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ABSTRACT

Trade openness and spatial inequality in emerging countries*

Emerging world countries have experienced over the last two decades a significant change in their trade patterns. Bold trade reforms have been followed by rapid rises in international trade levels. However, despite these radical changes, we know remarkably little about how changes in trade patterns are affecting the evolution of regional inequality in the developing world. This paper addresses the link between trade openness and spatial inequality across 22 emerging countries over the period between 1990 and 2006. Our findings show that changes in international trade bring about a significant rise in within country inequality across the developing world and that this impact is greatest in the poorest countries. This result is robust to the inclusion of a number of control variables, and to changes in the specification of the sample and in the measure used to quantify the level of regional disparities. Consequently, the increase in trade exposure across the emerging world, while possibly benefiting the countries involved in the process in aggregate terms, is generating winning and losing regions.

JEL Classification: F14, F43, F63, O18 and R11
Keywords: convergence/divergence, developing world, economic growth, emerging countries, spatial inequality and trade

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1. Introduction

One of the key features of the process of globalisation which has swept the world over the last three decades has been the phenomenal rise in international trade. According to the World Bank World Development Indicators, world trade has increased from levels of 38.8% of GDP in 1990 to 55.6% in 2010, down from a peak of 59.4% in 2008, right before the start of the crisis. One of the distinctive features of the rise in trade since the outset of globalisation has been that it has engulfed both developed and emerging countries alike. International trade, which used to be considered a North-North phenomenon (e.g. Hummels et al., 1991), has evolved in such a way that it now involves virtually all countries around the world, including the large majority of emerging countries. Indeed, low and middle income countries the world over are nowadays more exposed to changes in trade: whereas in 2010 the trade exposure of OECD countries was 50.1% of their GDP, in the countries classified as low- and middle-income by the World Bank the ratio was 56.2%. Emerging countries such as Malaysia (176% of GDP), Hungary (166%), Vietnam (165%), Slovakia (163%), Lesotho (163%) or Kyrgyzstan (145%) currently rank among those with the greatest engagement in trade in relative terms. Low- and middle-income countries now have a greater degree of trade openness than not just OECD countries, but also the world as a whole.

The economic literature has tended to highlight that trade openness brings about considerable benefits. Perhaps top of the list of these benefits is the generalised view that trade delivers substantial gains in economic performance over the medium and long-run (Sachs and Warner, 1997; Frankel and Romer, 1999; OECD, 1999). Countries with lower tariffs and trade barriers tend to outperform those that remain relatively closed or autarchic. This is particularly the case of emerging countries where the mid- to long-run growth advantages of greater engagement in trade have been well documented (e.g. Greenaway et al., 2002).

However, although trade is indeed considered to improve aggregate growth both at the world and at national level and there has been considerable recent research conducted on the effect of trade openness on interpersonal income inequalities (*cf.* Anderson, 2005 for a useful overview), very little is known about how trade impinges on within-country spatial levels of development. So far there has been only a limited amount of studies concerned with how changes in trade patterns affect the location of economic activity and subnational economic performance (Brülhart, 2011) and most of these studies have been carried out for individual countries, rather than across a number of countries. Those analyses which have ventured into the comparative realm have fundamentally tended to focus on countries in the developed world (e.g. Petrakos et al., 2005; Barrios and Strobl, 2009) or have considered emerging countries as part of a bigger sample, generally dominated by developed countries (e.g. Rodríguez-Pose and Gill, 2006; Rodríguez-Pose, 2012). Consequently, the spatial impact of the significant rises in trade experienced recently across the world, in general, and in emerging countries, in particular, remains poorly understood.

As there are almost as many studies which highlight that increases in trade bring about regional economic convergence as those that point in the opposite direction (Brülhart, 2011), numerous questions about which territories benefit and which territories lose out as a result of changes in trade patterns remained unanswered. Do changes in trade patterns generate winners and losers? Are the potential winners from trade located in core regions, therefore accentuating the risk of greater within-country economic divergence? Is the risk greater in emerging countries, which are known to have significantly higher levels of regional disparities than in developed ones?

This paper aims to answer the above questions by analysing the link between changes in trade patterns at the national level and within-country spatial inequality across a sample of 22 exclusively emerging countries covering the period between 1990 and 2006. We resort to an econometric analysis in order to establish that increases in trade in emerging countries generate winning and losing regions. Given that, winning regions tend to be concentrated in the core of emerging countries, while losing ones are fundamentally in the periphery, changes in trade bring about a significant rise in within-country inequality across the developing world. These results are robust to the inclusion of a number of control variables, and to changes in the specification of the sample and in the measure used to quantify the level of regional disparities. Consequently, while rising international trade can bring about aggregate benefits for emerging countries, it seems to affect the poorest countries and the poorest regions in these countries in a negative way.

In order to reach these conclusions, the paper is structured in four additional sections. Section 2 looks at the link between trade and spatial inequality from a general perspective. Section 3 introduces the preliminary evidence of the association between trade and spatial inequality in emerging countries, as well as the model used in the empirical analysis. The main results of the paper are covered in section 4. The conclusions are presented in the final section.

2. The link between trade and spatial inequality in the literature

Despite the considerable volume of trade literature, the link between trade and spatial inequality has hardly captured the interest of scholars. In a recent review of the literature on the spatial effects of trade openness, Brülhart (2011) finds no more than 11 cross-country studies exploring this link, and virtually all of them focus on the issue of whether trade affects urban primacy, rather than on whether changes in trade patterns impinge on regional convergence or divergence trends. The dearth of analyses linking trade and spatial inequality may be a consequence of two factors. The first factor is linked to the relatively recent development of theories that connect trade with geography. The happy coincidence that many of the scholars behind the development of New Economic Geography – e.g. Krugman, Venables – were originally trade economists has contributed to connect the two fields. As a result, a string of two-region, two-sector models (e.g. Krugman and Livas Elizondo, 1996; Paluzie, 2001; Crozet and Koenig-Soubeyran, 2004) have emerged, but the conclusions of this type of theoretical exercises are far from unanimous. While some tend to favour the idea that increases in trade ultimately lead to greater convergence (e.g. Krugman and Livas Elizondo, 1996), others (e.g. Paluzie, 2001) reach opposite conclusions.

The second factor behind the limited amount of studies dealing with this issue has to do with data availability problems. Empirical analyses of the link between trade openness, on the one hand, and the evolution of spatial inequality, on the other, require not only good quality trade data, but especially good, reliable and comparable subnational data on GDP per capita. While this type of data tends to be readily available across many parts of the developed world, getting reliable and homogeneous time series of subnational GDP data in emerging countries is far more complicated. Subnational data in many emerging countries are often lacking and, in those cases where the data are readily available, there are either questions about their reliability, or the time series are limited. It is therefore no surprise that the literature addressing the spatial implications of trade in emerging countries has been fundamentally limited to country-cases. Most of these studies have concentrated on two countries: China and Mexico. China is the most studied case (Jian et al., 1996; Zhang and Zhang, 2003; Kanbur and Zhang, 2005). While the results of analyses of the Chinese case are far from completely homogeneous, they tend to highlight that the opening of China to trade is at the source of the spectacular rise in regional inequality that the country has witnessed over the last two decades. Trade entry points along the coastal provinces have benefited considerably from the boom in exchanges with the rest of the world, whereas the more inaccessible, remote, and lagging interior has suffered as a result. Mexico is the other emerging country which has attracted considerable attention (e.g. Sánchez-Reaza and Rodríguez-Pose, 2002; Faber, 2007; Jordaan, 2008; Ford et al., 2009). Similarly to China, the majority of these analyses report a coincidence between the rise in trade after Mexico joined the General Agreement on Tariff and Trade (GATT) and, especially, since membership of the North American Free Trade Agreement (NAFTA), on the one hand, and a greater territorial divergence in the country, on the other.

Beyond the single country case studies, there is a very limited number of studies on this topic using cross-country data. All these studies (e.g. Milanovic, 2005; Rodríguez-Pose and Gill, 2006; Rodríguez-Pose, 2012) rely on samples which include various combinations of developed and emerging countries, making it sometimes difficult to extract the specific spatial effects of trade in developing areas. Once again, the results do not necessarily go in the same direction. Milanovic (2005), for example, finds that across the five countries included in his analysis – Brazil, China, India, Indonesia, and the United States – there is no clear-cut connection between changes in trade patterns and regional economic trajectories. Rodríguez-Pose (2012), based on a sample of 15 developed and 13 emerging countries, reports, by contrast, that changes in trade, in combination with country specific factors, significantly affect the evolution of regional inequalities. In his view, the polarising effect of trade is greater in emerging countries than in developed ones, especially in those cases of countries which already have considerable levels of interregional inequality and with a considerable degree of coincidence between its wealthiest regions and its key trade entry points.

However, the fact that there are no large cross-country analyses focusing exclusively in emerging countries makes it difficult to generalise the results of previous studies to the global South. With this paper, we aim to cover this gap in order to assess whether the seemingly dominant view that trade has a negative impact on the evolution of regional inequalities holds in the developing world. This is an area of the world where this question is particularly pertinent from a public policy point of view, as, in a large number of cases, trade reforms have only been implemented recently, the rise in trade has been more rapid and steep than in the developed world, and regional disparities tend to be considerably higher. We therefore build what we consider to be the largest database of subnational disparities across the emerging world, including a total of 22 countries scattered between Latin America (9), Central and Eastern Europe (6) and Asia (6). Because of lack of data, Sub-Saharan Africa and the Middle East are the only parts of the emerging world which are admittedly under-represented, with only South Africa and Turkey included in the sample.

3. Does trade affect spatial inequality in developing countries?

3.1. Preliminary evidence

This section aims to investigate empirically the link between the degree of trade openness and spatial inequality in developing countries. To do so we need reliable data on regional income. However, this information is only available for a reduced set of developing economies, which limits considerably the list of countries that can be included in an analysis of this type. Our dataset is an unbalanced panel covering 22 countries classified as emerging and developing economies by the International Monetary Fund (Table 1).[1] Given their varied history, geographical location and size, we consider that the selected countries represent a valid sample of the developing world. The study covers the period between 1990 and 2006 and, although data availability is not the same for all countries included in the sample, the average number of observations is 14.0 years from a possible maximum of 17 (see Table 1 for further details).

In order to quantify the level and evolution of spatial disparities within the sample countries, we resort to the following inequality measure proposed by Theil (1967) within the information theory context:

$$T(1)_{ct} = \sum_{i=1}^{n_c} p_{it} \left(\frac{y_{it}}{\mu_{ct}} \right) \log \left(\frac{y_{it}}{\mu_{ct}} \right) \quad (1)$$

where y_{it} and p_{it} denote respectively the GDP per capita and population share of region *i* in country *c* during year *t*. In turn, $\mu_{ct} = \sum_{i=1}^{n_c} p_{it} y_{it}$. T(1) is known in the literature as the Theil's first index of inequality. The advantage of this measure vis-à-vis other potential alternative indexes of inequality is that it is independent of scale and population size, and satisfies the Pigou-Dalton transfer principle (Cowell, 1995) Furthermore, as shown by Bourguignon (1979) and Shorrocks (1980), T(1) is additively decomposable by population subgroups, which explains its popularity in the literature on regional disparities (Ezcurra and Rodríguez-Pose, 2009). It should also be noted that this measure of inequality takes into account the differences in population size across the various territorial units considered. This aspect has traditionally been overlooked by the literature on economic convergence that has flourished since the contributions of Barro and Sala-i-Martin (1991, 1992), despite the fact that, as noted by Petrakos et al. (2005), omitting population size may greatly distort our perceptions of spatial inequality.

[1] For further details see the International Monetary Fund's World Economic Outlook Report, October 2009 (http://www.imf.org).

We begin our analysis by calculating the Theil's first measure of inequality for our case countries.[2] As shown in Table 1, the degree of spatial inequality varies considerably across the sample. In average terms, the highest T(1) values are found in Thailand, Ecuador, Indonesia, and the Philippines. These countries have the greatest levels of dispersion in the regional distribution of GDP per capita. At the opposite end of the spectrum we find Lithuania, Poland, Venezuela, and Romania.[3] Table 1 reveals that T(1) increased in most of the countries considered during the study period. The only exceptions to this general rule are Colombia, Indonesia, Peru, South Africa, and Turkey. This seems to suggest the existence of a tendency toward increasing spatial inequality in the developing world, which is in line with the empirical evidence provided by Kanbur and Venables (2005). In any event, the magnitude of the rise in regional disparities differs considerably across countries, with the highest rates of spatial divergence registered in the transition countries in Central and Eastern Europe (CEE).

INSERT TABLE 1 AROUND HERE

Most of the literature tends to measure the degree of openness to international trade as the ratio between total trade (exports and imports) and GDP (e.g. Frankel and Romer, 1999; Alesina et al., 2000; Frankel and Rose, 2002; Dollar and Kraay, 2004). Following this approach, we calculate trade openness using the value of exports and imports relative to GDP at constant prices in order to eliminate the potential impact on the results of changes in the level of prices.[4] Table 1 provides information on the degree of trade openness in the sample countries. The interpretation of the trade openness indicator in Table 1 is affected by when the different countries in the sample adopted trade liberalisation initiatives. Countries such as Thailand, China, and a number of Latin American states abandoned their traditional import-substitution development models in favour of export-orientated ones either before or around 1990. In most of these countries, trade openness continued to grow during the period of analysis. In other countries, such as India or the former communist countries in CEE, the increase in trade flows displayed in Table 1 has been the result of reforms to open their economies to world markets undertaken during the study period (Dollar and Kraay, 2004; Rodríguez-Pose and Gill, 2006). As a result of these trends, the average proportion of GDP traded in our sample rose from 51% in 1993 to 78% in 2006 (Figure 1).[5] Nevertheless, there are still important differences in the degree of trade openness among the sample countries. On the one hand, transition countries, in general, and Estonia (the most open country in the sample), Bulgaria, Lithuania, and Latvia, in particular, are the most open to trade at the end of the study period. The Asian countries – outside China and India – follow suit. Thailand, with a level of international trade close to 150% of GDP in 2006, is the second most open country being considered. The Philippines has levels of trade which are slightly above 100% of GDP. On the other hand, trade levels are significantly lower across Latin America, China and India (Figure 1). Brazil, where trade represents

[2] The definitions and sources of all the variables used in the paper are included in the Appendix.
[3] Regional inequality tends to be substantially higher in most emerging countries for which subnational data are available than in the developed world (Rodríguez-Pose and Ezcurra, 2010). In order to put the dimension of regional inequality in the emerging world in perspective, it suffices to note that the average value of T(1) for the United States between 1990 and 2005 was 0.008. This represents 31 times less than in Ecuador and almost 60 times less than in Thailand.
[4] Similar results to those presented later in the paper were obtained using the indicator of trade openness at current prices.
[5] 1993 was the first year of the study period where the indicator of trade openness was available for all the countries included in our sample.

barely one quarter of GDP, is the country with the lowest exposure to international trade in the sample. Turkey, India, Colombia, Peru, and Argentina all have volumes of international trade below 50% of their GDP.

INSERT FIGURE 1 AROUND HERE

Figure 2 displays the bivariate relationship between trade openness and spatial inequality in our case countries. The slope of the regression line points to a positive link between the two variables for the pooled data. In order to confirm this visual impression, we calculate the correlation coefficient between T(1) and the indicator of trade openness, obtaining a value of 0.281, which is statistically significant at the 1% level (p-value = 0.000). This implies that those emerging countries with higher levels of trade openness tend, in principle, to register a higher degree of spatial inequality. This preliminary result suggests that the openness of national economies to international trade may have spatial implications and affect the level and the evolution of regional disparities within developing countries. The rest of this section and the following one are devoted to examining this issue in greater detail.

INSERT FIGURE 2 AROUND HERE

3.2. The model

The previous analysis allows us to obtain an initial picture on the potential link between trade and spatial inequality. Nevertheless, the information provided by Figure 2 should be interpreted with caution because omitted variables may ultimately determine the connection between trade and regional inequality in emerging countries. In fact, it is likely that the level of spatial inequality in the sample countries does not depend exclusively on their degree of trade openness. Certain country-specific characteristics have been identified in the literature as factors which may enhance/diminish the impact of trade openness on regional inequality. Many of these involve subnational factors and dynamics such as the presence of economies of scale or diverse access to trade within a country, which are derived from geography and history. The sectoral composition of the economy is also an important determinant factor, as is the rural/urban composition of the country. A shift from agricultural to manufacturing and service activities is likely to be associated with a switch from rural locations to cities. This switch will, in turn, impinge on the costs of trade, given the concentrated nature of the infrastructure needed for trade-related activities. This reasoning implies that trade is likely to be a fundamental driver of territorial inequality, although, in the long-run, it may also be the trigger of a reduction of inequalities (Fujita, Krugman and Venables, 1999: 259). Differences in foreign market accessibility among the regions of any given country become thus a fundamental factor behind potential rises in polarisation associated to trade and that such trade-associated polarisation will be greatest in those countries where trade entry points coincide with the richest regions (Brülhart, 2011; Rodríguez-Pose, 2012). In addition, the redistributive capacity of the central government, as well inter-regional labour mobility, and the quality of institutions are bound to influence the effects of changes in trade patterns over the distribution of wealth (Rodríguez-Pose, 2012).

While it would be important to test the relationship of all these factors with the evolution of regional inequality, the specific focus on emerging countries and the lack of adequate subnational data available to test more exhaustively the exact mechanisms through which trade impinges on territorial disparities limits the scope of we can do. We thus formulate a simple econometric model in which the overall trade openness in developing countries is our dependent variable of interest. The model adopts the following form:

$$INEQ_{ct} = \alpha + \beta TRADE_{ct} + \boldsymbol{\varphi}\mathbf{X}_{ct} + \varepsilon_{ct} \quad (2)$$

where INEQ is the measure of spatial inequality, TRADE denotes the volume of trade expressed as a percentage of GDP, **X** stands for a set of variables that control for additional factors that are assumed to have an influence on regional disparities, and ε is the corresponding disturbance term. Our main interest here lies in the coefficient β, which captures the effect of trade openness on spatial inequality.

The control variables in vector **X** in our baseline specification of model (2) include the number of spatial units considered in each country, the level of economic development of the country and its size, as well as two proxies to capture the relevance of agglomeration effects and the redistributive capacity of the public sector. The relevance of these variables in explaining spatial inequality is, as we will see below, well documented in the literature. Nevertheless, our choice of controls is also constrained by the availability of reliable and comparable data for the sample countries during the different years covered in the analysis.

When estimating model (2) it is important to note that the level of regional disparities registered by each country may be affected by the number of spatial units used to compute the index of regional inequality (Portnov and Felsenstein, 2005). This is particularly relevant in our analysis, as our sample countries differ considerably in the number of territorial units used to calculate T(1) (Table 1). Although the values of the dependent variable have already been obtained taking into account the differences in population size across the various regions, we also control for the number of subnational units in order to minimize any potential bias emerging from the heterogeneity of the different territorial levels (Lessmann, 2011). Furthermore, the empirical literature on spatial inequality has tended to pay particular attention to the role of the level of economic development in explaining regional disparities (Terrasi, 1999; Petrakos et al., 2005). This interest goes back to the publication of the seminal work by Williamson (1965), who adopted the well-known study by Kuznets (1955) to a spatial framework. According to Williamson, as advances are made in the economic development process, spatial inequality tends to increase at first, before systematically decreasing in the ensuing stages of development. Accordingly, the trend in spatial inequality would follow an inverted U-shape.[6] Bearing this in mind, we test for the possible existence of a non-linear relationship between spatial inequality and the degree of economic development in our case countries, by including in the list of regressors of model (2) the national GDP per capita and its square.

The sample countries differ considerably in terms of size. Country-size may also be a factor explaining within-country inequality, as country size may hide greater spatial heterogeneity (Williamson, 1965). In order to control for country size, we use the

[6] See Lessmann (2011) for a recent survey on the literature on this topic.

population of a country.[7] We also investigate the possible influence on the dependent variable of the existence of agglomeration economies (Fujita and Thisse, 2002; Baldwin and Martin, 2004). To this end, we include in the list of regressors of model (2) the share of urban population living in the largest city to capture potential agglomeration effects (Brülhart and Sbergami, 2009). In addition, the redistributive capacity of the state is likely to affect the level and the evolution of territorial disparities within any given country (Rodríguez-Pose and Ezcurra, 2010). In view of this, we control for the size of the public sector, measured by the share of government final consumption expenditure in national GDP, as a proxy for the redistributive capacity of the countries in the sample.

As can be observed, model (2) exploits both the cross-sectional and time-series characteristics of the data in order to maximize the number of observations available. Similar models tend to include country-specific effects. However, controlling for country fixed effects is not useful in our case, as most of the variation registered by the dependent variable is between countries, rather than over time. Specifically, in our sample around 96% of the variation in the spatial inequality data is due to variations across countries. As pointed out by Breen and García-Peñalosa (2005) , in this case fixed effects models leave unexplained what is most important in the data and may produce inaccurate results (Quah, 2003). As an alternative, one may consider the estimation of a random effects model. Nevertheless, a random effects model assumes that the individual unobserved effects and the observed explanatory variables are uncorrelated (Wooldridge, 2002), which is unlikely to be satisfied in our context.

4. Empirical Results

Table 2 presents the results obtained when different versions of model (2) are estimated by OLS with heteroskedasticity and autocorrelation consistent standard errors, using T(1) as the dependent variable. As indicated in Table 2, the model works reasonably well in explaining cross-country variations in regional disparities, with relatively good values in terms of goodness-of-fit. Our main finding is that the coefficient of trade openness is in all regressions positive and statistically significant at the 1% level. This is consistent with the empirical evidence supplied by Figure 2, indicating that the greater the degree of trade openness in the developing world, the greater the dimension of the within-country regional inequality. This result is not affected by the inclusion of additional explanatory variables in the analysis, confirming its robustness and showing that the effect of international trade on regional disparities is not a spurious correlation resulting from the omission of relevant variables. In particular, it should be noted that the measure of trade openness remains significantly associated with spatial inequality when we control for the level of GDP per capita of the various countries. This is especially important, given that various studies have highlighted the role played by trade in promoting growth and economic development (Frankel and Romer, 1999; Alesina et al., 2000). Nevertheless, our results show that trade openness makes a relevant contribution in explaining the cross-country variations in regional disparities, and is not simply capturing the effect of the level of economic development.

INSERT TABLE 2 AROUND HERE

[7] The results are very similar if we employ alternatively the surface area to measure the country size. This is not surprising, since both variables are highly correlated (r = 0.83).

The results in Table 2 corroborate the empirical evidence provided by most single country studies conducted in the developing world (i.e. Sánchez-Reaza and Rodríguez-Pose (2002) for México, Kanbur and Zhang (2005) for China, or Rodríguez-Pose and Gill (2006) for Brazil and India). The rise in trade flows and the liberalization initiatives adopted to open the national economies to world markets has had a non-negligible effect in the rise of regional disparities in developing countries, which is particularly relevant when considering the consequences derived from the globalization process currently underway.

With respect to the control variables included in model (2), Table 2 reveals that the number of territorial units used to calculate the level of spatial inequality within the various countries is positively associated with the dependent variable. Furthermore, our results confirm the existence of an inverted U-shaped relationship between national development and spatial inequality, confirming the hypothesis put forward by Williamson (1965). In countries where economic development is relatively low, the growth of national GDP per capita is connected to increasing regional disparities. However, this relationship does not continue indefinitely. Beyond a certain threshold, our results detect the presence of a negative correlation between the two variables. Additionally, those countries where a greater share of the urban population lives in the largest city of country are characterized by a greater level of spatial inequality, supporting the relevance of agglomeration effects in this context. Finally, country size and the proxy for the redistributive capacity of the public sector tend to have the expected signs, but they are not statistically significant consistently across the various regressions included in Table 2.

In order to complete the information provided by Table 2, we now examine whether the estimated coefficients depend on the measure used to quantify the relevance of spatial inequality within our case countries. It is well-known that different inequality indices may actually yield different orderings of the distributions one wishes to compare, since each index has a different way of aggregating the information contained in the distribution (Ezcurra and Rodríguez-Pose, 2009). For this reason, and in order to complement the information provided by T(1), we resort to three alternative inequality indices. First, we calculate what is. known in the literature as Theil's second measure (Theil, 1967):

$$T(0)_{ct} = \sum_{i=1}^{n_c} p_{it} \log\left(\frac{\mu_{ct}}{y_{it}}\right) \tag{3}$$

Second, we estimate the coefficient of variation and the standard deviation of the logarithm of regional GDP per capita, which can be expressed respectively as:

$$c_{ct} = \frac{\sqrt{\sum_{i=1}^{n_c} p_{it} (y_{it} - \mu_{ct})^2}}{\mu_{ct}} \tag{4}$$

and

$$v_{ct} = \sqrt{\sum_{i=1}^{n_c} p_{it} (\log y_{it} - \tilde{\mu}_{ct})^2} \quad (5)$$

where $\tilde{\mu}_t = \sum_{i=1}^{n_c} p_{it} \log y_{it}$.[8]

Table 3 summarizes the main results obtained when model (2) is estimated again using T(0), c, and v in turn as dependent variables, instead of Theil's first measure of inequality. As can be seen, our previous findings hold, which indicates that the observed correlation between trade openness and spatial inequality does not depend on the specific indicator used to quantify the degree of dispersion in the regional distribution of per capita GDP within the different countries included in our study.

INSERT TABLE 3 AROUND HERE

Are our results robust to including dummy variables for the different regions of the world? Are they robust to the elimination of specific groups of countries? We investigate these questions in Table 4. Column 1 of Table 4 reveals that the coefficient of the degree of trade openness is still positive and statistically significant in the presence of regional dummies for Latin America, East Asia, and Central and Eastern Europe. Table 3 also shows the results obtained when different estimations of model (2) are carried out excluding various countries in turn. In particular, the groups of countries considered in this analysis are: transition countries in Central and Eastern Europe, Latin American countries, China and India, and the remaining Asian countries. Columns 2-5 of Table 4 indicate that the coefficient of the degree of trade openness continues to be positive and statistically significant in all cases, corroborating the negative effect of this variable on territorial disparities.

INSERT TABLE 4 AROUND HERE

In order to provide further evidence of the robustness of our findings, we now address the possibility that the impact of trade on spatial inequality may be contingent on the level of development of the various countries considered. We investigate this issue by dividing the sample countries into two groups based on the World Bank income classification: (i) lower-middle income countries and (ii) higher-middle income countries. We then estimate model (2) separately for the two subsamples just defined. The last two columns of Table 4 report the results for the lower-middle and higher-middle income countries respectively. The coefficient of the variable trade openness remains positive and statistically significant in both cases. This implies that international trade gives rise to increasing spatial inequality in the two groups of countries, although the effect of trade on regional disparities seems to be greater in poorer countries, which tend to be also those with the highest levels of territorial inequality.

[8] In their non-weighted versions, these dispersion measures have been widely used in the convergence literature in order to capture the concept of sigma convergence (Barro and Sala-i-Martin, 1995). As is the case of Theil's first measure of inequality, all the indices selected are independent of scale and population size and, except for the standard deviation of the logarithm, they all fulfil the Pigou-Dalton transfer principle for the whole definition domain of income (Cowell, 1995; Ezcurra and Rodríguez-Pose, 2009).

As an additional robustness check, we investigate the possibility that our results are driven by an omitted variable. We address this issue by controlling for different covariates that could plausibly be correlated with trade openness and checking whether the inclusion of these covariates affects our estimates. According to this strategy, we add to our baseline specification different geographical variables that may be important in this context: two dummies indicating if a country is landlocked or surrounded by water, a measure of the extent to which a country's surface is covered by mountains, and the standard deviation of the elevation within country borders. Likewise, the degree of trade openness of a country may be affected by natural resource abundance. For this reason, we include in the list of regressors of model (2) fuel, ores and metals exports expressed as a percentage of merchandise exports. Furthermore, it should be noted that most of the developing countries have undergone different processes of structural change during the study period. This is potentially important because structural change may be related to the degree of openness to international trade. In addition, those countries affected by structural change are likely to experience internal migration, which may affect spatial inequality. Accordingly, we add to our baseline specification the level of urbanization as a proxy for structural change.

INSERT TABLE 5 AROUND HERE

Table 5 shows the results obtained when model (2) is estimated again including these additional controls. As can be seen, their inclusion in the list of regressors has little effect on the main result of the paper. In particular, Table 5 shows that the additional controls considered do not affect the estimates of the impact of international trade on spatial inequality. The measure of trade openness remains positive and statistically significant throughout the analysis, confirming the robustness of our findings.

Our final test concerns how the rise in trade flows and the opening of national economies to world markets may also have led to the emergence of losing and winning regions (Rodríguez-Pose and Gill, 2006). In order to understand better the way in which the degree of trade openness affects spatial inequality, we now examine the impact it has on the income of various groups of regions. To that end we calculate for each country and year the average GDP per capita of (i) the regions whose GDP per capita at the beginning of the study period was below 75% of the national average (low income regions), (ii) the regions whose GDP per capita at the beginning of the study period was between 75% and 125% of the national average (middle income regions), and (iii) the regions whose GDP per capita at the beginning of the study period was above 125% of the national average (high income regions). Then, in a second step, we normalize the average GDP per capita of each group of regions by the national average in order to facilitate comparisons across countries and over time.

INSERT TABLE 6 AROUND HERE

Table 6 reports the results obtained when different versions of model (2) are estimated using as dependent variable the normalized GDP per capita of the various groups of regions. As can be observed, greater trade openness depresses the GDP per capita of poorer regions relative to national GDP per capita and increases that of rich regions, again relative to national GDP per capita. In turn, the impact of trade openness on the relative situation of middle income regions is not statistically significant in the full sample. These findings reveal that, on average, the group of losing (winning) regions tends to be formed mostly by low (high) income regions, which explains the effect of the degree of trade openness on regional disparities observed in the present article. Table 6 also indicates that the spatial impact of trade is quantitatively more important in the regions of poorer countries, which is in line with the results obtained in Table 4. In any case, when interpreting the information provided by Table 6, it is important to recall that this analysis allows us to examine the effect of international trade on the *relative* situation of the different regions. Accordingly, these results are compatible with a potential positive impact of trade openness on regional economic performance in *absolute* terms.

5. Conclusions

In this article we have examined the link between trade and spatial inequality in 22 developing countries over the period 1990-2006. Although the limited time frame and the nature of the study imply that any conclusion should be treated with caution, our analysis shows that the degree of trade openness is positively correlated with spatial inequality in the sample countries. This suggests that the liberalization initiatives and the rise in trade flows contributes to an increase in regional disparities in the developing world, a fact which should not be overlooked when considering the consequences derived from the globalization process currently underway.

This finding is robust to the inclusion in the analysis of additional explanatory variables, such as the national GDP per capita, the size of the country, agglomeration effects, or the redistributive capacity of the public sector. Furthermore, the positive association observed between trade openness and regional disparities still holds when alternative measures are used to quantify the level of spatial inequality registered within the various countries. Likewise, we have checked that our results are not driven by any specific group of countries.

In order to complete our study, we have also investigated the way in which trade openness affects the regional distribution of GDP per capita in the sample countries. In this respect, our estimates indicate that a greater degree of trade openness reduces the GDP per capita of poorer regions and increases the GDP per capita of richer regions in both cases relative to national GDP per capita. This helps to explain the positive link detected between trade openness and spatial inequality. Trade seems to generate clear winners and losers in relative terms, which tend to coincide respectively with the richest and poorest regions within a country. In addition, our analysis indicates that the quantitative effect of the degree of trade openness on regional disparities appears to be contingent on the level of development of the various countries. Specifically, our results reveal that the spatial impact of trade is greater in poorer countries, meaning that, while trade on the whole may have a beneficial effect for aggregate economic performance in the emerging world, the poorest regions in the poorest countries – the poorest of the poor – are likely to lose out from greater engagement in international trade.

Our research has contributed to address a number of important questions concerning different aspects of the relationship between trade openness and spatial inequality in the developing world. It has also raised, however, a series of issues that will require further research. Some relate directly to the size of the sample and the potential inclusion of additional countries. Lack of adequate regional data has prevented us from pursuing this issue, but addressing it may provide a more complete picture about the nature of the link between trade and spatial inequality. Moreover, as is usual in the literature, our analysis is based exclusively on the information provided by an aggregate measure of trade openness. Nevertheless, it would be interesting to complete our results by investigating the potential effect of trade composition on regional disparities (Rodríguez-Pose, 2012). Further research will also have to pay special attention to the need to identify and study the various theoretical mechanisms which explain the influence of the degree of trade openness on regional disparities. Only by pursuing these strands we will be able to achieve a more complete understanding about how trade affects spatial inequality in the emerging world.

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Appendix

Definitions and sources of control variables

- *Regional GDP per capita:* Level of regional GDP per capita. Sources: Cambridge Econometrics and national statistics.
- *Regional population:* Level of regional population. Sources: Cambridge Econometrics and national statistics.
- *Trade openness:* Sum of exports and imports as a share of national GDP. The variable is expressed at 2005 constant prices. Source: Penn World Tables 7.0.
- *National GDP per capita:* Natural log of real GDP per capita expressed in constant 2005 dollars. Source: Penn World Tables 7.0.
- *Population:* Natural log of total population. Source: Penn World Tables 7.0.
- *Agglomeration*: Percentage of urban population living in the largest city of the country. Source: World Development Indicators.
- *Government size:* Total government consumption as a percentage of national GDP. The variable is expressed at 2005 constant prices. Source: Penn World Tables 7.0.
- *Landlocked:* Dummy variable that takes the value one if the country is landlocked, and zero otherwise.
- *Island:* Dummy variable that takes the value one if the country is surrounded by water and has no bordering countries, and zero otherwise.
- *Mountains:* Measure of the extent to which a country's surface is covered by mountains. Source: Alesina and Zhuravskaya (2011).
- *Roughness:* Standard deviation of elevation of each country expressed in metres. Source: Alesina and Zhuravskaya (2011).
- *Natural resource abundance:* Fuel, ores and metals exports expressed as a percentage of merchandise exports. Source: World Development Indicators.
- *Urban population:* Percentage of the total population living in urban areas. Source: World Development Indicators.

Figures and Tables

Figure 1: The evolution of the degree of trade openness.

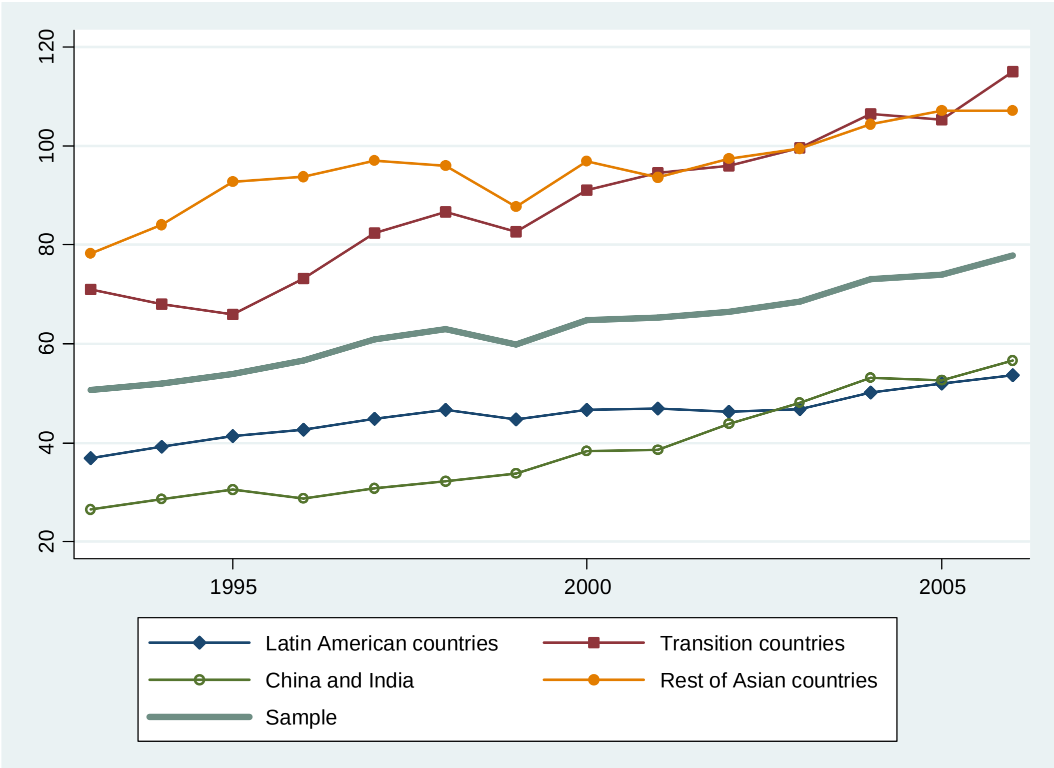

Figure 2: The relationship between trade openness and spatial inequality.

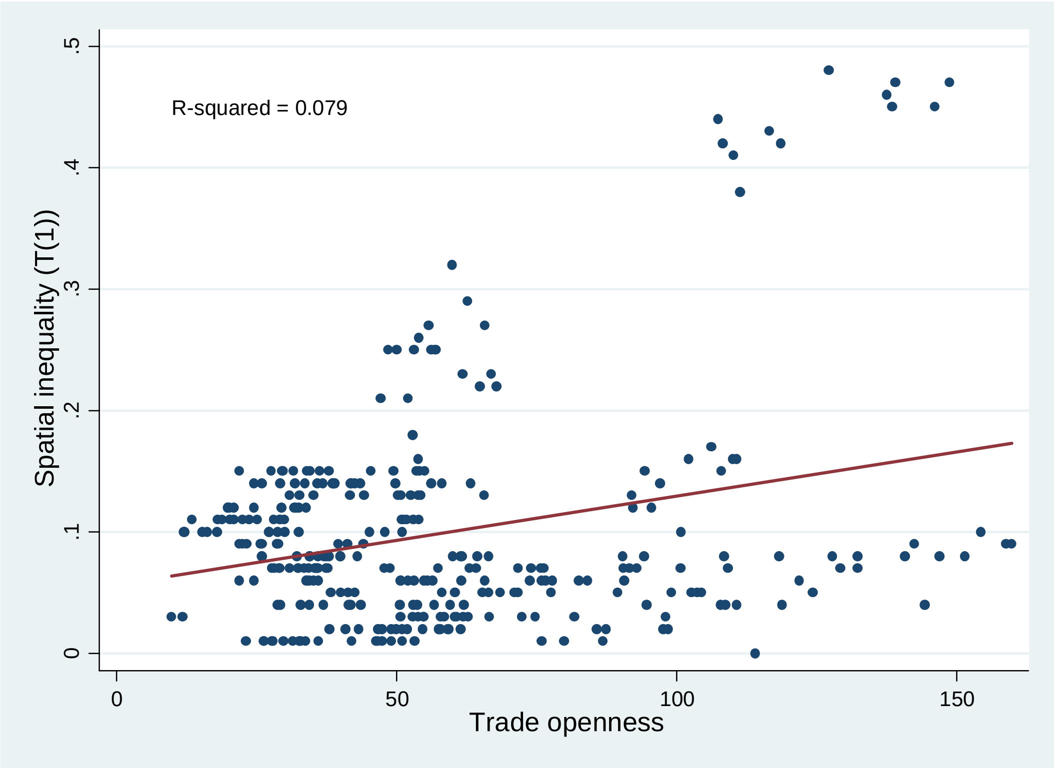

Table 1: Spatial inequality and trade openness.

			Spatial inequality			Trade openness		
Country	Spatial units	Period	Initial	Final	Average	Initial	Final	Average
Argentina	23	1992-2006	0.040	0.097	0.057	28.8	45.2	38.4
Bolivia	9	1990-2006	0.024	0.050	0.033	46.7	68.6	55.3
Brazil	27	1990-2006	0.102	0.110	0.109	12.0	25.1	18.7
Bulgaria	6	1990-2006	0.049	0.084	0.067	71.7	132.4	95.8
Chile	13	1990-2006	0.066	0.069	0.072	47.8	75.9	60.4
China	31	1990-2005	0.085	0.126	0.123	25.7	65.7	39.1
Colombia	33	1990-2006	0.076	0.052	0.065	25.9	40.1	34.4
Ecuador	21	1993-2006	0.211	0.266	0.250	47.2	65.8	55.7
Estonia	5	1990-2006	0.039	0.088	0.069	11.8	158.8	118.2
India	32	1993-2005	0.059	0.090	0.074	21.9	39.6	32.9
Indonesia	30	2000-2006	0.256	0.223	0.246	54.0	64.9	55.5
Latvia	6	1993-2006	0.030	0.156	0.097	77.7	110.1	93.2
Lithuania	10	1993-2006	0.004	0.049	0.021	114.1	124.4	99.7
Mexico	32	1993-2004	0.143	0.145	0.147	25.9	58.1	45.0
Peru	24	1990-2006	0.140	0.135	0.142	24.6	43.5	35.5
Philippines	16	2005-2006	0.163	0.169	0.166	110.8	106.2	108.5
Poland	16	1990-2006	0.009	0.033	0.021	27.8	81.7	52.8
Romania	8	1990-2006	0.008	0.064	0.030	26.3	82.6	46.3
South Africa	9	1995-2005	0.135	0.114	0.119	38.9	57.6	49.5
Thailand	76	1994-2005	0.439	0.473	0.439	107.4	148.8	125.8
Turkey	26	1990-2001	0.094	0.076	0.081	26.0	37.6	30.6
Venezuela	23	1990-2006	0.006	0.028	0.024	46.7	60.4	54.9

Notes: Spatial inequality is measured using the Theil's index described in the text. In turn, trade openness is the ratio between total trade (exports and imports) and GDP. For Ecuador there is not information on regional GDP for 1994, 1995, 1997, 1998 and 2000.

Table 2: The impact of trade openness on spatial inequality: Regression analysis.

	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)	(2.9)	(2.10)
Trade openness	0.002***	0.002***	0.001***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Spatial units	0.094***	0.095***	0.101***	0.096***	0.092***	0.063***	0.099***	0.077***	0.069***	0.054***
	(0.007)	(0.012)	(0.009)	(0.009)	(0.007)	(0.011)	(0.008)	(0.012)	(0.016)	(0.013)
GDP per capita	1.152***				1.113***	1.338***	1.007***	1.243***		1.331***
	(0.188)				(0.183)	(0.212)	(0.180)	(0.217)		(0.208)
(GDP per capita)^2	-0.070***				-0.068***	-0.080***	-0.061***	-0.075***		-0.080***
	(0.011)				(0.011)	(0.012)	(0.011)	(0.013)		(0.012)
Population		0.001				0.028***		0.009	0.023***	0.031***
		(0.004)				(0.007)		(0.007)	(0.008)	(0.008)
Agglomeration			0.001***			0.003***	0.001***		0.003***	0.003***
			(0.000)			(0.000)	(0.000)		(0.000)	(0.000)
Government				-0.000	-0.001		0.001	-0.002*	-0.001	-0.002
				(0.001)	(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
Constant	-5.007***	-0.281***	-0.297***	-0.262***	-4.814***	-6.301***	-4.407***	-5.502***	-0.645***	-6.282***
	(0.795)	(0.068)	(0.034)	(0.035)	(0.777)	(0.951)	(0.752)	(0.974)	(0.104)	(0.935)
F-test	46.78***	39.67***	44.71***	38.84***	37.37***	50.73***	41.95***	29.33***	33.63***	44.38***
Adjusted R2	0.633	0.548	0.574	0.548	0.633	0.690	0.653	0.637	0.602	0.693
Sample	All countries	All countries	All countries	All countries	All countries	All countries	All countries	All countries	All countries	All countries
Countries	22	22	22	22	22	22	22	22	22	22
Observations	307	307	307	307	307	307	307	307	307	307

Notes: The dependent variable is in all cases the Theil's first measure of inequality. The number of spatial units, GDP per capita and population are expressed in logs. Heteroskedasticity and autocorrelation consistent standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: Robustness analysis: Alternative measures of inequality.

	(3.1)	(3.2)	(3.3)
Dependent variable	T(0)	c	v
Trade openness	0.002***	0.004***	0.003***
	(0.000)	(0.000)	(0.000)
F-test	39.64***	76.61***	61.89***
Adjusted R2	0.737	0.568	0.669
Control variables	Yes	Yes	Yes
Sample	All countries	All countries	All countries
Countries	22	22	22
Observations	307	307	307

Notes: All the regressions include a constant and the full set of control variables of the baseline model described in the text. Heteroskedasticity and autocorrelation consistent standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Robustness analysis: Inclusion of regional dummies and elimination of specific groups of countries.

	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)	(4.7)
Trade openness	0.001***	0.002***	0.002***	0.002***	0.001***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
F-test	62.34***	81.12***	77.02***	56.62***	21.77***	247.7***	23.59***
Adjusted R2	0.734	0.731	0.840	0.732	0.316	0.818	0.494
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional dummies	Yes	No	No	No	Yes	No	No
Observations	307	211	169	278	286	110	197
Sample	All countries	Transition countries excluded	Latin American countries excluded	China and India excluded	Remaining Asian countries excluded	Low income	High income
Countries	22	16	13	20	19	9	13

Notes: The dependent variable is in all cases the Theil's first measure of inequality. All the regressions include a constant and the full set of control variables of the baseline model described in the text. Regional dummies for Latin America, East Asia and Europe. Heteroskedasticity and autocorrelation consistent standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: Robustness analysis: Additional controls.

	(5.1)	(5.2)	(5.3)	(5.4)	(5.5)	(5.6)
Trade openness	0.002***	0.002***	0.001***	0.001***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Landlocked	-0.030*					
	(0.016)					
Island		-0.088***				
		(0.012)				
Mountains			-0.024			
			(0.018)			
Roughness				-0.000**		
				(0.000)		
Natural resources					-0.001***	
					(0.000)	
Urban population						-0.003***
						(0.000)
F-test	53.94***	77.98***	12.07***	12.90***	104.2***	144.9***
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.695	0.697	0.342	0.354	0.748	0.770
Sample	All countries	All countries	All countries	All countries	All countries	All countries
Countries	22	22	19	19	22	22
Observations	307	307	262	262	294	307

Notes: The dependent variable is in all cases the Theil's first measure of inequality. All the regressions include a constant and the full set of control variables of the baseline model described in the text. Heteroskedasticity and autocorrelation consistent standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: The spatial implications of trade openness on regional inequality.

Groups of regions	Low income regions			Middle income regions			High income regions		
	(6.1)	(6.2)	(6.3)	(6.4)	(6.5)	(6.6)	(6.7)	(6.8)	(6.9)
Trade openness	-0.001***	-0.001***	-0.000	-0.000	0.001***	-0.001	0.009***	0.011***	0.008***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.003)	(0.003)
F-test	27.15***	51.32***	11.52***	6.884***	9.024***	11.17***	29.74***	20.47***	12.68***
Adjusted R2	0.423	0.693	0.437	0.188	0.633	0.258	0.427	0.348	0.559
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All countries	Low income	High income	All countries	Low income	High income	All countries	Low income	High income
Countries	19	9	10	20	9	11	19	9	10
Observations	256	107	149	276	110	166	259	110	149

Notes: The dependent variable is the normalized average GDP per capita of the various groups of regions. All the regressions include a constant and the full set of control variables of the baseline model described in the text. Heteroskedasticity and autocorrelation consistent standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.