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International Inequality and World Poverty: A Quantitative Structural Analysis

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Dominant explanations within the existing development literature for the differences in poverty levels around the world have tended to ignore the influence of international inequality on poverty, instead focusing solely on domestic factors. In this paper, I conduct a regression analysis of the effect of inequality between countries on world poverty between 1980 and 2007, employing a new structural measure of international inequality which is created using social network analysis to calculate countries' positions in international trade networks. Countries' infant mortality rates are used to measure poverty. The results of the empirical analysis provide cross-country evidence to demonstrate that structural inequalities in the international system have a significant impact on poverty around the world. As such, the analysis demonstrates the need to move beyond focusing exclusively on domestic attributes of developing countries towards considering the broader international political economy in analysing contemporary poverty.

Keywords: poverty, international inequality, underdevelopment, trade, social network analysis

1. Introduction

In recent years the reduction and elimination of poverty have risen to the top of the international development agenda (Fukuda-Parr 2004; Hickey 2008). This has brought with it renewed attention to understanding the causes of differing levels of poverty and wealth around the world. The recent analyses of the causes of poverty have led to much emphasis being placed on the role of geography (see Sachs 2001, 2005), government policies (see Sachs and Warner 1995a; Burnside and Dollar 2000; Dollar and Kraay 2002) and, in particular, the quality of domestic institutions (see Easterly and Levine 2003; Rodrik *et al.* 2004;

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Acemoglu and Robinson 2012) in explaining differences in levels of poverty and wealth. Yet, despite this significant body of research on the causes of poverty leading to a greater understanding of the factors that play a role in the creation and perpetuation of poverty; a fundamental weakness of mainstream development approaches is that the broader international context is largely ignored in analyses of poverty. The role of the international system in producing poverty around the world has received almost no attention in the mainstream development literature. This oversight is somewhat surprising given the extensive economic and political ties that connect countries and the ever-increasing number of international laws that govern the international system. These relations between countries, and the laws that regulate them, have a significant impact on both resource availability and governance in developing countries, which in turn affects development outcomes. In particular, the vast inequality between countries – which shape both economic relations and international laws – has considerable impact on poverty around the world.

This paper addresses this significant shortcoming of the existing literature by quantitatively analysing the effects of international inequality on poverty between 1980 and 2007. In doing so, this study introduces a new measure of international inequality, created using social network analysis (SNA) to calculate countries' positions within international trade networks. Countries' positions in international trade networks provides a *structural* measure of inequality between countries, and enables this study to move beyond the narrow focus on attributes that has dominated quantitative analyses of poverty. The results of the regression analysis demonstrate that international inequality has a significant effect on poverty, which is robust when controlling for countries' overall income levels. The robustness of the findings is further demonstrated through the use of alternative models and controlling for time and country fixed effects. As such, the key contribution of this paper is to provide empirical cross-country evidence for the influence of international inequality on poverty. The analysis highlights the need for a more holistic approach to analysing poverty, which considers the broader international context in which developing countries are embedded rather than focusing solely on domestic factors within these countries. In doing so, this article also serves to provide support for calls to re-ground the contemporary analysis of development in the broader study of international political economy (Tooze and Murphy 1996; Payne and Phillips 2010).

The paper proceeds as follows. First, I consider, in greater detail, the 'internalist' bias of mainstream development approaches, which has led to the exclusion of the broader international context in the analysis of poverty. Second, I discuss the theoretical argument made in this paper about the impact of structural inequality between countries on poverty. The third section provides an explanation of how social network analysis is used to calculate countries' positions in international trade networks, and how this is used to provide a structural measure of international inequality. Fourth, I specify the models and data used to empirically test the argument. Fifth, I discuss the results of the regression analyses and the checks used to demonstrate their robustness. Finally, I conclude by discussing the implications of the analysis.

2. The 'internalist' bias in explanations of poverty

A fundamental shortcoming of the existing explanations of poverty provided in the mainstream development literature is that the causes of poverty are almost exclusively domestic (see Hudson and Dasandi 2013). Little attention is given to the causal role of international factors on poverty. This failing has, in particular, been highlighted by political philosopher Thomas Pogge (2001: 330), who argues that while economists may differ in their views over the role of government in reducing poverty, their explanations of the causes of poverty are the same:

> . . . our attention is diverted from what both sides take for granted: That the social causes of poverty, and hence the key to its eradication, lie in the poor countries themselves. We find this shared belief all the more appealing because it reinforces our ever so dear conviction that we [in the developed world] and our governments and the global economic order we impose are not substantial contributors to the horrendous conditions among the global poor.

The 'internalist' bias towards focusing on domestic factors alone in explaining poverty can clearly be seen in dominant development approaches. For example, the modernisation theory perspective considered development to be a linear process in which countries began as impoverished 'traditional societies' and passed through different stages of economic growth before entering the 'age of mass consumption' (Rostow 1960). From this viewpoint, current poverty is considered endogenous to a country, and unrelated to external factors. This internalist explanation of poverty can also be observed with the more recent neoliberal or Washington Consensus paradigm. As Gore (2000: 792) points out, a central feature of the Washington Consensus was the manner in which it used a 'methodologically nationalist form of explanation which attributed what was happening within countries mainly to national factors and policies'.

The failure to consider the international causes of poverty is further demonstrated by more recent studies that have dominated development analysis. The renewed attention given to the role of institutions in development, in recent times, has led to a debate emerging over whether *domestic institutions*, *countries' geography* or the willingness of developing country governments to implement *market policies* is the underlying cause of poverty (see Sachs 2001, 2005; Easterly and Levine 2003; Rodrik *et al.* 2004; Acemoglu and Robinson 2012). The focus of this debate again being purely on domestic factors with the broader international context largely excluded from these analyses. An example of this can be seen in Besley and Persson's (2011) book, *Pillars of Prosperity*, where the authors develop an argument based on the use of sophisticated formal mathematical models, which presumes that countries' prosperity and poverty are determined exclusively by domestic factors such as political and legal institutions within a country.

This tendency of explaining poverty as a result of domestic factors alone is also demonstrated by the major international organisations and in development policy-making (see World Bank 1997; UNDP 2003). For example, the World Bank's

country Poverty Reduction Strategy Papers (PRSPs) and Poverty Assessments, in general, tend to ignore international factors in analysing poverty in developing countries (see Dasandi 2009). This leads to the view put forward by the UNDP that poverty reduction necessitates a partnership between developed and developing countries, 'requiring bold reforms from poor countries and obliging donor countries to step forward and support these efforts' (UNDP 2003: v). This again is based on the belief that change must occur within developing countries alone because this is where the causes of poverty lie.

In this paper, I address this significant shortcoming of the existing literature by empirically analysing the effects of structural inequalities in the international system on poverty. It is important to point out that in examining the relationship between international inequality and poverty, this articles does not make the claim that poverty is solely the result of international factors; on the contrary, this study seeks to overcome the biases of 'endogenism' and 'exogenism' in development analysis that Hettne (1995: 262) has highlighted, and contributes to the synthesis of these two approaches that is called for.

3.   International inequality and poverty

Inequalities between countries influence poverty levels because countries do not exist in isolation; since the colonial era they have become increasingly connected through various economic, political and social ties, which have a significant effect on development in the developing world. This has been highlighted by Beaudoin (2007: 12) in his study of *Poverty in World History*, arguing that while prior to 1500 'poverty resulted principally from local sources like natural disaster, warfare, and civilisation-specific systems of distribution'; since 1500, poverty is far more directly linked to colonial rule and the process of creating a world economy:

> As time passed, the world economy came to play a much greater causal role in world poverty, influencing both available resources and systems of distribution. This only intensified after the Second World War, as the Cold War and an expanding world economy involved more and more nations.

A fundamental feature of the world economy is that some countries benefit from a substantial economic, political and military dominance over other countries (Pogge 2008). This structural inequality has a significant impact on poverty levels around the world.

In this study, I focus specifically on the unequal structure of international trade relations, arguing that the fundamental way in which international inequality has produced and perpetuated poverty has been the manner in which some countries have been incorporated into the international system as suppliers of primary commodities and lower value-added manufactures; while others as the producers of higher value-added manufactured products. This structural inequality affects poverty in two ways. The first and principal channel is through wealth flowing from those countries in peripheral positions in the international system to those

in the core, which influences the amount of resources that are available to a country. The second is the manner in which countries in peripheral positions are likely to experience more unequal distribution of resources within the country, higher corruption and instability, greater vulnerability to shocks and weaker domestic institutions.

In making this argument, I draw on existing structural approaches to analysing development. Of particular importance are the structural approaches to development originating largely in Latin America in the 1950s and 1960s, which together can be labelled 'underdevelopment theory' (Payne and Phillips 2010).[1] An underlying argument of underdevelopment theory was that colonial rule has led to the creation of a capitalist world system based on exploitative economic relations between countries in 'the core' of the world economy, who were largely producers of manufactured goods, and the countries of 'the periphery', who were largely producers of primary commodities (see Prebisch 1950; Baran 1957; Frank 1969; Emmanuel 1972; Wallerstein 2004).[2] This unequal international system is seen as fundamental to understanding differences in levels of development between countries. I also draw on more recent structural arguments focusing on the impacts of the process of globalisation on poverty, particularly the 'global value chains' (GVC) literature (see Gore 2000; Kaplinsky 2000, 2005; Chang 2002; Gereffi *et al.* 2005).[3]

The current unequal and exploitative structure of trade relations has its roots in the colonial era. While at first colonialism created structural inequalities through the direct transfer of wealth from the colonies to the European powers, which benefitted the latter at the expense of the former (Fanon 1965; Frank 1969; Hoogvelt 2001), over time the European powers created a hierarchical world economy in which countries occupied different positions. A principal argument of underdevelopment theorists is that this world economy was characterised by an *international division of labour*, whereby the colonial powers, or the 'core', supplied manufactured goods to the world economy, while the colonies, or the 'periphery', supplied primary commodities (Prebisch 1950; Baran 1957; Frank 1969; Emmanuel 1972; Wallerstein 1979).[4] Following independence, these countries continued to supply primary commodities, until the 1960s when a number of developing countries, located mainly in Asia, experienced a period of rapid industrialisation (Frobel *et al.* 1980; Hoogvelt 2001; Dicken 2003). Despite increasing industrialisation within many developing countries, primary products continue to form the largest share of exports for the majority of least developed countries.

A key issue is the manner in which the price of primary commodities tend to fall in relation to the price of manufactured goods over time, which means that poorer countries continually have to export a greater volume of primary goods to purchase the same value of manufactured goods (Prebisch 1950).[5] Furthermore, despite many developing countries managing to industrialise, structural inequalities continue the terms of trade between labour-intensive low-skill manufactures, such as textiles, and capital and knowledge intensive manufactures, such as electronics (Kaplinsky 2005; UNCTAD 2005; Harvey *et al.* 2010). Along with wealth flowing from developing countries to developed countries, the declining terms of trade has meant lower income for developing world producers and higher trade deficits often pushing countries into debt (Locke and Ahmadi-Esfahani 1998).

In addition to the issue of declining terms of trade, the recent literature on global value chains (GVC) analysis has emphasised how the process of globalisation and structural inequalities have led to falling incomes for producers in many countries (see Kaplinsky 2000, 2005; Gereffi *et al.* 2005; Gereffi and Fernandez-Stark 2011). The GVC analyses have highlighted the manner in which producers must be able to protect themselves from competition using barriers to entry if they are to generate sufficient rents (see Kaplinsky 2005). The process of globalisation has led to greater competition and lower barriers to entry in different markets, particularly in the production of manufactured goods where there has been a move towards trade in sub-components (as opposed to final products). This, in turn, has led to a downward pressure on prices. While some producers – particularly those in more developed economies focusing on higher value-added exports – have been able to guarantee economic rents through constructing barriers to entry (by various means, such as marketing and design enabling product differentiation, the use of advanced technology and intellectual property right laws), other producers – particularly those in developing countries involved in more labour-intensive exports – are unable to construct barriers to entry and as such cannot generate sufficient economic rent. Subsequently, the manner in which these countries are inserted into markets with low barriers to entry has fuelled a 'race to the bottom', in which they face a situation of 'immiserising growth' with increasing competition and declining incomes (Kaplinsky 2000; de Boer *et al.* 2012: 38).[6] Therefore, the combination of the process of globalisation and structural inequality leads to greater poverty as well as driving further structural inequality between countries.

In addition to influencing resource availability in developing countries, structural inequality between countries also has an impact on domestic inequality and governance in developing countries. In general, the way in which economies of periphery countries have centred on transferring natural resources to industrialised nations has meant that they are based on land-intensive production. This has led to the creation of an elite land-owning class in the periphery countries (see Baran 1957), and has resulted in a highly unequal distribution of resources in these countries (see Auty 2001; Collier 2007). Furthermore, governance and institutions in such countries is worse, which is further linked to the broader international context. Pogge (2008: 119) highlights the way in which the international system recognises any group that comes to power in a national territory as having the legal rights to sell the countries' natural resources internationally, regardless of the means through which the group came to power or how repressive this group may be (he terms this 'the international resource privilege'). These factors, combined with the power vacuum that emerged in many developing countries in the wake of colonial rule, have provided strong incentives for coups, civil wars, high levels of corruption and authoritarianism, resulting in bad governance and weak institutions in periphery countries (Hudson and Dasandi 2013).

The structural inequality between countries have in recent times been reinforced by the ever-increasing number of international laws, which themselves are shaped by the vast inequalities of power between countries (Hurrell and Woods 1999). There are four particular aspects of international trade laws that adversely impact developing countries – particularly the least developed

countries (LDCs) – and thus directly affect poverty. Firstly, international trade rules have enable developed nations to continue to use tariff and non-tariff barriers to prevent developing countries from entering markets in which they may have a comparative advantage (Wade 2003; Bardhan 2006). Secondly, trade rules have allowed developed countries to use agricultural subsidies to lower world prices preventing developing country producers from being able to compete with agricultural producers from richer nations (Charlton and Stiglitz 2005; Khor 2005). Thirdly, international trade rules have forced many countries into rapid and comprehensive trade liberalisation. As Chang (2002) has highlighted, this runs counter to the historic experience of the richer nations, the majority of whom made tactical use of protectionist policies combined with investment in key sectors to develop their manufacturing sectors, before liberalising (see also Rodrik 2001; Wade 2003; Gallagher 2008).

The final way in which international laws perpetuate structural inequalities is the way in which international trade rules on intellectual property rights have restricted access to technology for developing countries – or have made it very expensive for developing countries to access important technology as the price of technology has been driven up by patents (Wade 2003; Bardhan 2006; Gallagher 2008; Pogge 2008). This has meant that even with increased industrialisation in the developing world, the technological superiority of the richer nations has meant that higher levels of processing, associated with higher growth, is concentrated in the developed nations (Kaplinsky 2000; Mahutga 2006). The combination of an increasingly globalised economy and the type of manufacturing done in the developing world has, in many cases, been harmful due to downward pressure on the prices of these manufactured products and greater unemployment in poorer countries, as the GVC analyses have highlighted (Kaplinsky 2005; de Boer *et al.* 2012). Furthermore, in cases where such inequalities are not enforced by international trade laws, developed countries have often turned to bilateral and regional trade agreements to ensure they are able to benefit from unequal trade relations (Shadlen 2005, 2008).

Therefore, based on the arguments made in this section on the relationship between international inequality and poverty, I would expect countries in more peripheral positions in the international system to experience higher levels of poverty than countries in more central positions. In the next section, I discuss the structural measure of international inequality used in this analysis, which is based on calculating countries' positions in trade networks using social network analysis.

4. Network position and structural inequality

Inequality between countries impacts poverty because countries are connected through various economic and political relations in an unequal world structure. Therefore, in order to analyse the impact of international inequality on poverty, it is necessary to use a *structural* measure of international inequality. This study does this by using social network analysis (SNA) to measure countries' positions within international trade networks. Network analysis is methodological approach which focuses on examining relations between actors, and the structures created

by these relations, rather than focusing solely on the attributes of the actors (Wasserman and Faust 1994; Scott 2000; Maoz 2011). Consequently, it enables the measurement and analysis of structures, and is uniquely suited to provide a structural measure of transnational processes, such as inequality, dependence and power in the international system. Therefore, in using countries' position in trade networks to measure structural inequality, I take a 'networks as structure' approach here (Hafner-Burton and Montgomery 2009). Such an approach also ensures that this study moves beyond the methodological nationalism that has dominated poverty analyses (Gore 2000).

Trade networks are used to measure countries' positions in this study, as trade can be seen as the fundamental relation between countries in the international system (Payne 2005: 167). However, structural inequalities between countries are perpetuated by other international relations. This is a point made by a number of underdevelopment theorists, who highlight the relationship between different economic and political relations (see Frank 1969; Dos Santos 1970). Recent empirical studies also indicate that different economic and political ties between countries are linked to one another. For example, studies have demonstrated the link between trade relations and political/security ties (Rosecrance 1986, 1999; Pollins 1989a, 1989b; Gowa 1994; Oneal and Russett 1999; Russet and Oneal 2001; Gowa and Mansfield 2004; Biglaiser and DeRouen 2009). A number of studies also highlight the link between trade flows and FDI flows (Jensen 2003, 2006; Biglaiser and DeRouen 2007; Büthe and Milner 2008) and trade and aid relations (Morrissey *et al.* 1992; McGillivray and Morrissey 1998). Therefore, while a measure of international structural inequality based on trade relations may not incorporate the full range of interactions between countries, it provides a good indicator of structural inequality in the international system, based on the relationship between trade and other international relations.

Using SNA, countries' positions in trade networks are calculated for each year between 1980 and 2007. The international trade networks are made up of trade relations between all countries in the international system. The trade relations are made up of directed gross exports between each pair of countries, where the level of aggregation for trade relations is at the country level. In other words, the network includes exports going from Country A to Country B, as well as exports from Country B to Country A for all pairs of countries in the international system. The aim of positional analysis in SNA is to 'partition actors into mutually exclusive classes of equivalent actors who have similar relations patterns' (Borgatti and Everett 1992: 3). As such, countries occupying the same position are connected in very similar ways to equivalent others in the network. A country's position in international trade networks reflects the manner in which it is incorporated into the world economy. Here, the concept of *regular equivalence* is used to measure countries' network positions (White and Reitz 1983; Borgatti and Everett 1989). Actors are considered regularly equivalent if they have identical ties to and from equivalent (but not necessarily the same) actors in the network (Wasserman and Faust 1994). This is particularly important because countries' positions, using regular equivalence, are determined by both their direct and indirect ties. As such, countries' positions in networks using regular equivalence are affected by the position of other countries in the network, providing a structural measure of

international inequality. This differs from a traditional approach of considering dyadic relations between pairs of countries, which fails to capture both the other relations that a country may simultaneously have, and the effect that other countries in the system have on a particular country. This also differs from alternative network concepts of position, such as *structural equivalence*, where actors are only considered equivalent if they are connected to the exact same actors (see Borgatti and Everett 1992). As a result, when using structural equivalence, it is only countries' direct relations which impact their network positions; hence this is not a structural measure of international inequality (Maoz 2011).

There are two stages in calculating countries' positions in international trade networks for each year of analysis.[7] The first is to measure the level of regular equivalence between each pair of countries. This is done using the *REGE* algorithm (White and Reitz 1985; see also Wasserman and Faust 1994). The algorithm employs an iterative procedure in which estimates of the level of regular equivalence between pairs of countries are adjusted based on the equivalences of the countries adjacent to and from members of the pair. The measure of regular equivalence produced by the REGE algorithm is specified, following White and Reitz (1985) and Wasserman and Faust (1994), as follows:

$$M_{ij}^{t+1} = \frac{\sum_{k=1}^{g} \max_{m=1}^{g} \sum_{r=1}^{R} M_{km}^{t}({}_{ijr}M_{kmr}^{t} + {}_{jir} M_{kmr}^{t})}{\sum_{k=1}^{g} \max_{m}^{*} \sum_{r=1}^{R} ({}_{ijr}Max_{kmr} + {}_{jir} Max_{kmr})}$$

In this equation, M_{ij}^{t+1} represents the regular equivalence between countries i and j at iteration $t + 1$ based on the trade network.[8] The denominator is the maximum possible value attainable if all of i's ties to and from all other countries, denoted by k, perfectly matched all of j's ties to and from all other countries, denoted m, and if i's and j's alters, k and m, were themselves regularly equivalent. The numerator selects the optimal matching of the ties between j and m, for i's ties with k, weighted by the regular equivalence of k and m from the previous iteration. Therefore, the algorithm finds the best possible matching of ties between i and all other countries, with ties between j and all other countries, weighted by the equivalence of the others actors, and divides this by the maximum possible value of the numerator (Mahutga 2006). Therefore, the regular equivalence value M_{ij} is a function of how well i's ties with other actors can be matched by j's ties with all other actors, and vice versa. The equivalences of each pair of actors are revised after each iteration (see Wasserman and Faust 1994: 477–8). The algorithm measures the level of equivalence between each pair of countries in the network, with 0 indicating that two countries are maximally dissimilar and 1 indicating that two countries are perfectly regularly equivalent.

The second stage of the positional analysis is to use these regular equivalence scores to partition countries into the different positions. I do this using the *hierarchical clustering* procedure (Johnson 1967). The hierarchical clustering procedure places the different countries into subsets based on the similarity of their regular equivalence in the network. This is done by setting a threshold value, α, whereby countries are considered regularly equivalent if their regular equivalence score is greater or equal to the threshold value. In other words for two countries

i and j, with regular equivalence M_{ij}, each subset should contain countries for which $M_{ij} \geq \alpha$. The *complete link* method of hierarchical clustering is used, as it produces more homogenous and stable clusters than other approaches (Wasserman and Faust 1994). This procedure uses sequentially less restrictive values of α to produce the clusters.

Countries are partitioned into four mutually exclusive positions both for theoretical and methodological reasons. There has been much discussion in the world-systems literature on the number of hierarchical positions in the world system. Traditionally, theorists such as Wallerstein (1974, 1979, 1980) have posited a threefold division of the world into core, semi-periphery and periphery. However, there has been some debate over the number of positions that the semi-periphery – defined as the middle sector in the world system between core and periphery both economically and politically (Wallerstein 1979: 69) – consists of (Blanton 1999). Having calculated three-, four-, and fivefold partitions of the network, I follow Van Rossem (1996) in using a fourfold partition. The use of the fourfold partition is supported methodologically, as it provides the greatest increase in the level of regular equivalence captured by each additional group (see Braithwaite *et al.* 2012). Hence, countries are placed into four hierarchical positions based on regular equivalence scores derived from international trade networks.[9]

The use of network position to measure structural inequality in the international system is supported by arguments made by underdevelopment theorists and by those associated with GVC analysis. As Mahutga (2006: 1867) has pointed out, the diversity of a country's production structure increases with the level of processing at which it is able to produce. As such, a country's position in international trade structures (or networks) is therefore closely tied to its level of processing, whereby greater variation in types of goods produced by a country means greater market access and more trading partners (Mahutga 2006). This is, in part, because the technological superiority that countries in the core have over more peripheral countries, and the manner in which peripheral economies are based on exporting a limited number of primary commodities and increasingly intermediate processed manufactures, means that countries at the core can easily substitute the goods purchased from the peripheral countries (Galtung 1971; Wallerstein 1974; Hirschman 1980; Mahutga 2006). The result is that core nations, which produce more capital-intensive and more technologically advanced goods, 'enjoy a structural advantage over peripheral nations by limiting their trading alternatives and maintaining trade relations that favour the core' (Mahutga 2006: 1866). Furthermore, because of the lack of economic diversification, trade between peripheral countries is limited and much of the trade is done with core or semi-periphery nations (Wallerstein 1974, 2004). As such, the pattern of trade relations between countries in different positions is shaped by, and further reproduces, structural inequality in the international system.

Therefore, the principal advantage of using countries' positions in the trade networks as a measure of structural inequality is that it captures more fully the different aspects of inequality in the international system. The structure of trade relations reflects both the colonial legacy of the international division of labour and the continued unequal trade relations linked to the technological superiority

and more capital-intensive production of developed nations. Furthermore, countries' network positions also reflect more completely the different components of international trade laws that perpetuated inequality between countries, such as the restricted access of developing countries to developed country markets and the technological inequality reinforced by international property right rules.

The structure of the international trade network and countries' positions within the network are demonstrated in Figure 1. The diagram depicts the international trade network for the year 2000 with countries' positions indicated by the different colours of the nodes in the network. Countries in the core (Position 1) are coloured red; the 'upper semi-periphery' (Position 2) countries are coloured blue; the 'lower semi-periphery' (Position 3) countries are coloured yellow; and the periphery (Position 4) countries are coloured green. The ties in the diagram indicate only whether or not a country trades with other countries, and does not show the volume of trade between countries. In order to more clearly demonstrate the structure of the network, only trade ties over the value of US$10 million (at 2000 prices) have been included in the diagram. The trade data used in the network analysis to produce this structural measure of international inequality is discussed in Section 5.

While Figure 1 is a simplified representation of the international trade network, it serves to highlight some of the differences in how countries in each of the four network positions are integrated in the international trade network. For example, the diagram demonstrates the manner in which countries trade ties (and hence trading partners) decreases as we move from countries in the core (Position 1) to those in the periphery (Position 4). Furthermore, the diagram also shows that there is very little intra-position trade between countries in the periphery, or even between those in the lower semi-periphery (Position 3), which is not the case for countries in the core or the upper semi-periphery (Position 2).
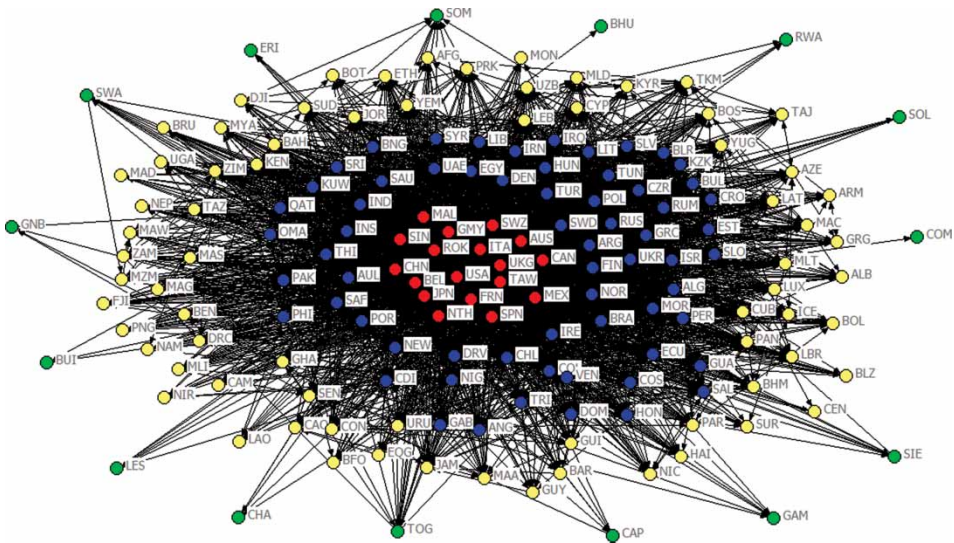

FIGURE 1. (Colour version available online) International trade network, 2000.

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5. Research design and data

This study employs country-year units of observation. In conducting the network analysis of countries' positions in international trade networks, the study attempts to model the international system closely. As such, the analysis includes all independent states for each year between 1980 and 2007, based on the criterion put forward by Gleditsch and Ward (1999).[10] To analyse the effects of international inequality on poverty, an OLS regression model is used with country-clustered robust standard errors in order to address potential heteroscedasticity and autocorrelation.[11] I further test the robustness of the findings by using two alternative models to conduct the analysis. The first is an OLS regression with panel-corrected standard errors (PCSE), which addresses potential contemporaneous correlation in the error term across panels. This model also controls for first-order autocorrelation (AR.1). The second additional test conducted is to use a fixed effects model, controlling for the effects of both country and time fixed effects, which is used to address potential omitted-variable bias.

Data on poverty

The dependent variable analysed in this study is *poverty*. The measurement of poverty continues to be the subject of much debate (see Lister 2004). In this analysis I use countries' infant mortality rate (IMR) as a proxy measure for poverty. The IMR data used here is taken from Abouharb and Kimball's (2007) 'infant mortality rate dataset'. The dataset provides annual data summarising the number of infants per 1000 that die before reaching the age of 1, up to 2007.[12] The natural log of IMR is used as the dependent variable. A number of studies use per capita national income as a measure of poverty (for example, Collier and Hoeffler 2002). However, such an approach ignores the widespread criticism that GDP per capita does not capture distribution within countries, and hence does not provide an accurate measure of poverty (Sen 1976, 1979). Furthermore, alternative measures of income poverty, such as the World Bank's $1.25/day poverty headcount are both sparse and unreliable (see Reddy and Pogge 2005; Deaton 2010). As such, I use annual IMR data, which has a high level of coverage, in addition to data being available for each country over a long period of time (Abouharb and Kimball 2007).

Infant mortality rate has long been identified as a measure of poverty because it is closely correlated with other measures of poverty (see Wilkinson 1996; Deaton 1999, 2001). A number of studies analysing poverty use (or advocate the use of) IMR as a measure of poverty (see Desai 1991; Dasgupta 1993; Sen 1998; Moser and Ichida 2001; Reddy and Pogge 2005). In addition, I conduct a pairwise correlation between a number of widely-used income- and non-income based measures of poverty (for the countries included in this study), to provide further support for the use of IMR as a measure of poverty in the analysis. The results of the pairwise correlation, which are presented in Table A1 in the Appendix, demonstrate that IMR is strongly correlated with both income-based measures of poverty, such as the $1.25/day poverty headcount, and non-income measures of poverty, such as life expectancy, literacy and malnourishment. Table A1 also shows that GDP

per capita is not as strongly correlated with other poverty indicators as IMR is – even when we consider the income poverty headcount measures. Furthermore, the table demonstrates that IMR has the highest number of observations for the countries and time period considered in this analysis, and covers the widest range of countries, in comparison to the other indicators.

International inequality data

The key independent variable is countries' *international inequality*. As discussed above, network position is used as a structural measure of international inequality and has been calculated using network analysis on dyadic trade relations. Countries have a position score between 1 and 4, where 1 represents the most central or core position in the network and 4 represents the most peripheral. In order to calculate countries' position in trade networks it is necessary to have data on all bilateral trade relations between pairs of countries for each year. Between 1980 and 2000, Gleditsch's (2002) bilateral trade flow data is used. For 2001 to 2007, I have combined data collected from the IMF's 'Direction of Trade Statistics' and aggregated product-specific trade data from the UN COM-TRADE database.[13] The Gleditsch trade data is highly correlated with the IMF and aggregated product-specific trade data.

Country characteristics

I also include a number of country-level control variables drawn from the existing literature on the causes of poverty. The first is the *latitude* of a country, which simply records the absolute mean latitude of the angular distance of the state from the equator. This variable provides a measure of whether a country is located in the geographical tropics, which is seen as a key cause of poverty in the existing literature (Sachs and Warner 1995b, 1997; Bloom and Sachs 1998; Gallup *et al.* 1999; Sachs 2001, 2005; UNDP 2003; United Nations Millennium Project 2005).

A dummy variable for whether a country is a *democracy* is also included based on panel data from the Polity IV dataset (Marshall *et al.* 2011). The absence of democracy has long been put forward as a reason for higher poverty (see Sen 1999; Varshney 2006). Using the Polity score, the dummy variable is coded '1' if the state's score is greater than or equal to 6 and '0' otherwise for each year of analysis. It is important to note that the Polity measure of democracy also considers the strength of a country's institutions, as a key component of the Polity measure of democracy is the existence of institutional constraints on the power of the executive in a country (Marshall *et al.* 2011: 14). As such, the *democracy* variable is also used in this analysis to control for the quality of a country's institutions, which in recent times has been seen as the key determinant of poverty in a country (see Acemoglu *et al.* 2001; Easterly and Levine 2003; Rodrik *et al.* 2004).

I also include *trade openness* as a control variable, which is taken from the UN National Accounts data. Trade openness is calculated as the sum of exports and imports as a proportion of a country's GDP measured at constant 1990 prices. This measure of trade openness has widely been used to consider the effects of

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TABLE 1.   Descriptive statistics of key variables

	Mean	Standard deviation	Minimum	Maximum
ln(IMR)	3.51	1.08	0.83	5.65
International inequality	2.65	0.94	1	4
Latitude (absolute)	25.22	16.61	0.23	64.15
Democracy	0.43	0.49	0	1
Trade openness	89.61	84.35	2.76	1375.66
Population growth$_{(t-1)}$	1.86	1.51	-7.55	12.24
ln(GDP per capita)	8.26	1.41	4.26	11.47

liberal trade policies, which some have argued is a key factor in reducing poverty (Dollar 1992; Sachs and Warner 1995a, 1995b; Burnside and Dollar 2000; Dollar and Kraay 2002).[14]

An additional control variable included in the model is lagged *population growth*, which indicates the percentage change in a country's population. This is calculated using the UN National Accounts population data. Population growth has long been associated with higher poverty (see Kelley and Schmidt 1994, 2001; Birdsall *et al.* 2001).

The final control variable included in one of the regression models is *GDP per capita*, which is logged. This is included to test whether international inequality affects poverty (measured by IMR), even when controlling for countries' per capita national incomes, as I have argued above. By including GDP per capita in the regression model, the analysis demonstrates that the relationship between countries' network positions and poverty does not simply reflect the manner in which wealthier countries are more integrated into trade networks; instead, the relationship between countries' network positions operates through a number of channels, as discussed. The GDP per capita data is taken from the World Bank's *World Development Indicators*. The summary statistics of all of the variables included in the models are provided in Table 1.

6.   Results

The results of the multivariate regression analysis of the impact of international inequality on poverty (measured by the natural log of IMR) are presented in Table 2. The models include a number of control variables drawn from the extant literature analysing causes of poverty, as I have discussed above. In the first model, I test the effect of international inequality on poverty, excluding GDP per capita from the regression model, as a principal channel through which we would expect international inequality to affect poverty is through its effect on countries' levels GDP per capita levels. Model 2 repeats the analysis, including GDP per capita, as we would expect international inequality to impact poverty through channels other than per capita national income, based on the argument made above.

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TABLE 2. OLS regressions of international inequality on poverty

	1	2
International inequality	0.377***	0.100**
	(0.054)	(0.041)
Latitude	−0.019***	−0.010***
	(0.003)	(0.003)
Democracy	−0.671***	−0.315***
	(0.089)	(0.077)
Trade openness	−0.002**	−0.001
	(0.001)	(0.000)
Population growth$_{(t-1)}$	0.099***	0.127***
	(0.030)	(0.024)
ln(GDP per capita)		−0.416***
		(0.036)
Constant	3.274***	6.894***
	(0.236)	(0.325)
R^2	0.658	0.780
Root mean square error	0.630	0.506
No. of observations	4217	4217

Notes: Country-clustered standard errors in parentheses. ***, ** and * indicate significance at the 1, 5 and 10% level, respectively.

The results show that international inequality has a strong and significant impact on infant mortality rates. Model 1 shows that a one-unit increase in international inequality (a move of one position from the centre towards the periphery) is associated with a 38 percentage-point increase in poverty, and this result is statistically significant at the 99 per cent confidence level. In Model 2, GDP per capita is included in the regression model. As I have argued above, while the principal channel through which international inequality affects poverty is through its effect on national income, this is not the only channel through which inequality between nations impacts poverty. Countries' positions in the international system impacts the type of production that takes place in a country, which in turn affects the distribution of resources within a country. The results suggest that when we control for (logged) GDP per capita, a one unit increase in international inequality is associated with a 10 percentage-point increase in infant mortality rate. This result is statistically significant at the 95 per cent confidence level. This is particularly important, as it demonstrates that the effect of countries' positions in the international system on poverty is not simply a reflection of countries' overall wealth levels; countries' positions in the international system impact poverty through a number of channels, as I have argued in this paper. As such, the results demonstrate that, controlling for other factors, inequality between countries in the international system has a strong and statistically significant effect on poverty. The results, therefore, provide strong support for the argument made in this paper.

It is important to note that the results also provide support for other explanations of poverty provided in the literature. A greater distance of countries from the

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tropics is associated with lower poverty; a country having strong democratic institutions is associated with far lower levels of poverty than countries that do not have democratic institutions; higher trade openness is associated with slightly lower poverty; and higher population growth is associated with higher poverty.

7. Additional robustness checks

In order to confirm the robustness of these findings I conduct a number of additional checks. As the analysis here uses panel data, I use two additional models that address issues that arise using a time-series analysis. The first is an OLS with PCSE model, which controls for first-order (AR.1) autocorrelation. The second is a fixed effects model, which controls for both country and time effects. The results are presented in Table 3.

The results of Model 1 suggest that when using panel-corrected standard errors and allowing for autocorrelation (AR.1), a one unit increase in international inequality is associated with a five percentage-point increase in IMR. This result is statistically significant at the 99 per cent confidence level. In Model 2, in which I control for country and time fixed effects, the regression analysis yields a point estimate of 0.02 which is statistically significant at the 95 per cent confidence level. It is worth pointing out that the results of the fixed effects analysis are likely to significantly understate the effect of international inequality on poverty, as a number of countries do not change position during the 28-year time period of analysis. For example, the USA and Germany always feature in the core, while Burundi and Eritrea feature constantly in the

TABLE 3. OLS with PCSE and fixed effects regressions of international inequality on poverty

	1 (OLS with PCSE)	2 (Fixed effects)
International inequality	0.049***	0.020**
	(0.018)	(0.009)
Latitude	−0.033***	
	(0.002)	
Democracy	0.291***	0.008
	(0.037)	(0.013)
Trade openness	−0.001***	−0.000***
	(0.000)	(0.000)
Population growth$_{(t-1)}$	0.057***	−0.007**
	(0.011)	(0.004)
Constant	4.367***	3.903***
	(0.087)	(0.031)
R^2	0.771	0.566
No. of observations	4217	4217

Notes: ***, ** and * indicate significance at the 1, 5 and 10% level, respectively. For Model 2, time- and country-dummies are not reported.

periphery. As such, the use of country fixed effects means that the relationship between international inequality and poverty in such cases is not taken into account, as it is absorbed by the country dummy variable.

I also consider whether the results hold when using alternative measures of poverty as dependent variables. Using GDP per capita as the dependent variable, I find that countries' network position has a strong effect on GDP per capita, which is significant to the 99 per cent level.

I further check the robustness of the results by considering alternative measures of the main independent variables. While I have used a fourfold partition of countries in international trade networks due to substantive and methodological concerns, I would still expect alternative partitions of countries to have a significant impact on poverty. Hence, I also conduct the analysis of network position on poverty for three- and five-splits of the network, and find that the results hold. Furthermore, I ensure that the results are not dependent on the method used to partition countries by conducting the hierarchical clustering using the average link method. Changing the method of clustering had no effect on countries' positions. Using a lagged network position also had no significant impact on the findings. As different dyadic trade datasets were used to calculate network position for 1980–2000 and for 2001–2007, I also run Models 1 and 2 again, splitting the data for these two different time periods, to ensure that the different datasets do not impact results. Again, the results show the effect of international inequality on poverty to be almost identical for both samples, and to be statistically significant at the 99 per cent level. Using an alternative measure of the quality of institutions, based on the average level of expropriation risk in a country, also has no impact on the findings.[15]

8.   Conclusion

This paper addresses a major weakness of current analyses of world poverty, which is the manner in which the impact of international inequality on poverty is overlooked. Using social network analysis to create a structural measure of international inequality and infant mortality rate to measure poverty, I find that international inequality has a significant impact on countries' poverty levels.[16] This finding holds when controlling for countries' overall income levels and for country and time fixed effects. As such, this paper provides cross-country empirical evidence to demonstrate that structural inequalities in the international system significantly influence the creation and perpetuation of poverty around the world.

There are two key aspects of the analysis that provide support for the causal argument made in this study regarding the impact of international inequality on poverty. The first is that, in using a measure of international inequality based on countries' positions in international trade networks, the analysis of the effect of international inequality on poverty captures more accurately the structural arguments made by underdevelopment theorists and GVC analysts, as I have explained previously. The use of a measure of international inequality with greater validity ensures that the analysis conducted here more precisely tests the effects of international inequality on poverty based on the theoretical argument put forward. The second feature of the study, which provides support for the paper's argument, is

that the regression analysis controls for the domestic factors that are viewed as the principal causes of poverty. In recent times, there are three domestic factors in the mainstream development literature, which have come to be seen as the main causes of poverty: geography, trade openness and, in particular, the quality of institutions (see Easterly and Levine 2003; Rodrik *et al.* 2004). The analysis conducted here demonstrates that the impact of international inequality on poverty occurs when controlling for each of these three factors. This is found to be the case when using alternative measures of the quality of institutions and alternative regression models. The analysis also demonstrates that international inequality has a significant effect on poverty when controlling for countries' overall GDP per capita levels, which further adds weight to the causal argument made here. Furthermore, the use of a fixed effects model demonstrates that countries' positions impact poverty levels when controlling for other country characteristics that remain fixed over the 28 year time period, such as natural endowments. The results of the fixed effects regression model also show that changes in international inequality over time are associated with corresponding changes in poverty. As such, these two features of the analysis support the causal argument put forward in this study.

The findings of this study have a number of key implications for the analysis of poverty. The study highlights the need to shift away from focusing solely on the attributes of developing countries, towards considering the broader international context in which these countries are embedded, and how international and domestic factors together contribute towards producing poverty. As such, this study also provides support for calls to re-ground the contemporary analysis of development within the wider domain of international political economy (see Tooze and Murphy 1996; Payne and Phillips 2010).

The results provide some significant support for underdevelopment theories, such as dependency theory and world-systems analysis, and for arguments made by those associated with GVC analysis. In particular, the focus on the effect of international inequalities on development that is central to these theories is demonstrated by the effect of network position on poverty levels. It is, however, important to note that this analysis also highlights the limitations of underdevelopment approaches, which at times have tended to explain development outcomes as being exclusively the result of international factors (Hettne 1995). This study finds evidence to support existing domestic-focused explanations of poverty and hence, in arguing that there is a need to consider international factors when considering poverty, I do not argue that poverty is *exclusively* a result of external factors, as posited by some underdevelopment theorists. Instead, this study highlights the need to consider both domestic and international factors in analysing poverty.

The results of this study also have significant policy implications for poverty reduction. The findings suggests that there is a need for developing countries to pay closer attention to their 'strategic integration' into the world economy, which would entail tactical use of tariffs, investment in key export sectors and a strategy that considers the actions of other countries in the international system (see Gore 2000; Rodrik 2001; Wade 2003; Kaplinsky 2005). As Gore (2000: 798) points out, such an approach:

... recognizes vulnerabilities associated with integration into the international economy and also external constraints due to restrictions in access to advanced country markets, falling terms of trade for primary commodities and simple manufactures, carterlization in global markers, difficulties in gaining access to technology and instabilities of the international financial system.

This approach differs greatly from the approach to development prevalent during the Washington Consensus era, in which a blanket set of policies was promoted by developed nations and international organisations.[17]

Furthermore, the findings regarding the effect of international inequality on poverty suggest that there is a greater need for policy-makers to consider the negative effects of international factors on poverty – specifically the manner in which the policies and actions of developed nations have a direct bearing on the poverty experienced by people in the developing world, rather than to focus exclusively on reforms to be undertaken within developing countries, as currently tends to be the case (see Dasandi 2009). In the case of trade, the focus of this study, the results suggest that the outcome of the currently unresolved Doha round of international trade negotiations is likely to have significant consequences for world poverty. More broadly speaking, this analysis highlights the need for a system of global governance that ensures developed countries 'stop doing harm' if poverty is to be eradicated (Green 2008: 429; see also Farmer 2005; Pogge 2008; Linklater 2011).

Finally, this paper also makes a significant methodological contribution through its use of social network analysis. SNA is used here to examine the structure of the international system and to incorporate this into an analysis of poverty. Current quantitative approaches to analysing development issues focus solely on attributes of countries, ignoring the broader economic and political system in which countries are embedded. Development outcomes, however, are a result of the social, economic and political processes that occur within and between states, and not just the attributes of actors. This study demonstrates that using social network analysis, with its focus on relations and structures in addition to attributes, enables us to effectively take into account this broader international structure when conducting quantitative analyses. Hence, this study builds on recent efforts to incorporate SNA into the study of international relations and international political economy (see Hafner-Burton *et al.* 2009; Maoz 2011).

A number of avenues of future research emerge from this study. While the analysis here has focused specifically on trade relations between countries, as trade represents a fundamental tie between nations, it is also important to consider other international ties, such as foreign direct investment, and how the structure of these relations impacts poverty. More generally, additional work is needed on how other dimensions of international inequality affect poverty. The analysis here has focused on the direct impact of international inequality on poverty. However, the impact of international inequality on poverty in a country is likely to vary according to the domestic context. Similarly, the impact of different domestic factors on poverty is likely to differ based on the level of international inequality a country faces. As such, an important area of future research is to consider the effects of the interaction of international and domestic factors on poverty. Finally, it is also

necessary to further examine the factors that influence countries' positions in international trade networks. This would also provide greater support for the causal argument made in this study about how international inequality leads to poverty. This paper does, however, provide strong empirical evidence for the effect of international inequality on poverty, and in doing so demonstrates the need to consider how poverty levels around the world are influenced by the broader international political and economic structure and cannot be explained by domestic factors alone.

Notes

1. As Payne and Phillips (2010: 71) explain, 'underdevelopment theory' can be seen to consist of different sub-fields, such as 'structuralism, neo-Marxism, dependency theory and world systems theory'.
2. Wallerstein (2004: 24) defines capitalist world system as one that 'gives priority to the *endless* accumulation of capital', and argues that when a system prioritises endless accumulation, 'it means that there exist structural mechanisms by which those who act with other motivation are penalized in some way, and are eventually eliminated from the social scene, whereas those who act with the appropriate motivates are rewarded, and if successful, enriched'.
3. The similarities between the arguments made by dependency/underdevelopment theorists and those made in critical discussions of globalisation have been highlighted by Herath (2008: 831), who claims 'some brands of globalisation theories have reworded and rephrased the central concept of dependency theory'.
4. This often involved the destruction of local economies in the colonies. In the case of India, colonial rule led to deindustrialisation, whereby the country went from producing 24.5 per cent of the world's manufactured goods in 1750 to only 1.4 per cent in 1913 (Beaudoin 2007: 69).
5. The observation that the prices of primary commodities tends to fall in relation to the price of manufactured goods is known as the 'Singer-Prebisch thesis' (after Hans Singer and Raul Prebisch who arrived at this conclusion independently of one another). While there has been some debate on whether empirically this is the case (see Easterly 2002), more recent studies have confirmed that in the long term, the price of primary commodities has fallen significantly in relation to the price of manufactured goods (see Kaplinsky 2005; Khor 2005; Harvey *et al.* 2010).
6. Kaplinsky (2000: 120) describes 'immiserising growth' as 'a situation where there is increasing economic activity (more output and more employment) but falling economic returns'.
7. The network analysis has been conducted using the UCINET 6 software (Borgatti *et al.* 2002).
8. The trade relations between countries are denoted X_r, whereby in the above equation, $_{ijr}M_{kmr}$ represents how well i's ties with a country k, correspond with j's ties with some country m on X_r. This can be quantified by $_{ijr}M_{kmr} = \min(x_{ikr}, x_{jmr}) + \min(x_{kir}, x_{mjr})$.
9. The hierarchy of these four positions was determined by the average level of trade that took place between countries in the same position.
10. East Timor and Montenegro are excluded from the network analysis, despite them meeting the criterion, due to the insufficient data available for these two states.
11. The data matrix is constructed using the EUGene software package v3.204 (Bennett and Stam 2000) and is, in large part, populated using data drawn from the Quality of Government (QoG) database (Teorell *et al.* 2011).
12. I am grateful to Rodwan Abouharb for providing me with an updated version of the dataset.
13. I am grateful to Jeffrey Kucik for providing me with the aggregated data. The product-specific data is available from: http://comtrade.un.org/ [accessed 8 August 2011].
14. It should be noted, however, that this measure has also received much criticism. Rodriguez and Rodrik (2001) argue that this measure of trade openness does not actual measure trade *policy*.
15. The results of the additional robustness checks not presented here are available upon request.

16. It is important to note that this analysis has focused on poverty levels in proportional terms rather than absolute terms. In other words, the IMR measure considers the number of infants *per 1000* that die before reaching the age of 1. In considering poverty in absolute terms, Sumner (2012) has shown that the majority of the world's poor live in middle income countries.

17. It is worth pointing out that Cornia (2010) finds that recent decline in domestic inequality in some developing countries, particularly Latin American countries, has occurred in part because of government programmes designed to address the unequalising impact of globalisation. As such, a further policy implication of this study is that governments may seek to address the negative impact of structural inequalities in the world economy by implementing programmes that promote greater domestic redistribution. However, the extent to which this is feasible for countries in the most peripheral positions (and hence facing the greater structural international inequalities) is an area that requires greater research.

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Appendix

TABLE A1.   Pairwise correlation of poverty measures

	Infant mortality rate	GDP per capita	Income poverty ($1.25/ day)	Income poverty ($2/day)	Life expectancy	Maternal mortality rate	Literacy	Human development index	Improved water source	Malnourishment
Infant mortality rate	1.000									
GDP per capita	−0.571	1.000								
Income poverty ($1.25/day)	0.759	−0.659	1.000							
Income poverty ($2/day)	0.771	−0.752	0.963	1.000						
Life expectancy	−0.906	0.637	−0.805	−0.790	1.000					
Maternal mortality rate	0.827	−0.479	0.738	0.727	−0.850	1.000				
Literacy	−0.792	0.532	0.532	−0.665	0.796	−0.746	1.000			
Human development index	−0.919	0.711	−0.797	−0.822	0.945	−0.845	−	1.000		
Improved water source	−0.814	0.552	-0.712	−0.747	0.806	−0.744	−	0.831	1.000	
Malnourishment	0.609	−0.456	0.726	0.773	−0.603	0.583	-0.578	−0.750	−0.496	1.000
Observations	4393	3976	539	539	4257	4387	309	922	583	544
Country coverage	174	163	114	114	169	170	171	164	159	136

Source: Own calculation based on IMR data from Abouharb and Kimball (2007); data for GDP per capita, income poverty measures, life expectancy at birth, proportion of population with access to improved water source, malnourishment prevalence and Human Development Index from the World Bank's *World Development Indicators*, http://data.worldbank.org/data-catalog/world-development-indicators; maternal mortality rate data from the University of Washington's Institute for Health Metrics and Evaluation (see Hogan *et al*. 2010); literacy rate data from Vanhanen (2003).
Notes: All correlations are statistically significant at the 0.01 per cent confidence level.