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Journal of Policy Modeling 42 (2020) 1208–1227

Journal of Policy Modeling

www.elsevier.com/locate/jpm

The impact of trade liberalisation on poverty and inequality: Evidence from CGE models☆

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Received 6 October 2019; received in revised form 18 April 2020; accepted 9 May 2020
Available online 23 June 2020

Abstract

In this paper we carry out a systematic review of the evidence from CGE models regarding the effect of trade liberalisation on income inequality and poverty in developing countries. The evidence suggests quite strongly that trade liberalisation tends to reduce poverty, but is more likely to increase inequality than reduce it; however, the predicted effects are relatively small. Variation in the size and direction of effects can be explained by the choice of outcome measure, the fiscal response to liberalisation, the type of CGE model, and certain country characteristics – but not the method used to link the CGE model to the distribution of income.

JEL codes: D58; D63; F13; F60; I38

Keywords: Trade liberalisation; CGE models; Poverty; Inequality

1. Introduction

In recent decades, the dominant trend in trade policy in developing countries has been one of liberalisation. Between the early 1980s and the late 1990s, the average import tariff fell by half, from around 20% in 1980 to 11% in 1999 (Martin, 2003). The same process has continued more recently, with average tariffs declining by half during the first decade of the 21st century, reaching

☆ A set of three appendices to this paper are available from the author on request.

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https://doi.org/10.1016/j.jpolmod.2020.05.006

5% by 2014 (UNCTAD, 2016). The effects of this profound shift have been the subject of much research and debate. The aim of this paper is to synthesise the results from computable general equilibrium (CGE) models, regarding the impact of trade liberalisation on income poverty and inequality.

CGE models possess a number of advantages for assessing the distributional impacts of trade liberalisation. Compared with simpler partial equilibrium models, they are much better placed to address the economy-wide effects of trade reforms, particularly on wages and employment, which are argued to determine the overall impact of liberalisation (Hertel & Reimer, 2004; Naranpanawa, Bandara, & Selvanathan, 2011). They also avoid the problems associated with cross-country econometric approaches, including selection bias, impact heterogeneity, and the difficulty of disentangling the effects of multiple policy reforms introduced simultaneously (Chen & Ravallion, 2004; De Melo, 1988; Dollar, Kleineberg, & Kraay, 2016). Although CGE models are often criticised, due to their complexity, or the sensitivity of results to particular modelling assumptions, they are still considered to be an important component of the 'tool-kit' that economists use to assess the distributional impacts of economy-wide policy reforms (Bourguignon & Silva, 2003; Bourguignon, Bussolo, & da Silva, 2008).

What then have we learned about the distributional impacts of trade liberalisation from CGE models? The answer to this question is not immediately clear, for two reasons. First, although there have been several reviews of this literature, there has not yet been a *systematic* review, designed to synthesise all the available evidence, in a transparent and replicable manner (White & Waddington, 2012). For example, Hertel and Reimer (2004) review around 30 studies using CGE modules to assess the poverty impacts of trade reforms, but stress that their review is "not exhaustive" (Hertel and Reimer, 2004: 4).

Second, previous reviews have focused mainly on methodological issues, and have as a result left some interesting questions unanswered. For example, how large are the effects of trade liberalisation on poverty and inequality, according to CGE models? It is fairly well known that standard CGE models typically show quite small gains from trade in the aggregate: the 'right signs' but the 'wrong magnitudes' (Bussolo & Whalley, 2003). However, small aggregate gains can still hide significant distributional changes (Rodrik, 2018), and so it remains to be seen whether CGE models also predict relatively small changes in poverty and inequality. Going beyond averages, by how much do the estimated impacts of trade liberalisation on poverty and inequality derived from CGE models vary, and what accounts for this variation? While there are various potential sources of heterogeneity – for example, different characteristics of the countries analysed, different types of CGE models, different measures of inequality, and so on – it remains to be seen which (if any) of these factors is able to account for the heterogeneity in results we see in practice.

In this paper, we carry out a systematic review of the literature using CGE models to simulate the effect of trade liberalisation on income poverty or inequality. We then assess the reasons for the observed heterogeneity in results, using meta-regression analysis (MRA). This technique has been widely applied to the results from econometric studies (e.g. Li & Beghin, 2012; Stanley & Doucouliagos, 2012), but it has been used much less for the results from CGE models. The only examples of which we are aware are Hess and Von Cramon-Taubadel (2008), who use MRA to explain variation in estimates of the aggregate welfare gains from multilateral trade liberalisation, and Freire-Gonzalez (2018), who uses MRA to explain variation in estimates of the effects of environmental taxation. Although the welfare outcomes and the precise nature of the policy experiment on which we focus are different – for example, we focus on unilateral as opposed to multilateral trade liberalisation – our paper otherwise follows a similar approach.

The remainder of the paper is organised as follows. Section 2 discusses possible sources of heterogeneity in the results from CGE models which we explore further in the meta-regression analysis. Section 3 then describes the inclusion criteria used to define the scope of the review, and the search procedure used. Sections 4 and 5 then present the results of the synthesis and meta-regression analysis, while Section 6 discusses the implications of the results for policy and further research.

2. Theoretical background and hypotheses

Estimates of the effects of trade liberalisation on income inequality and poverty derived from CGE models may differ for a number of reasons. In this section we discuss five possible sources of heterogeneity which we explore further in the meta-regression analysis. The first is the approach used to link CGE models to the distribution of income. Early CGE models used to assess the distributional impacts of policy reforms relied mainly on the 'representative household' approach (e.g. Adelman & Robinson, 1978; Taylor, Bacha, Cardoso, & Lysy, 1980; Derviş, De Melo, Robinson, & Dervis, 1982). In this case, estimated changes in the incomes of broad household groups (derived from the CGE model) are used to simulate changes in the overall size distribution of income, under the assumption that the distribution of income within each household group remains constant (Lofgren, Robinson, & El-Said, 2003). Clearly, this type of approach can only capture the effects of trade liberalisation on between-group inequality, and may as a result underestimate the impact on overall inequality, particularly if the number of groups included in the model is relatively small.

More recently, a range of other approaches have been developed to reflect the distributional effects of policy reforms more accurately. A basic distinction can be made between 'micro-accounting' approaches, 'micro-simulation' approaches, and 'integrated' approaches. 'Micro-accounting' approaches work by linking the CGE model to a recent household income and expenditure survey. The impact of the reform on each survey household is then estimated, for example by applying the simulated change in the income of the representative household group to which it belongs (e.g. Annabi, Khondker, Raihan, Cockburn, & Decaluwe, 2006), or on the basis of the predicted changes in consumer and factor prices faced by the household (e.g. Chen & Ravallion, 2004; Ravallion & Loshkin, 2008). The result is a new simulated distribution of income after the reform, which can be compared with the actual distribution prior to the reform.

However, micro-accounting approaches assume that household behaviour is unaffected by trade reform, which may again bias the results. By contrast, 'micro-simulation' approaches take behavioural responses into account when generating the new income distribution, either through econometric estimation of a household income generation model (e.g. Robilliard, Bourguignon, & Robinson, 2008), or through non-parametric methods (e.g. Vos & De Jong, 2003). In 'top-down' micro-simulation approaches, these behavioural changes are not fed back into the CGE model, implying that some distributional effects may again be ignored. 'Integrated approaches' seek to overcome this problem, either by a recursive two-way link between the macro and micro-level analysis (e.g. Bourguignon & Savard, 2008), or by a 'fully integrated' CGE model in which each household in the survey is modelled separately within the CGE model itself (e.g. Cororaton & Cockburn, 2007). An interesting question therefore is whether these more recent approaches, designed to reflect the distributional effects of policy reforms more accurately, have made a significant difference to the results.

The second potential source of heterogeneity is the characteristics of the countries being analysed. According to Heckscher–Ohlin theory, the impact of trade liberalisation depends on a

country's factor endowments: it will tend to reduce income inequality in countries with a relatively abundant supply of unskilled labour, by increasing the relative return to unskilled labour, but may raise it in developing countries with a more abundant supply of skilled labour (Wood, 1997). The effect of trade liberalisation on poverty may also vary, for similar reasons, since earnings from unskilled labour typically make up the predominant income source for poor households (Winters, McCulloch, & McKay, 2004). Trade liberalisation may also increase inequality, and have limited impact on poverty, in countries with relatively abundant natural resources, by raising the relative returns to assets (e.g. land) which tend to be unequally distributed (Gourdon, Maystre, & de Melo, 2008). Of course, most CGE models depart from the strict assumptions of Heckscher-Ohlin theory, and include more factors and sectors than the stylized theoretical models used to derive these hypotheses. Nevertheless, it is still of interest to ask whether the results from CGE models are still consistent with the basic predictions of Heckscher-Ohlin theory.

A third potential source of heterogeneity is the type of trade reform. In this paper, we focus only on the effects of unilateral trade liberalisation (see Section 3 below). Nevertheless, while some studies simulate the effect of complete liberalisation – i.e., the removal of all artificial barriers and inducements to trade – others consider more partial reforms, similar to what has actually occurred in practice. A further consideration relates to the fiscal implications of liberalisation. Where trade taxes make up a significant proportion of government revenue, the impact of trade liberalisation on poverty and inequality may depend on how the government responds to any reduction in tariff revenue (Winters et al., 2004): for example, whether through a compensatory rise in domestic taxation (either direct or indirect), a reduction in government spending, or an increase in government borrowing.[1]

A fourth potential source of variation is the precise measure of poverty of inequality used. The first studies to use CGE models to assess the distributional impacts of policy reforms in developing countries all found that the Gini coefficient changed relatively little in response to a range of policy reforms (e.g. Adelman & Robinson, 1978; Taylor et al., 1980; Derviş et al., 1982). However, two of these studies found that the impacts were much larger when using other measures of inequality, such as the Theil or Atkinson index. Differences may also arise between measures of poverty. For example, it has been argued that trade liberalisation has relatively little impact on households in geographically remote regions, who are relatively insulated from changes in prices at the border (e.g. Winters et al., 2004). If this is the case, the impacts of trade liberalisation on poverty may be smaller when using measures which are sensitive to the depth and severity of poverty (e.g. the poverty gap and squared poverty gap), compared to those which only reflect the incidence of poverty (e.g. the poverty headcount).

The fifth and final potential source of variation is differences in the type of CGE model. One issue is whether the CGE model is 'static' or 'dynamic'. Static models assume fixed supplies of factors of production and technology, while dynamic models allow for endogenous changes in factor supplies and technology, in response to changing prices and incentives. Dynamic models are better placed to reflect the potential growth effects of trade liberalisation – due for example to induced growth in total factor productivity – which are likely to be of importance for poverty reduction (e.g. Annabi et al., 2006; Cockburn, Corong, Decaluwe, Fofana, & Robichaud, 2010; Buffie & Atolia, 2012). Another issue is the assumptions made regarding inter-sectoral factor

[1] Trade liberalisation does not necessarily reduce government revenue, and the econometric evidence is generally inconclusive regarding this effect (Winters et al., 2004). However, the evidence from CGE models does on the whole suggest that government revenue declines following trade liberalisation, at least in the absence of compensatory taxes, in the short-run (Bevan, 1999; Cirera, Willenbockel, & Lakshman, 2011).

mobility. CGE models which allow for at least partial factor mobility across sectors of production are better placed to reflect the medium-term, economy-wide effects of trade liberalisation, which may again be important for poverty reduction: for example, if higher demand for labour in one industry pushes up the economy-wide wage rate (Chan, Dung, Ghosh, & Whalley, 2005).

In Section 4, we assess the extent to which each of these five potential sources of heterogeneity can explain any heterogeneity that we see in practice. First, we outline the precise criteria we use to define the scope of our analysis, and the methods we use to identify studies meeting our criteria.

3. Inclusion criteria, search strategy and results

We restrict our attention to studies meeting four main criteria. First, the study must use an applied CGE model, based on recent empirical data for an actual (not 'archetype') economy. Second, the study must simulate the effect of 'unilateral' trade liberalisation, defined as a reduction in one or more artificial barrier or inducement to trade that is directly controlled by the government (e.g. import tariffs, export taxes, export subsidies, import quotas), which is unconditional and unaccompanied by changes in other countries' trade barriers. We exclude studies in which trade liberalisation is combined with other changes in government policy (e.g. exchange rate devaluation, domestic market liberalisation), except changes in fiscal policy which are specifically required to offset the revenue implications of trade liberalisation. Third, the study must report the effect of trade liberalisation on a summary measure of income inequality or poverty at the national level. Finally, the study must refer to a developing country, defined here as a low or middle income country according to World Bank classifications at the time of liberalisation. In addition to these four main criteria, we restrict our attention to studies published since 1990 in English; in terms of publication type, we include both refereed and non-refereed journal articles, as well as working papers, conference papers, reports and book chapters, but not MA nor PhD dissertations.

The search strategy consisted of three main stages. First, we searched a range of on-line databases, including Scopus, IBSS, Web of Knowledge, Econlit and Google Scholar, using a combination of relevant search terms.[2] Second, we checked existing reviews of the literature – in particular, Reimer (2002), Hertel and Reimer (2004) and Cloutier, Cockburn, Decaluwé, Khondker, and Raihan (2008) – to see if there were any further studies which met our criteria but were not identified by our on-line searches. We also checked two recent systematic reviews on the effects of government policies on income inequality and poverty (Anderson, Esposito, Duvendack, & Jalles d'Orey, 2016a, b). Finally, we checked the reference lists of all peer-reviewed academic journals identified following the first two stages of our strategy, to see if there were any more studies meeting our criteria which we had missed. In total, the search and screening process identified 66 studies meeting the inclusion criteria (see Fig. 1).[3]

Table 1 provides basic details about the studies. Just over half are journal articles; the remainder are book chapters, working papers and policy reports. The majority have been published since 2005, and only three date from the 1990s. The majority use static CGE models, with just nine studies using dynamic models (all of which date from 2005). The most common distributional

[2] A full list of the on-line databases searched, and the precise search terms used, is contained in Appendix 1. All records identified by the online database searches were screened first by title and abstract, and then (if necessary) by full text, to determine if they met the inclusion criteria.

[3] A full list of the 66 studies is contained in Appendix 2.

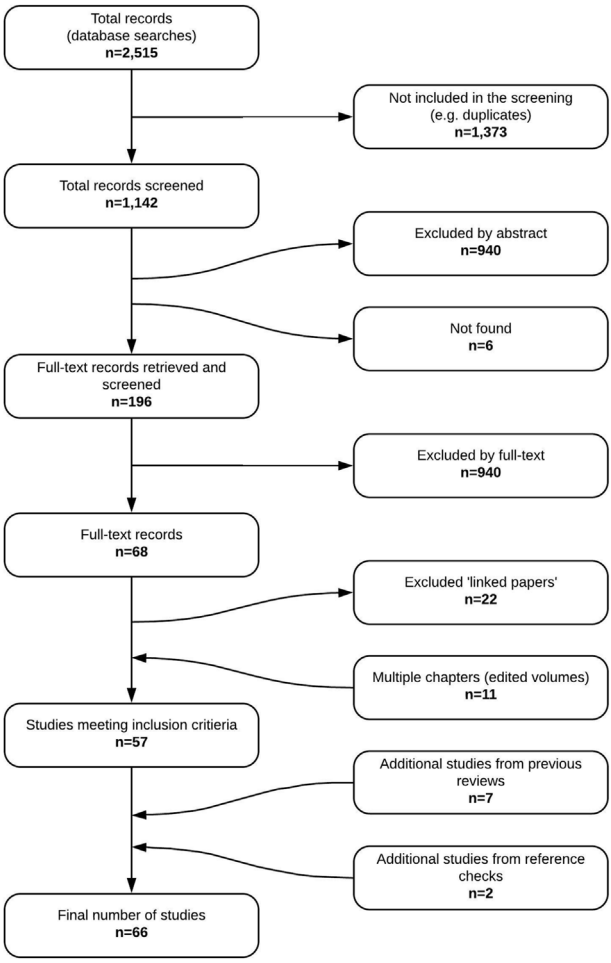

Fig. 1. The search and screening process.
Notes: Duplicates occur when the same article is identified in multiple databases. At this stage we also eliminated a few studies clearly not meeting the inclusion criteria (e.g. dated before 1990, PhD/MA theses). 'Linked' articles are primarily working papers which are followed by a book chapter or journal article; these are treated as being part of one single study rather than two separate studies (since the results are usually identical). For studies published in edited volumes, we also checked the remaining chapters of each volume, to see if there were any other studies relevant to our review from the volume which we had missed.

approach is micro-accounting (29 studies), followed by micro-simulation, representative household and fully-integrated (18, 15 and 9 studies respectively); only three studies used more than one distributional approach. The studies cover 33 countries in total, including 12 low income countries, 16 lower middle income countries, and 5 upper middle income countries, with levels of GDP per capita ranging from $508 to $11,436 in the baseline year.

Table 1 also provides details of the outcome measures used. 40 studies report the effects of trade liberalisation on income inequality while 55 report effects on income poverty; just under half (29 studies) report effects on both poverty and inequality. For inequality, the most common measure is the Gini coefficient (36 studies), followed by the Generalised Entropy measures and

Table 1
Included studies: basic information.

	Number of studies		Number of studies
Publication type		**Distribution approach***	
Peer-reviewed journal	34	Representative household	15
Working paper	8	Micro-accounting	27
Book chapter	23	Micro-simulation	18
Policy report	1	Fully integrated	9
Publication year		**Model type**	
1990−1999	3	Static	57
2000−2004	10	Dynamic	9
2005−2009	35		
2010−2014	16		
2015−2017	2		
Outcome measure, inequality*		**Outcome measure, poverty***	
Gini coefficient	36	Poverty headcount	55
GE measures	13	Poverty gap	39
Atkinson index	5	Squared poverty gap	29
Atkinson-Gini index	2	Watts index	1
Income shares	1	CHU index	1
Log variance	1	Sen Index	1

Notes: *Some studies use more than one distribution approach or outcome measure, so the totals in these sections add up to more than the total number of studies (66). Details of each individual study are provided in Appendix 2.

the Atkinson index (13 and 5 studies respectively). However, around two thirds of studies (25 out of 40) use only one measure of inequality. For poverty, all 55 studies use the poverty headcount; 39 also use the poverty gap, while 29 also use the squared poverty gap, although only one study uses other types of poverty measures.

Most studies contain multiple simulations: either different reductions in trade barriers, or the same reduction in trade barriers combined with different modelling assumptions (e.g. different fiscal policy responses, or different values of key model parameters). Across all studies there are 203 simulations, with the number of simulations per study varying from 1 to 18. The most common simulation is a reduction of import tariffs (56% of the total), followed by the complete removal of tariffs (34%). The remaining cases involve either the reduction or removal of various sorts of trade barriers (e.g. import quotas and export taxes as well as import tariffs). In terms of the fiscal implications, the most common approach (52% of simulations) is to assume 'revenue neutrality', i.e. a compensatory rise in domestic taxation following trade liberalisation; of these, around half involve a rise in indirect taxes while half involve a rise in direct taxes. The remainder involve a rise in government borrowing or a reduction in government spending (23% and 12% of simulations respectively), or the assumed response was not made clear (13% of simulations). Only 12 studies combined a given reduction in trade barriers with different types of fiscal responses.

To summarise therefore, there is a large body of literature using CGE models to assess the effects of unilateral trade liberalisation on income inequality and poverty, covering a diverse group of low and middle income countries. Despite this, relatively few studies test the sensitivity of results according to the distributional approach used, the assumed fiscal policy response, or the precise measure of inequality or poverty. As a result, there is limited evidence from comparisons within studies regarding the extent to which different modelling choices in these areas are associated with different results. This in turn suggests a potentially useful role for meta-regression analysis,

as a way of comparing and analyzing results across as well as within studies. This is the focus of Sections 4 and 5.

4. Meta-analysis: income inequality

We now turn to the synthesis and meta-analysis, focusing in this section on the effect of trade liberalisation on income inequality. We first outline our effect size measure, followed by the key descriptive statistics regarding the sign, magnitude and distribution of effects. We then turn to the meta-regression analysis (MRA), designed to assess the reasons for any observed heterogeneity in the sign or magnitude of effects, both across and within studies.

Our preferred effect size measure is the proportional change in income inequality following a given simulation, i.e. $(I_1 - I_0)/I_0$, where I is a summary measure of income inequality (e.g. Gini coefficient), subscript 0 indicates the initial base year, and subscript 1 indicates the alternative scenario in which one or more artificial barrier or inducement to trade is reduced from its initial level. We use proportional changes in order to control for the different scales of the inequality measures used.[4]

An obvious question is whether any given effect size is large or small. It is well known that some measures of income inequality are quite stable over time: the Gini coefficient for example (Li, Squire, & Zou, 2001). As a result, a predicted change in the Gini coefficient might seem quite small in absolute terms, but still relatively large in comparison with observed changes. Moreover, even a relatively small change in inequality due to trade liberalisation may still be quite large in comparison with the effect on average welfare. We therefore assess the size of effects against two alternative yardsticks, namely: 1) the average magnitude of proportional changes in the relevant measure of inequality, observed in the country since the early 1980s, over standardized periods of 5 years; and 2) the proportional change in average welfare following trade liberalisation, as predicted by the same CGE model used to predict the effect on inequality. The first is designed to indicate to what extent the effects of trade liberalisation on inequality predicted by CGE models are capable of explaining the actual changes in inequality observed in recent decades in the countries under analysis. The second allows us to investigate the hypothesis that small aggregate gains from trade liberalisation may nonetheless hide significant distributional changes (e.g. Rodrik, 2018).[5]

Table 2 presents the descriptive statistics for our effect size measure. There are 204 observations in total, each of which refers to the effect of a particular simulation on a particular measure of

[4] To be suitable for meta-analysis, effect sizes should be partial, i.e. measure the effect of one variable on another, holding other factors constant, and be comparable within and between studies (Stanley & Doucouliagos, 2012: 23). The nature of CGE modelling ensures that the first condition is met; the use of proportional changes ensures that the second condition is met. We also experimented using absolute changes in the Gini coefficient (the most common measure of inequality), as an alternative effect size measure; on the whole the results were very similar, and are therefore not reported here (details available on request).

[5] Trends in inequality were obtained from the World Bank Poverty and Equity database. Proportional changes in inequality were calculated over periods of at least 5 years in length. We first calculated the average annual rate of change in each period; we then calculated the corresponding proportional change over a 5-year period. We then converted each proportional change per period into its absolute value, before finally calculating the average absolute change for each country. Note that this database only contains information on trends in two measures of inequality used in the studies – the Gini coefficient and the mean log deviation – and so we were only able to use this first yardstick for these two measures. Changes in average welfare were available for 79 out of the 116 simulations covering income inequality. Welfare is measured by (in order of preference, where multiple welfare measures were available): equivalent variation, real consumption per capita, and real income per capita (42, 24 and 13 simulations respectively).

Table 2
Effects of trade liberalisation on income inequality: descriptive statistics.

	N	Count (+,-)	Mean	Median	St. dev	Min.	Max.
Effect size (%, unadjusted)	204	112, 79	1.4	1.0	4.6	−7.0	29.5
Effect size (%, magnitude)	204	–	2.2	0.8	4.3	0	29.5
Effect size magnitude, relative to yardstick 1	116	–	0.27	0.08	0.55	0	4.2
Effect size magnitude, relative to yardstick 2	119	–	3.9	1.0	7.7	0	39.4

income inequality, in a given country and base year. Slightly over half of the effects (55%) are positive, indicating that trade liberalisation increases inequality, while 39% are negative, indicating that trade liberalisation reduces inequality. In the remaining 6% of cases, there is no change in inequality. The effects range in size from a reduction of 7% to an increase of 30%; the average effect across all observations is an increase in inequality by 1.4% (std. dev. 4.6%).

How large are the effects? Relative to observed changes (yardstick 1), the effects are reasonably small, although certainly not negligible. The mean is an effect size equal to just over one quarter (27%) of an average change in inequality over a 5-year period. However, there are some large positive outliers, so the median is significantly lower (8% of an average change), and the effect is less than 20% of an average change for around 75% of observations. Relative to the predicted change in average welfare (yardstick 2), the effects are again not particularly large. The mean is an effect size which is four times larger than the change in average welfare, but this again reflects a handful of large positive outliers.[6] The median is around 1, indicating that the effect of trade liberalisation on inequality is as likely to be smaller than the effect on average welfare as it is to be larger.

The figures in Table 2 suggest therefore that trade liberalisation is slightly more likely to increase income inequality than to reduce it, but is capable of explaining only a small proportion of actual changes in income inequality observed in recent decades. Furthermore, while changes in inequality can in some cases substantially exceed the change in average welfare, there is no strong evidence that they are substantially greater on average.

Fig. 2 complements these results by plotting the average magnitude of effect for each study against its year of publication. This is a simple test of whether more recent studies show larger effects on income inequality, due either to better methods for linking the CGE model to income distribution (as discussed in Section 2), or more detailed and disaggregated sources of data. In fact, Fig. 2 shows no evidence of a significant time trend. The most recent study (Liyanaarachchi, Naranpanawa, & Bandara, 2016) does show much larger effects than previously obtained in the literature, but this is shown to be more of an outlier than part of a trend.

We now explore the variation in the estimated impacts of trade liberalisation on income inequality, using meta-regression analysis. A total of 16 'moderator' variables are included in the analysis, grouped under the five potential sources of heterogeneity discussed in Section 2, namely 1) *distributional approach*: dummy variables for micro-accounting, micro-simulation and fully-integrated

[6] These outliers are where the change in inequality is particularly large, relative to the change in average welfare: Liyanaarchchi et al. (2016), which contains some very large changes in inequality, combined with more moderate changes in average welfare; and Zhai and Hertel (2010) and Emini, Cockburn, and Decaluwé, (2006), which contain very small changes in average welfare (less than 0.1%), combined with small to moderate changes in the Gini coefficient. There is one negative outlier, from Jimenez (2006), which contains a small increase in average welfare, combined with a large fall in the Theil index.

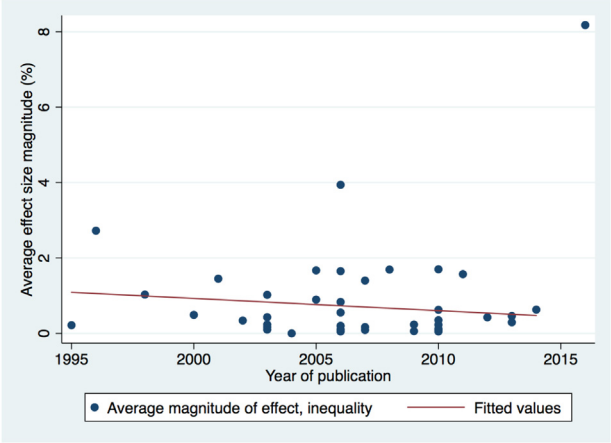

Fig. 2. Effect size (magnitudes) vs. year of study: inequality.
Notes: The vertical axis plots the simple (unweighted) average effect size magnitude for each study; the horizontal axis the year of publication. The outlier in the figure is the study by Liyanaarachchi et al. (2016); the regression line shown is estimated after excluding this study. The slope of this line is negative but not statistically significant (b = −0.032, p = 0.29, n = 39).

approaches, with the representative household approach as the base category; 2) *country characteristics*: per capita GDP, average years of schooling, land area per adult, and the average tariff level (all in the base year of the simulation); 3) *type of trade reform*: dummy variables for 'full' liberalisation, meaning the complete removal of import tariffs and/or other trade barriers (with 'partial' liberalisation as the base category), and three different fiscal responses: an increase in borrowing, a reduction in spending, and an increase in indirect taxation (with an increase in direct taxation the base category); 4) *outcome measure*: dummy variables for Generalised Entropy inequality measures (e.g. Theil index, mean log deviation) and other inequality measures (e.g. Atkinson index, income share of the richest/poorest quintile), with the Gini coefficient as the base category; and 5) *type of CGE model*: dummy variables for dynamic CGE models, including both 'short-run' and 'long-run' estimates (with static CGE models as the base category), and for perfect labour and capital mobility across sectors (the base category being imperfect labour or capital mobility). We also include certain other variables which might be expected to affect the results, namely the year of publication of the study, the type of publication (peer reviewed journal articles vs. working papers, book chapters and reports), and the base year of analysis. We also include dummy variables for the main regions of the countries covered (East Asia, South Asia, Middle East and North Africa, Sub-Saharan Africa, and Latin America).[7]

We estimate two sets of regressions. In the first, the dependent variable is the direction of the effect of trade liberalisation on inequality, either positive (=0) or negative (=1). Here, a positive (negative) coefficient implies that the moderator variable increases (reduces) the probability that trade liberalisation *reduces* inequality. In the second set, the dependent variable is the magnitude of effect, i.e. the absolute value of the proportional change in income inequality following lib-

[7] Descriptive statistics for each moderator variable are available in Appendix 3. It is worth noting that incomplete documentation was a problem for some of these moderator variables. In particular, 10 studies lacked sufficient details about the assumed fiscal response to liberalisation, while 11 lacked sufficient details about the extent of inter-sectoral factor mobility (17 studies in total). This resulted in a loss of 30 and 64 potential observations respectively.

eralisation. Here, a positive (negative) coefficient implies that the moderator variable increases (reduces) the size of the effect of trade liberalisation on inequality, irrespective of whether the effect is positive or negative. The first set of regressions are estimated using a Probit model; we simply omit the small number of observations (13 out of 204) where there is no effect.[8] The second set are estimated using OLS; in this case, we exclude the 32 observations from the study by Liyanaarachchi et al. (2016), which was shown in Fig. 2 to be a clear outlier.

The results are shown in Table 3. Columns 1–3 show the results for the direction of effect. The probability that liberalisation reduces inequality is lower in countries with higher years of schooling, and in countries with higher initial average tariffs (column 1; statistically significant at the 5% level). The probability is also lower when liberalisation is combined with a reduction in government spending (column 2; statistically significant at the 1% level). There is also some evidence that the probability is lower among more recent studies, and among studies using a micro-simulation approach, but these results are not statistically significant across all specifications. The results for the remaining moderator variables are on the whole not statistically significant.

Columns 4–6 show the results for the magnitude of effect. Effect sizes tend to be slightly larger when using outcome measures other than the Gini coefficient (by between 0.3 and 0.8 percentage points), but the results are not always statistically significant. Effects tend to be slightly smaller, the higher the level of GDP per capita, but slightly larger, the higher is land per adult (column 4; statistically significant at the 5% level). Combining liberalisation with a reduction in government spending increases the magnitude of effect, by around 0.7 percentage points (column 5; statistically significant at the 5% level). However, effects are smaller for CGE models assuming perfect labour or capital mobility, by 0.9 and 0.4 percentage points (column 6; statistically significant at the 5% and 10% level). The proportion of the overall variation in the magnitude of effects explained by the regression lies between 25% and 38%.

5. Meta-analysis: poverty

We now turn to the effect of trade liberalisation on poverty. Similar to the previous section, our preferred effect size measure is the proportional change in income poverty, i.e. $(P_1 - P_0)/P_0$, where P is a summary measure of income poverty (e.g. headcount, gap), subscript 0 indicates the initial base year, and subscript 1 indicates the alternative scenario in which one or more artificial barrier or inducement to trade is reduced from its initial level. Proportional changes are again used in order to control for the different scales of the poverty measures used. We assess the magnitude of effects according to the same two yardsticks, namely the average magnitude of proportional changes in the relevant measure of poverty, observed in the country since the early 1980s, over standardized periods of 5 years; and the proportional change in average welfare following trade liberalisation, as predicted by the same CGE model.[9]

Table 4 presents the descriptive statistics for our effect size measure. There are 352 observations in total, each of which refers to the effect of a particular trade liberalisation simulation on a measure

[8] We did experiment by running additional regressions with these observations included, so that the dependent variable also took the value of 0 if there was no change in inequality. However, the results were very similar and are therefore not reported here (details available on request).

[9] Changes in poverty in each country were obtained from the World Bank Poverty and Equity database. This database only contains information on the headcount and gap measures of poverty, so we were only able to apply our first yardstick to these two measures. We use data on each measure of poverty at both the $1.9-a-day and $3.2-a-day international poverty lines, at 2011 PPP exchange rates.

Table 3
Meta-regression analysis results: inequality.

	Direction of effect			Magnitude of effect		
	(1)	(2)	(3)	(4)	(5)	(6)
Fully-integrated	−0.308	−0.110	−0.180	0.441	−0.160	−0.910*
	(0.192)	(0.133)	(0.186)	(0.594)	(0.496)	(0.501)
Micro-accounting	−0.163	0.141	0.186	−0.0361	0.114	−0.383
	(0.136)	(0.0904)	(0.129)	(0.456)	(0.369)	(0.384)
Micro-simulation	−0.312**	−0.255***	−0.274	−0.196	0.151	−0.535
	(0.130)	(0.0906)	(0.167)	(0.507)	(0.480)	(0.471)
Full liberalisation	−0.0493	−0.0435	−0.182	0.457	0.263	0.0490
	(0.0946)	(0.0768)	(0.112)	(0.286)	(0.294)	(0.299)
Dynamic model, short-run						0.942
						(1.168)
Dynamic model, long-run				−0.192	−0.460	1.192
				(0.806)	(0.903)	(1.168)
GE inequality measure	0.0837	0.132*	0.0495	0.484*	0.314	0.450
	(0.0851)	(0.0742)	(0.113)	(0.279)	(0.286)	(0.301)
Other inequality measure	−0.0976	−0.124	−0.0946	0.774*	0.684*	0.355
	(0.130)	(0.0874)	(0.148)	(0.397)	(0.349)	(0.395)
GDP per capita	−0.119			−0.878**		
	(0.112)			(0.372)		
Land per adult	−0.0164			0.596**		
	(0.0742)			(0.243)		
Average years schooling	−0.0713**			0.171		
	(0.0327)			(0.110)		
Average tariff	−0.00823**			0.0110		
	(0.00362)			(0.0126)		
Higher gov. borrowing		−0.0574			0.0938	
		(0.0809)			(0.420)	
Lower gov. spending		−0.358***			0.714*	
		(0.0794)			(0.379)	
Higher indirect taxes		−0.121			−0.0921	
		(0.0854)			(0.350)	
Perfect labour mobility			0.0384			−0.917**
			(0.166)			(0.441)
Perfect capital mobility			−0.0338			−0.432*
			(0.0861)			(0.242)
Peer reviewed journal	0.0832	0.158**	−0.00921	−0.167	−0.241	0.708
	(0.105)	(0.0701)	(0.166)	(0.348)	(0.317)	(0.433)
Publication year	−0.0260	−0.0240**	−0.0282**	0.0180	−0.0581	−0.000997
	(0.0182)	(0.00963)	(0.0137)	(0.0648)	(0.0410)	(0.0406)
Base year	−0.000376	−0.00502	−0.00390	−0.0629	−0.0106	−0.0662
	(0.0140)	(0.0104)	(0.0157)	(0.0496)	(0.0480)	(0.0446)
Observations	166	159	127	148	142	124
Psuedo R-squared	0.399	0.627	0.356	0.363	0.326	0.380

Notes: The moderator variables for dynamic CGE models are excluded in columns 2–4: in columns 2–3, there are just 3 observations from dynamic models, all of which have an inequality-reducing effect; in column 4, there are just two observations using dynamic models, both of which show an inequality-increasing effect.

Table 4
Effects of trade liberalisation on income poverty: descriptive statistics.

	N	Count (+,-)	Mean	Median	St. dev	Min.	Max.
Effect size (%, unadjusted)	352	88,248	−1.6	−0.6	4.8	−37.5	17.6
Effect size (%, magnitude)	352	–	3.0	1.4	4.1	0	37.5
Effect size magnitude, relative to yardstick 1	258	–	0.13	0.05	0.24	0	2.9
Effect size magnitude, relative to yardstick 2*	203	–	6.1	1.7	12.8	0.02	122

Notes: * The statistics for yardstick 2 refer to the 'normal' case where poverty and average welfare moved in the opposite direction. The remaining observations either had no change in poverty or average welfare (16), or they moved in the same direction (52), or we have no data on the change in average welfare (81 observations).

of income poverty, in a given country and base year.[10] Trade liberalisation reduces poverty in the majority of cases (70%), and raises poverty in just 25% of cases (in the remaining 5% of cases, there was no change in poverty). The effects range from a reduction in poverty by 38% to an increase in poverty by 18%; the average effect across all observations is a reduction in poverty by 1.6% (std. dev. 4.8%).

How large are the effects? Applying yardstick 1, the effects are again relatively small. The mean is an effect size equal to around one eighth (13%) of an average change in poverty in each country over a 5-year period, but median value is significantly lower, at 5% of an average change. Moreover, the effect size is less than 20% of an average change for more than 75% of observations, and only in a very small minority of cases (less than 5%) do we see predicted changes in income poverty that exceed half of an average change over a five year period. The effects are larger when applying yardstick 2: the mean is an effect size which is 6.1 times greater than the percentage change in average welfare. Although the median is significantly smaller, at 1.7, the ratio exceeds 1 in 75% of cases, indicating that the proportional fall in poverty associated with trade liberalisation is typically greater than the proportional rise in average welfare.

On balance therefore, the evidence from CGE models suggests quite strongly that trade liberalisation reduces poverty, if not in all cases then at least a significant majority. In addition, trade liberalisation tends to be relatively 'pro-poor': the proportional fall in poverty is typically greater than the proportional rise in average welfare. Once again however, trade liberalisation is capable of explaining only a small proportion of the actual changes in income poverty observed in each country in recent decades – even less so than for inequality.

Similar to the previous section, Fig. 3 complements these results by plotting the effect sizes against the year of publication of the underlying study. In this case, there is a small positive time trend, suggesting that estimates of the impact of trade liberalisation on poverty have increased in size over time, by about 0.16 percentage points per year on average. This could be the result of better methods for linking the CGE model to income distribution (as discussed in Section 2), or other unobserved 'technological progress' in the literature (e.g. more detailed and disaggregated sources of data).

We now turn to the MRA, designed to explore the variation in the estimated impacts of trade liberalisation on poverty. We include the same set of moderator variables as in the previous section, except that we now include dummy variables for the poverty gap, squared poverty gap, and other

[10] We were unable to calculate our effect size measure for the poverty gap and squared poverty gap for one study, which only reported the absolute change in these measures, and another study which only reported the effects in graphical form. This resulted in the loss of seven potential observations. Two further observations were dropped from one study, due to inconsistencies in the reported baseline poverty figures.

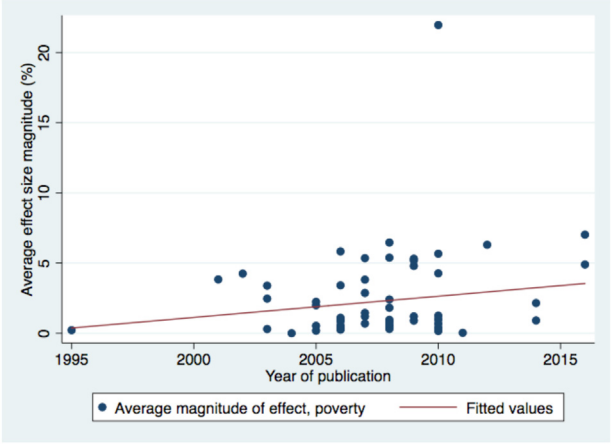

Fig. 3. Effect sizes (magnitude) vs. year of study: poverty.
Notes: The vertical axis plots the simple (unweighted) average effect size magnitude for each study; the horizontal axis the year of publication. The large (positive) outlier in the figure is the study by Hassine et al. (2010); the regression line shown is estimated after excluding this study. The slope of this line is positive and statistically significant at the 10% level (b = 0.16, p = 0.05, n = 53).

poverty measures.[11] We again estimate two sets of regressions; one in which the dependent variable is the direction of the effect of trade liberalisation on income poverty, either positive (=0) or negative (=1); and the other in which the dependent variable is the magnitude of effect. The first set of regressions are estimated using a Probit model; we again omit the small number of observations (16 out of 352) where there is no effect of trade liberalisation on poverty.[12] The second set of regressions are estimated using OLS; in this case, we exclude the results from the study by Hassine, Robichaud, and Decaluwe (2010), which is shown in Fig. 3 to be a clear outlier.

The results are shown in Table 5. Columns 1–3 show the results for the direction of effect. Combining liberalisation with lower government spending makes a poverty-reducing effect less likely (column 2; statistically significant at the 10% level), while perfect labour and capital mobility make a poverty-reducing effect more likely (column 3; statistically significant at the 10% and 1% level respectively). There is also some evidence that more recent studies, and studies using a micro-accounting, micro-simulation or fully-integrated approach, are more likely to find a poverty-reducing effect, while short-run estimates from dynamic CGE models are less likely, but these results are statistically significant in only some specifications. The results for the remaining moderator variables are on the whole not statistically significant.

Columns 4–6 show the results for the magnitude of effect. Effect sizes tend to be larger when using outcome measures other than the poverty headcount: by between 0.6 and 0.9 percentage points when using the poverty gap, 1.4 and 2.0 percentage points when using the squared poverty

[11] Incomplete documentation was again a problem for some moderator variables: 13 studies lacked sufficient details about the fiscal response to liberalisation, while 18 lacked sufficient details about factor mobility. This resulted in a loss of 79 and 133 potential observations respectively. Descriptive statistics for each moderator variable are provided in Appendix 3.

[12] We did experiment by running additional regressions with these observations included, so that the dependent variable took the value of 0 if there was either an increase in poverty or no change in poverty following liberalisation. The results were very similar however.

Table 5
Meta-regression results: poverty.

	Direction of effect			Magnitude of effect		
	(1)	(2)	(3)	(4)	(5)	(6)
Fully-integrated	−0.241*	−0.0979	0.189	−0.409	−1.157	0.500
	(0.130)	(0.140)	(0.117)	(0.919)	(0.874)	(0.802)
Micro-accounting	0.136	0.00624	0.338***	−2.549***	−2.880***	−1.042
	(0.121)	(0.152)	(0.127)	(0.832)	(0.941)	(0.811)
Micro-simulation	0.0775	0.0619	0.233**	−1.489	−2.955***	−1.283
	(0.135)	(0.175)	(0.113)	(0.922)	(1.041)	(0.811)
Full liberalisation	−0.0986	−0.0241	−0.111*	0.830*	1.078***	1.463***
	(0.0677)	(0.0730)	(0.0654)	(0.429)	(0.408)	(0.367)
Dynamic model, short-run	−0.217	−0.149	−0.316**	−1.146	0.173	−2.487***
	(0.162)	(0.145)	(0.130)	(0.975)	(0.813)	(0.770)
Dynamic model, long-run				2.672***	3.150***	0.631
				(0.720)	(0.669)	(0.731)
Poverty gap	0.0583	0.000683	−0.0248	0.893**	0.859**	0.588*
	(0.0650)	(0.0656)	(0.0666)	(0.403)	(0.351)	(0.349)
Squared poverty gap	−0.0282	−0.00687	−0.0553	1.957***	1.533***	1.372***
	(0.0745)	(0.0794)	(0.0705)	(0.473)	(0.417)	(0.381)
Other poverty measure	0.141	0.126		2.609***	1.956***	2.526***
	(0.115)	(0.140)		(0.777)	(0.699)	(0.843)
GDP per capita	0.117			0.188		
	(0.0910)			(0.588)		
Land per adult	0.0854			−0.0482		
	(0.0727)			(0.461)		
Average years schooling	−0.0316			−0.181		
	(0.0291)			(0.183)		
Average tariff	0.0182*			−0.00559		
	(0.0102)			(0.0641)		
Higher gov. borrowing		0.104			0.132	
		(0.0996)			(0.492)	
Lower gov. spending		−0.203*			1.914***	
		(0.114)			(0.570)	
Higher indirect taxes		−0.0714			−1.455***	
		(0.0792)			(0.403)	
Perfect labour mobility			0.121*			0.521
			(0.0732)			(0.372)
Perfect capital mobility			0.210**			−0.301
			(0.0848)			(0.448)
Peer reviewed journal	0.152*	−0.0181	0.0493	−0.371	−0.440	−0.558
	(0.0834)	(0.0776)	(0.0725)	(0.544)	(0.424)	(0.407)
Publication year	0.0380***	0.00927	0.0195	0.0982	0.456***	0.0531
	(0.0146)	(0.0145)	(0.0166)	(0.0962)	(0.0830)	(0.0874)
Base year	−0.0254**	−0.0104	0.00369	0.0413	−0.172***	0.0230
	(0.0106)	(0.0109)	(0.0112)	(0.0654)	(0.0560)	(0.0493)
Observations	247	243	173	272	273	215
Psuedo R-squared	0.203	0.094	0.309	0.325	0.427	0.358

Notes: All of the 'long-run' effects of liberalisation derived from dynamic CGE models show a reduction in poverty, and so this variable is omitted from columns 1–3.

gap, and 2.0 and 2.6 percentage points when using other poverty measures (statistically significant at the 10% level or below). Effect sizes also tend to be larger for simulations involving the complete liberalisation of trade barriers: by between 0.8 and 1.5 percentage points on average (statistically significant at the 10% level or below). The 'long-run' effects of liberalisation, as estimated by dynamic CGE models, also tend to be larger, by between 0.6 and 3.2 percentage points (statistically significant at the 1% level in two out of three cases). Combining liberalisation with a reduction in government spending increases the magnitude of effect, but financing through indirect taxes tends to reduce it (column 5, statistically significant at the1% level). Finally, there is some evidence that effects are larger among more recent studies – supporting the bivariate analysis in Fig. 3 – but this result is statistically significant in column 5 only.

6. Conclusion and policy implications

Trade liberalisation has been one of the most important and dramatic policy shifts witnessed in developing countries in recent decades. This paper seeks to improve our understanding of the impacts of this process on income inequality and poverty, by carrying out a systematic review and meta-analysis of evidence derived from CGE models.

There are three main findings from the paper. First, we show that there is a substantial body of literature using CGE models to investigate the effect of trade liberalisation on income inequality and poverty in developing countries. We identify a total of 66 separate studies published in English since 1990, containing over 500 estimates of the effect of trade liberalisation on income inequality or poverty, across 33 low and middle income countries. To our knowledge, this represents the most comprehensive 'stock-take' of the evidence to date, which both updates and extends earlier reviews (e.g. Hertel & Reimer, 2004; Cloutier et al., 2008).

Second, we show that the evidence from CGE models suggests quite strongly that trade liberalisation tends to reduce poverty, but it is more likely to increase inequality than to reduce it. However, the effects are quite small in relation to actual changes in poverty and inequality observed in recent decades. Furthermore, only in the case of poverty do we see effect sizes that typically exceed the impacts of trade liberalisation on average welfare. Although the small size of effects has been noted previously in the literature (e.g. Derviş et al., 1982; Cogneau & Robilliard, 2007; Ravallion & Loshkin, 2008), we show that this finding applies when considering the whole body of literature, and when examining the effects in relative as well as absolute terms.

Finally, we show that variation in the estimated effects of trade liberalisation across and within studies can be explained, at least in part, by a range of factors. The magnitude of effects is significantly affected by the choice of outcome measure: although the Gini coefficient and poverty headcount are by far the most common measures used in the literature, other measures tend to show larger effects. The fiscal response to liberalisation also matters: combining liberalisation with a reduction in government spending, as opposed to a rise in direct taxes, reduces the probability of both a poverty-reducing and an inequality-reducing effect. The direction of effects on inequality are shown to depend on country characteristics (e.g. average years of schooling), in ways which provide some qualified support for the predictions of Heckscher–Ohlin trade theory, in that trade liberalisation is less likely to reduce inequality in countries with higher levels of human capital. The use of dynamic CGE models also makes a clear difference to the effect of liberalisation on poverty, with the results from 'long-run' simulations being larger in size, and the results from 'short-run' simulations more likely to show a poverty-increasing effect. The assumption of perfect factor mobility also increases the magnitude of the effect of trade liberalisation on inequality, although not on poverty.

These findings are on the whole in line with prior expectations. More surprisingly however, we find very little evidence that the use of more advanced methods to link CGE models to the distribution of income – i.e., 'micro-accounting', 'micro-simulation' and 'fully-integrated' approaches – affects either the direction or magnitude of effects, in comparison with more traditional, 'representative household' approaches. Although we do see some evidence of larger effects among more recent studies, this appears to be due to other factors, rather than the use of micro-accounting, micro-simulation or fully-integrated approaches *per se*. Thus while there has undoubtedly been considerable technological progress in the CGE model literature, this appears to have made little difference to the results, at least so far.

Before turning to the wider implications of these findings, a few caveats should be noted. First, although our search of the literature is to our knowledge the most rigorous and extensive carried out to date, it is possible that we have missed some studies. On the one hand, there may be studies which are not available electronically, or not included in the academic databases we rely on; on the other hand, we have for reasons of resource and time constraints restricted our search to studies published since 1990 in English. Second, we have deliberately restricted this review to the effects of 'unilateral' trade liberalisation; the paper does not therefore shed any light on the effects of bilateral or multilateral trade liberalisation. The review is also restricted to the effects of liberalisation on overall income inequality and poverty, at the national level, and does not examine the more complex question of precisely who gains and who loses from trade liberalisation.

Finally, we have deliberately not attempted to judge studies in terms of the quality of analysis or methods used. Instead, our interest has been in documenting and comparing the results from different studies, and assessing the reasons for any observed heterogeneity in results. While it is possible that our conclusions could differ if we had focused only on 'higher quality' studies, it is difficult to test this hypothesis directly, in the absence of a reliable and objective indicator of study quality. Moreover, the one moderator variable which could be viewed in this light – the dummy variable for publication in a peer reviewed academic journal – did not have a statistically significant impact on either the size or direction of effect, on poverty or inequality.

Our findings have implications for further research and for policy. In terms of further research, the results illustrate the relevance of applying meta-analysis to the results from CGE models. While all of the studies reviewed include a certain amount of sensitivity analysis, we find that the extent of such analysis is quite limited. For example, very few studies test the sensitivity of results to the approach used to link the CGE model to the distribution of income; and only a minority combine a given reduction in trade barriers with different types of fiscal responses. This is perhaps to be expected, given the time and resource constraints facing any one study. However, it does suggest a useful role for meta-analysis, as a way of comparing and analyzing results across as well as within studies, as a complement to more traditional sensitivity analysis. Indeed, a better term for the analysis carried out in this paper might be 'meta-sensitivity' analysis rather than 'meta-regression' analysis.

However, we also find that incomplete documentation is a potential barrier to this type of analysis. A significant number of studies meeting our inclusion criteria do not provide sufficient information to be included in our analysis, about how the fiscal implications of trade liberalisation are modelled, or the precise assumptions made with regard to factor mobility across sectors; a similar problem was encountered by Hess and Von Cramon-Taubadel (2008). This is a cause for concern, because it undermines efforts to understand why the results from CGE models differ. Some form of standardized check-list, available as an on-line appendix for all primary studies using a CGE model, could be one way to address this problem.

From a policy perspective, the most obvious question raised by the results is a simple one: why are effects of trade liberalisation on income inequality and poverty predicted by CGE models generally so small? This is surprising at first sight, given that globalization – of which trade liberalisation is a key component – is often argued to have 'huge' distributional implications (e.g. Stiglitz, 2018). Moreover, the extent of liberalisation modelled by most studies is substantial, involving the removal of all import tariffs in the majority of cases. Are the effects of trade liberalisation on income inequality and poverty really this small? Or do CGE models systematically under-estimate the true effect of trade liberalisation on income inequality and poverty?

One way to address this question would be to combine the results of this paper with other systematic reviews. For example, if the predicted effects of trade liberalisation from CGE models were much smaller than the predicted effects of other economy-wide policy reforms (e.g. domestic tax reform), this would support the first answer. If the predicted effects were also smaller than estimates derived from cross-country or time-series econometrics, this would provide further support. Unfortunately however, systematic reviews of these other areas of the literature do not yet exist.

Nevertheless, certain findings from this paper do by themselves point to the conclusion that the effects of trade liberalisation on aggregate income inequality and poverty really are small. It is widely accepted that the 'representative household' approach could under-estimate the distributional impacts of policy reforms such as trade liberalisation on poverty and inequality (Lofgren et al., 2003). In this paper however, we have shown that more advanced approaches do not show significantly different results, suggesting that the evidence of relatively small effects is reasonably robust. The one major caveat with this conclusion is that 'technological progress' in this area of the literature is clearly on-going, and some of the most recent studies (e.g. Liyanaarachchi et al., 2016) report much larger impacts than previous studies. It will be interesting to observe whether any further studies generate similarly large effects.

For various reasons therefore, the results in this paper point to the relevance and importance of carrying out systematic reviews and meta-analysis of the results from CGE models, regarding the impacts of economy-wide policy reforms that are likely to have significant general equilibrium effects. These methods have been applied extensively to the results from econometric studies, but their application to the results from CGE models remains limited. Further use of these methods would improve our understanding of the impacts of economy-wide policy reforms, and contribute to better, evidence-based policy making.

References

Adelman, I., & Robinson, S. (1978). *Income distribution policy in developing countries: A case study of Korea*. Oxford: Oxford University Press for the World Bank.

Anderson, E., Esposito, L., Duvendack, M., & Jalles d'Orey, M. A. (2016a). *What policies and interventions have been strongly associated with changes in in-country income inequality? A Systematic Review*. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

Anderson, E., Esposito, L., Duvendack, M., & Jalles d'Orey, M. A. (2016b). *What policies and interventions have been strongly associated with the translation of growth into poverty reduction? A Systematic Review*. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

Annabi, N., Khondker, B., Raihan, S., Cockburn, J., & Decaluwe, B. (2006). Implications of WTO agreements and unilateral trade policy reforms for poverty in Bangladesh: Short versus long-run impacts. In T. Hertel, & L. A. Winters (Eds.), *Poverty and the WTO: Impacts of the Doha Development Agenda*. Washington D.C: The World Bank.

Bevan, D. (1999). Trade liberalisation and the budget deficit. *Journal of Policy Modeling*, *21*(6), 653–694.

Bourguignon, F., & Savard, L. (2008). Distributional effects of trade reform: An integrated macro-micro model applied to the Philippines. In F. Bourguignon, M. Bussolo, & L. da Silva (Eds.), *The impact of macroeconomic policies on poverty and income distribution: Macro-micro evaluation techniques and tools*. Washington D.C: World Bank.

Bourguignon, F., & Silva, L. A. P. d. (2003). *The impact of economic policies on poverty and income distribution: Evaluation techniques and tools*. Washington, D.C: World Bank.

Bourguignon, F., Bussolo, M., & da Silva, L. (2008). *The impact of macroeconomic policies on poverty and income distribution: Macro-micro evaluation techniques and tools*. Washington D.C: World Bank.

Buffie, E., & Atolia, M. (2012). Trade, growth and poverty in Zambia: Insights from a dynamic GE model. *Journal of Policy Modeling*, *34*, 211–229.

Bussolo, M., & Whalley, J. (2003). Exploring the links between transaction costs, income distribution and economic performance in a case study for Colombia. *Economie Internationale*, *94–95*(2–3), 235–260.

Chan, N., Dung, T., Ghosh, M., & Whalley, J. (2005). Adjustment costs in labour markets and the distributional effects of trade liberalisation: Analytics and calculations for Vietnam. *Journal of Policy Modeling*, *27*, 1009–1024.

Chen, S. H., & Ravallion, M. (2004). Welfare impacts of China's accession to the World Trade Organization. *World Bank Economic Review*, *18*(1), 29–57.

Cirera, X., Willenbockel, D., & Lakshman, R. (2011). *What is the evidence of the impact of tariff reductions on employment and fiscal revenue in developing countries? A systematic review*. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

Cloutier, M.-H., Cockburn, J., Decaluwé, B., Khondker, B., & Raihan, S. (2008). Welfare, poverty and distribution effects of trade liberalisation: A review of the CGE literature. In J. Cockburn, B. Decaluwe, & V. Robichaud (Eds.), *Trade liberalisation and poverty: A CGE analysis of the 1990s experience in Africa and Asia*. Poverty and Economic Policy (PEP) Research Network.

Cockburn, J., Corong, E., Decaluwe, B., Fofana, I., & Robichaud, V. (2010). The growth and poverty impacts of trade liberalisation in Senegal. *International Journal of Microsimulation*, *3*(1), 109–113.

Cogneau, D., & Robilliard, A.-S. (2007). Growth, distribution and poverty in Madagascar: Learning from a microsimulation model in a general equilibrium framework. In A. Spadaro (Ed.), *Microsimulation as a tool for the evaluation of public policies: Methods and applications*. Bilbao: Fundacion BBVA.

Cororaton, C. B., & Cockburn, J. (2007). Trade reform and poverty—Lessons from the Philippines: A CGE-microsimulation analysis. *Journal of Policy Modeling*, *29*(1), 141–163.

De Melo, J. (1988). Computable general equilibrium models for trade policy analysis in developing countries: A survey. *Journal of Policy Modeling*, *10*(4), 469–503.

Derviş, K., De Melo, J., Robinson, S., & Dervis, K. (1982). *General equilibrium models for development policy*. Cambridge: Cambridge University Press.

Dollar, D., Kleineberg, T., & Kraay, A. (2016). Growth still is good for the poor. *European Economic Review*, *81*, 68–85.

Emini, C. A., Cockburn, J., & Decaluwé, B. (2006). The poverty impacts of the Doha Round in Cameroon: The role of tax policy. In T. Hertel, & L. A. Winters (Eds.), *Poverty and the WTO: Impacts of the Doha Development Agenda*. Washington D.C: World Bank.

Freire-Gonzalez, J. (2018). Environmental taxation and the double dividend hypothesis in CGE modelling literature: A critical review. *Journal of Policy Modeling*, *40*, 194–223.

Gourdon, J., Maystre, N., & de Melo, J. (2008). Openness, inequality and poverty: Endowments matter. *Journal of International Trade & Economic Development*, *17*(3), 343–378.

Hassine, N. B., Robichaud, V., & Decaluwe, B. (2010). *Agricultural trade, liberalisation, productivity gain, and poverty alleviation: A general equilibrium analysis*. Centre Interuniversitaire sur le Risque, les Politiques Economiques et l'Emploi (CIRPEE).

Hertel, T. W., & Reimer, J. J. (2004). *Predicting the poverty impacts of trade reform*. World Bank.

Hess, S., & Von Cramon-Taubadel, S. (2008). A meta-analysis of general and partial equilibrium simulations of trade liberalisation under the Doha Development Agenda. *The World Economy*, *31*(6), 804–840.

Li, Y., & Beghin, J. (2012). A meta-analysis of estimates of the impact of technical barriers to trade. *Journal of Policy Modeling*, *34*, 497–511.

Li, H., Squire, L., & Zou, H.-f. (2001). Explaining international and intertemporal variations in income inequality. *The Economic Journal*, *108*(446), 26–43.

Liyanaarachchi, T. S., Naranpanawa, A., & Bandara, J. S. (2016). Impact of trade liberalisation on labour market and poverty in Sri Lanka. An integrated macro-micro modelling approach. *Economic Modelling*, *59*(1), 102–115.

Lofgren, H., Robinson, S., & El-Said, M. (2003). Poverty and inequality analysis in a general equilibrium framework: The representative household approach. In F. Bourguignon, & L. A. P. d. Silva (Eds.), *The impact of economic policies on poverty and income distribution : Evaluation techniques and tools*. Washington, D.C: World Bank.

Martin, W. (2003). Developing countries' changing participation in World Trade. *The World Bank Research Observer*, *18*(2), 187–203.

Naranpanawa, A., Bandara, J. S., & Selvanathan, S. (2011). Trade and poverty nexus: A case study of Sri Lanka. *Journal of Policy Modeling*, *33*(2), 328–346.

Ravallion, M., & Loshkin, M. (2008). Winners and losers from trade reform in Morocco. In F. Bourguignon, M. Bussolo, & L. da Silva (Eds.), *The impact of macroeconomic policies on poverty and income distribution: Macro-micro evaluation techniques and tools*. Washington D.C: World Bank.

Reimer, J. J. (2002). *Estimating the poverty impacts of trade liberalisation*. Washington D.C: World Bank.

Robilliard, A.-S., Bourguignon, F., & Robinson, S. (2008). Examining the social impact of the Indonesian financial crisis using a macro-micro model. In F. Bourguignon, M. Bussolo, & L. da Silva (Eds.), *The impact of macroeconomic policies on poverty and income distribution: Macro-micro evaluation techniques and tools*. Washington D.C: World Bank.

Rodrik, D. (2018). Populism and the economics of globalization. *Journal of International Business Policy*, *1*(1–2), 12–33.

Stanley, T. D., & Doucouliagos, H. (2012). *Meta-regression analysis in economics and business*. London: Routledge.

Stiglitz, J. E. (2018). *Globalization and its discontents revisited: Anti-globalization in the era of Trump*. New York: W.W. Norton & Company.

Taylor, L., Bacha, E., Cardoso, E., & Lysy, F. (1980). *Models of growth and distribution for Brazil*. Oxford: Oxford University Press for the World Bank.

UNCTAD. (2016). *Trade and development report 2016: Structural transformation for sustained and inclusive growth*. Geneva: United Nations.

Vos, R., & De Jong, N. (2003). Trade liberalisation and poverty in Ecuador: A CGE macro-microsimulation analysis. *Economic Systems Research*, *15*(2), 211–232.

White, H., & Waddington, H. (2012). Why do we care about evidence synthesis? An introduction to the special issue on systematic reviews. *Journal of Development Effectiveness*, *4*(3), 351–358.

Winters, L. A., McCulloch, N., & McKay, A. (2004). Trade liberalisation and poverty: The evidence so far. *Journal of Economic Literature*, *42*(1), 72–115.

Wood, A. (1997). Openness and wage inequality in developing countries: The Latin American challenge to East Asian conventional wisdom. *The World Bank Economic Review*, *11*(1), 33–57.

Zhai, F., & Hertel, T. (2010). China. In K. Anderson, J. Cockburn, & W. Martin (Eds.), *Agricultural price distortions, inequality, and poverty*. Washington, D.C: World Bank.