson framework in deriving empirically verifiable propositions on the link between purchasing power parity and exchange rates, and between purchasing power parity and inequality. The paper also provides an alternative methodology for calculating purchasing power parities that are benchmarked against the 2011 International Comparison Program purchasing power parities. As this study shows, the alternative methodology is capable of easy implementation on readily available data sets. The benchmarking exercise suggests that the 2011 International Comparison Program generally understates purchasing power parity and overstates gross domestic product, and that the purchasing power parities vary across expenditure percentiles. The study reports regional variation in the direction of the difference between the two purchasing power parities. The empirical evidence is supportive of the positive association between inequality and purchasing power parity derived in the paper.

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1. Introduction

Background

The recent release of the final report of the 2011 International Comparison Program (ICP)[1] has generated renewed interest in the subject of Purchasing Power Parity (PPP). PPPs are required in a range of cross-country comparisons that include real expenditure, inequality and poverty comparisons. For example, the implementation of the international poverty line (IPL), typically denominated in US dollars, requires the use of PPPs to convert the IPL to local currencies. The manner of implementation of the PPPs in specifying country specific poverty lines by the World Bank has, however, been criticized by Reddy and Pogge (2007) on the grounds that it (a) "uses an arbitrary international poverty line that is not adequately anchored in any specification of the real requirements of human beings" and (b) "employs a concept of 'purchasing power equivalence' that is neither well defined nor appropriate for poverty assessment". Reddy and Pogge's (2007) view is at odds with the result of Deaton and Dupriez (2011) who have sought to justify the conventional use of PPPs in defining IPL by finding that that PPPs for the global poor are not much different from the economywide PPPs obtained from national accounts statistics.

The International Comparison Program (ICP) that is centrally directed from the global office of the World Bank is, by any measure, truly impressive in the scale of the exercise and highly ambitious in what it claims to achieve. As the volume [World Bank (2013)] that describes the objectives, methodology and the data sets of the ICP 2005 exercise states in its title, it seeks to measure the 'real size' of the world economy, even though it is not clear what the term 'real' really means. It does so by calculating 'purchasing power parity' (PPP) rates between the various countries' currencies and using the PPPs rather than the market exchange rates in converting the national accounts of various countries and their components, denominated in local currencies, into a common currency, typically, the US dollar. As is well known, market

[1] See World Bank (2015). The preliminary results were published in World Bank (2014). See, also, Hamadeh and Mouyelo-Katoula (2014) for a lucid summary of the ICP, 2011 findings, and Diewert (2010) for a description of the new methodological developments in the earlier ICP, 2005 round.

exchange rates are inappropriate for currency conversions since they do not measure the 'true' purchasing power of a currency. For example, on market exchange rates, the price of a haircut in India seems incredibly cheap to an American visiting India or, conversely, a taxi ride in Australia will be almost as expensive as plane travel between two cities in India. PPP provides the adjustments required to market exchange rates such that the price of an item in two countries is identical if expressed in a common currency. A working definition of the PPP is provided in World Bank (2013, p. 19), namely, that '*it represents the number of currency units required to purchase the amount of goods and services equivalent to what can be bought with one unit of currency unit of the base or reference or numeraire country'*.

There are several reasons for the divergence between the market exchange rates and the PPP rates (however measured). The short term factors include the capital movements between countries, interest rate movements, speculation in foreign exchange markets, etc. The longer term factors include the fact that the exchange rates are almost exclusively dependent on the relative prices of tradeable items, while standard of living comparisons between countries should include both tradeable and non-tradeable items, especially in the context of developing countries. Consequently, the PPP rates are based on a much wider selection of items than market exchange rates including both tradeable and non-tradeable items. It is not surprising, therefore, that the PPP rates deviate from exchange rates much more for developing countries than the developed ones. The use of PPPs has provided some comfort to authorities in developing countries who have used them to argue that the 'real size' of their economies is much higher than shown by the exchange rate converted figures.

Though the concept of PPP can be traced back to the early work of Cassel (1916), its modern origin is due to Balassa (1964) and Samuelson (1964). The distinction between PPP and exchange rates is underpinned by the distinction between tradeable and non-tradeable items. While both PPP and exchange rates measure the ratio of prices of a basket of items in two countries, the former considers both tradeable and non-tradeable items, but the latter considers only tradeable items. Both Balassa (1964) and Samuelson (1964) base their distinction between PPP and exchange rates on productivity differences between the tradeable and the non-tradeable sectors. As Balassa (1964) notes (p.585), "under the assumption of constant marginal rates of transformation, the relative price of the non- traded commodity will thus be higher in the country with the higher productivity levels than the other". This leads him to conclude that (p. 586), "assuming that international productivity differences are greater in the production of

traded goods than in the production of non-traded goods, the currency of the country with higher productivity will appear to be overvalued in terms of purchasing power parity". Since developing countries have lower productivity than developed countries, this argument leads to what Ravallion (2013a) terms the 'static Penn effect', where the 'price level index', defined as the ratio of the PPP to the exchange rate is higher in the developed countries. Ravallion (2013a) extends this argument to claim that with economic growth, the developing countries witness productivity gains in the traded goods sector leading to the 'dynamic Penn effect' whereby there is a positive association between changes in economic growth and that in the 'price level index'. The Balassa Samuelson analysis is reinforced by Bhagwati (1984) who argues that services, a typical non-tradeable item, are cheaper in developing countries. Though the distinction is not always emphasized in the literature, Balassa (1964) draws a distinction between the 'absolute' and 'relative' interpretations of the PPP doctrine that views the PPP as 'equilibrium exchange rates.'[2] While, according to the first interpretation, PPP tends to approximate the equilibrium rates of exchange, according to the second interpretation, 'changes in relative prices would indicate the necessary adjustments in exchange rates' (Balassa (1964, p. 584)). Though the equivalence is not exact, the 'static Penn effect' corresponds to the absolute interpretation of the PPP doctrine while the relative interpretation corresponds to the 'dynamic Penn effect'. As we report later, while the present study finds no evidence in favor of the 'static Penn effect', which involves cross sectional PPP comparisons between countries in a given year, it does find robust evidence in favor of a 'dynamic Penn effect' which relates to the same country over time. The latter has, recently, been the subject of controversy between Ravallion (2013a, 2013b) and Inklaar (2013) with the former claiming robust evidence in favor of a 'dynamic Penn effect', and the latter denying such an effect.

Motivation

This paper revisits this debate using an extended analytical framework and presents evidence that suggests that both the protagonists are missing the role of within-country inequality movements in affecting the temporal changes in PPP. The importance of inequality movements in studying PPP changes becomes paramount in the context of non-homothetic consumer preferences on which we provide supporting evidence in this study. The examination of the

[2] This view has however been challenged by Rogoff (1996) who points to the 'PPP puzzle', namely, the need to 'reconcile the extremely high short term volatility of real exchange rates with the glacial rate… at which deviations from PPP seem to die out" (p.664). In a rare departure from the Balassa Samuelson framework, Rogoff (1996) points to the role of transportation costs and tariffs in explaining the 'PPP puzzle'.

effect of inequality on PPP, that is one of the principal motivations of this paper, requires an analytical framework that makes an explicit attempt to link consumer preferences with PPP movements.[3] One of the contributions of this paper is to provide such a framework.

The need to get a valid and reasonably general PPP specification stems from the fact that the ICP PPPs or, PPPs from other sources, are available only after discrete time intervals due to resource costs and administrative complexities in conducting PPP exercises, and that such time intervals between ICP exercises have been increasing. Yet, PPPs are required much more frequently, typically annually or even quarterly, as the international community and global agencies need to make cross-country poverty and real expenditure comparisons on a regular scale. This calls for a satisfactory PPP forecasting mechanism that generates PPPs between the ICP benchmark years. Examples of attempts to provide dynamic PPP mechanisms include Rambaldi, Rao and Ganegodage (2010), Rao, Rambaldi and Doran (2010), McCarthy (2013), Pelagatti (2010), Ravallion (2013a, 2013b) and Inklaar (2013).[4] The result of this study on the need to link inequality movements with PPP changes over time thus acquires considerable significance.

Another key motivation of this study is to subject the recently released 2011 ICP PPPs to robustness checks by comparing them with a set of counterfactual PPPs for 2011 that is obtained using an alternative methodology that is based on consumer preferences and using a data set that is similar to that used in the 2011 ICP study. In concentrating exclusively on the 2011 ICP, we depart from counterfactual exercises such as Jolliffe and Prydz (2015) and Inklaar and Rao (2015) that attempt to reconcile the 2005 and 2011 ICP results. A related motivation is the test of the underlying assumption in the ICP PPPs, and in their use in cross-country welfare comparisons, that a single PPP number is valid for all the expenditure classes, namely, the poor, middle income and affluent households. While there is now widespread appreciation of the importance of constructing 'subnational PPPs', this study is motivated by the need to draw attention to the importance of constructing 'subclass PPPs' as well.

[3] See Majumder, Ray and Sinha (2012, 2015a, 2015b) for recent attempts at estimating sub-national PPPs in India and Vietnam based on preference consistent demand systems.

[4] See, also, Chakrabarty, Majumder and Ray (2015) for an attempt to move from the cross country framework of forecasting national PPPs to the intra-country framework of forecasting subnational PPPs using a dynamic stochastic specification.

Distinctive Features

The existing attempts at forecasting PPP between benchmark years can be divided into two broad approaches. The first is largely an accounting exercise that adjusts PPPs for changes in the relative purchasing power of currencies by using inflation differentials between countries. The second, typified by Ravallion (2013a), links the PPP changes to changes in the real GDP of the countries.[5] The present study deviates from these approaches by attempting to link the PPP changes with that in consumer preferences over time. In doing so, the paper deviates from the Balassa Samuelson framework that has dominated the PPP literature and has given primacy, almost exclusively, to the role of productivity differences in driving differences between PPP and exchange rates. As this paper shows, extending the Balassa Samuelson framework to explicitly bring in consumer preferences allows the introduction of distributional variables such as intra-country Gini inequality in studying PPP changes. While in some cases changing consumer preferences can add to the Balassa-Samuelson effects on PPP, in others they can ameliorate such effects. As the empirical evidence presented later shows, one of the consistently robust results of this study is the significant effect of inequality changes on PPP movements in the case of low income countries. These results acquire significance in the context of the recent contribution of Piketty (2015) that has put distribution back at the center of international policy debates.

As indicated above in 'Motivation', another key feature of this study is that it provides counterfactual PPPs, along with a proposed methodology for calculating an alternative set of PPPs, which allow comparison with the 2011 ICP PPPs that have come out only very recently. The need for such counterfactual PPPs has recently been emphasized by, for example, Inklaar and Rao (2015) in the context of findings that suggest that while the 2005 ICP PPPs made the developing countries suddenly look a lot 'poorer' than they did previously [Chen and Ravallion (2010)], the 2011 ICP PPPs did the very reverse leading to the Inklaar and Rao (2015) conclusion that 'the (previous) international income inequality had been overstated'. Against a background of continuing controversy on the accuracy of the price information used in the 2005 and the 2011 ICPs, with one group arguing that the 2005 prices were 'too high', and the

[5] Though neither Ravallion (2013a, 2013b) nor Inklaar (2013) draws a distinction between the cross sectional/ cross country base of the 'static Penn effect' and the temporal context of the 'dynamic Penn effect', the present study does and provides separate estimates of the two quite different types of 'Penn effects'.

other side arguing that the 2011 prices were 'too low,'[6] the results of the comparison of the 2011 ICP PPPs with the counterfactual PPPs acquires considerable interest. Since a key distinctive feature of the alternative methodology proposed here to calculate PPP is that it dispenses with the need for price information, the present results acquire significance in the context of this debate on the quality of the price information used in the ICP PPPs. Moreover, it addresses a significant practical issue, namely, that in the case of most developing countries the required price information is missing or is of suspect quality.

Another distinctive feature of this exercise is the use of the Indian rupee as the numeraire currency instead of the US dollar. This is much more than a simple change of the base country, from USA to India, since while interest in all the existing PPP applications in 'real expenditure comparisons' centers on the question of whether the world is 'richer' or 'poorer' in relation to the USA, the counterfactual PPPs and their implied real expenditure comparisons presented here are with respect to India. While the 2011 ICP PPPs suggest that the world has suddenly become a lot 'richer', or more accurately 'less poor', with respect to the USA when compared with the 2005 ICP PPPs, a distinctive finding of this study is that the 2011 ICP PPPs make much of the developing world look 'richer' or 'less poor' with respect to India as well, but the comparison here is with the alternative set of 2011 non ICP PPPs, not with a previous set of ICP PPPs. The move to India is justified by the fact that India occupies a unique position in sharing the features of a developing economy in terms of its poverty rates and per capita expenditure, yet it offers a market and the size of its aggregate economy that dwarf many of the developed economies. If the often made comparisons between the 2005 and 2011 ICP PPPs suggest a downward bias in the 2011 ICP PPPs, vis a vis the US dollar, the counterfactual exercise of the present study extends that finding vis a vis the Indian rupee.

Organization

The rest of the paper is organized as follows. Section 2 proposes a non-homothetic preference based analytical framework that yields propositions on the relationship between (a) PPP and exchange rates, (b) PPP and consumption patterns, (c) PPP and factor endowments, and (d) PPP and inequality. Section 3 presents the empirical evidence on non-homothetic preferences

[6] See Ravallion (2014) and Jolliffe and Prydz (2015) for alternative, indeed contradictory, comparative assessments of the price information collected in ICP 2005 and ICP 2011. While Ravallion (2014) finds issues with ICP 2011, Jolliffe and Prydz (2015) are critical of the price information collected in ICP 2005. Inklaar and Rao (2015) attempt at reconciling the PPPs from ICP 2005 and ICP 2011, and argue that "relying on a single benchmark for country figures is hazardous".

that allow the link between PPP and inequality. Section 4 provides robust evidence that confirms the effect of inequality on PPP and of a stable 'dynamic Penn effect'. While the empirical results in Sections 3 and 4 are based on a time series of the ICP PPPs to date, Section 5 widens the study by proposing an alternative preference-based methodology for estimating PPPs and then using it to calculate counterfactual PPPs that provide a useful comparison with the ICP PPPs. Section 6 concludes the paper with a summary of the principal results and a discussion of issues that could feature in the future agenda of the ICP.

2. Analytical Framework and the Link Between PPP and Inequality

We model a system of two economies that are linked by trade. The consumption basket of the representative individual of either of these economies is composed of three goods[7] and the economies are allowed to engage in bilateral trade in two of these goods. Thus, the market for commodities of any economy is constituted by the domestically produced non-tradable good as well as by the tradable goods produced either domestically or imported from abroad. Note that although each of these economies is endowed with the technology to produce all the commodities, whether a particular tradable good is produced in an economy is determined by the nature of product specialization as directed by the terms of trade. Trade between the economies is assumed to be free[8] and balanced. The productions of the goods in the economies are organized by constant returns to scale production technologies that utilizes a single factor of production. We shall refer to this factor of production as capital. The factor of production is perfectly mobile within an economy but is immobile across the economies. There is perfect competition in both the product and factor markets.

Given this overview of the nature of the economies, we first detail their production structures. Henceforth, we refer to the economies as '*home*' (*h*) and '*foreign*' (*f*) and use as subscripts the letters *h* and *f* to distinguish the various exogenous and endogenous variables of the respective economies. Given the assumptions of our model, the production of non-tradable and tradable goods denoted by X, Y_1 and Y_2 in that order, are given by:

[7] In a perfectly competitive setting (as assumption that we invoke subsequently), three is the minimal number of commodities that ensures bilateral trade as also the presence of at least one non-tradable.

[8] Defined as trade that does not involve any transaction costs in the form of tariffs/subsidies or transportation costs.

$X_i = \alpha_i k_{xi}$, $Y_{1i} = \beta_{1i} k_{y1i}$ and $Y_{2i} = \beta_{2i} k_{y2i}$ where, $i = h, f$.

In the above relations, α, β_1 and β_2 represent the productivity parameters of the subscripted 'i^{th}' economy and k denotes the amounts of capital employed in the particular production activity. Since perfect competition prevails in both the commodity and factor markets, profit maximization on the part of the firms equates the prices of the goods to their marginal costs of production. Or, in terms of notations:

$$p_{xi} = \frac{r_i}{\alpha_i} \forall i \in \{h, f\} \quad (1)$$

$$p_{y1i} = \frac{r_i}{\beta_{1i}} \forall i \in \{h, f\} \quad (2)$$

$$p_{y2i} = \frac{r_i}{\beta_{2i}} \forall i \in \{h, f\} \quad (3)$$

In the above relations, p represents the price of the subscripted good and r represents the rental rate of capital: our sole factor of production. In the case where a particular traded good is not produced in a particular economy, the above equations depict the relationship between the price and the rental rate that would have prevailed had that good been manufactured by the competitive firms of the said economy.

In order to model the demand side of the economies, we assume that the individuals of both economies share identical tastes and preferences. As of now, we will assume a very general form of preferences of a typical individual of an economy and introduce the variables: $\theta_{xi}, \theta_{y1i}$and $\theta_{y2i} \forall i \in \{h, f\}$ to represent the fraction of total income, the 'i^{th}' economy spends to consume the subscripted goods. Obviously, for each of the economies, these income shares add up to unity. Additionally, apart from being functionally linked to the parameters of the utility function, these variables are functionally dependent on the market prices of the goods and the income distributions of the respective economies for general utility formulations. If the preferences are homothetic, then these income shares are homogenous of degree zero in the market prices and are not functions of the distributions of income in the respective economies.

With this very abstract form of individuals' preferences, we move on to analytically solve for the equilibrium that prevails at trade. For our model, given the assumptions so far, it is evident that the only way the countries might engage in gainful trade is when the relative productivity parameters of the traded goods vary across the countries; leading to a Ricardian type of

comparative advantage driven trade. For the sake of analytical tractability, we further assume that our model parameters are such that the two economies completely specialize in the production of one of the traded goods with (without loss of generality) home specializing in the production of Y_1 while foreign specializing in the production of Y_2. To derive the equilibrium at trade, we consider the market clearing condition for the factor market of '*home*'. This is given by:

$$\left(\frac{\frac{\theta_{xh}r_hK_h}{p_{xh}}}{\alpha_h}\right)+\left(\frac{\frac{\theta_{y1h}r_hK_h}{p_{y1h}}}{\beta_{1h}}\right)+\left(\frac{\frac{\theta_{y1f}r_fK_f}{E_h^f p_{y1h}}}{\beta_{1h}}\right)=K_h, \tag{4}$$

where K denotes the amount of capital endowment of the subscripted economy and the exchange rate, defined as units of the 'i'th economy's currency per unit of the 'j'th economy's currency, is denoted by E_j^i. In this notational style, we denote the subscript 'j' as the base economy and the superscript 'i' as the comparison economy. It is worthwhile to mention that the term in the first brackets from the left evaluates home's demand for capital from the sector producing the non-traded good X, the term in the middle brackets evaluates home's demand for capital in order to satisfy the domestic consumption of good Y_1, while the term in the last brackets from the left evaluates home's demand for capital to satiate foreign's consumption of the good. In this regard, one might also recall that our parameter restrictions ensure that home is the sole producer of good Y_1. For a solution, we normalize the rental rate of each economy to unity in terms of the currency for the respective economy i.e. $r_h = r_f = 1$ and use equations (1) through (3) to obtain:

$$p_{xi} = \frac{1}{\alpha_i} \forall i \in \{h, f\} \tag{5}$$

$$p_{y1h} = \frac{1}{\beta_{1h}} \tag{6}$$

$$p_{y2f} = \frac{1}{\beta_{2f}} \tag{7}$$

and $$E_h^f = \frac{\theta_{y1f}K_f}{\theta_{y2h}K_h} \tag{8}$$

The productions of the goods at equilibrium are given by:

$$X_i = \alpha_i\theta_{xi}K_i \ \forall i \in \{h, f\} \tag{9}$$

$$Y_{1h} = \beta_{1h}(1-\theta_{xh})K_h \tag{10}$$

and $$Y_{2f} = \beta_{2f}(1-\theta_{xf})K_f \tag{11}$$

The equilibrium consumptions of the non-traded goods coincide with their production figures whereas the equilibrium consumptions of the traded goods (where we use lowercase to indicate consumption demand) are given by:

$$y_{1h} = \beta_{1h}\theta_{y1h}K_h \tag{12}$$

$$y_{2h} = \beta_{2f}\theta_{y1f}K_f \tag{13}$$

$$y_{1f} = \beta_{1h}\theta_{y2h}K_h \tag{14}$$

and $y_{2f} = \beta_{2f}\theta_{y2f}K_f$ (15)

So that at equilibrium home (foreign) specialize in the production of Y_1 (Y_2), our parametric restrictions would require that the price at which the competitive home (foreign) firms supply the commodity market of Y_1 (Y_2) of either economies be less than the price that would have prevailed had that good been manufactured by the competitive firms of foreign (home). This yields us the following set of inequalities:[9]

$$E_h^f p_{y1h} < p_{y1f} \text{ and } E_h^f p_{y2h} > p_{y2f}$$

which may be combined with equations (2) and (3) to yield:

$$\frac{\beta_{2h}}{\beta_{2f}} < E_h^f < \frac{\beta_{1h}}{\beta_{1f}} \text{ or } \frac{\beta_{2h}}{\beta_{2f}} < \frac{\theta_{y1f}}{\theta_{y2h}}\frac{K_f}{K_h} < \frac{\beta_{1h}}{\beta_{1f}} \tag{16}$$

Note that our choice of normalizing the rental rates of the economies yields us the results that the prices observed at equilibrium depend solely on the respective sectoral productivity parameters and that the total income of the economies is equal to their respective endowments of capital. In all of the equations that we model throughout this theoretical section, except where explicitly mentioned, it is understood that the consumption shares: $\theta_{xi}, \theta_{y1i}$and $\theta_{y2i} \forall i \in \{h, f\}$ are functionally dependent on the commodity prices and the income distributions prevailing at the respective economies. This can be formally established through the following functional relationships:

$$\theta_{ch} \equiv \theta_{ch}\left(p_{xh}, p_{y1h}, \frac{p_{y2f}}{E_h^f}, G_h(\cdot)\right) \text{ and}$$

[9] Note that the first inequality ensures that home firms producing Y_1, are able to supply **both home and foreign markets** at a price lesser than their foreign counterparts and similarly, the second inequality ensures that foreign firms producing Y_2, are able to supply **both home and foreign markets** at a price lesser than their home counterparts.

$$\theta_{cf} \equiv \theta_{cf}\left(p_{xf}, E_h^f p_{y1h}, p_{y2f}, G_f(\cdot)\right) \forall c \in \{x, y_1, y_2\}$$

where $G(\cdot)$ represents the income distribution of the indexed economy.

Since this section deals in the possible theoretical determinants of the purchasing power parity (PPP), we are required to compute the same for our model economies. The PPP index represents the price of a reference consumption basket in an economy relative to a base economy. The selection of a suitable reference basket poses some challenge as the economies consume the goods in different ratios. This follows since the commodity prices as well as the income distributions vary across the economies. The latter consideration is important if we allow for non-homotheticity in consumer preferences. Since it is already known from the definition of the commodity shares (represented by subscripted θ) that the amounts of the commodities {X, Y_1, Y_2} consumed by home are given by:

$\left\{\frac{\theta_{xh}}{p_{xh}}K_h, \frac{\theta_{y1h}}{p_{y1h}}K_h, \frac{E_h^f \theta_{y2h}}{p_{y2f}}K_h\right\}$, respectively,

and that for foreign are respectively given by:

$\left\{\frac{\theta_{xf}}{p_{xf}}K_f, \frac{\theta_{y1f}}{E_h^f p_{y1h}}K_f, \frac{\theta_{y2f}}{p_{y2f}}K_f\right\}$,

we anoint the following expression as our reference commodity basket for the goods {X, Y_1, Y_2} respectively:

$$\left\{\frac{\frac{\theta_{xh}}{p_{xh}}K_h + \frac{\theta_{xf}}{p_{xf}}K_f}{D}, \frac{\frac{\theta_{y1h}}{p_{y1h}}K_h + \frac{\theta_{y1f}}{E_h^f p_{y1h}}K_f}{D}, \frac{\frac{E_h^f \theta_{y2h}}{p_{y2f}}K_h + \frac{\theta_{y2f}}{p_{y2f}}K_f}{D}\right\}.$$

In the above expression, various values of the parameter D yields us different definitions of the reference basket. For example, if D = 1, then the reference basket matches the total consumption quantities of the goods across the economies, if D = 2, then the reference basket corresponds to the average consumption quantities of the goods across the economies and if D is the total value of the combined population of both home and foreign, then the reference basket equates to the world's (i.e. combined home and foreign) average per-capita consumption of the goods. In line with the notation used to define the exchange rate, we use the symbol PPP_j^i to denote the price of the reference commodity basket in comparison economy 'i' relative to that in the base economy 'j'. Using this notation, PPP_h^f is given by:

$$PPP_h^f = \frac{\left(\frac{\frac{\theta_{xh}}{p_{xh}}K_h+\frac{\theta_{xf}}{p_{xf}}K_f}{D}\right)p_{xf}+\left(\frac{\frac{\theta_{y1h}}{p_{y1h}}K_h+\frac{\theta_{y1f}}{E_h^f p_{y1h}}K_f}{D}\right)E_h^f p_{y1h}+\left(\frac{\frac{E_h^f\theta_{y2h}}{p_{y2f}}K_h+\frac{\theta_{y2f}}{p_{y2f}}K_f}{D}\right)p_{y2f}}{\left(\frac{\frac{\theta_{xh}}{p_{xh}}K_h+\frac{\theta_{xf}}{p_{xf}}K_f}{D}\right)p_{xh}+\left(\frac{\frac{\theta_{y1h}}{p_{y1h}}K_h+\frac{\theta_{y1f}}{E_h^f p_{y1h}}K_f}{D}\right)p_{y1h}+\left(\frac{\frac{E_h^f\theta_{y2h}}{p_{y2f}}K_h+\frac{\theta_{y2f}}{p_{y2f}}K_f}{D}\right)\frac{p_{y2f}}{E_h^f}}.$$

Note that for any non-zero choice of *D*, the PPP index as defined above becomes free of the parameter *D*. The above relation may be simplified using (5) to yield:

$$PPP_h^f = \frac{\left[\frac{(1-\theta_{xh})E_h^f+\theta_{xh}}{\left(\frac{\alpha_f}{\alpha_h}\right)}\right]+\frac{K_f}{K_h}}{1+\frac{K_f}{K_h}\left[(1-\theta_{xf})\frac{1}{E_h^f}+\theta_{xf}\frac{\alpha_f}{\alpha_h}\right]}.$$

Note that in the absence of any non-traded goods (i.e. $\theta_{xh} = \theta_{xf} = 0$), the PPP equates to the exchange rate. Also, note that since by definition of exchange rate, $E_h^f \equiv 1/E_f^h$, and similarly for the PPP index, $PPP_h^f \equiv 1/PPP_f^h$, the above equation may be manipulated to yield:

$$PPP_f^h \equiv \frac{1}{PPP_h^f} = \frac{\left[\frac{(1-\theta_{xf})E_f^h+\theta_{xf}}{\left(\frac{\alpha_h}{\alpha_f}\right)}\right]+\frac{K_h}{K_f}}{1+\frac{K_h}{K_f}\left[(1-\theta_{xh})\frac{1}{E_f^h}+\theta_{xh}\frac{\alpha_h}{\alpha_f}\right]}$$

and this serves as a check for consistency of the previous equation. The last two equations may be written succinctly as:

$$PPP_j^i = \frac{\left[\frac{(1-\theta_{xj})E_j^i+\theta_{xj}}{\left(\frac{\alpha_i}{\alpha_j}\right)}\right]+\frac{K_i}{K_j}}{1+\frac{K_i}{K_j}\left[(1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right]}\forall i,j\in\{h,f\}, i\neq j \quad (17)$$

We also define the price level index (PLI) index for our model as:

$$PLI_j^i \equiv \frac{PPP_j^i}{E_j^i} = \frac{\left[\frac{(1-\theta_{xj})E_j^i+\theta_{xj}}{\left(\frac{\alpha_i}{\alpha_j}\right)}\right]+\frac{K_i}{K_j}}{E_j^i+\frac{K_i}{K_j}\left[(1-\theta_{xi})+\theta_{xi}\frac{\alpha_i}{\alpha_j}E_j^i\right]}\forall i,j\in\{h,f\}, i\neq j \quad (18)$$

Given this relational association of equation (18), we forward an interesting observation in the form of the following proposition.

Proposition 1: *The price level index of the comparison economy is greater than* (*equal to or lesser than*) *unity or equivalently that the purchasing power parity index of the comparison economy be greater than* (*equal to or lesser than*) *the exchange rate if and only if the following condition holds:*

$$1 \gtreqless E_j^i \left(\frac{\alpha_i}{\alpha_j}\right).$$

or as a special case, when the productivity parameter of the non-traded goods is equal between the two countries (i.e. $\alpha_i = \alpha_j$) then we obtain:

Corollary to proposition 1: *If the productivity parameter of the non-traded goods is equal between the two countries* (*i.e.* $\alpha_i = \alpha_j$) *then, any value of the exchange rate between the comparison and base economies that is greater than* (*equal to or less than*) *unity is enough to guarantee that the price level index of the comparison economy is lesser than* (*equal to or greater than*) *unity or equivalently that the purchasing power parity index of the comparison economy be lesser than* (*equal to or greater than*) *the exchange rate.*

Proof: Equation (18) implies that $PLI_j^i \gtreqless 1$ according to:

$$\left[(1-\theta_{xj})E_j^i + \theta_{xj}\frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)}\right] + \frac{K_i}{K_j} \gtreqless E_j^i + \frac{K_i}{K_j}\left[(1-\theta_{xi}) + \theta_{xi}\frac{\alpha_i}{\alpha_j}E_j^i\right]$$

Rearranging the above, it follows:

$$PLI_j^i \gtreqless 1 \Leftrightarrow \frac{\frac{K_i}{K_j}\theta_{xi} + \theta_{xj}\frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)}}{\theta_{xj} + \frac{K_i}{K_j}\theta_{xi}\frac{\alpha_i}{\alpha_j}} \gtreqless E_j^i \Leftrightarrow 1 \gtreqless E_j^i \left(\frac{\alpha_i}{\alpha_j}\right) \text{ QED.} \quad (19)$$

Also, from an inspection of equation (17) and (18), the following implications of our theoretical model are immediate:

Proposition 2: *For any given values of the consumption shares of the non-traded goods, the relative productivities of the non-traded sector and the relative factor endowments, if there is an increase* (*decrease*) *in the exchange rate* (E_j^i) *of an economy 'i' relative to economy 'j' then the purchasing power parity of that economy relative to the other economy* (*i.e.*PPP_j^i) *also rises* (*falls*).

Proposition 2A: *For an increase in the exchange rate* (E_j^i) *of an economy 'i' relative to economy 'j', the PLI of economy 'i' relative to economy 'j'* (*i.e.*PLI_j^i) *rises* (*remains unchanged* or *falls*) *if and only if:*

$$PLI_j^i < (= \text{or} >) \frac{(1-\theta_{xj})}{\left(1+\frac{K_i}{K_j}\theta_{xi}\frac{\alpha_i}{\alpha_j}\right)}.$$

Proof: Given the consumption shares of the non-traded goods, the relative productivities of the non-traded sector and the relative factor endowments, equation (17) clearly shows that an increase in in the exchange rate (E_j^i) unambiguously increases the numerator while decreasing the denominator. Thus the first part of the proposition follows. The second part follows since:

$$\frac{\partial PLI_j^i}{\partial E_j^i} \mid_{\frac{K_i}{K_j},\theta_{xi},\theta_{xj}} = \frac{(1-\theta_{xj})}{E_j^i+\frac{K_i}{K_j}\left[(1-\theta_{xi})+\theta_{xi}\frac{\alpha_i}{\alpha_j}E_j^i\right]} - \frac{\left\{\left[(1-\theta_{xj})E_j^i+\theta_{xj}\frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)}\right]+\frac{K_i}{K_j}\right\}\left(1+\frac{K_i}{K_j}\theta_{xi}\frac{\alpha_i}{\alpha_j}\right)}{\left\{E_j^i+\frac{K_i}{K_j}\left[(1-\theta_{xi})+\theta_{xi}\frac{\alpha_i}{\alpha_j}E_j^i\right]\right\}^2}$$

and $\frac{\partial PLI_j^i}{\partial E_j^i} \mid_{\frac{K_i}{K_j},\theta_{xi},\theta_{xj}} \gtreqless 0 \Leftrightarrow \frac{(1-\theta_{xj})}{\left(1+\frac{K_i}{K_j}\theta_{xi}\frac{\alpha_i}{\alpha_j}\right)} \gtreqless PLI_j^i$

QED.

Proposition 3: *For any given values of the consumption shares of the non-traded goods, the exchange rate and the relative productivities of the non-traded sector, an increase in the factor endowment of an economy 'i' relative to economy 'j' increases* (*does not affect* or *decreases*) *the purchasing power parity and the PLI of economy 'i' relative to the other economy 'j'* (*i.e.* PPP_j^i *and* PLI_j^i *respectively*) *if and only if:*

$$\left(\frac{PPP_j^i - E_j^i}{PPP_j^i}\right) < (= \text{or} >)\theta_{xi}\left(1-\frac{\alpha_i}{\alpha_j}E_j^i\right).$$

Proof: Differentiating (17) we obtain:

$$\frac{\partial PPP_j^i}{\partial\left(\frac{K_i}{K_j}\right)} \mid_{E_j^i,\theta_{xi},\theta_{xj}} = \frac{1}{1+\frac{K_i}{K_j}\left[(1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right]} - \frac{\left\{\left[(1-\theta_{xj})E_j^i+\theta_{xj}\frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)}\right]+\frac{K_i}{K_j}\right\}\left[(1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right]}{\left\{1+\frac{K_i}{K_j}\left[(1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right]\right\}^2}$$

Thus, $\frac{\partial PPP_j^i}{\partial\left(\frac{K_i}{K_j}\right)} \mid_{E_j^i,\theta_{xi},\theta_{xj}} \gtreqless 0 \Leftrightarrow 1 \gtreqless PPP_j^i\left[(1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right]$,

or on multiplying the relation throughout by E_j^i:

$$\frac{\partial PPP_j^i}{\partial\left(\frac{K_i}{K_j}\right)} \mid_{E_j^i,\theta_{xi},\theta_{xj}} \gtreqless 0 \Leftrightarrow E_j^i \gtreqless PPP_j^i\left(1-\theta_{xi}+\theta_{xi}\frac{\alpha_i}{\alpha_j}E_j^i\right).$$

The proof is completed once we rearrange the terms and invoke the condition that:

$$\frac{1}{E_j^i}\frac{\partial PPP_j^i}{\partial\left(\frac{K_i}{K_j}\right)} \mid_{E_j^i,\theta_{xi},\theta_{xj}} \equiv \frac{\partial PLI_j^i}{\partial\left(\frac{K_i}{K_j}\right)} \mid_{E_j^i,\theta_{xi},\theta_{xj}}$$

QED.

Proposition 4: *Given the exchange rate, the relative productivities of the non-traded sector and the relative factor endowments:*

(i) *If* $PPP_j^i > E_j^i$ *then, an increase in the proportion of income spent on consumption of the good produced in the non-traded sector of* ***either economy*** *increases* PPP_j^i *and* PLI_j^i.

(ii) *If* $PPP_j^i = E_j^i$ *then an increase in the proportion of income spent on consumption of the good produced in the non-traded sector of* ***either economy*** *does not affect* PPP_j^i *and* PLI_j^i.

(iii) *If* $PPP_j^i < E_j^i$ *then an increase in the proportion of income spent on consumption of the good produced in the non-traded sector of* ***either economy*** *decreases both* PPP_j^i *and* PLI_j^i.

Proof: This follows from equation (17) after differentiation with respect to the proportions of income spend by an economy '*i*' and '*j*' to consume the good produced in the non-traded sector. These are given by:

$$\frac{\partial PPP_j^i}{\partial\theta_{xi}} \mid_{E_j^i,\frac{K_i}{K_j},\theta_{xj}} = -\frac{\left[\left((1-\theta_{xj})E_j^i+\theta_{xj}\frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)}\right)+\frac{K_i}{K_j}\right]\frac{K_i}{K_j}\left(-\frac{1}{E_j^i}+\frac{\alpha_i}{\alpha_j}\right)}{\left[1+\frac{K_i}{K_j}\left((1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right)\right]^2} \quad \text{and}$$

$$\frac{\partial PPP_j^i}{\partial\theta_{xj}} \mid_{E_j^i,\frac{K_i}{K_j},\theta_{xi}} = \frac{-E_j^i+\frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)}}{1+\frac{K_i}{K_j}\left((1-\theta_{xi})\frac{1}{E_j^i}+\theta_{xi}\frac{\alpha_i}{\alpha_j}\right)}.$$

Thus,

$$\frac{\partial PPP_j^i}{\partial \theta_{xi}} \Big|_{E_j^i, \frac{K_i}{K_j}, \theta_{xj}} \gtreqless 0 \Leftrightarrow \frac{1}{E_j^i} - \frac{\alpha_i}{\alpha_j} \gtreqless 0 \text{ and } \frac{\partial PPP_j^i}{\partial \theta_{xj}} \Big|_{E_j^i, \frac{K_i}{K_j}, \theta_{xi}} \gtreqless 0 \Leftrightarrow -E_j^i + \frac{1}{\left(\frac{\alpha_i}{\alpha_j}\right)} \gtreqless 0.$$

Since by the definition of PLI,

$$\frac{\partial PLI_j^i}{\partial \theta_{xi}} \Big|_{E_j^i, \frac{K_i}{K_j}, \theta_{xj}} = \frac{1}{E_j^i} \frac{\partial PPP_j^i}{\partial \theta_{xi}} \Big|_{E_j^i, \frac{K_i}{K_j}, \theta_{xj}} \text{ and } \frac{\partial PLI_j^i}{\partial \theta_{xj}} \Big|_{E_j^i, \frac{K_i}{K_j}, \theta_{xi}} = \frac{1}{E_j^i} \frac{\partial PPP_j^i}{\partial \theta_{xj}} \Big|_{E_j^i, \frac{K_i}{K_j}, \theta_{xi}},$$

Proposition 4 is immediate once we compare the conditions with condition (19) of the proof of proposition 1. QED.

Let us now make the following additional assumption:

A1: The relatively poor consume the nontraded good proportionately more than the relatively rich.

Since we took the factor prices as our numeraire i.e. $r_h = r_f = 1$, given the endowments, the incomes of the economies are constant and, thus using proposition 4 **under A1**, leads us to the following further proposition as the corollary to Proposition 4:

Proposition 5: *Given the exchange rate, the relative productivities of the non-traded sector, the relative factor endowments and assumption A1:*

(i) *If* $PPP_j^i > E_j^i$ *then, an increase in the* ***inequality*** *in* ***either economy*** *decreases* PPP_j^i *and* PLI_j^i.

(ii) *If* $PPP_j^i = E_j^i$ *then, an increase in the* ***inequality*** *in* ***either economy*** *does not affect* PPP_j^i *and* PLI_j^i.

(iii) *If* $PPP_j^i < E_j^i$ *then, an increase in the* ***inequality*** *in* ***either economy*** *increases both* PPP_j^i *and* PLI_j^i.

Note that Proposition 5 holds because given the economy-wide income (given the endowments), an increase in inequality coincides with a regressive transfer of income from a poor to a rich individual within a country. This in turn implies that with the transfer, an additional amount of income (equal to the amount of the transfer) is being spent following the consumption pattern of the rich (which was previously being spent following the consumption pattern of the poor). Since the poor are assumed to consume the nontraded good proportionately more than the relatively rich, the transfer decreases the proportion of income

spent on the consumption of the good produced in the non-traded sector of the concerned economy. The rest of the result follows from proposition 4.

Note that in course of the above argument, the prices of the commodities (which depend on the productivity parameters only) remain unaltered. Under the altered assumption where the relatively poor consume the nontraded good proportionately less than the relatively rich, the previous propositions get completely reversed.

3. The Evidence in Favor of Non-Homothetic Preferences

In order for the income distribution to affect aggregate demand and, hence, the 'reference basket', thereby opening up the link between consumption pattern, inequality and PPP that is central to this exercise, preferences need to be non-homothetic. In other words, the item-wise budget shares must vary with aggregate household expenditure. To provide evidence on this issue, we ran cross-country regressions of mean budget shares on aggregate per capita expenditure, inflation (as measured by the GDP deflator), and country dummies reflecting the country's status as a 'low', 'middle' or 'rich' income country. Taking the high income OECD and non OECD countries as the default category, the country dummies 2, 3, and 4 refer to, respectively, 'middle high income' countries, 'middle low income' countries and 'low income' countries. [10] These cross-country regressions were run on the pooled cross-country consumption data collected in the ICP 2005 and ICP 2011 exercises [World Bank (2008, 2015)]. The local currency–denominated aggregate expenditures were converted to US $ using the PPP for that year.

[Table 1 about here]

The results of the regressions on a five broad item breakdown of aggregate expenditure have been reported in Table 1. Relative to the default country group consisting of the rich countries, the 'middle low' and 'low income' countries spend a greater share of the household budget on items of necessity such as food and clothing, and significantly less on education and health. Four of the five item groups reject homotheticity quite convincingly. Consistent with Engel's law, the budget share of the first group of items, which is heavily dominated by the necessities

[10] These are defined in Appendix A.

food and clothing, is negatively impacted by rising household expenditure, while the reverse is the case for the fourth group, which consists mainly of luxury items such as recreation, eating out and culture expenses. The insignificance of aggregate expenditure on budget share of the residual fifth group mainly reflects its heterogeneous constituents with the positive and negative expenditure effects on their budget shares cancelling one another to give a misleading impression of homothetic preferences of this motley group of items.[11] Table 1 also shows that a country's affluence status has a significant impact on its expenditure allocation, more for some items groupings, less for others. There is weak evidence of temporal shift towards food, clothing and footwear, and fuel, and away from education and health during the period between the two ICPs. Ceteris paribus, overall inflation, as measured by the GDP deflator, does not lead to significant changes in expenditure allocation, except for a move away from the fourth group of items which are mainly luxury items. The overall picture from Table 1 is one of non-homothetic preferences that set up the rationale for the rest of this empirical exercise.

4. Determinants of PPP Changes between Countries and over Time

The information for performing the cross-country empirical exercises reported in this section, and the next, was constructed from a variety of data sources, mostly from information published by the World Bank on its website. The data sources and explanation of variables have been listed in Appendix A.

Following the debate between Ravallion (2013a, 2013b) and Inklaar (2013), we investigate the effect of movements in the real per capita expenditure, exchange rate, inflation (as measured by the GDP deflator) and, crucially, the intra-country inequality on PPP changes. We ran panel regressions on cross-country data sets from the ICP years, 1993, 1996,[12] 2005 and 2011. Following the suggestion in Inklaar (2013, p. 616), the panel regressions 'unpacked' the exchange rate from the PPP and used the following specification that extends Inklaar's eq. (2) to include income inequality:

$$ln\left(\frac{PPP_{it}}{PPP_{it-1}}\right) = \alpha + \beta_1 ln\left(\frac{P_{it}}{P_{it-1}}\right) + \beta_2 ln\left(\frac{Y_{it}}{Y_{it-1}}\right) + \beta_3 ln\left(\frac{E_{it}}{E_{it-1}}\right) + \beta_4 ln\left(\frac{In_{it}}{In_{it-1}}\right) + \varepsilon_{it} \quad (20)$$

[11] Such a grouping was unavoidable since a finer breakdown led to many zeroes in the cross country data sets.

[12] There was a small ICP in 1996, as reported in Ravallion (2013a).

PPP is the purchasing power parity, P is the GDP deflator that is used as a measure of inflation,[13] Y is the GDP per capita at national prices, E is the nominal exchange rate, In is Gini measure of inequality, ε denotes the error term which includes omitted effects, *i* denotes country, *t* denotes time. The existence of 'Dynamic Penn effect' (DPE) is denoted by the term $[\beta_2\ ln\left(\frac{Y_{it}}{Y_{it-1}}\right) + \ \beta_3\ ln\left(\frac{E_{it}}{E_{it-1}}\right)]$, with the maintained hypothesis of a DPE given by the joint parametric restrictions, $\beta_2 > 0$ and significant, and $\beta_3 = 1$.

The 'Static Penn effect' (SPE), that was the basis of the original Balassa Samuelson formulation, is contained in the a-temporal version of (20) involving PPP variation between countries at a point in time.

$$ln\ (PPP_{it}) \ = \ \tilde{\alpha} \ + \ \widetilde{\beta_1}\ ln\ (P_{it}\ ) \ + \ \widetilde{\beta_2}\ ln\ (Y_{it}\ ) \ + \ \widetilde{\beta_3} ln\ (E_t) \ + \ \widetilde{\beta_4}\ ln\ (In_t) + \ \varepsilon_{\ it} \qquad (21)$$

The existence of 'Static Penn effect' (SPE) is denoted by the maintained hypothesis consisting of the joint parametric restrictions, $\widetilde{\beta_2} > 0$ and significant, and $\widetilde{\beta_3} = 1$.

[Figures 1, 2, 3 and 3a about here]

Figure 1 provides a visual representation of one of the necessary conditions for 'Static Penn effect' by plotting PPP against *Y* in logarithmic scale in each of the 4 ICP years, 1993, 1996, 2005 and 2011. There is clearly a positive relationship between the two in each year. This is also true of the corresponding relationship between PPP and exchange rate in Figure 2. Figure 3 shows that there is also prima facie evidence in favor of a positive relationship between PPP and intra-country inequality. As we report later, this evidence becomes much stronger once we control for the other determinants. While Figure 3 depicts the relationship between PPP and intra-country inequality year by year, Figure 3a shows the corresponding relationship on the combined data set pooled over the 4 years. The increasing relationship looks much stronger in

[13] We have taken our GDP deflator as the ratio of GDP evaluated at current international Dollar to GDP calculated at constant 2011 international Dollar. This contrasts with the definition used by both Inklaar and Ravallion. We have done this basically for three reasons: (1) Since PPP constitutes the dependent variable, it seems more appropriate to measure price changes in terms of PPP; (2) the use of current and constant US Dollars may lead to misleading results because the effect of US inflation will be embedded in it as we are using a long time span and (3) the ratios in local currency units are not comparable as the base years vary with countries.

Figure 3a which introduces the temporal movement in the inequality changes that seem to reinforce and strengthen the positive relationship between PPP and inequality.

[Table 2 about here]

Table 2 provides the estimates of equation (21) for 2005 and 2011. Here evidence of the 'Static Penn effect' is not observed in either year. Although $\widetilde{\beta_2} > 0$ and significant, the test for $\widetilde{\beta_3} = 1$ strongly rejects the hypothesis in both years. Effect of the GDP deflator is non-significant. The evidence on the effect of inequality (interacted with the countries classified into 'low' and 'middle and upper' income levels) on PPP is mixed. Effects are positive for both years for the low income countries, but significant only in 2005. For the higher income countries the effects are non-significant.[14] A possible explanation for the differential effect of the low and high income countries could be that with increase in income while low income countries almost certainly move towards consumption of tradeable goods, the higher income countries, who are already consuming tradeable goods, move towards consumption of luxurious non-tradeable items (like recreation, services of maids etc.). Consistent with Proposition 2, there is a strong and significantly positive relationship between PPP and exchange rate, the effect being much stronger in 2011.

Turning now to the pooled ICP data sets over the 4 years, the following was the estimable form of equation (20).

$$Dln(PPP_{it}) = \text{Trend} + \alpha_1 Dln(GDP\text{Deflator}_{it}) + \alpha_2 Dln(GDP_{it}) + \alpha_3 Dln(E_{it}) + \beta DZ_{it} + \epsilon_{it} \quad (22)$$

Note:

a. Trend is adjusted by the gap (no. of years) between two time periods. It is used to remove country specific fixed effects.
b. The operator *D* denotes difference over time i.e., $Dx_t \equiv x_t - x_{\text{previous } t}$.
c. $t \in \{1993, 1996, 2005, 2011\}$.
d. Z_{it} is a vector of interaction terms between inequality and two groups of countries (the 'low income countries' and 'higher income countries' consisting of lower middle, upper middle, high income non OECD and high income OECD countries) and β is a vector of the associated coefficients.[15]

[14] When the two groups are merged the overall effect of inequality turns out to be non-significant for both years.

[15] The results are robust to alternative classification of countries (e.g. merging the 'lower middle income' group with the 'low income' group).

[Table 3 about here]

Table 3 presents the estimates of equation (22) without the inequality variables. Since the information on inequality is available for only a subset of the countries, Table 2 allowed estimation on the maximum number of observations available in the pooled sample. Note that the evidence in favor of a 'Dynamic Penn effect' is quite strong (for both with and without the 'Trend' variable) with the highly significant positive estimates of the coefficients of per capita GDP variable and exchange rate variable and non-rejection of the hypothesis of $\alpha_3 = 1$. The coefficient of the GDP deflator variable is positive, but non-significant. The strong positive relationship between PPP and exchange rate corroborates the prediction of Proposition 2. The inclusion or omission of the Trend variable has little or no effect on the estimates.

[Table 4 about here]

Table 4 presents a more complete picture by reporting the estimates of equation (22) with the inequality. Proposition 5 predicts that the nature of the effect of inequality on PPP will vary between countries (mostly developing) with PPP less than exchange rates, and those with PPP equal to or greater than exchange rates (mostly affluent developed countries). Table 4 presents robust evidence of a positive relationship between PPP and intra-country inequality as predicted by Proposition 5 for countries with PPP less than the exchange rate.[16] Note from the table that the inclusion or omission of the Trend variable has little effect on the strong statistical significance of the inequality coefficient estimate in case of the low income countries. A comparison between the first two columns of estimates of Table 4 shows that the enforcement of the restriction that the exchange rate coefficient, α_3 =1, which means that we are estimating the changes in the price level index (PLI) rather than in the PPP, increases quite sharply the magnitude of the estimated inequality effect. Note, also, from the first and third columns of estimates, that the existence of the DPE ($\alpha_2 > 0$, α_3 =1) is robust to the inclusion of the inequality variable and, as in Table 3, the Trend variable has no visible effect on the estimates.

5. Counterfactual PPPs : Methodology and Comparison with the ICP PPPs

The Methodology

[16] In the 'low income group' in 98% cases PPP is less than the Exchange rate.

The procedure used here for calculating the alternative set of PPPs to bench mark against those implied by the ICP PPPs is due to Coondoo, Majumder and Chattopdhyay (2011). The present study extends the Coondoo et al. (2011) study by using their suggested procedure proposed in the single country context of India to provide evidence on sub-national PPPs to the current cross country context to estimate an alternate set of PPPs that provide a useful comparison with the recently released ICP PPPs from the 2011 round.

The Coondoo, Majumder and Chattopadhyay (2011) procedure is based on the estimation of Engel curves on a single cross section data. The attractiveness of their procedure has been described by the authors as follows: "The novelty of the procedure is that it overcomes the problem of data inadequacy, a problem that is shared by most of the developing countries. The procedure does not require item-specific price/unit value data and price index numbers can be calculated from consumer expenditure data grouped by per capita income/total consumer expenditure class in a situation where unit level data are not available." (p. 138) In the current context, this offers a significant advantage for benchmarking the ICP PPPs, since much of the controversy over the accuracy of the ICP PPPs has centered around questions over the accuracy of the price information used in the ICP 2005 and ICP 2011 rounds. The counterfactual PPPs presented here allow a clean comparison since the procedure does not need to use the controversial price information collected in the ICP 2011 round. Moreover, as this study illustrates, the published World Bank data does contain the disaggregated expenditure information (by items and by expenditure classes) at country level required to implement the procedure to calculate the alternative set of PPPs.

The use of estimated Engel curves to construct price indices has a rich history. The idea can be traced back to Costa (2001) and Hamilton (2001) who used it to investigate and correct the 'biases' in official consumer price indices. Recent applications include Almas (2012) to estimate the consequence of 'PPP bias' on real income comparisons between countries, Almas, Kjelsrud and Somanathan (2013) to examine the bias in calculating poverty rates in India, and Beatty and Larsen (2005), Gibson, Stillman and Le (2008), Barrett and Brozozwoski (2010) to estimate the bias in CPI in Canada, the Russian Federation and Australia, respectively. The procedure rests on the underlying assumption of Costa (2001) and Hamilton (2001) that (a)

there is a stable Engel relationship[17] at the household level between the budget share of food and per capita household expenditure, (b) a household's budget share of food is a measure of that household's welfare and (c) that equal food shares between households, corrected for household compositional and demographic characteristics, denote equal welfare.

In estimating the counterfactual PPPs, the present exercise follows Almas (2012) in adopting a preference consistent, 'complete demand systems' estimation procedure on cross country data that embodies the preference PPP link that is a central feature of this paper. The methodology is based on the fact that the PPP can be viewed as a True Cost of Living Index that is defined below. The general cost function underlying Quadratic Logarithmic (QL) systems, (e.g., the Quadratic Almost Ideal Demand System (QAIDS) of (Banks, Blundell and Lewbel, 1997) is of the form:

$$C(u,p) = a(p).exp\left(\frac{b(p)}{(1/ln\,u)-\lambda(p)}\right), \tag{23}$$

where p is the price vector, $a(p)$ is a homogeneous function of degree one in prices, $b(p)$ and λ (p) are homogeneous functions of degree zero in prices, and u denotes the level of utility.[18] The budget share functions corresponding to the cost function (23) are of the form

$$w_i = a_i(p) + b_i(p)\,ln\left(\frac{x}{a(p)}\right) + \frac{\lambda_i(p)}{b(p)}\left(ln\frac{x}{a(p)}\right)^2, \tag{24}$$

where x denotes nominal per capita expenditure and *i* denotes item of expenditure.

The corresponding True Cost of Living Index (TCLI) in logarithmic form comparing price situation p^1 with price situation p^0 is given by

$$ln\,P(p^1,p^0,u^*)=[ln\,a(p^1) - ln\,a(p^0)] + \left[\frac{b(p^1)}{\frac{1}{ln\,u^*}-\lambda(p^1)} - \frac{b(p^0)}{\frac{1}{ln\,u^*}-\lambda(p^0)}\right], \tag{25}$$

where u^* is the reference utility level. Note that "price situation" refers to the prices prevailing in a particular country in a given year. The first term of the R.H.S. of (25) is the logarithm of the basic index (measuring the cost of living index at some minimum benchmark utility level) and the second term is the logarithm of the marginal index. Note that for $p^1 = \theta p^0, \theta > 0$, $a(p^1) = \theta a(p^0)$, so that the basic index takes a value θ and hence, may be interpreted as that

[17] The empirical support for the idea of a stable Engel relationship between countries can be traced back to Houthakker (1987).

[18] Equation (23), and the ones following, should have a country subscript that we have omitted to simplify the exposition.

component of TCLI that captures the effect of uniform or average inflation on the cost of living. On the other hand, for $p^1 = \theta\, p^0$, $\theta > 0$, $b(p^1) = b(p^0)$ and $\lambda(p^1) = \lambda(p^0)$, the marginal index takes a value of unity. Hence, the marginal index may be interpreted as the other component of TCLI that captures the effect of changes in the relative price structure.

The procedure for estimating PPP for *R* countries, taking country 0 as base,[19] involves three stages.

Stage 1: a set of item-specific Engel curves relating budget shares to the logarithm of income are estimated for each country *r = 0, 1, 2…R* as follows.

$$w_{ij}^r = a_i^r + b_i^r ln x_j^r + c_{ir}(ln x_j^r)^2 + \varepsilon_{ij}^r, \tag{26}$$

i denotes item, *j* denotes income category (or household)[20], ε_{ij}^r is a random disturbance term and a_i^r, b_i^r, c_i^r are parameters that contain the price information on item *i* in country *r.*

Stage 2: $a(p^r)$, *r = 0, 1, 2…,R* is estimated from the following equation obtained by equating equations (24) and (26):

$$\hat{b}_i^r - \hat{b}_i^0 = ln a(p^0)(2\hat{c}_i^0) - ln a(p^r)(2\hat{c}_i^r) + e_i^r\ ; \qquad r = 1, 2, \dots, R. \tag{27}$$

Here e_i^r is a composite error term, which is a linear combination of the individual errors of estimation of the parameters a_i^r, b_i^r, c_i^r and p^0 denotes the price vector of the base country.

Stage 3: Using the normalization $b(p^0) = \lambda(p^0) = 1$, the money metric utility u_j^0 of the *j*-th income group of the base country (India) that has nominal per capita income $x_j^0 \left(= C\left(u_j^0 p^0\right)\right)$ is obtained from (23) as:

$$\frac{1}{ln\, u_j^0} = \frac{1}{ln \frac{x_j^0}{a(p^0)}} + 1. \tag{28}$$

Again, using the expression in (23) for country *r,* income group *j,* and (28), $b(p^r)$ and $\lambda(p^r)$, *r = 1, 2…, R;* are estimated from the following regression equation:[21]

[19] In the calculations reported later, we take India as the base country, 0.

[20] For all countries the counterfactual PPPs are based on data by income categories (rural and urban combined), as provided by the World Bank on its website. Additionally, for some selected countries counterfactual PPPs have been calculated based on household level data. Details are provided in Appendix A.

[21] The regression set up arises because $\widehat{a(p^r)}$ and $\widehat{a(p^0)}$ are estimated values. See Coondoo, Majumder and Chattopadhyay (2011) for a detailed description.

$$\frac{1}{ln\left(\frac{x_j^r}{\widehat{a(p^r)}}\right)} = \frac{1}{b(p^r)}\left(\frac{1}{ln\frac{x_j^0}{\widehat{a(p^0)}}} + 1\right) - \frac{\lambda(p^r)}{b(p^r)} + \ error. \tag{29}$$

To estimate (29) we take *j* as decile (percentile) group so that the data are comparable across countries. The PPPs are then estimated as TCLIs from equation (25) for a given reference level of utility u^* (taken to be the one corresponding to the median level income of the base country, India). It may be emphasized that $a(p^r), b(p^r)$and $\lambda(p^r)$ are estimated as composite variables and no explicit algebraic forms for these functions are assumed. This confers the advantage that the estimated PPPs are not dependent on a priori specified particular functional forms such as, for example, the specification proposed by Banks, Blundell and Lewbel (1997).

Comparison with the ICP PPPs

[Table 5 about here]

Table 5 presents the counterfactual PPPs based on World Bank data on broad item groups by income categories for rural and urban sectors,[22] with India as base. The table also presents the 2011 ICP Consumption PPPs, where the base country has been shifted from the US to India by dividing all the PPPs (with respect to US $) by the PPP of India with US as base. In case of a few countries, for example, Chad, Ethiopia and Ghana, the two PPPs are nearly identical, but this is not always the case. The bias in the 2011 ICP PPPs in relation to the counterfactual PPP is not unidirectional. In general, the 2011 ICP PPPs in the African region exceed the counterfactual PPPs, and the reverse is the case in the Asia/Pacific region. While in case of several countries, for example, South Africa, China and Indonesia, there is a large difference between the 2011 ICP PPP and its 2011 counterfactual, overall, there is a positive correlation between the two. The overall correlation coefficient, over all countries taken together, turns out to be 0.9134. The region specific correlations are 0.9189, 0.9996, 0.9985 and 0.9706, respectively, for the 'African region', the 'Asia and Pacific region', the 'Commonwealth of Independent States and Eurostat-OECD' region and the remaining region consisting of Latin America, Western Asia and the Caribbean.[23]

[Figures 4, 5 and 6 about here]

[22] See Appendix A for description of income category level.

[23] All the correlations are significant at less than 1% level.

Figure 4 presents a graph of these counterfactual PPPs against the 2011 ICP PPPs in logarithmic scale. The 45 degree broken line through the origin represents the benchmark case of equality between the two PPPs for each country. It can be clearly observed that for most part the 2011 ICP PPPs are lower than the counterfactual PPPs. From the table it is evident that almost the entire non-African region and some African countries constitute this part with the ICP PPPs lower than the corresponding counterfactuals. This result is analogous to the observation made in, for example, Ravallion (2014) that the 2011 ICP PPPs were lower than their counterpart in the 2005 ICP PPP. This feature translates into the PPP deflated GDP values, presented in Figures 5 and 6. While Figure 5 plots the per capita GDP values using counterfactual PPP deflator against those using the 2011 ICP PPP deflator, Figure 6 plots the corresponding aggregate GDP values. On superimposition of the line of equality between the two axes Figure 5 shows that for most part the per capita GDPs deflated by 2011 ICP PPPs lie above those deflated by the counterfactual PPPs. Figure 6 shows the overstatement of GDP by the 2011 ICP PPP in relation to the counterfactual PPP more clearly since the 45 degree line of equality between the two GDP values lies uniformly above the fitted line. This is analogous to the result noted in Ravallion (2014), Inklaar and Rao (2015), Jolliffe and Prydz (2015) on the overstatement of the 2011 PPP deflated real GDP in relation to the 2005 PPP deflated real GDP. While the temporal comparison between the 2005 and 2011 PPP and real GDP values in the above cited studies is with respect to the US dollar and the US economy, the comparison here relates to the same year (2011) and is with respect to the Indian Rupee and the size of the Indian economy. If one considers the present results in conjunction with the earlier ones, then we have robust evidence of understatement of the PPPs and overstatement of the PPP deflated GDP values in the 2011 ICP.

[Tables 6a and 6b about here]

Table 6a presents the per capita annual GDP evaluated at 2011 ICP Consumption PPP and at counterfactual PPP with India as base and Table 6b presents the corresponding values for per capita aggregate consumption.[24] The qualitative pictures portrayed by these tables are quite similar and mirror the comparative PPP estimates reported in Table 5. The revisions to the 2011 ICP PPP deflated GDP and consumption figures implied by the corresponding counterfactual

[24] Tables B6a and B6b, in Appendix B, present the results in logarithmic scale.

PPP deflated estimates are not unidirectional and vary across regions and between countries. However, the large downward revisions from the 2011 ICP PPP deflated to the counterfactual PPP deflated GDP and consumption figures occur more frequently than the reverse, especially in the larger and more populated countries such as South Africa, China, Mexico and Russia. Consequently, consistent with Figures 5 and 6, a comparison of the mean and median figures between the two PPP deflated values in either table establishes the result that the 2011 ICP overestimates the real size and consumption of the world at large. A result of particular interest is that the feature that China's dominance over India on per capita GDP is sharply reduced from the ICP PPP to the counterfactual PPP deflated values.

[Tables 7a and 7b about here]

The ratios of per capita annual GDP of the different countries to the per capita annual GDP of India, evaluated at the alternative PPPs, are presented in Table 7a and the corresponding ratios for per capita annual aggregate consumption are given in Table 7b. These tables mirror Tables 6a, 6b in showing that in most cases the dominance over India in the per capita GDP and consumption figures shrinks, and in few cases even gets reversed, when we use the counterfactual PPP in place of the 2011 ICP PPP. The widely made claim that the 2011 ICP made the poorer countries look lot 'less poor' vis a via the USA can be extended to the result that India looks 'far poorer' on the ICP PPP than on the counterfactual PPP.

An underlying assumption in both sets of PPPs that we have compared in this study is that all the income groups face the same PPP, analogous to the assumption of a single economy-wide PPP for each country's currency that holds true for all regions. While the latter assumption is now considered untenable as reflected in the increasing emphasis on the calculation of subnational PPPs, there is still not much awareness of the need for subclass PPPs. Table 8 provides evidence on the latter and, also, on the robustness of the comparison between the 2011 ICP PPP and its counterfactual, by presenting the counterfactual PPP by income quintile based on the publicly available disaggregated household level expenditure data of Iraq, Malawi and Tanzania supplemented by the unit records from India's National Sample Survey and Vietnam's Living Standard Survey- see Appendix A for details.

[Table 8 about here]

It is evident from Table 8 that except for Tanzania, the overall PPPs based on household level data are greater than the ICP PPPs. This is in line with the finding from Table 5, where for almost the entire non-African region and some African countries this feature is observed. There are variations in PPP values across income quintiles, the values of the coefficient of variation (CV) for Iraq, Malawi, Tanzania and Vietnam being 0.152, 0.085, 0.084 and 0.074, respectively. This complements the evidence in favor of subnational PPPs, and is consistent with the variation across expenditure percentiles in PPP between India and Vietnam reported in Majumder, Ray and Sinha (2015a). In other words, poverty level PPP s are quite different from the aggregate PPPs, and this should be recognized when drawing up international poverty lines. However, this variation in PPP has little effect on the overall inequality between households pooled over these four countries as evident from the values of the Gini coefficient presented in Table 9.

[Table 9 about here]

6. Concluding Remarks

This paper is written in the wake of the recent release by the World Bank (2015) of the final results of the 2011 International Comparison Project (ICP) that provided estimates of the Purchasing Power Parities (PPP) between different countries' currencies. PPPs play a central role in economic analysis because they are required in a host of international welfare comparisons, such as cross-country comparisons of poverty rates, real GDP and real consumption expenditures, and the calculation of the total number of people in poverty. The 2011 ICP exercise has generated renewed interest in the concept of PPP that can be traced back to the early work of Cassel, Balassa and Samuelson. PPPs are considered better measures of the 'true' purchasing power of a country's currency and more relevant in comparisons of living standards than exchange rates, since PPPs are based on both tradeable and non-tradeable items unlike exchange rates, which reflect only the price differences of tradeable items. This distinction makes the PPP of particular importance for developing countries with a lower consumption share of tradeable items leading to a greater deviation of the PPPs from exchange rates in relation to the developed countries.

Since inaccurate PPP estimates are likely to distort the cross-country comparisons, much attention has been focused on the accuracy of the estimated PPPs yielded by the successive ICPs. If, as happened between 1993 and the 2005, the PPPs are revised upwards sharply, the

developing world suddenly looks lot ‘poorer’ than previously in relation to the USA, which is adopted as the base country. The reverse occurred between 2005 and 2011, with the downward revision not able to fully restore the PPPs to the 1993 level. With the poverty rates fluctuating wildly over time, it is not clear whether this is really due to changes in the poverty situation or is merely reflecting the PPP revisions between the ICP rounds. For example, are the 2011 ICP PPPs really ‘too low’ or are they merely correcting the ‘implausibly high’ estimates of the 2005 ICP? This raises the issue of benchmarking the 2011 ICP PPPs against those from using an alternative methodology on data for the same year. Since, given the large-scale nature of the ICP, such exercises cannot be undertaken frequently, and one needs the PPPs in intermediate years, much attention has also been paid recently to the econometric specification used to predict the PPPs in the intermediate years and beyond. This raises the issue of identifying the principal determinants of PPP changes between countries and over time. This paper investigates both sets of issues and provides empirical evidence that is likely to inform the World Bank on future directions for the ICP exercises.

The contribution of this study to the topic of PPP is analytical, methodological and empirical. On the analytical front, it provides a framework that deviates from the conventional Balassa Samuelson framework that is driven by productivity differences in the non-tradeable sector between the developed and developing countries. The proposed framework of this study focusses attention, instead, on the neglected link between consumer preferences and PPP, and derives propositions on the relation between PPP and exchange rate and, more significantly, between PPP and intra country inequality. The paper provides empirical evidence that provides support for several of the propositions. Taken in conjunction with the Balassa Samuelson predictions on PPP changes, this paper shows that the addition of inequality as a determinant of PPP changes helps to improve the estimating equation over the narrow specifications adopted previously that either considered only inflation differentials or differences in real GDP, dubbed the ‘Penn effect’, or both.

The role of the inequality variable in driving PPP changes, namely, a positive association between a country’s inequality and its PPP, is one of the most significant analytical results of this study. An increase in inequality leads to a shift in consumer preferences towards tradeable items, since the affluent are now able to access the international markets more readily than before. Easier credit availability to the new rich as the economy develops helps in making such access easier. This change in preferences spreads to the other households as the economy

witnesses greater availability of the tradeable goods and the lifestyles of the affluent influence those in the rest of the economy. A good example of this is the phenomenon witnessed in countries such as India with a move towards greater consumption of tastier food items that are imported and away from the domestically produced traditional food items. The 'inequality effect' supplements the 'Penn effect' in moving the PPP towards the exchange rates, i.e. increases the 'Price Level Index' towards unity.

This study proposes and applies an alternative methodology to that used in the ICP to present a set of PPPs that serve as a benchmark for comparing the 2011 ICP PPPs. The methodology is based on a utility theory consistent specification of consumer preferences and has quite modest data requirements. As the empirical exercise shows, the methodology can be readily implemented on easily available data sets published on the World Bank website. This is an attractive feature since it not only avoids the requirement of detailed price information, the quality of which has dogged successive ICPs, it is an easy procedure to use.

The empirical contribution of this paper includes the feature that this is the first attempt at benchmarking the 2011 ICP, indeed any ICP, not by reconciling the PPPs with those from a previous ICP, but with PPPs calculated on a similar data from the same year. Another distinguishing feature is the moving of the 'base country' from the USA to India. The latter country shares many of the features of a developing country including high poverty rates, but at the same time provides a market and an economy size that places it in the top tier of nations. The significant result here is the finding that, while there is remarkable closeness between the two PPPs for many countries, the overall picture is one of understatement by the ICP PPPs leading to an overstatement of the PPP deflated real GDP. The study does find, however, that there are large regional variations in the sign and size of the deviation of the two PPPs from one another. Another feature of this study is the use of expenditure percentile disaggregated data sets to show that the PPPs vary significantly between the expenditure percentiles. This has the important policy message that the aggregate data based PPPs may not be appropriate for use in poverty calculations.

This study takes place at a time when the ICP exercise is at a cross road with questions over its methodology, the quality of the price information used and accuracy of its PPP estimates. The results of this study point to the need to experiment with alternative methodologies that allow proper robustness check on the PPP estimates. The results also raise questions over the wisdom

of spending an enormous amount of time and resources to come up with a single number as the PPP for the whole country. In the wake of recent results on sharp regional variation in prices within large heterogeneous countries, the present results on PPP variation between expenditure percentiles point to a new research agenda on subnational and expenditure group varying PPPs that the ICP could explore in its future exercises.

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Table 1: Results of the Regressions of Budget Shares: Evidence in Favor of Non-Homothetic Preferences

Explanatory Variables	Item groups				
	Food, Clothing, Fuel etc.	**Education and Health**	**Communication and Transport**	**Recreation, Culture, Personal care etc.**	**Miscellaneous others**
ln (total expenditure)[&]	-0.070*** (0.000)	0.013** (0.035)	0.022*** (0.000)	0.039*** (0.000)	-0.004 (0.437)
ln (GDP Deflator)	0.005 (0.272)	0.002 (0.518)	0.002 (0.410)	-0.015*** (0.000)	0.006** (0.017)
Country group Dummy[$$]					
Middle high income	0.030* (0.069)	-0.019** (0.018)	0.026*** (0.001)	-0.036*** (0.002)	-0.001 (0.918)
Middle low income	0.088*** (0.001)	- 0.038*** (0.002)	0.013 (0.216)	-0.057*** (0.001)	-0.006 (0.616)
Low income	0.077** (0.038)	-0.043** (0.027)	0.008 (0.605)	-0.035 (0.161)	-0.007 (0.667)
Year dummy[@]					
2011	0.029*** (0.007)	-0.012** (0.029)	-0.005 (0.322)	-0.011 (0.114)	-0.001 (0.848)
Constant	1.019*** (0.000)	0.067 (0.251)	-0.082* (0.073)	-0.109 (0.160)	0.105* (0.053)
No. of observations	294	294	294	294	294
No. of countries	161	161	161	161	161
R^2	0.6770	0.3347	0.3192	0.6494	0.0369

Note: (1) Figures in parentheses are the p-values. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

(2) [&]: These are PPP (consumption) adjusted expenditures.

(3) [$$]: Default category: high income OECD and non OECD countries.

(4) [@]: Default year: 2005.

Table 2: Regression Results of Static Inequality augmented Inklaar Equations

Dependent Variable: ln (PPP)

Explanatory Variables	Estimated Parameters	
	Year 2005	**Year 2011**
ln (GDP Deflator)	0.405 (0.740)	Omitted due to collinearity
ln (GDPPC)	0.627*** (0.000)	0.227*** (0.000)
ln (Exchange rate)	0.357** (0.016)	0.769*** (0.000)
Inequality		
Low income countries	4.200** (0.045)	0.227 (0.577)
Higher income countries	1.709 (0.245)	-0.147 (0.619)
Constant	- 6.607*** (0.000)	-2.373*** (0.000)
R^2	0.9182	0.9856
No. of observations	107	101
No. of countries	107	101
F-statistic for testing $\widetilde{\beta_3} = 1$	21.86*** (0.000)	38.59*** (0.000)

Note: (1) Figures in parentheses are the p-values. **: significant at 5% level; ***: significant at 1% level.

(2) **Low income countries** are those as specified by World Bank. **Higher income countries** include lower middle, upper middle, high income non OECD and high income OECD countries.

Table 3: Regression Results of Dynamic Inklaar Equation (22) without the Inequality Variable

Dependent Variable: D ln (PPP)

Explanatory Variables	Estimated Parameters	
Trend	-0.000 (0.995)	
D ln (GDP Deflator)	0.325 (0.278)	0.323 (0.153)
D ln (GDPPC)	0.555* (0.074)	0.555** (0.050)
D ln (Exchange rate)	0.749*** (0.003)	0.749*** (0.003)
R^2	0.6846	0.6846
No. of observations	311	311
No. of countries	120	120
F-statistic for testing $\alpha_3 = 1$	1.25 (0.275)	1.26 (0.273)

Note: (1) Figures in parentheses are the p-values. **: significant at 5% level; ***: significant at 1% level

(2) The operator *D* denotes difference over time.

Table 4: Regression Results of Dynamic Inklaar Equation (22) with the Inequality Variable

Dependent Variable: D ln (PPP)

Explanatory Variables	Parameter Estimates with Trend		Parameter Estimates without Trend
Trend	-0.000 (0.990)	-0.023 (0.344)	-
D ln (GDP Deflator)	0.343 (0.182)	0.334* (0.096)	0.338 (0.160)
D ln (GDPPC)	0.563** (0.041)	0.921 (0.158)	0.563** (0.030)
D ln (Exchange rate)	0.756*** (0.003)	1 (constrained)	0.757*** (0.003)
D Inequality			
Low income countries	3.980*** (0.004)	5.241*** (0.007)	3.980*** (0.005)
Higher income countries	0.041 (0.941)	-0.444 (0.396)	0.041 (0.941)
R^2	0.6898		0.6898
No. of observations	303	303	303
No. of countries	119	119	119
F-statistic for testing $\alpha_3 = 1$	1.18 (0.288)		1.43 (0.245)

Figures in parentheses are the p-values. *: significant at 10% level; **: significant at 5% level; ***: significant at 1% level.

Table 5: 2011 ICP Consumption PPPs and Counterfactual PPPs (CPPP1) based on data by Income Categories (Base Country: India)

Region	Country	2011 ICP Consumption PPP	Counter factual PPP	Region	Country	2011 ICP Consumption PPP	Counter factual PPP	Region	Country	2011 ICP Consumption PPP	Counter factual PPP
AFRICA	Benin	14.801	11.821	AFRICA	South Africa	0.340	0.571	EUROSTAT-OECD	Albania	3.400	1.486
	Burkina Faso	14.552	8.171		Swaziland	0.273	0.169		Bosnia and Herzegovina	0.055	0.398
	Cameroon	15.253	12.418		Tanzania	38.494	21.820		Bulgaria	0.047	0.288
	Chad	16.499	16.787		Togo	14.966	10.190		Latvia	0.025	0.127
	Congo, Rep.	35.145	31.664		Uganda	61.989	48.688		Lithuania	0.112	0.491
	Congo, Dem. Rep.	19.711	13.335		Zambia	166.554	95.465		Macedonia (FYR)	1.392	6.807
	Cote d'Ivoire	15.691	19.943	ASIA AND THE PACIFIC	Bangladesh	1.628	1.786		Mexico	0.549	1.126
	Djibouti	6.727	11.370		Bhutan	1.119	1.906				
	Egypt	0.115	0.252		Cambodia	96.712	120.760		Montenegro	0.028	0.175
	Ethiopia	0.352	0.397		China	0.249	0.415		Romania	0.120	0.458
	Gabon	23.877	59.136		Fiji	0.080	0.140		Russia	1.059	5.498
	Gambia (The)	0.697	0.596		**India**	**1.000**	**1.000**		Serbia	2.802	13.968
	Ghana	0.051	0.052		Indonesia	266.380	311.831		Turkey	0.072	0.059
	Guinea	165.403	148.692		Lao PDR	181.329	222.421	LATIN AMERICA	Bolivia	0.200	0.409
	Kenya	2.365	2.164		Maldives	0.677	1.250		Brazil	0.106	0.231
	Lesotho	0.261	0.209		Mongolia	36.881	59.862		Colombia	81.836	173.525
	Liberia	0.037	1.956		Nepal	1.698	2.114		El Salvador	0.036	0.036
	Madagascar	46.309	18.850		Pakistan	1.673	2.147		Guatemala	0.261	0.588
	Mali	14.437	10.579		Philippines	1.261	1.552		Honduras	0.706	0.767
	Mauritania	7.395	10.857		Sri Lanka	2.689	6.834		Nicaragua	0.613	0.310
	Mauritius	1.181	2.826		Thailand	0.858	3.297		Peru	0.104	0.265
	Morocco	0.276	0.605		Vietnam	479.060	569.544	WESTERN ASIA	Iraq	35.882	41.932
	Mozambique	1.051	0.552	COMMONWEALTH OF INDEPENDENT STATES	Armenia	10.880	22.195		Jordan	0.021	0.093
	Namibia	0.342	0.284		Azerbaijan	0.020	0.066		Yemen	5.319	14.339
	Nigeria	5.184	4.483		Belarus	109.735	414.875	CARIBBEAN	Jamaica	4.136	9.063
	Republic of Cabo Verde	3.164	8.940		Kazakhstan	5.037	17.722				
					Kyrgyz Republic	1.037	1.852				
					Moldova	0.328	0.840				
	Senegal	16.285	14.954		Tajikistan	0.106	0.215				
	Sierra Leone	114.179	146.402		Ukraine	0.204	0.811				

Table 6a: Per Capita Annual GDP (PCGDP) in '000 local currencies converted to Indian Rupees under 2011 ICP Consumption PPPs and Counterfactual PPPs of Table 5 (Base Country: India)

Region	Country	PCGDP evaluated at		Region	Country	PCGDP evaluated at		Region	Country	PCGDP evaluated at	
		2011 ICP PPP	Counter factual PPP			2011 ICP PPP	Counter factual PPP			2011 ICP PPP	Counter factual PPP
AFRICA	Benin	25.54	31.98	AFRICA	South Africa	169.82	101.19	EUROSTAT-OECD	Albania	133.19	394.24
	Burkina Faso	19.72	35.11		Swaziland	90.49	146.00		Bosnia and Herzegovina	126.93	17.52
	Cameroon	41.06	50.44		Tanzania	21.10	37.22		Bulgaria	218.56	35.57
	Chad	30.11	29.59		Togo	18.88	27.73		Latvia	274.49	54.54
	Congo, Rep.	47.99	53.27		Uganda	21.48	27.34		Lithuania	314.48	71.87
	Congo, Dem. Rep.	17.33	25.62		Zambia	45.05	78.60		Macedonia (FYR)	160.43	32.82
	Cote d'Ivoire	38.82	30.54	ASIA AND THE PACIFIC	Bangladesh	39.81	36.30		Mexico	228.81	111.60
	Djibouti	33.70	19.94		Bhutan	108.43	63.68				
	Egypt	150.21	68.24		Cambodia	37.85	30.31		Montenegro	187.72	29.74
	Ethiopia	16.96	15.05		China	141.35	84.93		Romania	216.86	56.95
	Gabon	219.64	88.68		Fiji	98.58	56.35		Russia	368.47	70.99
	Gambia (The)	21.48	25.13		**India**	71.54	71.54		Serbia	157.75	31.65
	Ghana	46.93	46.32		Indonesia	115.61	98.76		Turkey	244.05	299.56
	Guinea	19.59	21.80		Lao PDR	55.91	45.58	LATIN AMERICA	Bolivia	81.86	40.04
	Kenya	30.99	33.86		Maldives	1.61	0.87		Brazil	202.89	93.42
	Lesotho	32.05	39.92		Mongolia	126.98	78.23		Colombia	161.30	76.07
	Liberia	7.50	0.14		Nepal	32.22	25.88		El Salvador	103.63	102.10
	Madagascar	20.54	50.46		Pakistan	64.74	50.45		Guatemala	96.84	43.00
	Mali	21.97	29.99		Philippines	81.74	66.41		Honduras	61.09	56.19
	Mauritania	50.00	34.05		Sri Lanka	116.59	45.88		Nicaragua	59.84	118.22
	Mauritius	209.38	87.45		Thailand	191.63	49.90		Peru	160.15	62.99
	Morocco	90.26	41.10		Vietnam	66.06	55.57	WESTERN ASIA	Iraq	160.21	137.09
	Mozambique	14.51	27.63	COMMONWEALTH OF INDEPENDENT STATES	Armenia	115.15	56.44		Jordan	155.73	35.15
	Namibia	114.08	137.15		Azerbaijan	285.56	86.62		Yemen	52.97	19.65
	Nigeria	45.14	52.19		Belarus	285.86	75.61	CARIBBEA	Jamaica	109.00	49.74
	Republic of Cabo Verde	94.07	33.29		Kazakhstan	330.60	93.97				
					Kyrgyz Republic	52.44	29.35		**MEAN**	**104.66**	**59.77**
	Senegal	32.55	35.44		Moldova	70.45	27.54		**MEDIAN**	**81.80**	**46.10**
	Sierra Leone	18.63	14.53		Tajikistan	36.82	18.11				
					Ukraine	139.91	35.11				

Table 6b: Per Capita Annual Aggregate Consumption (PCAgC) in '000 local currencies converted to Indian Rupees under 2011 ICP Consumption PPPs and Counterfactual PPPs of Table 5 (Base Country: India)

Region	Country	PCAgC evaluated at		Region	Country	PCAgC evaluated at		Region	Country	PCAgC evaluated at	
		2011 ICP PPP	Counter factual PPP			2011 ICP PPP	Counter factual PPP			2011 ICP PPP	Counter factual PPP
AFRICA	Benin	20.63	25.83	AFRICA	South Africa	115.97	69.10	EUROSTAT-OECD	Albania	113.67	336.47
	Burkina Faso	13.34	23.76		Swaziland	81.54	131.56		Bosnia and Herzegovina	118.60	16.37
	Cameroon	32.17	39.52		Tanzania	14.42	25.43		Bulgaria	153.65	25.01
	Chad	20.68	20.32		Togo	16.71	24.55		Latvia	192.37	38.22
	Congo, Rep.	11.89	13.19		Uganda	19.47	24.79		Lithuania	231.62	52.94
	Congo, Dem. Rep.	11.15	16.49		Zambia	24.91	43.45		Macedonia (FYR)	132.81	27.17
	Cote d'Ivoire	27.72	21.81	ASIA AND THE PACIFIC	Bangladesh	29.95	27.31		Mexico	165.88	80.91
	Djibouti	24.08	14.25		Bhutan	56.00	32.89				
	Egypt	119.46	54.28		Cambodia	31.89	25.54		Montenegro	172.48	27.33
	Ethiopia	13.71	12.17		China	60.66	36.45		Romania	156.64	41.14
	Gabon	83.71	33.80		Fiji	75.60	43.22		Russia	212.55	40.95
	Gambia (The)	17.10	20.00		**India**	42.34	42.34		Serbia	141.57	28.40
	Ghana	31.40	30.99		Indonesia	67.31	57.50		Turkey	192.33	236.08
	Guinea	11.04	12.29		Lao PDR	32.79	26.73	LATIN AMERICA	Bolivia	51.27	25.08
	Kenya	27.13	29.65		Maldives	0.61	0.33		Brazil	138.75	63.88
	Lesotho	35.36	44.04		Mongolia	77.05	47.47		Colombia	109.75	51.76
	Liberia	8.48	0.16		Nepal	25.88	20.79		El Salvador	102.04	100.54
	Madagascar	18.65	45.82		Pakistan	54.99	42.85		Guatemala	87.15	38.70
	Mali	14.66	20.01		Philippines	62.89	51.09		Honduras	52.50	48.29
	Mauritania	29.26	19.93		Sri Lanka	89.55	35.24		Nicaragua	50.23	99.24
	Mauritius	165.44	69.10		Thailand	118.73	30.92		Peru	100.11	39.38
	Morocco	60.35	27.48		Vietnam	41.89	35.24	WESTERN ASIA	Iraq	75.36	64.49
	Mozambique	12.46	23.73	COMMONWEALTH OF INDEPENDENT STATES	Armenia	102.30	50.15		Jordan	124.21	28.03
	Namibia	81.61	98.12		Azerbaijan	117.17	35.54		Yemen	38.69	14.35
	Nigeria	29.06	33.60		Belarus	162.14	42.89	CARIBBEAN	Jamaica	101.42	46.28
	Republic of Cabo Verde	66.49	23.54		Kazakhstan	159.83	45.43				
					Kyrgyz Rep.	49.10	27.48		**MEAN**	**73.30**	**43.21**
	Senegal	26.94	29.34		Moldova	79.18	30.95				
	Sierra Leone	16.72	13.04		Tajikistan	42.37	20.84		**MEDIAN**	**58.17**	**31.94**
					Ukraine	110.74	27.79				

Table 7a: Ratio of Per Capita Annual GDP evaluated at different PPPs to Per Capita Annual GDP of India evaluated at the corresponding PPP

Region	Country	PCGDP evaluated at			Region	Country	PCGDP evaluated at			Region	Country	PCGDP evaluated at		
		2011 ICP GDP PPP	2011 ICP consumption PPP*	Counter factual PPP*			2011 ICP GDP PPP	2011 ICP consumption PPP*	Counter factual PPP*			2011 ICP GDP	2011 ICP consumption PPP*	Counter factual PPP*
AFRICA	Benin	0.373	0.357	0.447	AFRICA	South Africa	2.558	2.374	1.414	EUROSTAT-OECD	Albania	2.104	1.862	5.511
	Burkina	0.284	0.276	0.491		Swaziland	1.336	1.265	2.041		Bosnia and H.	2.034	1.774	0.245
	Cameroon	0.582	0.574	0.705		Tanzania	0.328	0.295	0.520		Bulgaria	3.278	3.055	0.497
	Chad	0.419	0.421	0.414		Togo	0.277	0.264	0.388		Latvia	4.223	3.837	0.762
	Congo, Rep.	0.138	0.136	0.358		Uganda	0.337	0.300	0.382		Lithuania	4.756	4.396	1.005
	Congo, Dem. Rep.	1.231	1.196	0.745		Zambia	0.666	0.630	1.099		Macedonia (FYR)	2.525	2.242	0.459
	Cote	0.564	0.543	0.427	ASIA AND THE PACIFIC	Bangladesh	0.591	0.556	0.507		Mexico	3.459	3.198	1.560
	Djibouti	0.509	0.471	0.279		Bhutan	1.520	1.516	0.890					
	Egypt	2.238	2.100	0.954		Cambodia	0.574	0.529	0.424		Montenegro	2.984	2.624	0.416
	Ethiopia	0.256	0.237	0.210		China	2.124	1.976	1.187		Romania	3.410	3.031	0.796
	Gabon	3.481	3.070	1.240		Fiji	1.596	1.378	0.788		Russia	4.752	5.150	0.992
	Gambia	0.318	0.300	0.351		**India**	1.000	1.000	1.000		Serbia	2.504	2.205	0.442
	Ghana	0.723	0.656	0.647		Indonesia	1.803	1.616	1.380		Turkey	3.755	3.411	4.187
	Guinea	0.272	0.274	0.305		Lao PDR	0.868	0.781	0.637	LATIN AMERICA	Bolivia	1.174	1.144	0.560
	Kenya	0.451	0.433	0.473		Maldives	2.406	2.006	1.087		Brazil	3.092	2.836	1.306
	Lesotho	0.450	0.448	0.558		Mongolia	1.841	1.775	1.093		Colombia	2.399	2.255	1.063
	Liberia	0.114	0.105	0.002		Nepal	0.469	0.450	0.362		El Salvador	1.554	1.449	1.427
	Madagascar	0.298	0.287	0.705		Pakistan	0.940	0.905	0.705		Guatemala	1.472	1.354	0.601
	Mali	0.319	0.307	0.419		Philippines	1.219	1.143	0.928		Honduras	0.919	0.854	0.785
	Mauritania	0.674	0.699	0.476		Sri Lanka	1.713	1.630	0.641		Nicaragua	0.868	0.836	1.652
	Mauritius	3.275	2.927	1.222		Thailand	2.809	2.679	0.697		Peru	2.319	2.239	0.880
	Morocco	1.428	1.262	0.574		Vietnam	0.996	0.923	0.777	WEST ASIA	Iraq	2.350	2.239	1.916
	Mozambiqu	0.201	0.203	0.386	COMMONWEALTH OF INDEPENDENT STATES	Armenia	1.414	1.609	0.789					
	Namibia	1.766	1.595	1.917		Azerbaijan	3.371	3.991	1.211		Jordan	2.359	2.177	0.491
	Nigeria	0.664	0.631	0.730		Belarus	3.506	3.996	1.057					
	Republic of Cabo Verde	1.294	1.315	0.465		Kazakhstan	4.387	4.621	1.313		Yemen	0.785	0.740	0.275
						Kyrgyz Rep.	0.647	0.733	0.410					
	Senegal	0.474	0.455	0.495		Moldova	0.883	0.985	0.385	CARIBBEAN	Jamaica	1.759	1.524	0.695
	Sierra Leone	0.289	0.260	0.203		Tajikistan	0.474	0.515	0.253					
						Ukraine	1.752	1.956	0.491					

*These columns are derived from Table 6a.

Table 7b: Ratio of Per Capita Annual Consumption evaluated at different PPPs to Per Capita Annual Consumption of India evaluated at the corresponding PPP

Region	Country	PCAgC evaluated at		Region	Country	PCAgC evaluated at		Region	Country	PCAgC evaluated at	
		2011 ICP consumption PPP*	Counter factual PPP*			2011 ICP consumption PPP*	Counter factual PPP*			2011 ICP consumption PPP*	Counter factual PPP*
AFRICA	Benin	0.487	0.610	AFRICA	South Africa	2.739	1.632	EUROSTAT-OECD	Albania	2.685	7.947
	Burkina Faso	0.315	0.561		Swaziland	1.926	3.107		Bosnia and H.	2.801	0.387
	Cameroon	0.760	0.933		Tanzania	0.341	0.601		Bulgaria	3.629	0.591
	Chad	0.488	0.480		Togo	0.395	0.580		Latvia	4.544	0.903
	Congo, Rep.	0.148	0.389		Uganda	0.460	0.586		Lithuania	5.471	1.250
	Congo, Dem. Rep.	0.501	0.312		Zambia	0.588	1.026		Macedonia (FYR)	3.137	0.642
	Cote d'Ivoire	0.655	0.515	ASIA AND THE PACIFIC	Bangladesh	0.707	0.645		Mexico	3.918	1.911
	Djibouti	0.569	0.337		Bhutan	1.323	0.777				
	Egypt	2.822	1.282		Cambodia	0.753	0.603		Montenegro	4.074	0.645
	Ethiopia	0.324	0.287		China	1.433	0.861		Romania	3.700	0.972
	Gabon	1.977	0.798		Fiji	1.786	1.021		Russia	5.020	0.967
	Gambia (The)	0.404	0.472		**India**	1.000	1.000		Serbia	3.344	0.671
	Ghana	0.742	0.732		Indonesia	1.590	1.358		Turkey	4.543	5.576
	Guinea	0.261	0.290		Lao PDR	0.774	0.631	LATIN AMERICA	Bolivia	1.211	0.592
	Kenya	0.641	0.700		Maldives	1.285	0.696		Brazil	3.277	1.509
	Lesotho	0.835	1.040		Mongolia	1.820	1.121		Colombia	2.592	1.223
	Liberia	0.200	0.004		Nepal	0.611	0.491		El Salvador	2.410	2.375
	Madagascar	0.441	1.082		Pakistan	1.299	1.012		Guatemala	2.058	0.914
	Mali	0.346	0.473		Philippines	1.486	1.207		Honduras	1.240	1.141
	Mauritania	0.691	0.471		Sri Lanka	2.115	0.832		Nicaragua	1.187	2.344
	Mauritius	3.908	1.632		Thailand	2.805	0.730		Peru	2.365	0.930
	Morocco	1.425	0.649		Vietnam	0.990	0.832	WEST ASIA	Iraq	1.780	1.523
	Mozambique	0.294	0.560	COMMONWEALTH OF INDEPENDENT STATES	Armenia	2.416	1.184				
	Namibia	1.928	2.318		Azerbaijan	2.768	0.840		Jordan	2.934	0.662
	Nigeria	0.686	0.794		Belarus	3.830	1.013				
	Republic of Cabo Verde	1.571	0.556		Kazakhstan	3.775	1.073		Yemen	0.914	0.339
					Kyrgyz Rep.	1.160	0.649				
	Senegal	0.636	0.693		Moldova	1.870	0.731	CARIBBEAN	Jamaica	2.396	1.093
	Sierra Leone	0.395	0.308		Tajikistan	1.001	0.492				
					Ukraine	2.616	0.656				

*These columns are derived from Table 6b.

Table 8: Counterfactual PPPs (CPPP2) based on Household level Data: (Base Country: India)

Country	2011 ICP PPP*	Overall	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Iraq	35.882	41.932	45.060	45.705	40.995	37.678	29.124
Malawi	5.195	7.166	5.718	7.244	7.116	7.461	6.811
Tanzania	38.494	30.080	23.887	29.605	29.047	31.053	30.117
Vietnam	479.060	639.906	562.399	663.861	635.605	628.115	542.026

*****Base country: India

Table 9: Gini Expenditure Inequality Index of households pooled over the 5 Countries at Different PPPs (Base Country: India)

Gini Index (in %) based on			
2011 ICP PPP	CPPP1*	CPPP2	Quintile wise PPPs
38.634	38.585	38.541	38.572

*Excluding Malawi

Figure 1

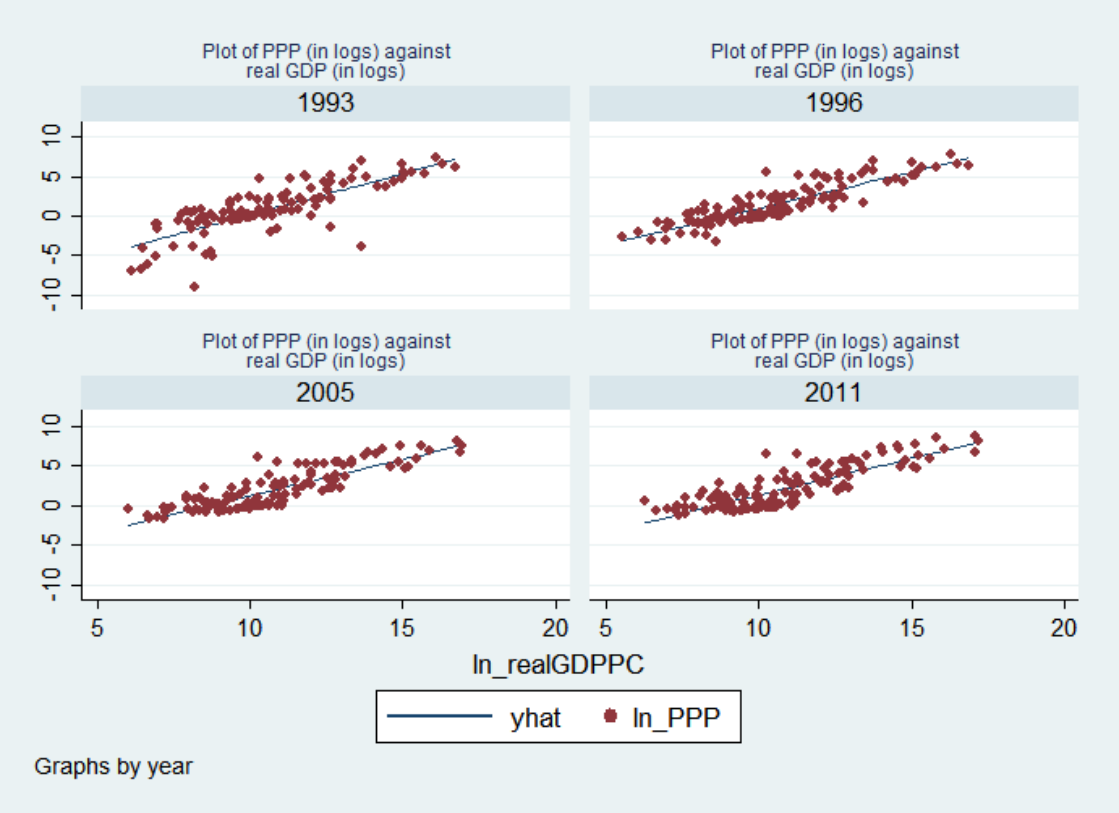
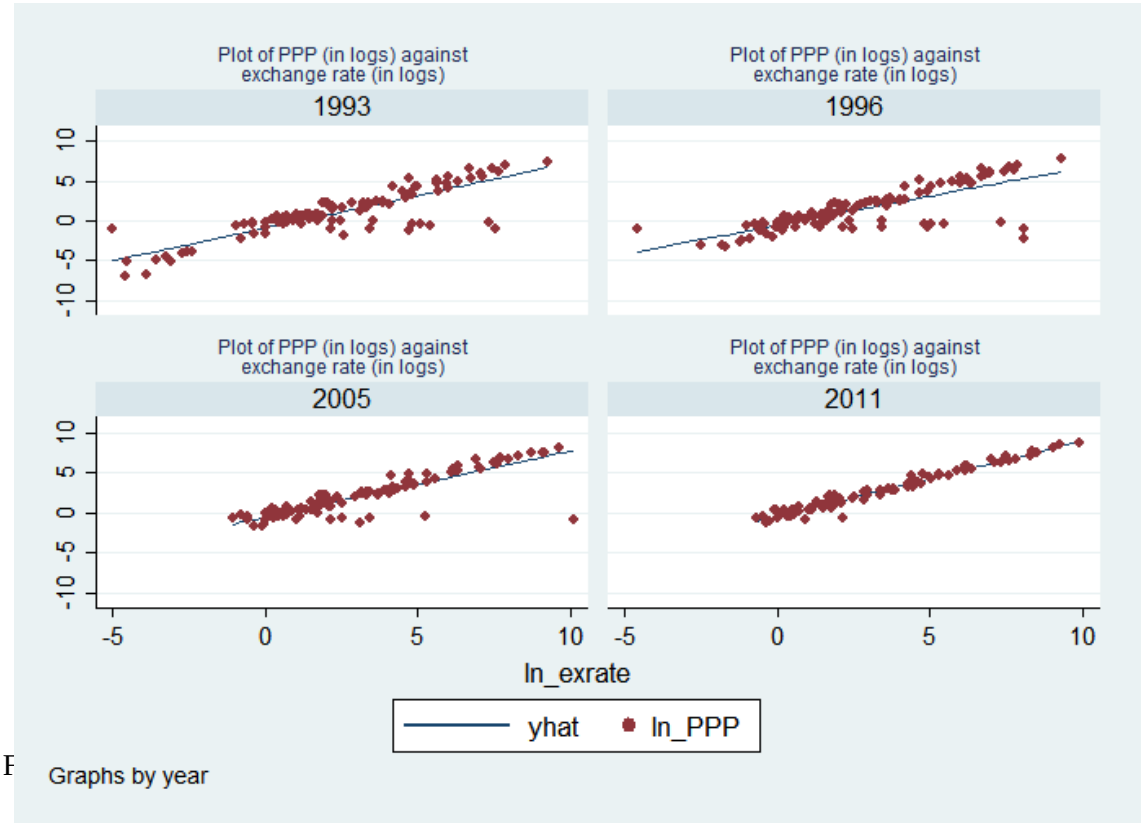


Figure 2



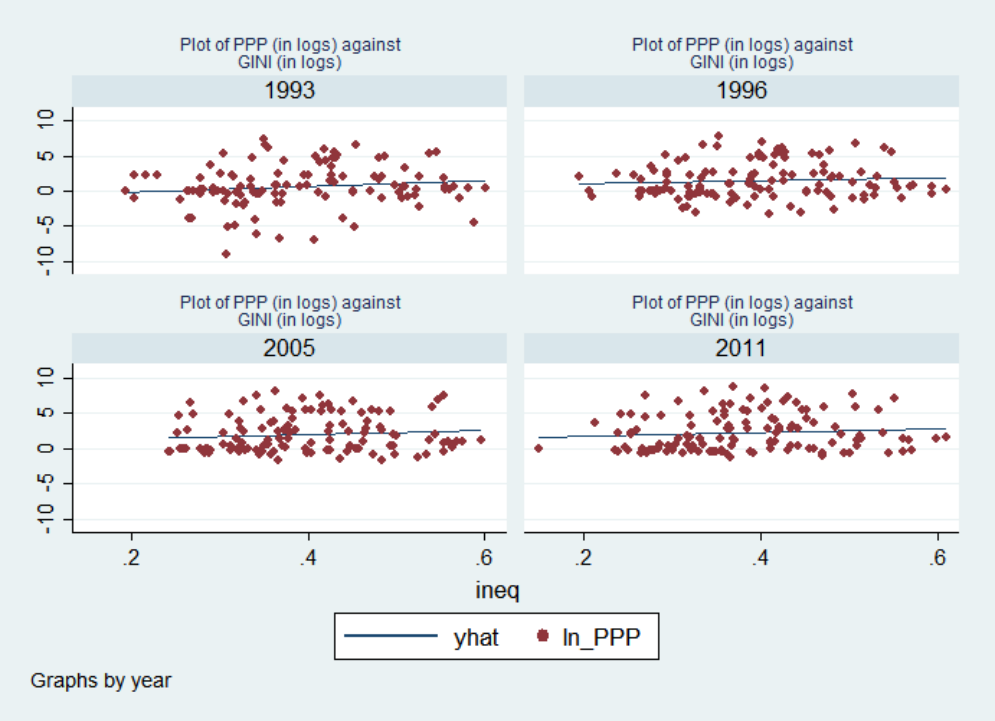

Plot of PPP (in logs) against GINI (in logs)
1993
Plot of PPP (in logs) against GINI (in logs)
1996
Plot of PPP (in logs) against GINI (in logs)
2005
Plot of PPP (in logs) against GINI (in logs)
2011
-10 -5 0 5 10
.2 .4 .6
ineq
yhat
ln_PPP
Graphs by year

Figure 3a

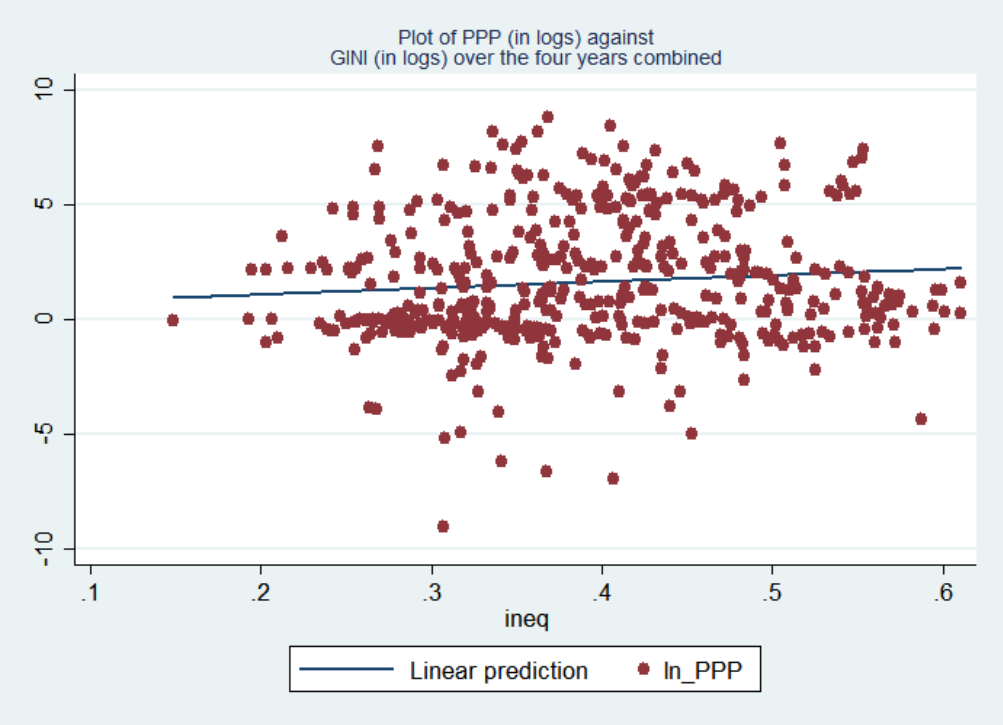

Plot of PPP (in logs) against GINI (in logs) over the four years combined
-10 -5 0 5 10
.1 .2 .3 .4 .5 .6
ineq
Linear prediction
ln_PPP

Figure 4

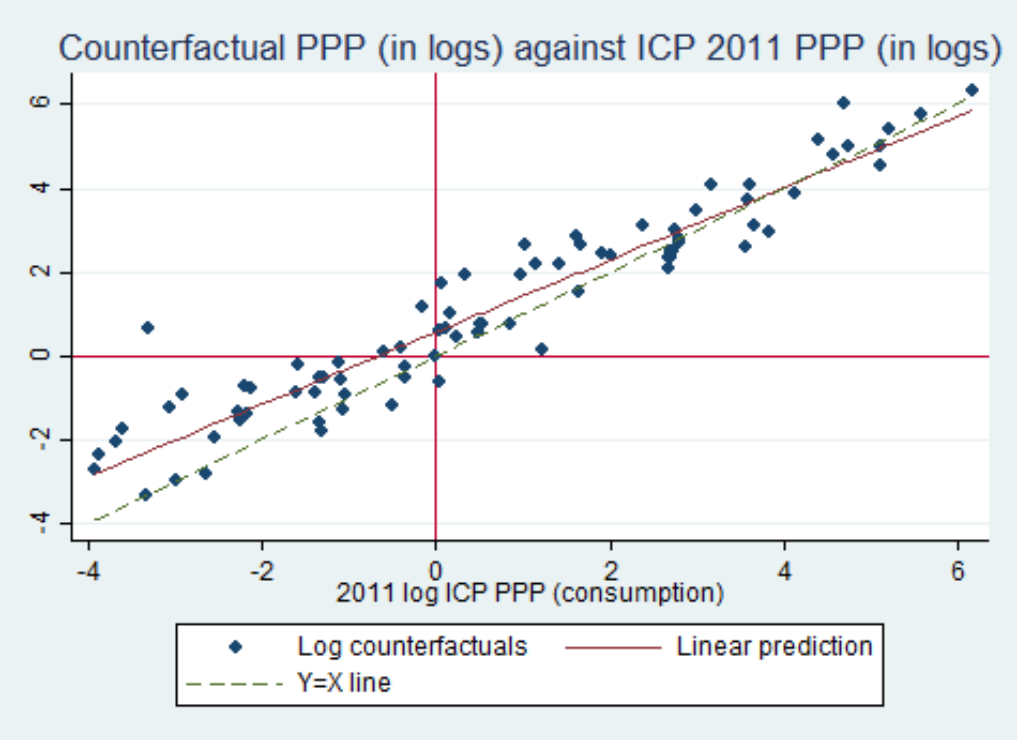


Figure 5

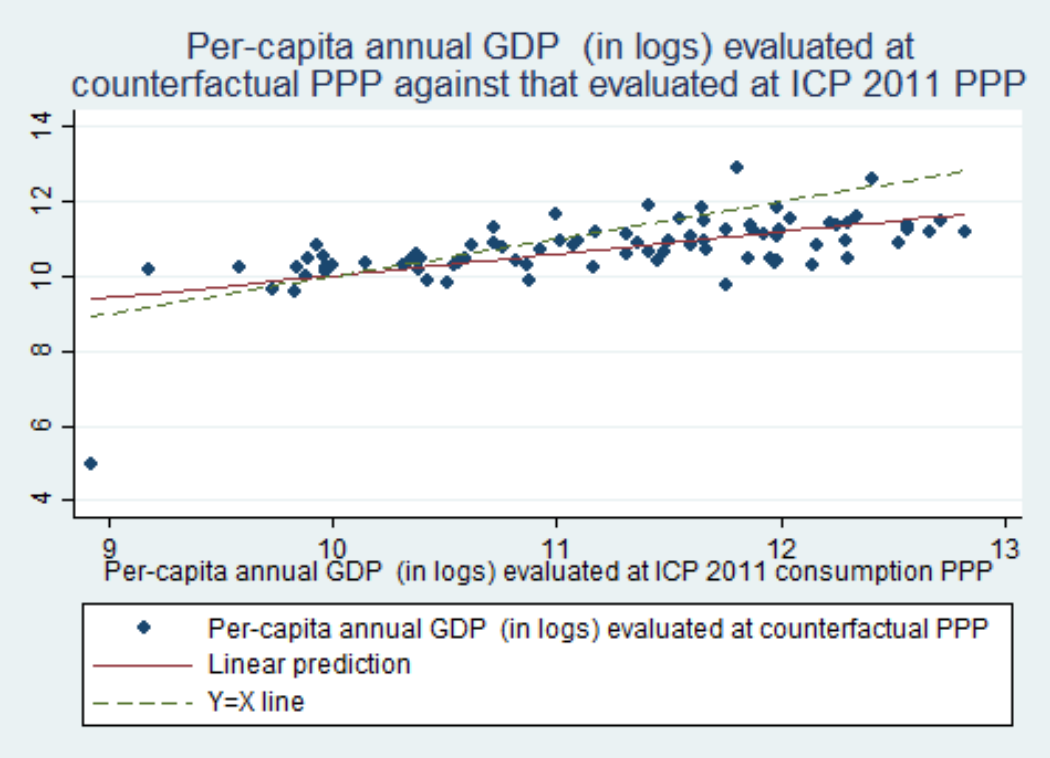
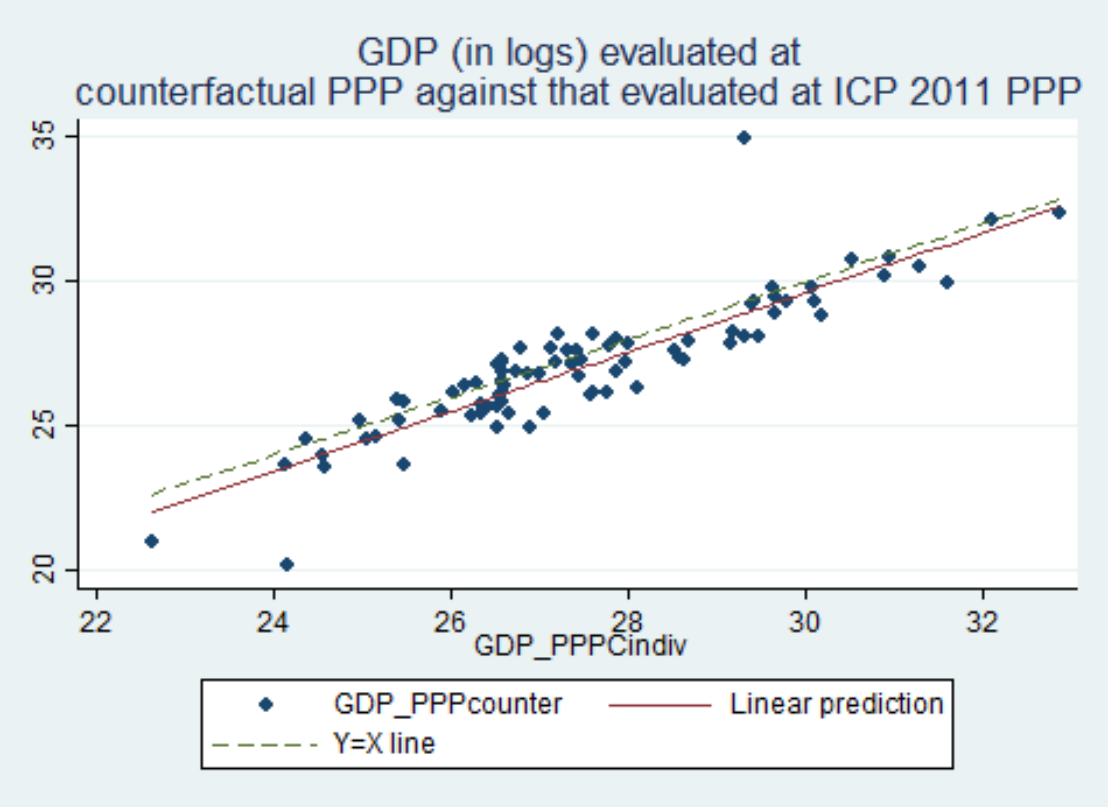


Figure 6


GDP (in logs) evaluated at
counterfactual PPP against that evaluated at ICP 2011 PPP
35
30
25
20
22
24
26
28
30
32
GDP_PPPCindiv
GDP_PPPcounter
Linear prediction
Y=X line

Appendix A

Definition of Income based Classification of the Countries in Table 1:

Default group of countries: High income OECD and non OECD countries.

High-income economies are those in which 2014 GNI per capita was $12,736 or more.

Middle high income countries:

Middle high income economies are those in which 2014 GNI per capita was between $4,126 and $12,735.

Middle low income countries:

Middle low income economies are those in which 2014 GNI per capita was between $1,046 and $12,734.

Low income countries:

Low-income economies are those in which 2014 GNI per capita was $1,045 or less.

Data Sources:

1. Data on item groups by income categories:

Source: World Bank Global Consumption Data Base 2010: (downloaded on 4/7/2015):

http://datatopics.worldbank.org/consumption/detail

Item groups:

• Alcohol beverages • Appliances, articles and products for personal care • Catering • Clothes • Dairy • Education • Electricity • Financial Services • Footwear • Fruits and vegetables • Fuel • Gas • Grains	• Housing • Meat and fish • Medical goods and services • Non-Alcohol beverages • Other • Other ICT goods and services • Other food • Other sources (coal, firewood etc.) • Pharmaceutical products • Telephone equipment and services • Vehicles and other transport services • Water utilities

Income categories:

Four levels of consumption are used to segment the market in each country: lowest, low, middle, and higher. They are based on global income distribution data, which rank the global population by income per capita. The lowest consumption segment corresponds to the bottom half of the global distribution, or the 50th percentile and below; the low consumption segment to the 51th–75th percentiles; the middle consumption segment to the 76th–90th percentiles; and the higher consumption segment to the 91st percentile and above.

These thresholds were used to establish the four consumption segments:

- Lowest—below $2.97 per capita a day
- Low—between $2.97 and $8.44 per capita a day
- Middle—between $8.44 and $23.03 per capita a day
- Higher—above $23.03 per capita a day

To convert a PPP $ threshold into annual expenditure in local currency (as of 2010), the following formula was applied:

Threshold * U.S. inflation rate for the period 2005–10 (1.117) * PPP conversion factor for 2010 * 365.

[The U.S. inflation rate and PPP conversion factors are available in the World Bank's World Development Indicators database.]

For example, the PPP $2.97 threshold is equivalent to 25,702.22 Indian rupees (2.97 * 1.117 * 21.226 * 365).

2. **Data on item groups at household level** (available latest data prior to 2011):

Sources:

World Bank LSMS link:

http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21588800~menuPK:4196952~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html

- Iraq: 2006-07 Iraq Household Socio-Economic Survey
- Malawi - Third Integrated Household Survey 2010-2011.
- Tanzania: Tanzania 2010-2011 National Panel Survey.

Additional Sources:

- Vietnam: Vietnam Household Living Standards Survey (VHLSS) 2010.
- India: National Sample Survey Organisation – NSS 68th Round Consumer Expenditure Survey, 2011-2012.

Item groups*:

• **Food**: (food items and non-alcoholic beverages) • **Alcoholic Beverages: (**Alcoholic beverages, Tobacco & Narcotics) • **Housing: (**Housing, water, electricity, gas and other fuels) • **Furnishing: (**Furnishings, household equipment and routine household maintenance)	• **Health** • **Transport** • **Communication** • **Recreation & Culture:** (Recreation, newspapers, magazines) • **Education**

* The 'total expenditure' used in our analysis is the sum of expenditures on these items only. We have omitted the 'Others' group, consisting of the remaining items, as this group is highly heterogeneous in nature.

Definition of variables used:

GDPPC: Per capita gross domestic product in constant local currency units.

GDP Deflator: The GDP implicit deflator is the ratio of GDP in current International Dollar to GDP in constant 2011 International Dollar.

Exchange rate: Official exchange rate refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

Inequality: GINI index [to account for missing values and procedural discrepancies, smoothed values of GINI index has been used.]

PPP: Purchasing power parity conversion factor is the number of units of a country's currency required to buy the same amounts of goods and services in the domestic market as U.S. dollar would buy in the United States. This conversion factor is for GDP.

APPENDIX B

Table B6a: Logarithm of Per Capita Annual GDP (PCGDP) in '000 local currencies converted to Indian Rupees under 2011 ICP Consumption PPPs and Counterfactual PPPs (Base Country: India)

Region	Country	log PCGDP evaluated at		Region	Country	log PCGDP evaluated at		Region	Country	log PCGDP evaluated at	
		2011 ICP consumption PPP	Counter factual PPP			2011 ICP consumption PPP	Counter factual PPP			2011 ICP consumption PPP	Counter factual PPP
AFRICA	Benin	10.148	10.373	AFRICA	South Africa	12.042	11.525	EUROSTAT-OECD	Albania	11.800	12.885
	Burkina Faso	9.889	10.466		Swaziland	11.413	11.891		Bosnia and Herzegovina	11.751	9.771
	Cameroon	10.623	10.829		Tanzania	9.957	10.525		Bulgaria	12.295	10.479
	Chad	10.313	10.295		Togo	9.846	10.230		Latvia	12.523	10.907
	Congo, Rep.	10.779	10.883		Uganda	9.975	10.216		Lithuania	12.659	11.183
	Congo, Dem. Rep.	9.760	10.151		Zambia	10.716	11.272		Macedonia (FYR)	11.986	10.399
	Cote d'Ivoire	10.567	10.327	ASIA AND THE PACIFIC	Bangladesh	10.592	10.500		Mexico	12.341	11.623
	Djibouti	10.425	9.901		Bhutan	11.594	11.062				
	Egypt	11.920	11.131		Cambodia	10.541	10.319		Montenegro	12.143	10.300
	Ethiopia	9.738	9.619		China	11.859	11.350		Romania	12.287	10.950
	Gabon	12.300	11.393		Fiji	11.499	10.939		Russia	12.817	11.170
	Gambia (The)	9.975	10.132		**India**	11.178	11.178		Serbia	11.969	10.362
	Ghana	10.756	10.743		Indonesia	11.658	11.500		Turkey	12.405	12.610
	Guinea	9.883	9.989		Lao PDR	10.931	10.727	LATIN AMERICA	Bolivia	11.313	10.598
	Kenya	10.341	10.430		Maldives	7.385	6.772		Brazil	12.220	11.445
	Lesotho	10.375	10.595		Mongolia	11.752	11.267		Colombia	11.991	11.239
	Liberia	8.922	4.957		Nepal	10.380	10.161		El Salvador	11.549	11.534
	Madagascar	9.930	10.829		Pakistan	11.078	10.829		Guatemala	11.481	10.669
	Mali	9.998	10.308		Philippines	11.311	11.104		Honduras	11.020	10.936
	Mauritania	10.820	10.436		Sri Lanka	11.666	10.734		Nicaragua	10.999	11.680
	Mauritius	12.252	11.379		Thailand	12.163	10.818		Peru	11.984	11.051
	Morocco	11.410	10.624		Vietnam	11.098	10.925	WESTERN ASIA	Iraq	11.984	11.828
	Mozambique	9.582	10.227	COMMONWEALTH OF INDEPENDENT STATES	Armenia	11.654	10.941		Jordan	11.956	10.467
	Namibia	11.645	11.829		Azerbaijan	12.562	11.369		Yemen	10.877	9.886
	Nigeria	10.717	10.863		Belarus	12.563	11.233	CARIBBEAN	Jamaica	11.599	10.815
	Republic of Cabo Verde	11.452	10.413		Kazakhstan	12.709	11.451				
					Kyrgyz Republic	10.868	10.287		**log (MEAN)**	**11.558**	**10.998**
	Senegal	10.390	10.476		Moldova	11.163	10.223		**log (MEDIAN)**	**11.312**	**10.739**
	Sierra Leone	9.832	9.584		Tajikistan	10.514	9.804				
					Ukraine	11.849	10.466				

Table B6b: Logarithm of Per Capita Annual Aggregate Consumption (PCAgC) in '000 local currencies converted to Indian Rupees under 2011 ICP Consumption PPPs and Counterfactual PPPs (Base Country: India)

Region	Country	log PCAgC evaluated at		Region	Country	log PCAgC evaluated at		Region	Country	log PCAgC evaluated at	
		2011 ICP consumption PPP	Counter factual PPP			2011 ICP consumption PPP	Counter factual PPP			2011 ICP consumption PPP	Counter factual PPP
AFRICA	Benin	9.935	10.159	AFRICA	South Africa	11.661	11.143	EUROSTAT-OECD	Albania	11.641	12.726
	Burkina Faso	9.499	10.076		Swaziland	11.309	11.787		Bosnia and Herzegovina	11.684	9.703
	Cameroon	10.379	10.584		Tanzania	9.576	10.144		Bulgaria	11.942	10.127
	Chad	9.937	9.919		Togo	9.724	10.108		Latvia	12.167	10.551
	Congo, Rep.	9.383	9.487		Uganda	9.877	10.118		Lithuania	12.353	10.877
	Congo, Dem. Rep.	9.320	9.710		Zambia	10.123	10.679		Macedonia (FYR)	11.797	10.210
	Cote d'Ivoire	10.230	9.990	ASIA AND THE PACIFIC	Bangladesh	10.307	10.215		Mexico	12.019	11.301
	Djibouti	10.089	9.564		Bhutan	10.933	10.401				
	Egypt	11.691	10.902		Cambodia	10.370	10.148		Montenegro	12.058	10.216
	Ethiopia	9.526	9.407		China	11.013	10.504		Romania	11.962	10.625
	Gabon	11.335	10.428		Fiji	11.233	10.674		Russia	12.267	10.620
	Gambia (The)	9.747	9.904		**India**	10.653	10.653		Serbia	11.861	10.254
	Ghana	10.355	10.342		Indonesia	11.117	10.959		Turkey	12.167	12.372
	Guinea	9.310	9.416		Lao PDR	10.398	10.193	LATIN AMERICA	Bolivia	10.845	10.130
	Kenya	10.208	10.297		Maldives	6.414	5.801		Brazil	11.840	11.065
	Lesotho	10.473	10.693		Mongolia	11.252	10.768		Colombia	11.606	10.854
	Liberia	9.046	5.080		Nepal	10.161	9.942		El Salvador	11.533	11.518
	Madagascar	9.834	10.732		Pakistan	10.915	10.666		Guatemala	11.375	10.564
	Mali	9.593	9.904		Philippines	11.049	10.841		Honduras	10.869	10.785
	Mauritania	10.284	9.900		Sri Lanka	11.403	10.470		Nicaragua	10.824	11.505
	Mauritius	12.016	11.143		Thailand	11.685	10.339		Peru	11.514	10.581
	Morocco	11.008	10.221		Vietnam	10.643	10.470	WESTERN ASIA	Iraq	11.230	11.074
	Mozambique	9.430	10.074	COMMONWEALTH OF INDEPENDENT STATES	Armenia	11.536	10.823		Jordan	11.730	10.241
	Namibia	11.310	11.494		Azerbaijan	11.671	10.479		Yemen	10.563	9.572
	Nigeria	10.277	10.422		Belarus	11.996	10.666	CARIBBEAN	Jamaica	11.527	10.742
	Republic of Cabo Verde	11.105	10.066		Kazakhstan	11.982	10.724				
					Kyrgyz Republic	10.802	10.221		**log (MEAN)**	**11.202**	**10.674**
	Senegal	10.201	10.287		Moldova	11.280	10.340		**log (MEDIAN)**	**10.971**	**10.372**
	Sierra Leone	9.724	9.476		Tajikistan	10.654	9.945				
					Ukraine	11.615	10.232				