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# Alternative Agricultural Price Distortions for CGE Analysis, 2007 and 2011

By

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# Alternative Agricultural Price Distortions for CGE Analysis, 2007 and 2011

Hans G Jensen and Kym Anderson

A recent World Bank research project has generated an annual time series of distortions to agricultural incentives over the past half century for 82 countries, the majority of which are low-and middle-income countries (Anderson and Valenzuela 2008; Anderson and Nelgen 2013).[1] This new dataset can provide an alternative set of estimates of agricultural price distortions in developing countries to those provided for 2007 in the GTAP 8 database and 2011 in the GTAP 9 database (see Narayanan *et. al.* 2012 and forthcoming). This World Bank resource contains ad valorem tax/subsidy rates on outputs, inputs, imports and exports by country, for as many as 75 agricultural products (around a dozen per country on average).

As explained in the methodology paper for the World Bank project (Anderson et al. 2008), these new estimates of the extent of price distortions in national economies are based on the ratio of actual domestic to border prices. They therefore differ from those in the GTAP database, which are mostly based on just applied rates of import tariffs. They should not be seen as superior to the standard GTAP distortions database, which in combination with detailed information on bound import tariff tariffs and agricultural subsidies in high-income countriers is meant for analyzing such things as multilateral and preferential trade policy reforms. Rather, the new dataset provides an alternative for those wishing to focus on the fuller range of distortions to national markets for farm products, as needed for analyses of agricultural and trade policies affecting developing countries.

There are several situations in which the analyst may not want to rely on just applied import tariffs for analyzing the impact of, say, removing all distortions to agricultural incentives. One is that there may be 'water' or unused protection in such tariffs (because the government chooses to or finds itself unable to collect duties at the border), in which case the nation's applied rate overstates the extent of actual protection from import competition for that product. It is also possible that nontariff import barriers exist to such an extent that an applied tariff understates the actual protection level. As well, production or export taxes or other export restrictions, or exchange rate distortions – generally not included in the GTAP protection database for developing countries – may be in place. And value added taxes on agricultural products may be applied at the border on imported products but not (or not as fully) on domestically produced like products. In principle, careful domestic-to-border price comparisons, appropriately adjusted for marketing margins, quality differences, etc., can overcome these problems and provide a more-accurate indicator of the price-distorting effects of a country's agricultural and trade policy measures.

[1] In addition to the publicly available database, the project's website ( www.worldbank.org/agdistortions) includes a lengthy series of background, methodology and working papers and underlying national spreadsheets. Country case studies are ublished in a series of four regional books (Anderson and Martin 2009, Anderson and Masters 2009, Anderson and Swinnen 2008 and Anderson and Valdés 2008) as well as a global overview volume (Anderson 2009). The four regional volumes, and a follow-up volume of CGE studies on the effects of those distortions on income inequality and poverty (Anderson, Cockburn and Martin 2010), are available as free e-books at http://go.worldbank.org/R34AP8DA80

The estimates of price distortions for developing countries from the World Bank's Distortions to Agricultural Incentives (DAI) project are decomposed into trade or border instruments, including import and export taxes or subsidies, and domestic instruments such as farm output or input subsidies and consumer tax equivalents.

This DAI database contains data for 71/68 individual countries found in the GTAP database for the 2007/2011 base years of the GTAP version 8/version9 database.[2] As for specific commodities in individual countries, the DAI database provides an estimate of the nominal rate of assistance (NRA) to producers of the most-valuable dozen or so farm products that comprise around 70% of the gross value of agricultural production in each country. The NRA is the percentage by which domestic producer prices exceed the border price of like products at the same point in the value chain. Hence the NRA is negative if producers receive less than the price they would have for a like product in the absence of government intervention. The NRA captures three domestic policies affecting agricultural producer prices, namely border measures ($NRA\_{bms}$), output subsidies/taxes ($NRA\_{dms}$) and intermediate input subsidies/taxes/import tariffs ($NRA\_{i}$) so that

$$NRA = NRA\_{bms} + NRA\_{dms} + NRA\_{i} \quad (1)$$

The sum of the border and domestic output price support measures are based on actual product price comparisons rather than applied tariff rates. In principle, careful domestic to border price comparisons can capture nontariff import barriers as well as producer price subsidies, production or export taxes or other export restrictions, or exchange rate distortions, most of which are generally not included in the GTAP protection data for developing countries. The reported contribution of the ad valorem equivalent input taxes (specific input taxes are multiplied by input-output coefficients and summed up to obtain the combined $NRA\_{i}$) can be added together with the border measure to give the total NRA estimate by commodity and country.

Looking at consumer incentives, these are affected by border measures $NRA\_{bms}$ together with any domestic consumption taxes or subsidies affecting final consumers. In the present version of the DAI database for the years 2007/11, only border measures are affecting consumer prices, with a few exceptions. Hence there is no recalibration of the GTAP database's domestic taxes/subsidies on private and government consumption already found in that database.

### *Steps in putting NRA estimates into GTAP*

In order to recalibrate the GTAP database with NRA estimates, we draw on the latest version of the World Bank's *Distortions to Agricultural Incentives* (DAI) database (Anderson and Nelgen 2013) to alter the GTAP database's estimates of national support and trade restrictions. This involves revising the effort by Valenzuela and Anderson (2008), who made a similar adjustment to the Version 7 GTAP protection database for 2004. In particular, we introduce the NRA estimates of the actual price wedges at national borders and farm output and input subsidies/taxes, using an ALTERTAX closure of the GTAP model (Malcolm 1998).

As mentioned, the DAI database for the year 2007/2011 covers 71/68 countries and a wide range of commodities. In order to aggregate the DAI database to GTAP concordance, a new program (DAItoGTAP) was written, using GEMPACK (Harrison *et al.* 2013), to process the NRA

[2] The DAI database includes 2011 data for only 42 countries, but it has data up to 2010 for an additional 26 countries. So, in recalibrating the v9 database, those 2010 estimates of distortions are used as a proxy for 2011 (when international prices were similar to those in 2010).

data in a consistent manner and to document our approach. The DAItoGTAP program works as follows:

- *first*, it aggregates the World Bank's NRA data consisting of NRA_$_{bms}$, NRA_$_{dms}$, and NRA_$_{i}$ to GTAP commodity concordance,
- *Second*, NRA_$_{bms}$ are allocated as price wedges at national borders as either import or export taxes in the GTAP database, depending on a country's trade status as net exporter/importer,
- *third*, GTAP output and input subsidies/taxes are brought into line with the commodity specific NRA_$_{dms}$ and NRA_$_{i}$ estimates so that the GTAP database mirrors the DAI database relationship, NRA = NRA_$_{bms}$ + NRA_$_{dms}$,+ NRA_$_{i}$, and
- *fourth*, even though the DAI database also contains estimates of non-product-specific (NPS) assistance and decoupled payments (decpay), the DAItoGTAP program does not use this information and does not change the NPS and decoupled payments already found in the GTAP database, with the exception of a few developing countries,[3] and
- *fifth*, the DAItoGTAP program generates a shock file used in the ALTERTAX program to incorporate the DAI price wedge data into any aggregation of the GTAP database.

### *Incorporating NRA_$_{bms}$*

The aggregation of the DAI commodities to GTAP concordance in each country results in one NRA_$_{bms}$(i,r) measure to compare with the multiple ad valorem tariffs and export taxes found in the GTAP database for commodity *i* being imported from or exported to *s* countries to/from country *r*. We therefore make the assumption that the estimated NRA_$_{bms}$(i,r) represents the average trade distortion on GTAP commodity *i* in country *r*.[4]

More precisely, the NRA_$_{bms}$(i,r) is measuring the percentage price difference between the domestic farm gate price PP and the world marker border price BP,

$$NRA\_{bms}(i,r) = 100*(PP(i,r) - BP(i))/BP(i) \quad (2)$$

In GTAP terms this would be equivalent to:

$$NRA\_{bms}(i,r) = 100*[sum(s, REG,(VIMS(i,s,r)/VIWS(i,s,r))) - 1] \quad (3)$$

or

$$NRA\_{bms}(i,r) = 100*[sum(s, REG,(VXMD(i,r,s)/VXWD(i,r,s))) -1] \quad (4)$$

As the NRA_$_{bms}$(i,r) measures the percentage by which the domestic producer price differs from the border price, the question arises as to which border restriction is responsible for the price

[3] The DAI database's NPS and decpay estimates stem mainly from the OECD's PSE tables. Since the OECD PSE tables already are the source of domestic support embedded into the GTAP database, the DAItoGTAP program makes no change to the land, labor, capital, and intermediate input subsidies/taxes already found in the database, where NPS and decpay support already are allocated. In some developing countries the DAI's NPS estimates are calibrated into the GTAP database as homogenous intermediate input subsidies, which is added to the any commodity specific NRA_$_{i}$ in primary agricultural production.

[4] For the EU countries, intra-EU trade is excluded when calculating average trade barriers faced by non-member countries.

gap? In the DAItoGTAP program, this is determined by using the self-sufficiency estimate (domestic share in total use) calculated using the initial GTAP database. If the self-sufficiency ratio is above 1.01, we allocate the country to be an exporter, otherwise an importer.

Since the $NRA\_{bms}(i,r)$ estimates are linked to primary agricultural products, which first have to pass through processing industries before being consumed, we aggregate the primary GTAP commodities pdr, osd, c_b, ctl, oap, rmk together with their respective processed products pcr, vol, sgr, cmt, omt mil before calculating self-sufficiency ratios in each country.[5]

In a similar manner, when allocating the $NRA\_{bms}(i,r)$ border distortion for the primary commodities listed above, we also allocate the same border distortion to the associated processed sector. It is assumed for these products that the estimated price gap in the DAI database is at a higher level in the value added chain (processed products) and that wholesale prices (WP) are used instead of farm-gate prices (PP) for comparison with associated border prices (BP). The estimated relative percentage price gap ($NRA\_{bms}(i,r)$) for the processed products is then allocated to the associated primary production at the farm gate in the DAI database. Using this assumption, we allocate the same border price distortion in both primary and the associated secondary processing industries found in the GTAP database.

For GTAP commodities where the self-sufficiency is equal to or below 1.01, the country is classified as an importer. The $NRA\_{bms}(i,r)$ border distortions are then calibrated into the GTAP database by changing initial import tariffs. In the DAItoGTAP program *two methods* of incorporating the $NRA\_{bms}(i,r)$ as changes to import tariffs are available.

The *first method* follows the approach used by Valenzuela and Anderson (2008), where the preferential bilateral tariff structures (TMS(i,s,r)) originally included in the GTAP version 8 Database are maintained by multiplying each bilateral tariff by the ratio of the import tariff equivalent $NRA\_{bms}(i,r)$ to the GTAP average tariff for each commodity.

$$TMS_{NRA}(i,s,r) = RATIO(i,r)*TMS(i,s,r) \quad (5)$$

where

$$RATIO(i,r) = NRA\_{bms}(i,r)/ 100*[sum(s, REG,(VIMS(i,s,r)/VIWS(i,s,r)))- 1] \quad (6)$$

By using this method, initial imports entering a country duty free maintain their zero-tariff status and it is assumed there are no additional trade distortions on goods entering from these countries. This means that we are assuming that all price gaps between the domestic and border prices are caused by the restrictions on trade with countries that do not have zero tariff access to the market. If the RATIO(i,r) is above/below one, then the average import tariff (equation (3)) has to increase/decrease. This is done in multiple steps in the DAItoGTAP program to exclude bilateral tariffs becoming negative when the ratio is below 1. In the special cases where there are import subsides, we reduce all tariffs to zero and allocate a homogenous import subsidy across all bilateral trades in that product.

Even though we classify a country as an importer (self-sufficiency <= 1.01) in the GTAP database, these countries are often still exporting smaller amounts of the same commodity. This means that if there are any exports from a country where the $NRA\_{bms}$ is not zero, we also introduce export subsidies or taxes equivalent to the import barriers. This means that if the domestic price is above the world market price, for example, then an export subsidy has to be in place, otherwise the domestic producer would not export. In the GTAP database we found only one domestic price where for we had to implement this stylized approach in our representation of the $NRA\_{bms}$ in our alternative database.

[5] For the EU countries the self-sufficiency ratio is calculated for the EU aggregated and not at the individual country level, thereby excluding intra-EU trade.

If a country is classified as an exporter (self-sufficiency > 1.01), we implement equation 4 above by allocating a homogenous export tax or subsidy across all bilateral exports. Once again, if a country subsidizes exports then the average import tariff has to be as large as the export subsidy. If the average import tariff is below the export subsidy rate then the import tariff is raised using the method outlined above.

A *second method* of adjusting import tariffs also is available in the code DAItoGTAP program. This can be activated as an alternative to the above approach which was used by Valenzuela and Anderson (2008). In this second approach, we assume the initial ad valorem equivalent tariffs already embedded in the GTAP version 8/9 databases are already captured by the NRA_**bms**. Using this assumption, we can the estimate the ad valorem equivalent of the non-tariff barrier (NTB) to trade as

$$NTB(i,r) = NRA\_{\mathbf{bms}}(i,r) - 100*[sum(s, REG,(VIMS(i,s,r)/VIWS(i,s,r))) - 1] \quad (7)$$

This second method then adds the NTB to the already present tariff structure found in the GTAP database, so that

$$TMS_{NRA}(i,s,r) = NTB(i,r) + TMS(i,s,r) \quad (8)$$

This method adds an NTB across all imported goods even where there are zero tariffs. It thus assumes that NTBs effect all trade equally. Estimating NTBs using this method will result in both negative and positive non-tariff barriers. The question could be asked if the trade-weighted average tariff used here is understating the trade distortion imposed by prohibitive tariff, in which case the estimated NTB in this second method is too large. The opposite could be said about the first method, which puts all the NRA_**bms** adjustment into the applied tariff, and thereby perhaps better reflects the trade distortion imposed by prohibitive tariffs – but then it could be understating the NTBs on initial bilateral trades with zero tariffs.

### *Incorporating NRA_dms and NRA_i plus NPS*

Domestic support, in the form of output subsidies and intermediate input subsidies, is only allocated to the primary agricultural commodities found in the GTAP database. Output subsidies are changed to mirror the NRA_dms estimates:

$$NRA\_{dms}(i,r) = (VOA(i,r)/VOM(i,r) - 1)*100 \quad (9)$$

In the case of intermediate input subsidies, the commodity specific $NRA\_i$ is the ad valorem equivalent of the sum of each individual input's NRA times its input-output coefficient. Thus NRA = NRA_bms + NRA_dms + $NRA\_i$. But to get $NRA\_i$ into the GTAP database as an intermediate input subsidy, we have to reverse this calculation to get the correct shocks for the TFD and TFM taxes in the GTAP database This is done by dividing the $NRA\_i$ by the SHARE of intermediates in total demand for inputs and then using the relationship between the market price NRA(i,r) and the intermediate price to calculate the relative power of the input subsidies for domestic and imported commodities (equations 11 and 12).

$$SHARE(i,r) = sum(a, demd\_comm, VIFA(a,i,r) + VDFA(a,i,r))/ [(sum(a, demd\_comm, VIFA(a,i,r) + VDFA(a,i,r)) \quad (10)$$

$$+ \quad \text{sum}(a, \text{endw\_comm}, \text{EVFA}(a,i,r))]$$

$$TFD_{NRA}(i,r) = (1+NRA(i,r)/100 - ((NRA\_i(i,r)/100)/ SHARE(i,r)))/(1+NRA(i,r)/100) \quad (11)$$

$$TFM_{NRA}(i,r) = TFD_{NRA}(i,r) \quad (12)$$

With regard to the NPS input subsidies, these are only issues for non OECD PSE countries. Since the DAI's NPS input subsidies already are included in the GTAP database for countries where the OECD calculates a PSE, we make no changes to the GTAP database for these countries. For the remaining countries where the DAI database contains a value for NPS inputs subsidies we calculate a generic homogenous input subsidy rate (13) on all intermediate inputs (a) in primary agricultural production (i).

$$NPS_{ratio}(r) = - (NPS(r)/1000000) / \text{sum}(a, \text{trad\_comm}, \text{sum}(i, \text{primary}, VDFM(a,i,r) + VIFM(a,i,r))) \quad (13)$$

This is then added to the commodity specific input subsidy rate. The calculated price relationships in equation 11, 12 and 13 are then calibrated into the GTAP database as homogenous input subsidies between the agent and market prices of intermediate inputs in non OCED PSE countries (equations 14 and 15)

$$TFD_{NRA}(i,r) + NPS_{ratio}(r) = VDFA(a,i,r)/VDFM(a,i,r) \quad (14)$$

$$TFM_{NRA}(i,r) + NPS_{ratio}(r) = VIFA(a,i,r)/VIFM(a,i,r) \quad (15)$$

The above method of calibrating the DAI's NRA for the year 2007 or 2011 has been programed into the GEMPACK file DAItoGTAP.tab. This TAB file also documents our approach and gives the end user the possibility of choosing between the two methods outlined above.

***Input/Output to/from the DAItoGTAP program***

The DAItoGTAP GEMPCK TAB file should be downloadable together with this document as well as the associated DAI data found in the DAI2007.har (DAI2011.har) file for the GTAP v8.1 (v9) database.[6] Other files needed to run the program are the output from your aggregation of the v8.1 (v9) database, Basedata,har, Default.parm and Sets.har (see the Readme document for how to run the program).

The DAItoGTAP produces three output files, DAIshk.har, Altertax.prm and DAIview.har.

The DAIshk.har file contacts shocks to import tariffs (tms), export taxes (txs), output subsidies (to) and intermediate input subsidies (tfd, tfm) for any specific aggregation of the GTAP v8.1 (v9) database. These shocks can then be used together with the Altertax.prm file to run an Altertax closure of the GTAP model (Hertel 1997), changing the initial distortions found in the GTAP database to the NRA estimates.

The DAIview.har file containing an overview of the changes made to the GTAP v8.1 database is shown, by way of example, in Table 1.

[6] When the GTAP v9 database is released, a DAI2011.har file will also become available. This can be used together with the DAItoGTAP program to generate shock files for changing the GTAP v9 database's distortions to agricultural incentives.

Table 1. Overview DAIview.har

| | Header | Coeff | Name |
|---|---|---|---|
| 1 | DAIG | DAIgeneral | DAI data with general information by country |
| 2 | DAIC | DAIcomREG | DAI data with commodity specific information by country |
| 3 | NRA_ | NRA | NRA = NRAbms+NRAdms+NRAi & production mill US$ |
| 4 | BMS | NRAbms | Border measures |
| 5 | DMS | NRAdms | Output subsidies |
| 6 | I | NRAi | Intermediate input subsidies NRAi + NPS |

Table 1's first two headers, DAIG and DAIC, contains the original 2007 DAI data downloaded from the World Bank's website. Two adjustments have been made to the original data: where TrStat2 was noted as x, m, h they are now coded so that x = 1, m = 2, h = 3 and Region is now Africa = 1, Asia (excluding Japan) = 2, ECA = 3, HIC = 4 LAC = 5.

Header 3, NRA_ gives an overview of the NRAs used to recalibrate the GTAP database, with the exception of NotCovered commodities which is excluded.

Taking c_b as an example in Table 2, the border measure $NRA_{bms}$ is raising the domestic price by 83% compared to the world market price. So if the world market price is set equal to 1.0 then the domestic Chinese price would be 1.83. The value of c_b at the farm gate is US$1,980 million and the total value of primary agricultural production is US$428,180 million for the year 2007 in China.

Header 4, BMS, shows the result of the recalibration of the border measures in the GTAP data base. In this header the average import tariffs/subsidies and export taxes/subsidies are shown for the individual countries.

Table 2. Header 3 NRA_, taking China as an example

| | NRA | NRAbms | NRAdms | NRAi | VOP_prod |
|---|---|---|---|---|---|
| pdr | -0.8 | -0.8 | 0.0 | 0 | 41800 |
| wht | 14.3 | 14.3 | -0.0 | 0 | 19100 |
| gro | 20.7 | 20.7 | 0.0 | 0 | 20900 |
| v_f | 0 | 0 | 0 | 0 | 6180 |
| osd | 9.3 | 9.3 | 0.0 | 0 | 5230 |
| c_b | 83.4 | 83.4 | -0.0 | 0 | 1980 |
| pfb | 78.0 | 78.0 | 0.0 | 0 | 7490 |
| ocr | 0 | 0 | 0 | 0 | 0 |
| ctl | 0 | 0 | 0 | 0 | 0 |
| oap | 1.0 | 1.0 | 0.0 | 0 | 155100 |
| rmk | -25.5 | -25.5 | 0 | 0 | 13400 |
| wol | 0 | 0 | 0 | 0 | 0 |
| NotCovered | 9.8 | 9.8 | 0 | 0 | 157000 |
| Total | | | | | 428180 |

Taking China as an example again, Table 3 shows that the border measures are reducing the domestic price of rice by -0.8%. Since the self-sufficiency of rice is below 1.01, then China is classified as an importer of rice and the NRA_bms is classified as an import distortion (NRAbmsM). The initial v8.1 average import tariff is 17.0 (TMSold), which is then reduced to -0.8 (TMSnew). Since there is an import subsidy on rice we also impose an export tax of -0.8% (TXSnew). These measures are imposed on both commodities pdy and pcr in the GTAP database.

Looking at wht, China is assumed to be an exporter of wheat and since the domestic market price is 14.3% (NRAbmsX) above the world market price, we implement an export subsidy. Since there is an export subsidy the import tariff has to be as large as the export subsidy, so we also increase the average import tariff from 1.4 to 14.3%.

Since there is very little trade in c_b and rmk we maintain the initial GTAP distortions on these commodities and put the NRA_bms trade distortions on the refined commodities mil and sgr.

Table 3. Header BMS border measures, taking China as an example

| | TMSold | TMSnew | NRAbmsM | TXSold | TXSnew | NRAbmsX | VOP_prod | Self_Suff |
|---|---|---|---|---|---|---|---|---|
| pdr | 17.0 | -0.8 | -0.8 | 0 | -0.8 | 0 | 41800 | 1.00 |
| wht | 1.4 | 14.3 | 0 | 0 | 14.3 | 14.3 | 19100 | 1.03 |
| gro | 1.9 | 20.7 | 0 | 0 | 20.7 | 20.7 | 20900 | 1.05 |
| v_f | 3.5 | 0 | 0 | 0 | 0 | 0 | 6180 | 1.01 |
| osd | 2.5 | 9.3 | 9.3 | 0 | 9.3 | 0 | 5230 | 0.76 |
| c_b | 2.0 | 2.0 | 0 | 0 | 0 | 0 | 1980 | 0.96 |
| pfb | 3.7 | 78.0 | 78.0 | 0 | 78.0 | 0 | 7490 | 0.72 |
| ocr | 8.0 | 8.0 | 0 | 0 | 0 | 0 | 0 | 1.27 |
| ctl | 1.9 | 1.9 | 0 | 0 | 0 | 0 | 0 | 0.97 |
| oap | 8.4 | 1.0 | 1.0 | 0 | 1.0 | 0 | 155100 | 1.00 |
| rmk | 0 | 0 | 0 | 0 | 0 | 0 | 13400 | 0.97 |
| wol | 37.4 | 37.4 | 0 | 0 | 0 | 0 | 0 | 0.77 |
| cmt | 10.5 | 10.5 | 0 | 0 | 0 | 0 | 0 | 0.97 |
| omt | 7.9 | 1.0 | 1.0 | 0 | 1.0 | 0 | 0 | 1.00 |
| vol | 1.6 | 9.3 | 9.3 | 0 | 9.3 | 0 | 0 | 0.76 |
| mil | 8.8 | -25.5 | -25.5 | 0 | -25.5 | 0 | 0 | 0.97 |
| pcr | 2.5 | -0.8 | -0.8 | 0 | -0.8 | 0 | 0 | 1.00 |
| sgr | 0.2 | 83.4 | 83.4 | 0 | 83.4 | 0 | 0 | 0.96 |
| NotCovered | | 0 | 9.8 | 0 | 0 | 0 | 157000 | - |
| Total | | | | | | | 428180 | |

The BMS header shows the implemented changes in average border distortions for the 71 countries found both in the DAI and GTAP v8.1database. In a similar manner, header DMS shows the old v8.1 output subsidy rates (TOold) and the new NRA_dms rates (TOnew). In header I the same is done for intermediate input subsidies on imported and domestically produced inputs.

In a similar manner, running the DAItoGTAP program together with the forthcoming DAI2011.har file and any aggregation of the GTAP v9 database will produce the same set of output files. These can then be used to change distortions to agricultural incentives in the forthcoming v9 database.

***How different is this alternative distortions database?***

As a way of exploring the difference between the 2007 GTAP v8.1 distortions to agricultural incentives and those provided from the World Bank's DAI database, we simulated full liberalization of all agricultural and processed food markets globally in 2007 (using v8.1) and 2011 (using v9) of the GTAP Model. Three sets of welfare effects of such a reform are presented in Table 4: those using the standard GTAP protection database, those using the DAI database as transposed with the first (tariff ratio) method, and those using the DAI database as transposed with the second method (that assumes NTBs on agricultural products apply to imports from all trading partners).

The results in Table 4 reveal four sets of differences: across countries/regions, across the two years shown, across the two methods of transposing DAI estimates, and across policy instruments. Overall, they suggest the standard GTAP protection database, by not including measures other than applied import tariffs and input distortions for developing countries, leads to an underestimate of the global welfare effects of agricultural distortions. For 2011 the problem is relatively minor, but for 2007 the welfare effect is underestimated by at last one-third in all three regions.

The total welfare effect for all developing countries is much larger in dollar terms in 2011 and 2007, especially using the GTAP database, but that is mainly because the developing economies are so much larger by 2011. When expressed as a percentage of GDP, the differences between the two periods is much less (see final two rows of Table 4).

As for the two alternative methods of dealing with import restrictions, when the estimated NTBs are applied to all trading partners including those with whom there is a zero-tariff arrangement, the estimated welfare cost of policies for many countries is slightly higher (i.e., the benefit from reform is greater) than with the ratio method, as is also true globally.

The most striking difference between the results from using the GTAP database and those from using the alternative DAI database stem from the different instruments used to distort prices. Table 5 subdivides the global welfare effects according to whether policies directly affect agricultural exports, imports, domestic output, domestic consumption, or intermediate farm inputs. It reveals that using the DAI database ensures that export taxes are taken into account. In both years they are estimated to account for around one-quarter of the global welfare costs of agricultural price distortions, and for as much as two-fifths in 2007, while the GTAP database suggests there are just minor export subsidies in place that slightly offset the adverse welfare effect of import restrictions. The extent of the price distortions as contributed by the various policy instruments in 2007, according to the GTAP and DAI databases, are shown for the major countries and residual regions in Table 6.

Table 4. Welfare effects on developing countries of full global agricultural liberalization of primary agric. and processed food products, 2007 and 2011 (EV, US$ million)

| | GTAP v8.1 (2007) | | | GTAP v9 pre release( 2011) | | |
|---|---|---|---|---|---|---|
| | Standard | DAI database: | | Standard | DAI database: | |
| | GTAP | Ratio | NTB | GTAP | Ratio | NTB |
| China | 8576 | 11174 | 11052 | 17855 | 23548 | 23556 |
| Indonesia | 1309 | 500 | 708 | 896 | 1305 | 1976 |
| Malaysia | 1745 | 2678 | 2917 | 2616 | 2947 | 3145 |
| Philippines | -144 | -128 | -136 | 129 | 396 | 384 |
| Thailand | 1899 | 3013 | 3084 | 3393 | 4233 | 4217 |
| South Korea | 6403 | 9434 | 9886 | 12047 | 10358 | 10408 |
| Taiwan | -178 | 94 | 95 | -270 | -278 | -284 |
| India | 3468 | 2324 | 3435 | 4697 | 2281 | 5182 |
| Pakistan | -306 | 1845 | 1829 | -15 | 56 | 36 |
| Sri Lanka | 92 | 58 | -115 | 159 | 232 | 220 |
| Bangladesh | -185 | 644 | 698 | -329 | -112 | -120 |
| Rest of Asia | 3449 | 3233 | 3379 | 5902 | 4346 | 4057 |
| **Asia** | **26128** | **34868** | **36833** | **47079** | **49311** | **52777** |
| Mexico | 706 | 798 | 781 | 393 | 1001 | 1016 |
| Argentina | 2889 | 6652 | 5886 | 4823 | 4988 | 4445 |
| Chile | 493 | 474 | 511 | 1152 | 1328 | 1395 |
| Ecuador | 357 | 1225 | 1184 | 1026 | 2926 | 2842 |
| Colombia | 300 | 1152 | 1166 | 1201 | 1991 | 1987 |
| Brazil | 10240 | 10977 | 10831 | 13960 | 11770 | 11911 |
| Rest Latin America | 1863 | 2783 | 2764 | 3152 | 3803 | 3700 |
| **Latin America** | **16847** | **24062** | **23123** | **25707** | **27807** | **27297** |
| North Africa | -591 | 477 | 504 | -907 | -219 | -188 |
| Morocco | 145 | 153 | 329 | 393 | 425 | 469 |
| Ghana | 83 | 918 | 882 | 372 | 1420 | 1420 |
| Egypt | -87 | 2621 | 2733 | 1489 | 3257 | 3155 |
| South Africa | 743 | 1120 | 1152 | 1434 | 1549 | 1420 |
| Madagascar | 33 | 736 | 732 | 31 | 547 | 547 |
| Burkina Faso | 20 | -50 | 19 | 34 | 41 | 42 |
| Kenya | 546 | 850 | 816 | 855 | 910 | 1004 |
| Cameroon | 57 | 45 | 50 | 64 | 81 | 77 |
| Ethiopia | 184 | 439 | 438 | 323 | 447 | 444 |
| Tanzania | 122 | 523 | 522 | 157 | 1181 | 1180 |
| Uganda | 94 | 181 | 180 | 158 | 395 | 393 |
| Nigeria | -55 | 190 | 229 | -719 | 475 | 457 |
| Mozambique | 31 | 35 | 33 | 46 | 98 | 99 |
| Rest of Africa | 424 | 1750 | 1721 | 931 | 801 | 645 |
| **Africa** | 1748 | 9988 | 10338 | 4662 | 11409 | 11167 |
| **ALL DEV. COUNTRIES** | **45405** | **73459** | **74925** | **78139** | **93517** | **96288** |
| ***% of GDP*** | 0.34 | 0.55 | 0.56 | 0.36 | 0.43 | 0.44 |

Table 5. Welfare contributions on developing countries from agricultural import, export, output and input price distortions in the full global liberalization of primary agric. and processed food products

| | EV | % contribution from policies affecting: | | | | | |
|---|---|---|---|---|---|---|---|
| **2007** | US$m | Imports | Exports | Outputs | Inputs | Consumer | Total |
| Standard | 45405 | 52 | -1 | 6 | 6 | 20 | 100 |
| DAI--ratio | 73459 | 38 | 28 | 6 | 4 | 15 | 100 |
| DAI--NTB | 74925 | 39 | 27 | 6 | 4 | 14 | 100 |
| | | | | | | | |
| **2011** | | | | | | | |
| Standard | 78139 | 50 | -1 | 7 | 6 | 22 | 100 |
| DAI--ratio | 93517 | 36 | 22 | 5 | 5 | 18 | 100 |
| DAI--NTB | 96288 | 38 | 21 | 5 | 5 | 17 | 100 |

Table 6. GTAP V8.1 and the updated GTAP DAI database's agricultural price distortions, 2007 (percent)

| | | GTAP V8.1 | | | | | | DAI updated V8.1 (Ratio) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Import | Subsidy | | | | | Import | Subsidy | | | | |
| | Agriculture | Tariff | Export | Output | Input | Factor | Consumer | Tariff | Export | Output | Input | Factor | Consumer |
| Europe | Prim. | 2.1 | 0.1 | 0.3 | 0.8 | 27.5 | 0.2 | 2.8 | 1.9 | 0.2 | 0.8 | 27.5 | 0.2 |
| | Sec. | 3.6 | 0.6 | -5.3 | -0.5 | 0.0 | -16.9 | 3.6 | 1.0 | -5.3 | -0.5 | 0.0 | -16.9 |
| Russia | Prim. | 5.5 | -0.1 | 0.0 | 5.2 | 7.3 | -4.1 | 8.2 | -16.8 | 0.6 | 5.2 | 7.2 | -4.1 |
| | Sec. | 17.7 | 0.0 | 0.0 | -0.5 | 0.0 | -34.9 | 26.3 | 10.2 | 0.0 | -0.5 | 0.0 | -34.9 |
| Central Asia | Prim. | 5.4 | 0.0 | -1.0 | 1.1 | 3.3 | -1.2 | 5.3 | -2.2 | 0.6 | 1.2 | 3.2 | -1.2 |
| | Sec. | 11.5 | 0.0 | -2.1 | -0.2 | 0.0 | -13.5 | 11.1 | 4.7 | -2.1 | -0.2 | 0.0 | -13.5 |
| Middle East | Prim. | 8.0 | 0.0 | 0.9 | -4.5 | 4.2 | -0.3 | -3.5 | 4.5 | 11.5 | -6.4 | 3.9 | -0.3 |
| | Sec. | 13.7 | 0.0 | -3.7 | -0.4 | 0.0 | -3.4 | 13.1 | 0.5 | -3.7 | -0.4 | 0.0 | -3.4 |
| USA | Prim. | 1.7 | 0.0 | 0.1 | 3.1 | 7.5 | -5.0 | 1.6 | 8.2 | -0.1 | 3.1 | 7.4 | -5.0 |
| | Sec. | 3.0 | 0.0 | -0.8 | -0.2 | 0.0 | -9.8 | 3.7 | 2.2 | -0.8 | -0.2 | 0.0 | -9.8 |
| Canada | Prim. | 1.2 | 0.0 | 0.0 | 0.2 | 21.2 | 1.7 | 1.1 | 0.7 | 0.0 | 0.2 | 20.6 | 1.7 |
| | Sec. | 17.0 | 0.0 | -0.5 | -0.1 | 0.0 | -34.5 | 14.8 | 2.2 | -0.5 | -0.1 | 0.0 | -34.5 |
| Australia | Prim. | 0.3 | 0.0 | 0.0 | 5.4 | 4.7 | -2.4 | 0.3 | 0.0 | 0.0 | 5.4 | 4.7 | -2.4 |
| | Sec. | 1.5 | 0.0 | -4.5 | -0.1 | 0.0 | -31.5 | 1.3 | 0.0 | -4.5 | -0.1 | 0.0 | -31.5 |
| Rest of Oceania | Prim. | 1.7 | 0.0 | 0.0 | 0.2 | 0.0 | -10.0 | 2.1 | 1.3 | 0.0 | 0.2 | 0.0 | -10.0 |
| | Sec. | 5.0 | 0.0 | -0.5 | 0.0 | 0.0 | -12.3 | 5.1 | 0.1 | -0.6 | 0.0 | 0.0 | -12.3 |
| Japan | Prim. | 12.2 | 0.0 | 2.3 | 1.1 | 8.2 | -5.0 | 12.6 | 25.5 | 1.7 | 1.1 | 8.3 | -5.0 |
| | Sec. | 19.6 | 0.0 | -8.4 | -0.4 | 0.0 | -5.0 | 24.0 | 3.1 | -8.4 | -0.4 | 0.0 | -5.0 |
| China | Prim. | 6.0 | 0.0 | 0.0 | 27.7 | 29.1 | -0.4 | 16.1 | 3.1 | 0.0 | 27.7 | 29.1 | -0.4 |
| | Sec. | 6.2 | 0.0 | 0.0 | -0.1 | 0.0 | -12.8 | 7.4 | 0.1 | 0.0 | -0.1 | 0.0 | -12.8 |
| Indonesia | Prim. | 2.4 | 0.0 | 0.0 | 8.4 | 0.4 | -1.1 | 3.2 | 5.4 | 0.0 | 8.4 | 0.4 | -1.1 |
| | Sec. | 9.0 | 0.0 | 0.0 | 0.0 | 0.0 | -8.2 | 15.5 | -3.8 | 0.0 | 0.0 | 0.0 | -8.2 |
| Malaysia | Prim. | 7.8 | 0.0 | 1.1 | 0.0 | 0.0 | -3.7 | 5.1 | 2.7 | 0.0 | 0.0 | 0.0 | -3.7 |
| | Sec. | 8.9 | 0.0 | 0.0 | 0.3 | 0.0 | -8.0 | 9.5 | -33.3 | 0.0 | 0.3 | 0.0 | -8.0 |
| Philippines | Prim. | 6.0 | 0.0 | 0.0 | -0.1 | 0.0 | -3.4 | 6.9 | -13.2 | 0.0 | 0.0 | 0.0 | -3.4 |
| | Sec. | 12.8 | 0.0 | 0.0 | -0.2 | 0.0 | -5.3 | 10.7 | 3.5 | 0.0 | -0.2 | 0.0 | -5.3 |
| Thailand | Prim. | 10.5 | 0.0 | 0.0 | -1.6 | 0.0 | 0.0 | 5.9 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Sec. | 14.0 | 0.0 | 0.0 | -0.2 | 0.0 | -20.5 | 11.5 | 16.0 | 0.0 | -0.2 | 0.0 | -20.5 |
| Vietnam | Prim. | 9.2 | 0.0 | -1.0 | 0.0 | 0.0 | -2.7 | 9.2 | 0.0 | -1.0 | 0.0 | 0.0 | -2.7 |
| | Sec. | 16.6 | 0.0 | -0.5 | 0.0 | 0.0 | -17.7 | 16.7 | 0.0 | -0.5 | 0.0 | 0.0 | -17.7 |
| RestAsia | Prim. | 0.7 | 0.0 | -0.1 | -0.1 | 0.0 | -1.2 | 0.7 | 0.0 | -0.1 | -0.1 | 0.0 | -1.2 |
| | Sec. | 2.0 | 0.0 | -1.9 | -0.1 | 0.0 | -7.1 | 2.0 | 0.0 | -1.9 | -0.1 | 0.0 | -7.1 |
| South Korea | Prim. | 24.8 | 6.8 | 0.0 | 1.9 | 8.2 | -3.3 | 66.0 | 91.4 | 2.8 | 2.0 | 7.8 | -3.3 |
| | Sec. | 29.6 | 0.2 | -12.1 | -0.2 | 0.0 | -21.7 | 50.2 | 3.0 | -12.1 | -0.2 | 0.0 | -21.7 |
| Taiwan | Prim. | 6.0 | 0.0 | -0.4 | -0.1 | 0.0 | 0.0 | 10.0 | 14.0 | -0.2 | -0.1 | 0.0 | 0.0 |
| | Sec. | 14.1 | 0.0 | -6.8 | -0.2 | 0.0 | -0.6 | 19.9 | 2.7 | -6.7 | -0.2 | 0.0 | -0.6 |
| India | Prim. | 42.2 | 0.0 | 4.6 | -0.7 | 0.0 | 1.7 | 3.2 | 2.2 | 0.0 | 24.0 | 0.0 | 1.7 |
| | Sec. | 78.8 | 0.0 | -1.6 | -2.6 | 0.0 | -3.6 | 18.0 | 17.8 | -1.5 | -2.6 | 0.0 | -3.6 |
| Pakistan | Prim. | 6.2 | 0.6 | 0.0 | -0.1 | 0.0 | -0.5 | 3.1 | -14.1 | 0.0 | 0.0 | 0.0 | -0.5 |
| | Sec. | 20.1 | 0.0 | 0.0 | -0.2 | 0.0 | -11.3 | 17.5 | -10.2 | 0.0 | -0.2 | 0.0 | -11.3 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SriLanka | Prim. | 13.8 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 14.3 | 14.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Sec. | 22.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19.1 | -0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bangladesh | Prim. | 4.7 | 0.8 | -1.3 | -0.3 | 0.0 | 0.0 | -25.6 | -28.9 | -0.1 | 0.0 | 0.0 | 0.0 |
| | Sec. | 9.0 | 0.0 | -1.8 | 0.0 | 0.0 | -1.7 | 7.0 | -0.1 | -1.8 | 0.0 | 0.0 | -1.7 |
| Mexico | Prim. | 5.1 | 0.3 | 0.4 | 9.4 | 8.1 | -0.1 | 0.3 | 0.1 | 0.1 | 9.4 | 8.2 | -0.1 |
| | Sec. | 2.7 | 0.0 | -0.2 | 0.0 | 0.0 | -9.1 | 2.6 | 1.5 | -0.2 | 0.0 | 0.0 | -9.1 |
| Argentina | Prim. | 0.7 | 0.0 | -5.0 | -4.3 | 0.0 | -69.5 | 0.8 | -26.2 | -1.5 | -0.9 | 0.0 | -69.5 |
| | Sec. | 4.7 | 0.0 | -2.2 | -0.1 | 0.0 | -37.2 | 4.7 | -27.4 | -2.4 | -0.1 | 0.0 | -37.2 |
| Chile | Prim. | 0.7 | 0.0 | -1.7 | -0.4 | 0.0 | -28.0 | 1.0 | 0.0 | -0.2 | -0.4 | 0.0 | -28.0 |
| | Sec. | 1.8 | 0.0 | -0.5 | -0.2 | 0.0 | -25.4 | 1.9 | 0.6 | -0.5 | -0.2 | 0.0 | -25.4 |
| Ecuador | Prim. | 7.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | -35.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Sec. | 9.2 | 0.0 | -1.4 | -0.1 | 0.0 | -3.1 | 1.3 | -0.1 | -1.4 | -0.1 | 0.0 | -3.1 |
| Colombia | Prim. | 13.3 | 0.0 | 0.3 | -1.4 | 0.0 | -1.3 | -0.4 | -23.7 | 0.1 | -0.4 | 0.0 | -1.3 |
| | Sec. | 9.2 | 0.0 | -0.7 | -0.3 | 0.0 | -13.4 | -0.2 | 14.3 | -0.7 | -0.3 | 0.0 | -13.4 |
| Brazil | Prim. | 2.0 | 0.0 | 1.5 | 0.8 | 7.8 | -8.8 | 2.4 | 1.2 | 1.6 | 0.8 | 7.8 | -8.8 |
| | Sec. | 6.0 | 0.0 | -0.8 | -0.2 | 0.0 | -15.2 | 6.4 | 0.4 | -0.8 | -0.2 | 0.0 | -15.2 |
| RestLAmerica | Prim. | 6.6 | 0.0 | -0.5 | -0.4 | 0.0 | -2.4 | 6.6 | -1.9 | -0.5 | -0.4 | 0.0 | -2.4 |
| | Sec. | 12.6 | 0.0 | -1.5 | -0.1 | 0.0 | -9.5 | 12.2 | -0.3 | -1.5 | -0.1 | 0.0 | -9.5 |
| Nafrica | Prim. | 17.0 | 0.0 | -3.9 | 0.0 | 0.0 | 0.0 | 17.0 | 0.0 | -3.9 | 0.0 | 0.0 | 0.0 |
| | Sec. | 11.5 | 0.0 | -4.4 | 0.0 | 0.0 | 0.0 | 11.5 | 0.0 | -4.4 | 0.0 | 0.0 | 0.0 |
| Morocco | Prim. | 25.9 | 0.0 | -0.1 | 0.0 | 0.0 | 0.0 | 27.1 | 21.6 | -4.1 | 2.2 | 0.0 | 0.0 |
| | Sec. | 25.3 | 0.0 | -0.2 | 0.0 | 0.0 | 0.0 | 29.1 | 6.4 | -0.2 | 0.0 | 0.0 | 0.0 |
| Ghana | Prim. | 6.6 | 0.0 | 0.0 | 0.0 | 0.0 | -0.2 | 6.7 | -23.9 | 0.0 | 0.0 | 0.0 | -0.2 |
| | Sec. | 16.2 | 0.0 | 0.0 | 0.0 | 0.0 | -7.4 | 17.9 | 0.1 | 0.0 | 0.0 | 0.0 | -7.4 |
| Egypt | Prim. | 2.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -4.1 | -6.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Sec. | 21.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.5 | -5.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| SouthAfrica | Prim. | 3.7 | 0.0 | 0.0 | 1.7 | 6.0 | -5.0 | 2.3 | 0.0 | 0.0 | 1.7 | 6.0 | -5.0 |
| | Sec. | 9.2 | 0.0 | -0.3 | 0.0 | 0.0 | -14.3 | 8.0 | 7.8 | -0.3 | 0.0 | 0.0 | -14.3 |
| Madagascar | Prim. | 4.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.4 | -46.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Sec. | 8.3 | 0.0 | -0.5 | 0.0 | 0.0 | 0.0 | 17.9 | 1.1 | -0.5 | 0.0 | 0.0 | 0.0 |
| Burkina Faso | Prim. | 4.9 | 0.0 | -0.1 | 0.0 | 0.0 | -0.3 | 3.8 | 3.0 | 0.0 | 0.0 | 0.0 | -0.3 |
| | Sec. | 8.6 | 0.0 | -1.4 | 0.0 | 0.0 | -5.0 | 8.6 | 0.0 | -1.4 | 0.0 | 0.0 | -5.0 |
| Kenya | Prim. | 3.6 | 0.0 | 2.7 | 0.0 | 0.0 | -0.1 | 9.5 | -10.6 | 1.4 | 0.0 | 0.0 | -0.1 |
| | Sec. | 22.7 | 0.0 | 2.8 | 0.0 | 0.0 | -0.1 | 25.2 | 1.3 | 2.8 | 0.0 | 0.0 | -0.1 |
| Cameroon | Prim. | 10.8 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 9.8 | -3.5 | 0.0 | 0.0 | 0.0 | -0.1 |
| | Sec. | 16.0 | 0.0 | -0.2 | -0.1 | 0.0 | -4.8 | 16.0 | 0.0 | -0.2 | -0.1 | 0.0 | -4.8 |
| Ethiopia | Prim. | 7.3 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 | 14.8 | -14.2 | 2.5 | 0.0 | 0.0 | -0.1 |
| | Sec. | 21.9 | 0.0 | 0.0 | -0.1 | 0.0 | -10.8 | 21.9 | 0.0 | 0.0 | -0.1 | 0.0 | -10.8 |
| Tanzania | Prim. | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | -2.0 | 30.3 | -17.0 | 0.0 | 0.0 | 0.0 | -2.0 |
| | Sec. | 21.8 | 0.0 | 0.0 | 0.0 | 0.0 | -11.0 | 26.5 | 9.4 | 0.0 | 0.0 | 0.0 | -11.0 |
| Uganda | Prim. | 7.2 | 0.0 | -0.1 | 0.0 | 0.0 | -2.7 | 7.2 | -26.5 | 0.0 | 0.0 | 0.0 | -2.7 |
| | Sec. | 19.9 | 0.0 | -0.6 | 0.0 | 0.0 | -6.5 | 20.1 | 0.0 | -0.6 | 0.0 | 0.0 | -6.5 |
| Nigeria | Prim. | 6.3 | 0.0 | -0.1 | 0.0 | 0.0 | -0.2 | 6.8 | 16.1 | -2.4 | 0.0 | 0.0 | -0.2 |
| | Sec. | 20.6 | 0.0 | -1.8 | 0.0 | 0.0 | 0.0 | 11.3 | -0.4 | -1.8 | 0.0 | 0.0 | 0.0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mozambique | Prim. | 5.9 | 0.0 | 0.0 | 0.0 | 0.0 | -0.4 | 5.2 | -2.4 | 0.0 | 0.0 | 0.0 | -0.4 |
| | Sec. | 10.1 | 0.0 | 0.0 | 0.0 | 0.0 | -10.5 | 21.4 | 17.5 | 0.0 | 0.0 | 0.0 | -10.5 |
| RestSSAfrica | Prim. | 6.4 | 0.0 | -0.5 | 0.0 | 0.0 | -0.8 | 5.9 | -15.4 | -0.5 | 0.0 | 0.0 | -0.8 |
| | Sec. | 13.9 | 0.0 | -1.1 | 0.0 | 0.0 | -8.2 | 15.9 | 0.2 | -1.1 | 0.0 | 0.0 | -8.2 |

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