Trade Liberalization and Income Inequality: The Case for Pakistan

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Abstract

Trade liberalization policies have been adopted by many developing countries to increase economic growth and reduce poverty. While the positive relationship between trade liberalization and economic growth is generally well accepted, the impact of trade liberalization on poverty and income inequality is still unclear. The objective of this paper is to examine the impact of trade liberalization on the incomes of multiple households and possible effects on inequality using a global trade model. To illustrate, we simulate the impact of several alternative bilateral and regional free trade agreements on household income and income inequality in Pakistan. The results show that trade liberalization does not always lead to a decline in income inequality in the short run. Trade agreements that do improve income equality, favor agriculture and often hinge on a decline in urban and non-farm household income. In the long run, changes in income equality are more positive, suggesting that efforts might best be applied to improving access to education and financial markets.

Keywords: Income Inequality, trade liberalization, CGE modeling, Pakistan

JEL classification: F11, F17, O19, C68

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1 Introduction

In the present era of globalization, developing countries continue to seek policies that will enhance their economic growth and reduce poverty. Trade is generally believed to be a catalyst to higher economic growth in the long run, which in turn is expected to reduce poverty. Many developing economies have therefore joined various regional and bilateral trade agreements in the hope of raising their trade performance to achieve economic growth and reduce poverty.

While the empirical evidence broadly supports a positive relationship between trade, growth and poverty, Winters, McCulloch and McKay (2004) note that "it is clear, however, that on occasions growth has been accompanied by worsening poverty" (p. 80). Winters, McCulloch, and McKay (2004) therefore conclude that the impact of trade on poverty is likely to depend on "the trade reform measures being undertaken, who the poor are and how they sustain themselves" (p. 107). The impact of trade on inequality is even more ambiguous, with recent evidence from Latin American countries (Wood, 1997) contradicting earlier evidence, based on Asian economies, that trade narrows the gap between the wages of skilled and unskilled workers. The purpose of this paper is to contribute to our understanding of the impact of trade agreements on household income and income inequality using a global trade model.

Pakistan is used to illustrate the impact of trade policy on household income and income inequality. Like many developing countries, Pakistan has embraced trade liberalization as a means of increasing growth. In 1988 the government of Pakistan implemented the first International Monetary Fund's (IMF) Structural Adjustment Program (SAP); and then in 1995, trade liberalization received a further boost with Pakistan's accession to the World Trade Organization (WTO). Pakistan also actively participates in many bilateral and preferential trading agreements, including free trade agreements with China, Sri Lanka, Malaysia, and South Asia, and preferential trading arrangements with Iran, Indonesia, Mauritius and the developing 8 (PTA-D8)[4]. Pakistan

[4] The 8 African and Asian developing countries include Pakistan, Egypt, Nigeria, Bangladesh, Turkey, Malaysia, Iran, and Indonesia.

also has a preferential arrangement with the European Union (EU), the European Generalized System of Preferences (GSP) Plus, and is actively pursuing free trade agreements with Turkey, Thailand and Korea.

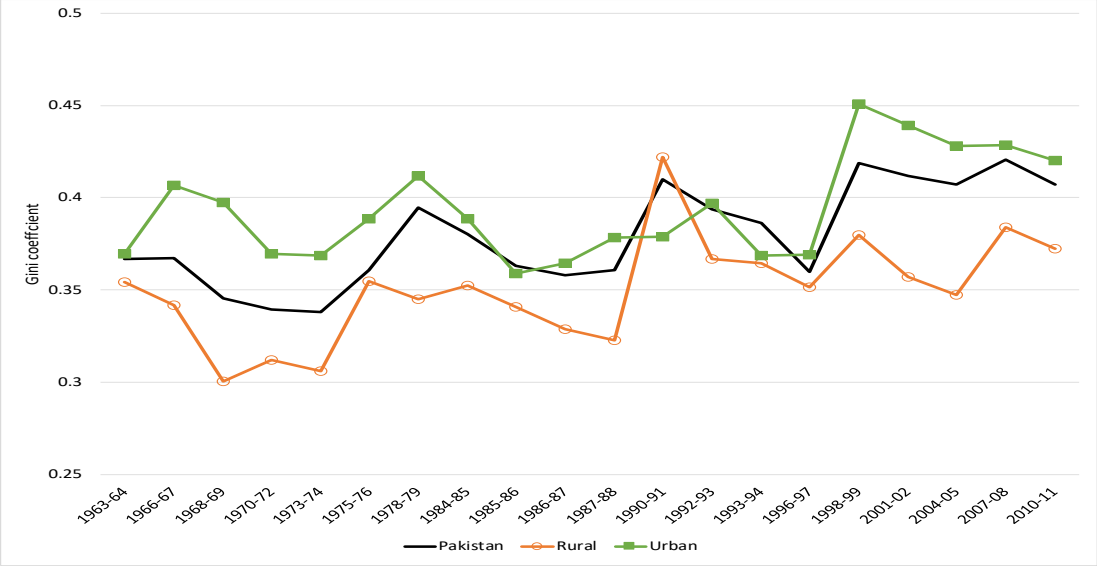
Income inequality in Pakistan is traditionally estimated from the Household Income and Expenditure Survey (HIES) and Pakistan Integrated Household Survey (PIHS). There are many widely used measures of income inequality, but in Pakistan the Lorenz curve and Gini coefficients are most common. Anwar (2005) used grouped household income data[5] to develop a consistent series of Gini coefficients in Pakistan over time, and Kemal (2006) examined the Gini coefficients for rural and urban workers[6] (Figure 1). Figure 1 illustrates that income inequality has increased marginally in Pakistan over the last 4 decades, despite modest economic growth and recent trade liberalization efforts. Most recently, the Gini coefficient calculated from the latest HIES survey (2010-11) shows a marginal decline compared to the one calculated in 2007-08, reversing the previous increase. This decline was primarily due to the decline of income inequality in the rural areas.

In this paper we examine the impacts of the various trade agreements on household income and income inequality in Pakistan, along with several other regional trade initiatives, using a global trade model with multiple households. The rest of the paper is organized as follows. First, we present an overview of alternative methodologies used to incorporate poverty and income inequality into global computable general equilibrium models. Section 3 presents the methodological framework, data sets and measures of income inequality used in this study. Results are then discussed in Section 4, including a section on sensitivity analysis, followed by concluding remarks in Section 5.

[5] Grouped data assumes away the inequalities within each group.

[6] The urban labor force is more diversified in terms of skill, education, union membership, coverage by the minimum wage legislation and therefore the wage incomes are more unevenly distributed than in rural areas.

Figure 1: Trends in Gini Coefficients in Pakistan



Source: Anwar (2005) and Jamal (2014)

2 Poverty and Income Inequality in CGE Models

The general equilibrium nature and reliance on real data of computable general equilibrium (CGE) models make them an ideal tool for analyzing the impact of trade policies on poverty and income distribution. CGE based poverty and income inequality focused models can be classified into two broad approaches: the integrated approach and the linked micro-simulation approach. In the first case, household information is integrated into a CGE model, and in the second, CGE model results are fed into a micro-simulation model containing the additional household detail to obtain the household impacts.

Integrated models generally rely on the assumption of a representative household. The 'household' is usually disaggregated into multiple household groups, with one 'representative' household representing the economic behavior of the whole household group. Household groups can be defined by location, income level or other socio-economic criteria, with the representative household (RH) given the mean value of expenditure and income of the household group, obtained from household consumption or income survey data. A number of CGE models with multiple households use the represented household assumption (see Coxhead and Warr (1995); Horridge,

et al. (1995); Sapkota (2001),; and Humphreys (2000)). In these models, the pattern of income distribution within a household group is not taken into consideration and is assumed homogenous to the representative household. These types of models can be used to compute poverty indicators or determine the inter-group income inequality, although, as Agenor et al. (2004) points out, they cannot be used to examine intra-group income inequality.

Micro-simulation models are very popular in household level income studies. These models do not rely on the representative household assumption, instead, all available households in the survey data are modelled, allowing them to capture heterogeneity between households. In addition, these models allow researchers to completely endogenise within-group income distributions in conjunction with within-group variation. The Micro-simulation and CGE models remain two separate and distinct models that are applied in a sequential fashion; i.e., taking parameters from the CGE model[7] and feeding them into the micro module without any further interaction between the macro and the micro levels.

These techniques are normally applied in a single country context and static framework. More recently, researchers have attempted to incorporate these features into global and dynamic models. There are several different initiatives:

First, Hertel *et al*. (2011) introduced the GTAP poverty module known as GTAP-POV which links the comparative static GTAP model with microdata from household surveys. Within this framework, different strata of households are identified based on income sources. The model incorporates an AIDADS demand system[8] to estimate the expenditure required for households in each strata to remain at the initial level of utility after commodity prices change. This initial level of utility is used to obtain changes in real income by stratum. Using stratum elasticities of poverty headcounts with respect to real income, variations to poverty headcounts by stratum in each

[7] In the case of top-down microsimulations, parameters can also be taken from partial equilibrium models or econometric estimations. Contrarily to CGE models, however, these macro models do not provide information on the labor market, so their scope is more limited (Estrades, 2013).

[8] AIDADS ("An Implicit Direct Additive Demand System") is a more flexible demand functional form.

country are estimated. This method is adapted by Hertel *et al.* (2009) to analyze the impact of the Doha Development Agenda on poverty, Climate volatility (Ahmed *et al.* 2009), among others (see Hertel *et al.* 2011 for a full list of studies).

Second, is World Bank's Global Income Distribution Dynamic (GIDD) model; which links the Global CGE Model, LINKAGE, with Household surveys from around 130 countries. This approach considers the dynamics of demographic changes, before being fed with results from the CGE model (micro-simulation approach), the household surveys are re-weighted with exogenous demographic projections and with "semi-exogenous" projections of skill levels. This approach is used by Bussolo et al (2010) to analyze the poverty impact of agricultural distortions and by Dessus et.al (2008) to analyze the impact of soaring food prices.

Third, the International Food Policy Research Institute (IFPRI), adapted the MIRAGE model to include household disaggregation within a global dynamic CGE model, for a number of developing countries[9] (Bouet *et al.* 2010; 2012). This approach explicitly models household behavior within the model (integrated approach) so that the responses of the different households to trade policies are fully captured at the CGE level. To do this, the authors use microdata from household surveys and apply a clustering procedure that groups households from the survey into groups according to their consumption pattern, their income pattern, and their per capita income.

Forth, the MyGTAP modeling framework is an integrated approach based on the GTAP model. The framework provides a flexible country and household approach allowing users to incorporate additional labor and household categories from household survey data or other sources into the GTAP database for any of the existing countries.[10] The additional data and economic theory permit an examination of the impact of policies on multiple households' income and consumption patterns. The model has been used to examine policies in Pakistan (Khan, Zada & Mukhopadhyay

[9] This method has been used to analyze the impact of global trade liberalization on poverty in five developing countries: Brazil, Pakistan, Tanzania, Uruguay, and Vietnam (Bouet et al. 2012).

[10] The framework does not provide the household data, instead it provides a publicly available program to assist the user with incorporating their own country data into the GTAP database.

(2018) and Khan, Mehmood, Husnain & Zakaria (2018)), Oman (Boughanmi & Khan, 2018) Mozambique, Zimbabwe, Kenya and Nigeria (Siddig, Aguiar, Greth, Minor & Walmsley, 2014).

After analyzing the various available models to incorporate labor and household categories from household survey data into the GTAP database for Pakistan, the MyGTAP modeling framework was found to be the most appropriate for the current study, due to its flexibility and accessibility.

Given this backdrop, the purpose of this paper is to contribute to understanding of the impact of trade agreements on household income and income inequality using a global trade model for future policy discourse. By linking each household's income to individual factors of production, the differential impact of trade policy on sectoral production and factor use leads to differential impacts on household incomes that can then be used to identify the impact of trade policies on the incomes of poor households separately from those on rich households. Moreover, differences in consumption patterns between these households can also lead to differential impacts on household consumption, real incomes and welfare. Finally, we add a number of inequality measures to measure the differences between household incomes before and after the trade policy is implemented.

3 Methodological Framework

The methodological framework used in this paper is based on neo-classical theory. The MyGTAP model, developed by Walmsley and Minor (2013), is an extended version of the GTAP model (Hertel and Tsigas 1997)[11] which is based on a common global database, the GTAP database (Aguiar, Narayanan, and McDougall, 2016). The model assumes that all markets are perfectly competitive, production and trade activities exhibit constant returns to scale, and firms and household display profit and utility maximizing behavior respectively.

The MyGTAP model extensions include several new characteristics that are helpful in examining the behavior of multiple households using the representative household approach discussed above.

[11] The model is solved using the software GEMPACK (Harrison and Pearson 1996).

First, it allows more flexibility in the treatment of government savings and spending by removing the regional household from the standard GTAP model and replacing it with a separate government and private household. Second, the model allows for additional factors of production and multiple private households; and third, the model also includes transfers between government and households and among household groups, as well as foreign aid, remittances and capital income. These additions allow for the assessment of policy impacts on different household groups.

While many of these additional features are standard in the MyGTAP framework, the inclusion of multiple households and additional factors requires additional data to be supplied from a social accounting matrix (SAM) or household survey. These data are incorporated into the augmented MyGTAP framework using a facility developed by Minor and Walmsley (2013). In this paper, we incorporate additional data on Pakistani households and factors of production in order to examine the impact of trade liberalization on Pakistani households. Further details on how this is achieved are provided in section 3.2 below.

The MyGTAP model is also extended to include several measures of income inequality, including the Gini and Hoover coefficients, so that we can examine the impact of trade liberalization on income inequality between representative household groups. These additions are outlined in the next section.

3.1 Income Inequality Estimation

The MyGTAP model is further modified to incorporate various measures of income inequality. Inequality is the dispersion of the distribution of income or some other welfare indicator (Litchfield, 1999) and is related to a number of mathematical concepts, including dispersion, skewness, and variance. There are several ways to measure inequality, which itself arises from various social and physical phenomena. While this research will not discuss all of them exhaustively, we will briefly discuss some of the most popular inequality measures used in this study and how they are incorporated into the model.

3.1.1 Gini coefficient of inequality

The Gini coefficient is the most commonly used measure of inequality. The base of the Gini coefficient is a cumulative frequency curve – the Lorenz curve – that compares the distribution of

a specific variable (e.g. income, expenditure, etc.) with the uniform distribution that represents equality. The coefficient value ranges between 0 and 1. A Gini value of 0 indicates perfect equality and 1 (or 100%) indicates maximum inequality. The closer a Gini coefficient is to one, the more unequal is the income distribution. The Gini index is the most frequently used inequality index. The reason for its popularity is that it is easy to compute the Gini index as a ratio of two areas in Lorenz curve diagrams. The disadvantage of the Gini index is that it only maps a number to the properties of a diagram, but the diagram itself is not based on any model of a distribution process. The "meaning" of the Gini index can therefore only be understood empirically. Additionally, the Gini does not capture the location in the distribution where the inequality occurs. Thus, two very different distributions of income can have the same Gini index.

We can state the Gini Coefficient (*Gini*) as:

$$Gini = \frac{2}{n^2 \bar{y}} \sum_{i=0}^{n} (y_i - \bar{y}) \qquad (1)$$

Where: y_i is the wealth or income of household *i*;

$\bar{y}$ is mean income; and

n is total number of households.

According to Litchfield (1999) the Gini coefficient is a good measure of income inequality because it meets four of the five criteria set out by Litchfield: mean independence, population size independence[12], symmetry[13], and the Pigou-Dalton Transfer sensitivity[14].[15]

3.1.2 Generalized Entropy measures

The five criteria of good measures of inequality, outlined by Litchfield (1999) are satisfied by several inequality measures, including various Generalized Entropy (GE) measures. GE measures

[12] If income or populations size are doubled, the measure would not be changed.

[13] If individuals exchange their income still no change in the inequality measure.

[14] If Income transferred from rich to poor (or vice versa) would reduce (raise) income inequality.

[15] The fifth criteria, decomposability, is the ability to decompose inequality by population / income or in some other way in such a way that the total is the sum of the decomposed parts.

do not rely on the Lorenz curve, like the Gini coefficient. GE measures originate from information theory and seek to quantify the level of disorder within a distribution of income. Normally, GE measures are calculated in discrete form from tabulated income share data. Theil's measure of inequality is the most widely used GE measure. Unlike the Gini coefficient, GE measures satisfy the decomposability characteristic – the fifth criteria (Litchfield, 1999) – which implies that the aggregate inequality measure can be decomposed into inequality *within* and *between* any defined population subgroups.[16]

The general formula of GE measure is given by equation 2:

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)}\left[\frac{1}{N}\sum_{h=1}^{N}\left(\frac{YH_h}{\overline{YH}}\right)^{\alpha} - 1\right], \qquad (2)$$

Where: YH_h is the income of household h;

$\overline{YH}$ is mean income of all households;

N is the total number of households; and

α represents the weight given to distances between incomes at different parts of the income distribution.

The values of generalized entropy measures vary between 0 and ∞, with zero representing an equal distribution and a higher value representing a higher level of inequality. In the generalized entropy class of inequality indexes, the parameter α represents the weight given to distances between incomes at different parts of the income distribution, and it can take any real value. The generalized entropy measure is more sensitive to changes in the lower tail of the distribution for lower values of α (α = 0, Theil-L) whereas, for higher values, the generalized entropy measure is more sensitive to the changes that affect the upper tail (α = 1, Theil-T).

Theil's T index (GE(1)) can be written as:

[16] The equations for measuring the between group inequality based on the Theil indexes are provided in Appendix 1.

$$GE(1) = \frac{1}{N}\sum_{h=1}^{N} \frac{YH_h}{\overline{YH}} \ln\left(\frac{YH_h}{\overline{YH}}\right) \tag{3}$$

Theil's L index (GE(0)) is sometimes referred as the mean log deviation measure. It can be written as:

$$GE(0) = \frac{1}{N}\sum_{h=1}^{N} \ln\left(\frac{\overline{YH}}{YH_h}\right) \tag{4}$$

There is one inherent problem with the Theil Index, unlike the Gini index, which varies from 0 to 1, the scale for the Theil index can vary between 0 and ∞, making it difficult to judge the level of inequality (Sen, 1997). To overcome this problem, we normalize the Theil index (Domínguez-Domínguez, 2005).

3.1.3 Hoover's inequality measure

Finally, the Hoover index (HI), also known as the Pietra ratio, represents the maximum vertical distance from the Lorenz curve to the 45° line of equality (Kawachi et al., 1997). This index is also known as the Robin Hood index because it can be interpreted as the proportion of income that would need to be transferred from those above the mean, to those below the mean, in order to achieve an equal distribution (Atkinson and Micklewright, 1992). The HI index is also between 0 and 1, as it represents the share of income that would need to be transferred. A high value Hoover index therefore indicates a more unequal society, since the larger the share of income, the more income that needs to be redistributed to achieve equality. The Hoover framework does not include a sensitivity parameter like the GE indexes (α). The Hoover's Index can be written as:

$$HI = \frac{1}{2}\sum_{h}\left|\frac{YH_h}{\sum_{h} YH_h} - \frac{N_h}{\sum_{h} N_h}\right| \tag{5}$$

The Hoover index is the simplest of all inequality measures. The multiplication of the Hoover index with the sum of all resources (i.e. income) yields the share of all resources which would have to be redistributed to achieve perfect equality. Like the Gini coefficient, it meets four of the five criteria set out by Litchfield (1999): mean independence, population size independence, symmetry, and the Pigou-Dalton Transfer sensitivity.

3.1.4 Decomposing inequality

In order to understand the determinants of inequality, households are grouped according to certain characteristics, such as gender, education, skilled and unskilled, urban and rural, and regional location, that are thought to drive differences in income. At least part of the value of any given inequality measure is expected to reflect the fact that people have different levels of educational, gender, occupations, or live in certain regions. This part of the inequality measure is referred to as the "between-group" component of inequality. Inequality may also exist among households with the same characteristics, this is referred to as the "within-group" component of inequality. The integrated household method used here can be used to capture changes in between-group inequality, however it is unable to capture within-group changes. In the next section we outline how the households are grouped and data incorporated into the GTAP database.

3.2 Incorporating Multiple Household and Factors

To study the impact of trade liberalization on income inequality in Pakistan additional information on factors of production and the incomes and consumption patterns of Pakistani households must be incorporated into the GTAP database.

The GTAP 9a 2011 Database (Aguiar, Narayanan, and McDougall, 2016), aggregated from 140 to 30 regions and the number of commodities/sectors from 57 to 11, is used for this purpose.[17] Data for 16 household types (or representative households)[18] and 12 factors of production are incorporated into this database using data obtained from the 2010-11 Pakistani SAM (IFPRI

[17] The regional and sectoral aggregation used in this study is shown in Appendix 2 Tables 1 and 2 respectively.

[18] As mentioned above, the integrated approach relies on the 'household' being disaggregated into multiple household groups, with one 'representative' household representing the economic behavior of the whole household group. The MyGTAP model is based on this representative household approach, hence only the inequality between the defined groups can be calculated using each of the methods outlined above.

2016).[19] The framework, developed by Minor and Walmsley (2013), incorporates the household data into GTAP, ensuring that the household data are consistent with the original GTAP data.

The 16 types of household provided in the Pakistani SAM classify households by quartile or geographical zone[20] and type of settlement (i.e., rural or urban) (Table 1). Household types are based on land ownership and the size of the land owned. For instance, medium rural farms are greater than 12.5 acres, and small farms are those less than 12.5 acres. Landless farmers own no land, but may operate land on an owners behalf, thereby receiving rents from land (IFPRI, 2016). The households in Table 1 are ordered by per capita income. Rural farm worker (quartile 1) and rural non-farm worker (quartile 1) households account for 14 percent of the population and have the lowest per capita incomes – when converted to US Dollars their annual per capita income is just US$ 240 and US$ 332 respectively. Urban (quartile 4) households have the highest per capita incomes, over US$ 4,423. An examination of the data reveals that 89 percent of the poor households (defined as earning less than $2 per day) are rural, split (roughly) equally between farm and non-farm households. The three richest household categories are primarily (65 percent) urban households, followed by rural non-farm households (24 percent).

In order to examine the impact of trade liberalization on these 16 household groups, the supply and use of 13 factors of production are distinguished (12 obtained from the SAM plus natural resources, Table 2), with the Pakistani SAM providing data on the ownership of these factors by each household and their use by each sector, as well as consumption by each household.

[19] The link between the sectors in the Pakistan SAM and GTAP are provided in Appendix 2 Table 3.

[20] Quartile 1 represents the largest province in Pakistan, Punjab; while Quartile 234 represents Sindh, Khyber Pakhtunkhwa and Baluchistan provinces.

Table 1: Pakistan households identified in this study

Household Types[a]	Short code	Members per group (millions of people)	Total Income per group (PKR billions of rupees)	Income per capita (PKR rupees)	Income (US dollars per day)
Rural farm worker[b] (quartile 1)	hhd_rw1	6.3	131.0	20,682	0.66
Rural non-farm worker (quartile 1)[c]	hhd_rn1	12.6	359.8	28,571	0.91
Urban worker (quartile 1)	hhd_u1	5.9	229.6	38,720	1.23
Rural farm workerb (quartile 234)	hhd_rw234	8.3	352.0	42,379	1.35
Rural small farm ownere (quartile 1)	hhd_rs1	4.2	180.6	43,075	1.37
Rural farmer operating landd (quartile 1)	hhd_rl1	3.3	154.8	46,231	1.47
Rural non-farm worker (quartile 2)[b]	hhd_rn2	10.9	539.9	49,587	1.58
Urban worker (quartile 2)	hhd_u2	8.8	574.7	65,159	2.08
Rural non-farm worker[c] (quartile 3)	hhd_rn3	9.1	757.2	83,320	2.65
Rural small farm owner[e] (quartile 234)	hhd_rs234	15.6	1321.2	84,887	2.70
Rural medium-large farm ownerf (quartile 1)	hhd_rm1	0.2	18.3	88,147	2.81
Rural farmer operating land[d] (quartile 234)	hhd_rl234	7.3	724.1	99,296	3.16
Urban worker (quartile 3)	hhd_u3	11.5	1278.2	111,089	3.54
Rural non-farm worker[c] (quartile 4)	hhd_rn4	6.3	1309.5	207,343	6.61
Rural medium-large farm owner[f] (quartile 234)	hhd_rm234	2.9	643.4	220,813	7.03
Urban worker (quartile 4)	hhd_u4	17.1	7085.9	414,874	13.22

a. Quartiles also represent ecological zones. Quartile 1 represents the largest province in Pakistan, Punjab; while Quartile 234 represents Sindh, Khyber Pakhtunkhwa and Baluchistan provinces.

b. Rural non-farm workers work in rural areas, but in non-farm occupations.

c. Rural farm workers work on farms owned and operated by others.

d. Rural farmer operating land do not own land, but they operate farms for owners and hence earn returns on that land.

e. Small farms are between less than 12.5 acres.

f. Medium-large rural farms are greater than 12.5 acres

Source: Pakistan Social Accounting Matrix 2010-11, Household Income and Expenditure Survey (HIES) 2011.

Table 2: Share of factor in sectoral value added, percent

	Grain Crops	Vege & Fruit	Meat & Livestock	Extr act.	Proc. Food	Textiles & Apparel	Light Manuf	Heavy Manuf	Util & Const	Transp & Comm	Other Services
Labor - farm worker	4	6	5	7	-	-	-	-	-	-	-
Livestock	-	-	66	-	-	-	-	-	-	-	-
Labor - non-farm low skilled	-	1	4	25	5	28	12	17	15	6	6
Land – small	18	36	-	-	-	-	-	-	-	-	-
Capital – agriculture	46	6	-	3	-	-	-	-	-	-	-
Labor - small farmer	14	23	13	1	-	-	-	-	-	-	-
Land – medium	8	8	-	-	-	-	-	-	-	-	-
Labor - medium farmer	8	6	8	-	-	-	-	-	-	-	-
Land – large	3	-	-	-	-	-	-	-	-	-	-
Labor - non-farm high skilled	-	1	1	2	2	11	5	7	11	11	36
Capital – informal	-	4	1	0	18	9	16	4	5	58	31
Capital – formal	-	8	2	32	75	51	67	71	68	25	27
Natural Resources	-	-	-	29	-	-	-	-	-	-	-
Total	100	100	100	100	100	100	100	100	100	100	100

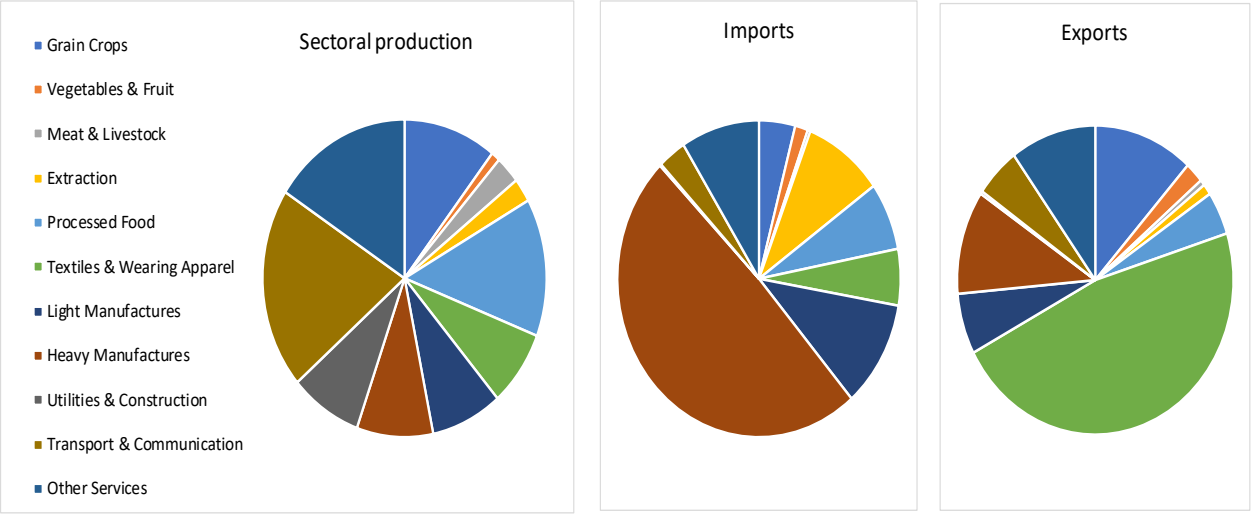
a. Labor - farm worker: work on farms owned by others or as operators of land owned by others.

Source: Pakistan SAM 2010-11 and GTAP Database (Aguiar, Narayanan, and McDougall 2016)

Table 2 depicts the allocation of these 12 factors of production to the 11 sectors used in this study. Of the 12 factors of production, 8 of them relate to agricultural production, including 5 types of labor, 3 types of land, 1 livestock and 3 types of capital. The table shows that most of the agricultural factors are used exclusively in the production of the three agricultural commodities (grain crops, vegetables & fruit, and meat & livestock), while the non-agricultural factors (skilled and low skilled non-farm labor, formal and informal capital) are used across all sectors, except grain crops. The final factor of production, natural resources, is used exclusively by the extraction sector.

Figure 2 illustrates that most (73 percent) of Pakistan's agricultural production is of grain crops, which also represent its most important agricultural export. According to Table 2, grain crops tend to be produced by larger farms, while vegetables & fruit and meat & livestock are produced by smaller farms. Textiles & wearing apparel are Pakistan's largest export, while heavy manufactures are the largest import; both of which are produced using low skilled non-farm labor and formal capital. This figure clearly shows the reliance of Pakistan on a few key export sectors. Processed food and transport & communications are also important for domestic production, although primarily for domestic demand rather than for export.

Figure 2: Sectoral production, imports and exports in Pakistan



Source: GTAP Database (Aguiar, Narayanan, and McDougall 2016)

It is assumed that a factor is mobile across the sectors that use the factor of production (Table 2), hence the 8 factors specific to agricultural production are mobile, but only across the agricultural

sectors. For this reason, the results should be considered short run, since farm workers, for instance, cannot find employment in non-agricultural sectors as non-farm low skilled workers. We therefore do not capture the possible movement of workers from rural to urban areas or from farm to non-farm work. This will be discussed further in the sensitivity analysis section.

The Pakistani SAM is also used to provide data on the ownership of those factors by each household. Table 3 shows the link between household income and their ownership of factors or the differences in the sources of income between rural farm, rural non-farm and urban households.

The table shows that farm households rely primarily on agricultural factors of production for their income, while non-farm and urban households rely on non-farm labor and their ownership of capital. Poorer farm households tend to rely on income from farm work and livestock, while richer farm households earn more income from the ownership of larger plots of land and agricultural capital. Urban or non-farm households, on the other hand, rely on more mobile factors of production – labor and capital – with poor households supplying low skilled non-farm, labor and informal capital, and richer households obtaining more of their income from the ownership of formal capital and their supply of skilled non-farm labor.

Combining these details with those in Table 2, therefore suggests that poorer farm household incomes are more reliant on the success of the smaller meat & livestock and vegetables & fruit sectors, while richer farm households depend on the success of the larger grain crops sector for their income. Urban or non-farm households, on the other hand, rely on manufactures and services, with extraction, and textiles & wearing apparel using the low skilled non-farm labor supplied by poorer households; and the other sectors using more skilled labor and formal capital, supplied by the richer urban and non-farm households. Understanding the links between households and sectors in the data will assist us later when we examine the impacts of Pakistan's trade liberalization efforts on income inequality.

Table 3: Share of household income attributable to ownership of each factor of production for selected households, percent

	Rural farm				Rural non-farm		Urban	
	Farm worker[a]	Small farmer[a]	Landless farmer[a]	Medium+ farmer[a]	Quartile 1[b]	Quartile 4[c]	Quartile 1[d]	Quartile 4[e]
Labor - farm worker	23.7	-	-	-	-	-	1.5	0.2
Livestock	14.7	10.3	4.4	5.5	-	-	0.2	-
Labor - non-farm low skilled	20.7	3.1	5.8	0.5	38.9	23.0	28.2	2.1
Land – small	-	19.7	15.3	-	-	-	1.7	0.1
Capital – agriculture	-	27.6	30.8	37.3	-	-	1.3	0.5
Labor - small farmer	-	20.7	9.0	-	-	-	1.3	0.1
Land – medium	-	-	2.9	21.0	-	-	0.2	0.1
Labor - medium farmer	-	-	6.5	22.7	-	-	0.1	0.2
Land – large	-	-	2.6	7.3	-	-	-	-
Labor - non-farm high skilled	12.1	3.6	4.8	3.4	9.1	13.3	9.2	15.6
Capital – informal	28.5	14.7	17.6	1.9	51.6	61.6	55.7	21.3
Capital – formal	-	-	-	-	-	1.5	-	59.0
Natural resources[f]	0.3	0.3	0.4	0.3	0.5	0.6	0.5	0.8
Total	100	100	100	100	100	100	100	100

a. Includes quartiles 1-4
b. Non-farm Household with the lowest income
c. Non-farm Household with the highest income
d. Urban Household with the lowest income
e. Urban Household with the highest income
f. No data available, allocation based on capital ownership (agricultural, informal and formal)

Source: Authors' calculations

The relevant shares from the Pakistani SAM are then used to disaggregate factor use, and the income and consumption of each household using the facility developed by (Minor and Walmsley, 2013). These modifications are made in such a way that the total returns to factors and consumption are consistent with the original GTAP Database. The process is undertaken in four steps (depicted in Figure 3):

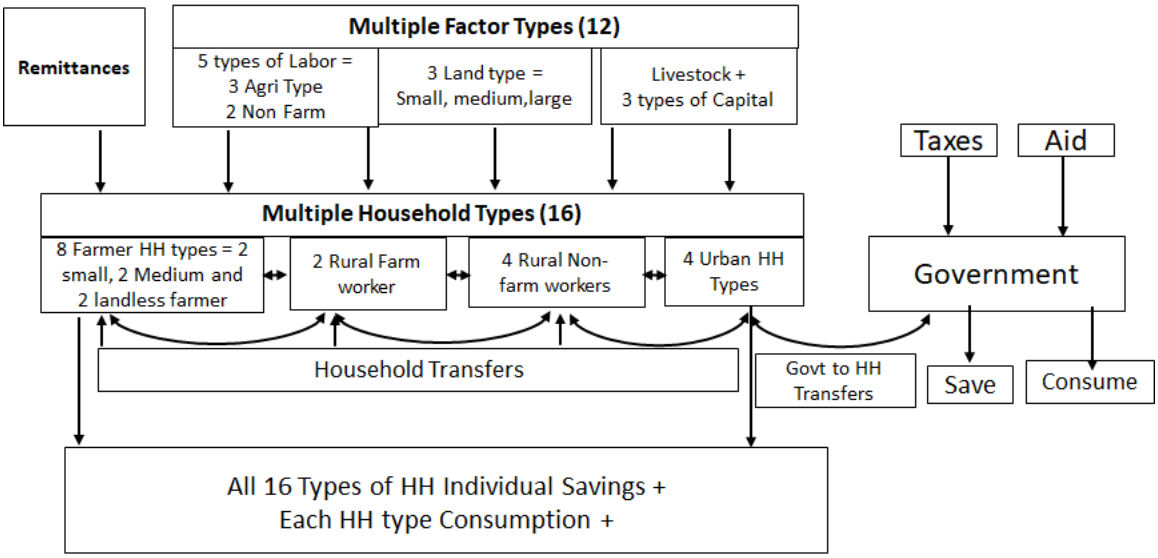
— first, remittances and the incomes earned by the 12 factors of production provide the sources of income to the 16 households, based on each household's ownership of those factors;

— second, the government, which is separated in the MyGTAP model, collects income from taxes and foreign aid which it uses to consume (with the difference being the government surplus/deficit);

— third, transfers between the government and the 16 households, as well as between the 16 households can be incorporated; and

— finally, private consumption and savings by each of the 16 households are included.

Figure 3: Overview of the Pakistani data in the GTAP Database and model after the modifications



Source: Authors' own design based on MyGTAP model.

3.3 Simulations and Assumptions

To illustrate the impact of trade liberalization on incomes and income inequality, we first investigate the impact of several existing (China and Malaysia) and potential (Turkey, Thailand and Korea) bilateral and regional, trade agreements on income inequality in Pakistan (Table 4). Pakistan is also involved in a regional initiative, the South Asia Free Trade Agreement (SAFTA)[21], and has been granted preferential access to the European Union through EU GSP Plus through which EU provides market access to developing countries.

Following this, we examine the impact of several large regional initiatives that Pakistan is not a member of, but is impacted by, to examine the impact of the proliferation of large agreements on income inequality of non-member countries. These include Regional Comprehensive Economic Partnership (RCEP) and the Comprehensive and Progressive Agreement for Trans-pacific Partnership (CPTPP)[22] that operate within its region, and other large agreements, such as the Transatlantic Trade Investment Partnership (TTIP), that involve important trading partners. While the proposed RCEP, CPTPP and TTIP agreements are expected to facilitate trade among the member economies, other countries in the region that are left out of the agreements are likely to be adversely affected due to significant trade diversion. We then compare these results to the alternative scenario, where Pakistan is accepted as a member of the RCEP and CPTPP agreements. This allows us to examine both the impact of membership and non-membership in these mega trade deals on income inequality. Table 4 lists the various trade agreements examined.

[21] Involving Pakistan, India, Bangladesh, Sri Lanka, Maldives, Bhutan, Nepal and Afghanistan

[22] Formerly known as the Transpacific Partnership which included the USA; this new agreement excludes the USA.

Table 4: List of trade agreements examined and the share of Pakistan's export and import with member countries (2015)

	Share of world GDP (%)	Share of Pakistan's imports (%)	Share of Pakistan's exports (%)
Pakistan's Existing Bilateral Free Trade Agreements			
China	14.9	26.8	8.7
Malaysia	0.4	0.45	0.84
Pakistan's Potential Free Trade Agreements			
Turkey	1.14	0.92	1.1
Thailand	0.54	1.9	0.54
Korea	1.87	1.5	1.3
Regional Free Trade Agreements			
SAFTA[a]	3.3	4.9	13.6
EU- GSP Plus			
EU-28	24.6	9.7	30.0
Mega Trade Agreements			
RCEP[b]	28.9	41	17.5
CPTPP[c]	14	9	6
TTIP[d]	46	14	45.5

a. Pakistan, India, Bangladesh, Sri Lanka, Maldives, Bhutan, Nepal and Afghanistan.

b. ASEAN and its 6 FTA Partners i.e. China, India, Korea, Japan, New Zealand and Australia.

c. Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam. (Excludes the USA)

d. EU 28 and USA

Source: World Bank national accounts data (https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)) and Trademap

As can be seen from Table 4 several large and small agreements, in terms of share of world GDP and share of Pakistan's exports and imports, are covered. It is assumed that all parties to the agreement remove all import duties on all imported commodities. The exception is the EU-GSP plus which is not bilateral, although the EU is assumed to remove tariffs on all commodities imported from Pakistan.[23] No changes are assumed to be made to non-tariff measures (NTM)[24]

[23] In general, the GSP plus agreements over 66 percent of tariff lines, including textiles.

[24] The exclusion of NTMs from consideration reflects the fact that for developing countries the impact of removing NTMs is not clear. For instance, if consumers have a greater aversion to developing country goods than developed country goods, due to heightened concerns over quality and safety, the existence of (and adherence to) regulations

and no account is taken of sensitive products.[25] Our aim is to examine the impact of agreements in general on income inequality in Pakistan, rather than provide a full analysis of the agreements.[26]

Each of the income inequality measures is calculated before and after trade liberalization shock. The initial values are calculated directly from data available in the augmented database, based on the GTAP database and the Pakistani SAM, as well as additional data provided on the size of each household group. Trade liberalisation is then simulated using the MyGTAP model and new values of these income inequality measures are produced using the updated values of income by household. The difference provides an indication of how trade liberalization will impact inequality in Pakistan.

The standard GTAP closure is taken as the starting point for our analysis. This assumes that factors capital and labor are fully mobile between the sectors that use them,[27] whereas land and natural resources are assumed to be sluggish to move. Full employment is assumed, although we consider the consequences of relaxing this assumption in the sensitivity analysis section. Real government spending is assumed to fixed and there is no tax replacement; hence as tariff revenue falls, the government deficit (savings) rises (falls). We investigate the implications of tax replacement in the section on sensitivity analysis. Foreign income flows are assumed to rise or fall with factor prices in the country in which they are located, and investment is driven by the expected rate of return as in standard GTAP. Total savings depends on private household savings and the

imposed by developed countries may result in increased demand for developing country goods that outweighs the costs imposed. We therefore restrict our analysis to examining the impact of tariff reductions on income inequality.

[25] Since even trade agreements rarely cover all trade, this assumption is likely to lead to some over-estimation of the results. This is probably most significant in the case of the EU GSP plus, which only covers around 66 percent of EU trade.

[26] Those interested in an analysis of the impacts of these trade agreements on the Pakistan economy are refer to Khan (2015) and Khan, Zada and Mukhopadhyay (2018), Khan, Mehmood, Husnain and Zakarias (2018).

[27] As noted previously, not all capital and labor factors are used in all sectors, hence there is some limit to the mobility of capital and labor. We examine the implications of this in the sensitivity analysis section.

government budget deficit, as well as foreign savings. Hence the trade balance is endogenous; although again we examine the consequences of this assumption in the sensitivity analysis section.

4 Results

The analysis in this paper focusses on the impact of trade liberalization on the real incomes of each of the 16 Pakistan households and on income inequality in Pakistan using the various measures included in the model and outlined above.

4.1 Impact of Pakistan's current and potential bilateral and regional trade agreements

Table 5 illustrates the impact of the various bilateral and regional trade agreements on the standard macroeconomic measures used in CGE models, namely real GDP and welfare or equivalent variation (EV). The impact of Pakistan's involvement in bilateral and regional free trade agreements on Pakistan's real GDP is positive, with the exception of the extension of Pakistan's FTA with China.[28] Where Pakistan is excluded, RCEP, CPTPP and TTIP, Pakistan's real GDP also declines as expected. While the impact on real GDP and welfare are related, a positive change in real GDP does not necessarily imply a positive change in welfare. For Pakistan the negative welfare impacts are usually driven by a decline in the terms of trade, due to a decline in the export price of textiles and wearing apparel caused mostly by their own liberalization of tariffs.

The impact of the trade agreements on income inequality (Gini coefficient) is also illustrated in Table 5. The results show that the Gini coefficient, and hence inequality, does not always fall as a result of the liberalization of tariffs, with several bilateral FTAs and Pakistan's admission into GSP+ and CPTPP causing income inequality to increase. Neither the changes in real GDP nor welfare appear to be a good indicator of the potential impact of a trade agreement on income inequality. This is not too surprising, given that income inequality measures the changes in the

[28] Fixing the government deficit, instead of government spending, results in smaller or more negative real GDP impacts from the FTAs.

relative incomes of household groups within the country, and trade theory demonstrates that trade has differential impacts on the various factors of production, creating winners and losers from trade. Hence it is possible that the country gains, while income inequality rises, from trade liberalization. In the next section, we investigate the sources of the changes in income inequality further.

Table 5: Impact of trade liberalization on Pakistan's real GDP, welfare and income inequality

	I Real GDP (% change)	II Welfare (US$ Millions)	III Gini (% change)
Pakistan Bilateral Free Trade Agreements			
China	-0.039	-459	0.007
Malaysia	0.004	-25	-0.312
Pakistan Potential Trade Agreements			
Turkey	0.010	131	-0.128
Thailand	0.001	-182	0.075
Korea	0.014	224	0.068
Regional Free Trade Agreements			
SAFTA	0.041	487	-0.124
GSP-Plus			
EU-28	0.089	840	0.147
Other			
All above agreements simultaneously	0.165	948	-0.231
Mega Trade Agreements			
RCEP	-0.057	-406	-0.101
RCEP + Pakistan	0.261	-736	-0.124
CPTPP	-0.009	-65	-0.031
CPTPP + Pakistan	0.167	-140	0.016
TTIP	-0.003	-23	-0.008

Source: Authors' calculations

As discussed in the methodology section, there are quite a few methods for measuring inequality. Above, we examined the most popular method and here we also examine the impact of the FTAs on inequality between our 16 household groups using several other popular methods: Theil-L, Theil-T, Theil-S and Hoover indices. Table 6 shows the results for each of the measures.

In the case of Pakistan's extension of its current bilateral trade agreement with Malaysia, all of the income inequality measures (Gini, Theil-T, Theil-L, Hoover, and Theil-S) show a decrease,

indicating that inequality falls as a result of this agreement. The results for the trade agreement with China are small and mixed, suggesting that income inequality is not affected by the agreement.

In the three potential trade agreements with Turkey, Thailand and Korea, only the trade agreement with Turkey results in a decline in income inequality. In the trade agreements with Thailand and Korea, the various income inequality measures show a rise in income inequality. Pakistan's regional trade agreement with six other countries in South Asia, the South Asia Free Trade Agreement (SAFTA), on the other hand, results in a decrease in income inequality.

Table 6: Impact on income inequality in Pakistan using various measures

	Gini Coefficient	Theil-T	Theil-L	Hoover	Theil-S
Base level	0.4775	0.4071	0.3973	0.3754	0.4022
Pakistan Bilateral Free Trade Agreements					
China	0.007	-0.054	0.057	-0.047	0.001
Malaysia	-0.312	-0.898	-0.650	-0.549	-0.775
Pakistan Potential Trade Agreements					
Turkey	-0.128	-0.399	-0.257	-0.246	-0.329
Thailand	0.075	0.163	0.194	0.087	0.178
Korea	0.068	0.147	0.165	0.082	0.156
Regional Free Trade Agreements					
SAFTA	-0.124	-0.366	-0.245	-0.246	-0.306
GSP-Plus					
EU-28	0.147	0.375	0.352	0.215	0.364
Other					
All above agreements simultaneously	-0.231	-0.884	-0.307	-0.616	-0.598
Mega Trade Agreements					
RCEP	-0.101	-0.270	-0.224	-0.161	-0.248
RCEP + Pakistan	-0.124	-0.570	-0.104	-0.407	-0.339
CPTPP	-0.031	-0.087	-0.068	-0.052	-0.078
CPTPP + Pakistan	0.016	-0.143	0.161	-0.127	0.007
TTIP	-0.008	-0.023	-0.017	-0.014	-0.020

Source: Authors' calculations

One surprising result in Table 6 is the considerable rise in income inequality resulting from the EU-GSP plus preferences, despite the rise in real GDP and welfare. The large increase in income inequality resulting from the GSP plus program is particularly concerning, given the aim of the

program is to assist developing countries that meet certain labor and environmental standards. Since the EU's GSP plus program does not require Pakistan to reduce its tariffs on EU goods, it raises the question of whether the impact on income inequality depends on whether it is Pakistan or the partner country that is reducing tariffs. Decomposition of the results into those due to Pakistan's liberalization efforts and the partners' liberalization efforts, however, did not indicate that the impact on inequality depended on which party reduced its tariffs.

Finally, the larger regional agreements to which Pakistan is not a member, RCEP, CPTPP and TTIP, tend to reduce income inequality in Pakistan, albeit they also reduce real GDP, suggesting that these agreements hurt richer households in Pakistan relatively more than poorer ones as members trade is diverted from Pakistan to members of the agreements. Pakistan's inclusion in the two large regional agreements (RCEP and CPTPP) raises real GDP, although only its inclusion in RCEP reduces income inequality relative to its non-inclusion.

4.2 What determines the impact on income inequality?

The impact of trade liberalization on real GDP and welfare depend on macro-economic factors, while the impact on income inequality depends on micro-economic factors. In the case of real GDP, allocative efficiency gains and changes in aggregate production drive the changes, while the change in welfare depends on these allocative efficiency gains, as well as the terms of trade effects. The impact of trade liberalization on income inequality, on the other hand, depends on the relative changes in incomes of the 16 household groups within Pakistan and the wages of the factors owned by these households, which in turn depend on the gains and losses of the particular sectors that use them. Since trade theory tells us there are winners and losers from trade, it is not surprising that the trade liberalization can raise or lower income inequality. Moreover, income inequality is a relative measure which means that an improvement may occur with a rise or fall in incomes and poverty in general.

Table 7 reports the impact of the various FTAs on the real income of 16 different types of households. In general, Table 7 shows that agreements that lead to a decrease in income inequality (Pakistan-Malaysia, Pakistan-Turkey and SAFTA) generally raise the real incomes of the rural farm households, relative to the non-farm and urban households. In the Pakistan-Malaysia and Pakistan-Turkey agreements, the incomes of the richer rural farm households rise faster than those

of the poorer rural farm households, but inequality still falls due to the decline in incomes of the rich and poor non-farm and urban households. Most of the other agreements create gains for the urban and rural non-farm households, while farm worker households lose, causing inequality to rise.

Only in the SAFTA agreement do incomes rise across most rural (farm and non-farm) and urban households (Table 7), with the incomes of rural farm households relatively more, causing inequality to fall. The FTA with China also tends to raise incomes (Table 7), although the rural farm workers experience declines, causing income inequality to rise. In Table 6 we noted that the EU-GSP plus agreement raised income inequality considerably. Here in Table 7 we see that this agreement stands in stark contrast to the Pakistan-Malaysia and Pakistan-Turkey agreements – the incomes of non-farm and urban households rise, while those of farm households fall – reiterating our conclusion that income inequality depends crucially on the impact of the agreement on the incomes of farm households.

This becomes even clearer when we examine the impact of the trade agreements on wages (Table 8). In the Pakistan-Malaysia and Pakistan-Turkey agreements, the wages of all the agricultural factors of production owned by farm households rise, while those factors owned by the non-farm and urban households, low skilled and skilled labor and capital, experience a fall in wages. In both cases the rise in wages/rentals of the factors owned by poor rural households are lower than those owned by rich rural households, however, this is offset by the fact that the fall in wages/rentals on factors owned by rich non-farm and urban households is greater than that of poorer non-farm and urban households.

Table 7: Impact on real incomes in Pakistan

	Pakistan-China	Pakistan-Malaysia	Pakistan-Turkey	Pakistan-Thailand	Pakistan-Korea	SAFTA	EU GSP+	All FTAs
Rural farm worker (quartile 1)	-0.12	0.70	0.07	-0.54	-0.15	0.33	-0.40	-0.04
Rural non-farm (quartile 1)	0.36	-0.37	-0.31	0.21	0.12	-0.03	0.64	0.69
Urban (quartile 1)	0.51	0.00	-0.12	0.22	0.13	0.18	0.54	1.44
Rural farm worker (quartile 234)	-0.17	0.42	-0.03	-0.55	-0.10	0.21	-0.14	-0.23
Rural small farmer (quartile 1)	0.79	2.08	0.96	-0.13	0.10	1.41	-0.23	4.57
Rural landless farmer (quartile 1)	1.16	2.41	1.16	0.16	0.16	1.50	-0.16	5.85
Rural non-farm (quartile 2)	0.42	-0.39	-0.30	0.23	0.14	-0.01	0.66	0.82
Urban (quartile 2)	0.52	-0.12	-0.16	0.24	0.15	0.12	0.59	1.35
Rural non-farm (quartile 3)	0.49	-0.35	-0.26	0.26	0.18	0.04	0.67	1.08
Rural small farmer (quartile 234)	0.86	2.18	1.05	-0.13	0.11	1.43	-0.25	4.82
Rural medium+ farmer (quartile 1)	1.25	2.99	1.51	0.08	0.18	1.20	-0.28	6.25
Rural landless farmer (quartile 234)	1.12	2.19	1.09	0.15	0.17	1.17	-0.08	5.32
Urban (quartile 3)	0.55	-0.18	-0.16	0.25	0.19	0.13	0.63	1.41
Rural non-farm (quartile 4)	0.66	-0.34	-0.17	0.36	0.28	0.17	0.71	1.64
Rural medium+ farmer (quartile 234)	1.39	3.02	1.58	0.17	0.20	1.17	-0.25	6.60
Urban (quartile 4)	0.65	-0.25	-0.12	0.30	0.30	0.21	0.67	1.72
Average income	0.67	0.27	0.10	0.21	0.22	0.39	0.47	2.23

Source: Authors' calculations

Table 8: Impact on real wages in Pakistan, percent change

	Pakistan-China	Pakistan-Malaysia	Pakistan-Turkey	Pakistan-Thailand	Pakistan-Korea	SAFTA	EU GSP+	All FTAs
Labor - farm worker	0.54	2.46	0.93	-0.42	-0.31	1.29	-1.49	2.64
Livestock	-3.27	1.32	0.05	-3.90	-0.60	0.00	-1.50	-7.03
Labor - non-farm low skilled	0.41	-0.24	-0.20	0.24	0.11	0.10	0.76	1.20
Land – small	1.96	2.98	1.57	0.63	0.25	3.36	-0.26	9.65
Capital – agriculture	1.89	3.53	1.92	0.58	0.31	0.87	-0.11	8.11
Labor - small farmer	0.74	2.67	1.25	-0.42	0.04	2.13	-0.58	5.32
Land – medium	1.93	3.26	1.75	0.60	0.29	2.14	-0.16	8.96
Labor - medium farmer	0.59	2.83	1.35	-0.55	0.06	1.25	-0.51	4.51
Land – large	1.89	3.57	1.96	0.57	0.34	0.80	-0.05	8.20
Labor - non-farm high skilled	0.50	-0.19	-0.21	0.30	0.06	0.04	0.73	1.25
Capital – informal	0.47	-0.32	-0.20	0.24	0.22	0.10	0.65	1.17
Capital – formal	0.41	-0.45	-0.20	0.17	0.35	0.17	0.68	1.14
Natural Resources	1.19	1.68	-0.87	1.50	-2.65	-4.18	-7.89	-10.41

Source: Authors' calculations

Table 9 then shows the impact of the agreements on sectoral production. Those agreements that lower income inequality do so by raising the production of agriculture. In the case of the extension of the Pakistan-Malaysia and the new Pakistan-Turkey agreements, this increase in agricultural production is the result of an increase in the production of grain crops, with small declines in meat & livestock. While improvements in grain crops primarily benefit the richer rural households, poorer farm workers also benefit as new farm worker jobs in grain crops become available, offsetting any losses they may have made from the declines in vegetables & fruit production or meat & livestock. In the case of SAFTA, the improvement in agriculture comes from the increase in production of vegetables and fruit, a commodity produced by smaller (poorer) farms.

Meat & livestock is also particularly important because many poor households' own livestock and hence derive a share of their incomes from livestock, which hence impacts them more than richer households. Moreover, livestock is sector specific and hence returns rise or fall significantly with the success or failure of the meat & livestock sector. Loses in the returns to livestock can offset the gains to poor households from higher wages in grain crops or vegetables & fruit, lowering their incomes (e.g., the agreements with China, Thailand and Korea).

Table 9: Sectoral impacts of Pakistan's trade liberalization, percent

	Pakistan-China	Pakistan-Malaysia	Pakistan-Turkey	Pakistan-Thailand	Pakistan-Korea	SAFTA	EU GSP+	All FTAs
Agriculture	**-0.05**	**0.02**	**0.01**	**-0.06**	**0.00**	**0.02**	**-0.01**	**-0.07**
Grain Crops	0.09	0.11	0.09	0.08	0.04	-0.24	0.07	0.19
Vegetables & Fruit	0.26	-0.61	-0.41	0.19	-0.09	3.50	-0.27	2.49
Meat & Livestock	-0.69	-0.10	-0.14	-0.66	-0.11	-0.23	-0.20	-1.94
Extraction	0.10	0.21	-0.13	0.19	-0.41	-0.66	-1.24	-1.82
Light Manufactures	**-0.29**	**-0.28**	**0.00**	**-0.39**	**0.15**	**0.21**	**0.82**	**0.25**
Processed Food	0.14	-0.91	0.01	-0.13	0.97	0.30	0.01	0.31
Textiles & Wearing Apparel	0.54	0.55	0.12	0.70	-0.89	0.61	3.65	5.08
Light Manufactures	-1.81	0.02	-0.15	-1.89	-0.27	-0.34	-0.49	-4.48
Heavy Manufactures	-1.24	0.55	-0.07	0.24	-0.84	-0.59	-1.70	-3.55
Utilities & Construction	0.79	0.24	0.18	0.33	0.29	0.48	0.61	2.75
Transport & Communication	0.04	0.04	0.00	0.04	0.00	-0.01	-0.10	0.00
Other Services	0.08	0.25	-0.02	0.12	-0.34	-0.18	0.05	-0.01

Source: Authors' calculations

The losses to urban and rural non-farm households, under the agreements with Malaysia and Turkey, generally stem from a decline in processed food, textiles & wearing apparel, light manufactures or services. Note that the source of these declines is not attributable to any one sector, since the factors used by these sectors are more mobile across all these sectors and hence any

declines are likely to keep returns from rising significantly. As these sectors decline, wages of the low skilled workers fall, as does returns to capital and skilled workers. As a result, all rural non-farm and urban households, both poor and rich, tend to lose. In the other agreements, EU-GSP plus for instance, the gains in textiles & wearing apparel cause an increase in demand for factors owned by both rich and poor rural non-farm and urban households, raising returns. While incomes rise, they rise equally for both rich and poor households, and hence again we see that income inequality is driven by changes in the incomes of the rural farm households.

The gains and losses in sectoral production stem from the tariff reductions that take place as part of the agreements. Both Malaysia and Turkey have high tariffs on grain crops from Pakistan and hence the removal results in an increase in imports from Pakistan and hence Pakistani production. India (SAFTA), on the other hand, has very high tariffs on vegetables & fruit and to a lesser extent grains crops from Pakistan. The decline in meat & livestock production in Pakistan stems from the high tariffs imposed by Pakistan on meat & livestock from Malaysia, Thailand and China. The decline in tariffs results in an increase in imports and a decline in domestic production of meat & livestock. Malaysia also has high tariffs on Pakistani textiles & wearing apparel, and many countries Korea, India, EU, Turkey and Malaysia) have high tariffs on Pakistani processed food. Pakistan also has high tariffs on processed food, hence results vary depending on the relative size of the tariffs.

As we noted previously, the non-agricultural factors of production are generally used in the production of a wider range of goods and services than the agricultural factors of production, making them more mobile across sectors. Moreover, the manufacturing and services industries can also substitute more easily between these factors as the elasticities of substitution are higher. For these reasons, returns to the agricultural-based factors of production can rise or fall quite dramatically with changes in agricultural production, while factors used in manufactures and services are more mobile and their returns less volatile. For this reason, the incomes of non-farm and urban households tend to increase or decrease together, regardless of whether the household is rich or poor. The main drivers of changes in inequality therefore tend to depend on how a trade agreement impacts agriculture. Agreements, such as the GSP+, Pakistan-China, Thailand and Korea, that raise production of textiles & wearing apparel (or processed food) and grain crops, are

unable to ensure returns to livestock, which disproportionately impact poor rural households, reducing income inequality.

The trade agreements that do improve incomes and income inequality are SAFTA and all of the agreements simultaneously. These two agreements raise the production of vegetables & fruit – a sector directly linked to poor rural farm households – while also raising production of processed food and textiles & wearing apparel and hence the incomes of rural non-farm and urban workers. The impact of the decline in meat & livestock on the poor rural farm households is offset by the rise in production of vegetables & fruit and grain crops (all FTAs).

4.3 Mega agreements and income inequality

The impact of the mega agreements on sectoral production is provided in Table 10. As indicated above, RCEP and CPTPP lower income inequality in Pakistan despite Pakistan's exclusion from the agreements. This is due to the small gains in agricultural production, which benefit the rural poor; and the losses in processed food and textiles & wearing apparel sectors, which result in lower incomes for richer urban households. Pakistan's inclusion in RCEP lowers inequality further, although its inclusion in CPTPP raises income inequality. This is the case, even though the sectoral impacts of the two agreements are for many sectors quite similar (Table 10). As outlined above the reason for the rise in inequality under the CPTPP relative to RCEP is due to the smaller gain made by the vegetables & fruit sector under the CPTPP. The reason for this difference is that RCEP includes India, a fellow member of SAFTA, which applies a large 24 percent tariff on Pakistan's vegetables and fruit. As under SAFTA, RCEP also produces gains to the vegetables & fruit sector, which, as mentioned above, uses factors that tend to be owned by poor rural farm households. The CPTPP does not include India, and therefore does not result in the same gains to vegetables and fruit.

Table 10: Sectoral impacts of Pakistan's trade liberalization, percent

	RCEP excl. Pakistan	RCEP incl. Pakistan	CPTPP excl. Pakistan	CPTPP incl. Pakistan-
Grain Crops	-0.01	0.30	0.00	0.35
Vegetables & Fruit	0.12	1.65	0.06	0.14
Meat & Livestock	0.06	-2.81	0.00	-2.37
Extraction	0.20	0.70	0.06	0.44
Processed Food	-0.15	-0.85	-0.03	-1.35
Textiles and Wearing Apparel	-0.04	2.99	-0.03	3.94
Light Manufactures	0.19	-6.90	0.03	-5.63
Heavy Manufactures	0.25	-0.62	0.06	0.75
Utilities & Construction	-0.67	1.63	-0.11	1.31
Transport & Communication	0.01	0.19	0.00	0.11
Other Services	0.12	0.63	0.02	0.67

Source: Authors' calculations

4.4 Sensitivity analysis

In this section we conduct sensitivity analysis to examine the impact of some of the key modeling assumptions on the inequality results. The base model and closure discussed above are analogous to a sector specific trade model; in the alternative assumptions we investigate the short run assumption of unemployment, as well as long run assumptions which allow these factors to become more mobile. The following alternative assumptions are considered:

I. Unemployment: The unemployment rate in Pakistan, while improving, was reported to be 6 percent in 2011 (Economic Survey of Pakistan, (2015). With this in mind, we test the assumption of unemployment of unskilled labor by fixing the real wage of unskilled workers, namely farm workers and low skilled non-farm workers.
II. Trade Balance: It is generally argued that developing countries, such as Pakistan, do not have easy access to foreign capital and hence any increases in investment must be funded by domestic savings. In order to examine the impact of this, we assume a fixed trade balance and that investment will be limited.
III. Tax replacement: In the base closure we have assumed that the loss of tariff revenue does not reduce government spending, causing the government deficit to increase (or surplus to decrease). In this scenario we argue that this position is not sustainable and hence we introduce a consumption tax to replace the lost revenue.

IV. Increased mobility of factors: In the base model and closure, there are a number of factors that are specific to meat & livestock or to agriculture in general. In this case we allow for greater mobility of factors across sectors by merging the factors that are most likely to be substitutable over time. The following aggregations are made; 1) farm workers and small farm owners are merged with low skilled non-farm labor allowing them to move into non-agricultural occupations; 2) medium farmers are assumed to be more skilled and therefore merged with skilled non-farm labor; 3) small farm land is combined with larger plots reflecting the fact that farms may amalgamate; and 4) livestock and agricultural capital are merged with formal or informal capital reflecting the idea that savings may be invested outside of agriculture. This is analogous to the Heckscher-Ohlin trade model where factors of production are more mobile. In this scenario we also assume that lost tariff revenue is replace by a consumption tax, as in alternative scenario 3.

V. Capital accumulation: In this scenario we assume that there is increased mobility of factors and tax replacement (from scenarios 3 and 4), as well as the possibility for capital accumulation. This is achieve using the long run closures developed in Francois and McDonald (1996) and Walmsley (1998).

The impact of the alternative assumptions on the income inequality results under the different trade liberalization scenarios are provided in Table 11. We can see from Table 11 that in the long run, with capital accumulation and increased mobility of the factors across sectors, all of the trade liberalization scenarios result in decreases in the Gini coefficient and hence in income inequality. The three agreements (with Malaysia, Turkey and SAFTA), that reduced inequality in the short run, do not decrease inequality as significantly in the long run, as the short run results suggested, although inequality still declines. Moreover, long run gains in income equality appear to be greatest in agreements with more, larger, trading partners. It is also worth noting that in the long run, the fall in income inequality does not generally occur at the expense of the non-farm and urban household incomes. In most of the agreements, there is a rise in incomes across all households, although rural farm households still experience the larger gains. The exceptions to this are the free trade agreements with Malaysia, China and Thailand where the incomes of non-farm and urban households continue to decline in absolute terms.

Somewhat interesting is that the restriction of foreign savings to fund investment, i.e., fixed trade balance scenario (column II, Table 11), tends to decrease inequality in most scenarios. This is due to the fact that very few poor households benefit directly from the increase in demand for capital goods, primarily heavy manufactures and utilities & construction, and hence their income rises further when investment is restricted. The long run results, on the other hand, show that poor households do benefit significantly from the resulting accumulation of capital that the new investment creates (column V, Table 11).

Table 11: Impacts of Pakistan's trade liberalization on income inequality under alternative assumptions, percent

	Base Case (standard closure)	Alternative assumption scenarios				
		I	II	III	IV	V
		Unemployment	Fixed Trade balance	Tax replacement	Mobile factors	Capital accumulation
Pakistan Bilateral Free Trade Agreements						
China	0.007	-0.002	-0.183	0.028	-0.030	-0.064
Malaysia	-0.312	-0.265	-0.363	-0.291	-0.086	-0.075
Pakistan Potential Trade Agreements						
Turkey	-0.128	-0.105	-0.138	-0.118	-0.035	-0.047
Thailand	0.075	0.059	0.006	0.079	-0.014	-0.030
Korea	0.068	0.058	0.035	0.070	0.019	-0.014
Regional Free Trade Agreements						
SAFTA	-0.124	-0.112	-0.158	-0.049	-0.035	-0.072
GSP-Plus						
EU-28	0.147	0.092	0.122	0.138	0.023	-0.062
Other						
All above agreements simultaneously	-0.231	-0.244	-0.587	-0.127	-0.144	-0.331
Mega Trade Agreements						
RCEP	-0.101	-0.084	-0.066	-0.057	-0.012	-0.004
RCEP + Pakistan	-0.124	-0.133	-0.499	-0.044	-0.151	-0.253
CPTPP	-0.031	-0.024	-0.025	-0.024	-0.006	-0.005
CPTPP + Pakistan	0.016	-0.012	-0.210	0.044	-0.110	-0.165
TTIP	-0.008	0.131	-0.001	-0.005	-0.001	0.005

Source: Authors' calculations

The impact of unemployment on income inequality is mixed. In three of the agreements where income inequality fell, the trade agreements with Malaysia, Turkey and SAFTA, the fall in income

inequality is smaller as a result of unemployment, while in all other trade agreements, income inequality fell relative to the base case. In the former cases employment of farm workers increases, but employment of low skilled non-farm workers falls. Since there are more low skilled non-farm workers, the incomes of the poor fall causing inequality to rise. Thus, agreements that experienced a fall in income inequality due to wages of farm workers rising and those of non-farm and urban workers falling, now experience a reversal under the assumption of unemployment, as the importance of non-farm workers to income inequality rises.

Tax replacement does not seem to have a significant impact on income inequality according to Table 11 (column III), although there is some indication that income inequality rises slightly relative to the base case. This is not too surprising given that the consumption tax used to replace import duties is placed equally on domestic and imported consumer goods, purchased by all households; tariffs on the other hand affect only imports, which are primarily purchased by richer households.

Greater mobility of factors also has mixed results (column IV, Table 11). In the three agreements (with Malaysia, Turkey and SAFTA), where we saw decreases in income inequality, the increase in mobility caused the gains made to the returns on agricultural factors to dissipate across other factors as mobility increases, thereby reducing the gains in income made by poor rural households. In other agreements with China, Thailand, Korea and the EU, where the gains were greater in textiles & wearing apparel and processed food, the additional mobility of factors allowed farm workers to move out of agriculture towards the other sectors to obtain greater returns, raising the incomes of the poor rural households and reducing income inequality. In the two mega agreements, RCEP and CPTPP extended to include Pakistan, income inequality fell significantly with greater factor mobility, also due to the gains in textiles & wearing apparel obtained under both these agreements. While not all agreements resulted in decreased income inequality, there were more cases where agreements did cause inequality to fall. In those agreements where income inequality did fall, it was due to farm workers being able to more away from agriculture into other sectors to capture higher returns.

Finally, in the long run, when investment added to the availability of capital (V, Table 11) in Pakistan, this raised wages and lowered returns to capital. Since poorer households rely more on wages (relative to capital rentals), than richer households, income inequality fell in all scenarios.

Table 12 shows the impact of some of these alternative assumptions on real GDP. In the base simulation we found no relationship between the impact of a trade agreement on real GDP or welfare and income inequality. In the long run, with increased mobility (scenario IV), we find a negative relationship between real GDP and income inequality, and to a less extent welfare and income inequality. This relationship between real GDP and income inequality impacts is even stronger when capital accumulation (scenario V) is considered.

Table 12: Impacts of Pakistan's trade liberalization on GDP under alternative assumptions

	Base simulation	Scenario IV	Scenario V
		Mobile factors	Capital accumulation
Pakistan Bilateral Free Trade Agreements			
China	-0.039	-0.083	0.526
Malaysia	0.004	-0.007	-0.207
Pakistan Potential Trade Agreements			
Turkey	0.010	0.011	0.222
Thailand	0.001	-0.018	0.180
Korea	0.014	0.009	0.593
Regional Free Trade Agreements			
SAFTA	0.041	0.030	0.703
GSP-Plus			
EU-28	0.089	0.086	1.313
Other			
All above agreements simultaneously	0.165	0.101	3.463
Mega Trade Agreements			
RCEP	-0.057	-0.050	-0.316
RCEP + Pakistan	0.261	0.178	1.809
CPTPP	-0.009	-0.006	-0.031
CPTPP + Pakistan	0.167	0.112	1.072

Source: Authors' calculations

5 Conclusion

In this paper, a global economic trade model was adapted to include more detailed information on Pakistan's labor and household groups in order to allow for a more detailed analysis of the impact of the different regional integration scenarios on household income and income inequality in Pakistan. The analysis found that trade liberalization does not always lead to a reduction in income inequality in Pakistan in the short run. Moreover, no relationship was found between the estimated gains in real GDP or welfare and income inequality, in the short run.

Changes in income inequality were found to be primarily driven by increases in the income of poor rural farm households and dependent on gains in agricultural production. In most cases it was grain crops, the largest agricultural export, that rose; while in the SAFTA agreement it was the production of vegetables & fruit. In all cases the liberalization of trade led to a decline in returns to livestock, a specific factor in the production of meat & livestock that was primarily owned by poor rural households. Where these losses in livestock were small, they could be offset by gains in the wages of farm workers, due to increased production of grain crops or vegetables & fruit.

In most cases, when income inequality fell, the rise in incomes of the rural farm households was also associated with a decline in the incomes of non-farm and urban workers. Hence the improvement in income equality was primarily driven by a rise in the wages of the poor (farm) households, assisted in some cases by a decline in the wages of the rich (urban) households. These declines were the result of decreased production of textiles & wearing apparel, processed food or services – the sectors that employ non-farm and urban labor.

The importance of agriculture to changes in income inequality stems from the fact that many poor households are rural and agricultural factors were less mobile across sectors and hence returns to these factors rise or fall more significantly with changes in agricultural production. Further investigation of the implications of the mobility of factors revealed that greater mobility dissipated the short run gains in income equality obtained under the Malaysia-Pakistan, Turkey-Pakistan and SAFTA agreements. The increase in income inequality in many of the other agreements reversed, to give declines in income inequality. In the long run, when investment added to the stock of available capital, income inequality fell in all our trade liberalization scenarios and the relationship between real GDP and income inequality became clear. We also investigated the impact of

unemployment, tax replacement and fixing the trade balance on income inequality. While the differences were relatively small, tax replacement led to an increase in income inequality, while fixing the trade balance lowered it. As in the case of increased factor mobility, the impact of unemployment on income inequality was mixed.

The results therefore suggest that trade liberalization may not reduce income inequality in the short run, except when associated with a de-industrialization of the Pakistani economy. On the other hand, when combined with increased mobility of factors in the long run, trade liberalization did lead to improvements in income inequality. This suggests that policy makers efforts might be better placed implementing policies that increase the mobility of poor farm household's labor and capital assets, such as improving access to education and to the financial system, so that they might participate in non-farm related work or invest in land or capital more generally.

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Appendix 1

Mathematically, the Theil-T index can also be defined between groups, as follows:

$$TT = \sum_h \frac{YH_h}{\sum_h YH_h} \ln\left(\frac{YH_h / \sum_h YH_h}{N_h / \sum_h N_h} \right) \tag{A1-1}$$

we can rewrite Theil-T as:

$$TT = \ln\left(\frac{\sum_h N_h}{\sum_h YH_h} \right) - \frac{\sum_h YH_h \ln\left(\frac{N_h}{YH_h} \right)}{\sum_h YH_h} \tag{A1-2}$$

Theil-L index between groups can be explain as:

$$TL = \sum_h \frac{N_h}{\sum_h N_h} \ln\left(\frac{N_h / \sum_h N_h}{YH_h / \sum_h YH_h} \right), \tag{A1-3}$$

We can calculate the “symmetrized” Theil index (Theil-S) as:

$$TS = \frac{1}{2}[TT - TL]. \tag{A1-4}$$

Appendix 2

Appendix Table 1: Regional Aggregation used in this study

Region	Description
Pakistan	Pakistan
China	China
India	India
USA	USA
Bangladesh	Bangladesh
Sri Lanka	Sri Lanka
Indonesia	Indonesia
Malaysia	Malaysia
Singapore	Singapore
Thailand	Thailand
Turkey	Turkey
Australia	Australia
New Zealand	New Zealand
Japan	Japan
Korea	Korea
Chile	Chile
Canada	Canada
Peru	Peru
Iran	Iran
Brunei	Brunei
Saudi Arabia	Saudi Arabia
UAE	United Arab Emirates
Vietnam	Vietnam
Mexico	Mexico
Egypt	Egypt
Rest of S. Asia	Rest of S. Asia
Other OECD	Australia, New Zealand, Japan, Korea, Canada, Mexico, Chile
Europe 28	Austria, Belgium, Cyprus, Czech Rep, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Norway, Rest of EFTA, Turkey, Albania, Bulgaria, Belarus, Croatia, Romania, Ukraine, Rest of E. Europe, United Kingdom, Rest of Europe
Rest of Asia	Hong Kong, Taiwan, Rest of East Asia, Cambodia, Lao People's Democratic Republic, Philippines, Rest of Southeast Asia
Rest of World	Morocco, Tunisia, Bahrain, Argentina, Colombia, Ecuador, Paraguay, Uruguay, Venezuela, Rest of S. America, Cost Rica, Guatemala, Nicaragua, Panama, Rest of Central America, Caribbean, Israel, Kuwait, Oman, Qatar, Rest of N. Africa, Cameroon, Cote d'Ivore, Ghana, Nigeria, Senegal, Rest of W. Africa, Central Africa, South Central Africa, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe, Rest of E. Africa, Botswana, Namibia, South Africa, Rest of Southern Africa Customs Union, Rest of N. America, Rest of World

Source: Author's own aggregation using GTAP 9a Data Base

Appendix Table 2: Sectoral Aggregation used in this study

Short name	Comprising GTAP sectors[a]
Grain Crops	PDR, WHT, GRO, OSD, C_B, PFB, OCR, PCR
Vegetables & Fruit	V_F
Meat & Livestock	CTL, OAP, RMK, WOL, CMT, OMT
Extraction	FRS, FSH, COA, OIL, GAS, OMN
Processed Food	VOL, MIL, SGR, OFD, B_T
Textiles & Wearing Apparel	TEX, WAP
Light Manufacturing	LEA, LUM, PPP, FMP, MVH, OTN, OMF
Heavy Manufacturing	P_C, CRP, NMM, I_S, NFM, ELE, OME
Utilities & Construction	ELY, GDT, WTR, CNS
Transport & Communication	TRD, OTP, WTP, ATP, CMN
Other Services	OFI, ISR, OBS, ROS, OSG, DWE

a. See https://www.gtap.agecon.purdue.edu/databases/v9/v9_sectors.asp for a more detailed description of GTAP sector codes.

Source: Author's own aggregation using GTAP 9a Data Base

Appendix Table 3: Pakistan's 2010-11 SAM sectors and mapping to GTAP sectors

No	GTAP Codes	SAM Codes	Aggregated Sectors Used in This Study
1	pdr	cpadi, cpadb	Graincrops
2	wht	cwheat	Graincrops
3	gro	cmaize	Graincrops
4	v_f	cpota,cvege,cfrui	VegFruit
5	osd	coils	Graincrops
6	c_b	csugr	Graincrops
7	pfb	ccott	Graincrops
8	ocr	cocrp	Graincrops
9	ctl	ccatt	Meatlstk
10	oap	cpoul	Meatlstk
11	rmk	cmilk	Meatlstk
12	wol	ccatt	Meatlstk
13	frs	cfore	Extraction
14	fsh	cfish	Extraction
15	coa	ccoal	Extraction
16	oil	ccoil	Extraction
17	gas	cngas	Extraction
18	omn	comin	Extraction
19	cmt	cmeat	Meatlstk
20	omt	cmeat	Meatlstk

No	GTAP Codes	SAM Codes	Aggregated Sectors Used in This Study
21	vol	cvoil	ProcFood
22	mil	cdair	ProcFood
23	pcr	cgmri, cgmrb	Graincrops
24	sgr	csref	ProcFood
25	ofd	cgmwh	ProcFood
26	b_t	cfood	ProcFood
27	tex	clint,cyarn,cclth	Textile
28	wap	cknit,cgarm	Wap
29	lea	cleat	Leather
30	lum	coman	lightMnfc
31	ppp	coman	lightMnfc
32	p_c	cpetr	HeavyMnFc
33	crp	cfert.cchem	HeavyMnFc
34	nmm	cceme,cnmet	HeavyMnFc
35	i_s	cmetl	HeavyMnFc
36	nfm	cmetp	HeavyMnFc
37	fmp	cmetl	lightMnfc
38	mvh	cvehi	lightMnfc
39	otn	cvehi	lightMnfc
40	ele	cappl	HeavyMnFc
41	ome	cmach	HeavyMnFc
42	omf	cmach	HeavyMnFc
43	ely	celec1,2,3,4,5,6	Util_Cons
44	gdt	cngas	Util_Cons
45	wtr	cwtr	Util_Cons
46	cns	ccons	Util_Cons
47	trd	ctrad	TransComm
48	otp	ctran	TransComm
49	wtp	ctran	TransComm
50	atp	ctran	TransComm
51	cmn	ccomm	TransComm
52	ofi	cfsrv	FinServices
53	isr	cbsrv	FinServices
54	obs	cbsrv	BusServices
55	ros	creal	OthServices
56	osg	cpadm,cedu,creal,cdsrv	OthServices
57	dwe	cdwel	OthServices

a. See https://www.gtap.agecon.purdue.edu/databases/v9/v9_sectors.asp for a more detailed description of GTAP sector codes.

Source: SAM 2010-11 and GTAP 9a data base