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The Upstream Tariff Simulator (UTAS)

A Tool to Assess the Impact of Tariff Reform on Input Costs and Effective Protection across Sectors

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Abstract

Increased international production fragmentation implies that firms at home rely on imported intermediates for production. In this context, tariff policy design needs to consider the impact downstream of changes in tariffs upstream. Policy makers embarking on tariff reforms need to answer questions such as: what is the impact of tariff changes on production costs downstream? What are the key input tariffs that could be reduced to lower production costs in priority sectors considering sectors' backward linkages? Or how will a tariff rationalization plan that focuses on tariff reductions in raw materials and intermediates affect effective protection across sectors? This paper presents the Upstream Tariff Simulator, a simple Microsoft Excel–based tool designed to help policy makers answer these questions, by combining information on tariffs and input-output structures and allowing alternative sectoral aggregations, and alternative market structures for input markets. It provides the underlying conceptual framework and a range of examples that show the insights that the tool can provide to policy makers when analyzing the impact of tariff reforms.

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The Upstream Tariff Simulator (UTAS): A Tool to Assess the Impact of Tariff Reform on Input Costs and Effective Protection across Sectors*

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1) Introduction

Tariff policy reform is a policy lever for countries seeking to increase consumer welfare, boost productivity, and attract greater inward investment in the medium to long-term. When asked how these outcomes materialize, economists typically distinguish between two channels. First, as protection levels on the production of final goods decline, tariff reform induces pro-competitive forces among domestic producers, which now face tougher import competition, and incentivizes them to become more productive. Second, with lower tariffs, the costs of intermediate inputs decline, allowing firms to shift to new or better-quality inputs, access better technology and integrate into increasingly important global value chains.

Although these benefits are widely acknowledged in academia, in policy-making spheres, policy makers will often have to deal with short-term adjustment costs, possible distributional consequences that may be politically sensitive, and other policy trade-offs of tariff reforms. They will therefore want to consider these issues before embarking on a comprehensive tariff reform. Similarly, high levels of protection accorded to some sectors may make the sudden removal of tariffs unfeasible. Policy makers may hence seek more gradual reform approaches. In addition, many countries may have in place complex 'cascading' tariff structures intended to reconcile the desire for lower input tariffs with a policy of continued protection accorded to downstream activities. In this case, policy makers will be interested to know how different activities intertwine with a set tariff structure and how they affect effective protection levels across sectors.

[1]

This paper presents a Microsoft Excel-based tool – "UTAS" (Upstream Tariff Simulator) to help policy makers assess the impact of tariff reforms on production costs and effective protection across a variety of sectors in a flexible and time-efficient manner. The tool allows policy makers embarked on a tariff reform to answer key policy questions such as: What is the impact of tariff changes on production costs downstream? What are the key input tariffs that could be reduced to lower production costs in priority sectors taking into account sectors' backward linkages? How will a tariff reform affect effective as opposed to nominal protection rates across the sectors of an economy?

Recent evidence shows that the consideration of such questions is important to maximize the potential benefits of a tariff reform.

First, a growing body of evidence shows that the productivity gains arising from lower tariffs on intermediate inputs are particularly large. In fact, two seminal studies by Topalova and Khandelwal (2011) and by Amiti and Konings (2007) show that, in India and Indonesia, the impact of trade reform on productivity was larger on account of the impact on the cost of inputs than due to the pro-competitive effects it unleashed through reductions of tariffs on final goods. Moreover, a reduction in tariffs on intermediate inputs can also play a very important role in boosting firms' exports. Recent research shows, for example, that China's well-known export success story is at least in part attributable to cheaper imports of intermediates. Feng et al. (2016) find that Chinese firms that benefitted from lower tariffs on intermediate inputs after China's accession to the World Trade Organization (WTO) exhibited stronger export growth than those that did not benefit from the decline in input tariffs. They also find that these effects were larger for firms that were not involved in any

[1] Also, importantly, many developing countries rely heavily on trade taxes to pay for public expenditure, as customs duties and other trade-related taxes provide a relatively easy and straightforward source of revenue. Policy makers will thus need to consider how much customs revenue a country can afford to lose in the short-run.

form of international trade before the reform, which suggests that lower input tariffs can help firms to start exporting. This is also found in a paper by Bas (2012), who investigates the trade liberalization in Argentina during the early 1990s and demonstrates that firms producing in industries with the largest declines in input tariffs experienced the greatest increase in the probability of entering the export market. Moreover, Bas and Strauss-Kahn (2015) show that Chinese firms that benefitted most from input tariff cuts accessed higher quality inputs to quality-upgrade their exports, which is key to penetrate the most advanced markets around the globe that place strict quality requirements on imports. A thorough assessment of the cost implications of a tariff reform for firms should thus be an integral part of any trade policy analysis considering different reform options.

Second, with the growing importance of global manufacturing networks along global value chains, even low tariffs can have large effects on production costs, as parts and components comprising a product are produced in multiple locations crossing borders various times before they are assembled into the final product (Rouzet and Mirodout, 2013). Moreover, when value chains are global, it is not only the nominal values of tariffs that matter, but also their distribution between processed and unprocessed goods. In many developing countries, tariffs are lower on unprocessed than on processed goods. Diakantoni and Escaith (2014) discuss how the combination of such 'tariff escalation' and high levels of nominal duties can lead to a significant anti-export bias and reduce firms' incentive to export. On the one hand, this arises because steep tariff escalation increases firms' returns on the domestic market relative to the international market. On the other, it stems from the fact that on the global stage exporting firms will be at a disadvantage compared to foreign competitors operating in a free trade environment with zero tariffs. Establishing changes to effective protection rates, which take into account the spread between tariff-related upstream costs and the nominal protection accorded to a sector, is thus an essential aspect of trade policy analyses.

By shedding light on how tariffs intertwine with an economy's production structures across sectors, UTAS seeks to promote a more evidence-based policy decision-making process. It joins the set of trade analysis tools that the World Bank puts at the disposal of policy makers in client countries following the principles of accessibility, simplicity, and tractability.[2] The tool is MS Excel-based, not requiring particular programming skills. It is straightforward to use and builds on a simple and transparent underlying trade model, where users can choose between different modeling assumptions and parameters. The data needed to run UTAS are relatively limited, requiring a country's current tariff schedule, a proposed tariff schedule, and an input-output table with a reasonable sectoral disaggregation.[3] The tool is also highly flexible to accommodate and combine different sector classification systems, which often make combining tariff schedules and sector-specific production data a cumbersome and time-consuming exercise.

The remainder of this paper explains how UTAS can assist policy makers in considering the impact of different trade reform options on tariff-related costs for firms active in downstream activities and on effective protection rates across sectors. Section 2 outlines the overall objective of UTAS and how it allows policy makers to overcome a series of practical challenges when assessing the impact of tariff reform. Section 3 describes the analytical framework underlying UTAS. The structure of the tool and data requirements are discussed in section 4. Section 5 presents a series of policy examples that can be addressed with UTAS. Section 6 concludes.

[2] Previous simulation tools include, for example, TRIST and SMART (Brenton et al., 2011).
[3] I/O tables from GTAP are provided alongside the tool.

2) The purpose of UTAS

UTAS allows users to take full ownership of the tool and to develop it further to address varying country needs. It offers solutions to several challenges that typically complicate policy makers' assessment of the impact of tariff reforms on production costs in a flexible and time-efficient manner.

First, previous studies assessing the impact of tariffs on firms' production costs and effective protection have generally relied on firm-level survey or census data on manufacturing that allow disaggregating firms' consumption of intermediate inputs. These data are then used to extract firms' input cost shares and weigh input tariffs accordingly, and to subsequently attain firm-level estimates of tariff-related cost.[4] Most often, however, such highly disaggregated firm-level data are not readily available, as they tend to include sensitive information and are expensive and time-consuming to collect. The alternative pursued in UTAS is to build on economy-wide input-output (I/O) tables that provide a disaggregation of production costs by sector. Although more aggregated than firm-level data, I/O tables are available in most countries and allow policy makers to attain a quick overview of varying input cost shares across sectors.[5] Yet the use of I/O tables is not without its challenges. Sector classifications of most I/O tables cannot be matched easily with available tariff-schedules typically classified at a much finer product level on the basis of the Harmonized System (HS) tariff nomenclature of the WTO. UTAS overcomes this problem by drawing on pre-defined concordance tables between HS codes and a range of commonly used I/O sector classifications (e.g. GTAP, ISIC or NAICS). A key function of UTAS is therefore to help users handling different sets of data to combine tariff schedules with I/O sectors' input cost shares and to calculate tariff-related input costs and effective protection rates for different sectors.

Second, a common problem to both firm-level data and I/O tables is that it involves assigning weights to each input tariff according to a firm's/industry's *current* reliance on that particular input. To date, most academic research has followed this approach (e.g. Amiti and Konings, 2007; Topalova and Khandelwal, 2011; Yu, 2014). The drawback of pursuing such a weighting approach is that it will understate the true cost impact of an upstream tariff reduction, as it does not consider substitution effects that could kick-in, if tariffs were to be removed. Moreover, *new* intermediates, which are used only after an input tariff is removed, will not be taken into account, as they will carry an effective weight of zero. Diakatoni and Escaith (2012) underline that the failure of taking into account substitution effects also puts the calculation of effective protection rate on weak theoretical grounding. In practice, a strategy to assess the magnitude of this bias could for example involve the use of a proxy I/O cost structure pertaining to a different country that is deemed less distorted by tariffs and is assumed to represent the sectors' I/O structure in the absence of input tariffs. This implies assuming technological convergence across countries or across groups of countries with similar characteristics. By allowing for an easy switch between different I/O tables, UTAS enhances policy makers' ability to carry out such sensitivity analyses and allows benchmarking results against the use of different I/O tables in a straightforward manner.

Third, studies that have calculated upstream tariff costs and effective protection rates have generally done so on the basis of direct input requirements alone. This omits the possibility of input tariffs affecting production costs indirectly through the value chain. To the extent that producers in upstream sectors are able to pass on changes in tariff costs to downstream producers, the true cost impact of a tariff on an upstream activity will be underestimated, if solely direct requirements are considered. UTAS automatically re-calculates I/O tables that take into account direct and indirect requirements

[4] An example is Amiti and Konings (2007) or Rahardja and Varela (2014).
[5] GTAP has input output information on over 120 countries.

and allows users to choose between original I/O tables that reflect either direct intermediate input requirements alone, or that take into account both direct and indirect requirements.[6] Moreover, it allows users to deviate from the perfect homogeneity assumption between imports and domestic inputs, underlying most studies on tariff-related input costs available to date.[7] Assuming perfect homogeneity between imported and domestic varieties has two implications. First, domestic input producers are likely to compete with an infinitely elastic supply of imports and will therefore be unable to pass-on higher tariff associated costs to upstream producers. Only then would calculating upstream tariffs on the basis of direct inputs alone appear to be the appropriate assumption. Second, the pass-through from changes in tariffs to changes in input costs is likely to be close to 100 percent. By allowing for differentiation between the domestic and imported varieties of the same product, UTAS thus allows considering scenarios where the pass-through effect of input tariffs on production costs is incomplete. With this choice, UTAS therefore greatly increases the range of modeling scenarios that can be considered compared to previous applications.

3) Analytical framework

UTAS is an Excel-based tool that allows policy makers to simulate the impact of tariffs on production costs across sectors in an economy and perform comparative static analysis for different tariff structures on the basis of a simple partial equilibrium framework.[8] It combines I/O data with detailed product-level tariff data to establish average output tariff rates for each sector specified in the I/O table. To do this, UTAS draws on a series of pre-set concordance tables that establish how product-level tariff schedules match with more aggregate sector-level data of I/O tables. For each I/O sector, the tool then calculates an upstream tariff (UT) reflecting the total incidence of all intermediate input tariffs on sector i's production costs as follows:

$$UT_i = \sum_{j=1}^{J} w_{ij}\beta_j t_j \qquad (1)$$

The variable w_{ij} stands for the weight of upstream sector j in sector i's total production output and t_j stands for the simple average of all ad-valorem tariffs on products that belong to input sector j. The parameter β_j measures the level of pass-through of a tariff in sector j on output prices of sector j and can take values between 0 and 1. On the basis of equation (1), UTAS then establishes the effective protection rate (EPR) in each sector i. Effective protection rates measure how a sector's output protection weighs up against the tariff costs it faces due to protection accorded to upstream sectors relative to a sector's value added. They are calculated as follows:

$$EPR_i = \frac{\beta_i t_i - UT_i}{va_i} \qquad (2)$$

Equation (2) deducts from a sector i's nominal protection ($\beta_i t_i$) the additional production cost that producers face on account of upstream tariffs (UT_i), where this difference is compared with the sector's value added share in total output (va_i). It therefore allows policy makers to gauge the net impact of an entire tariff schedule given the sector's backward linkages.

[6] This is done by calculating Leontief's inverse.

[7] An exception is a paper by Chevassus-Lozza et al. (2013) who show that under imperfect competition and product differentiation the impact of lower input tariffs on the probability of firms entering export markets will differ between high and low productivity firms.

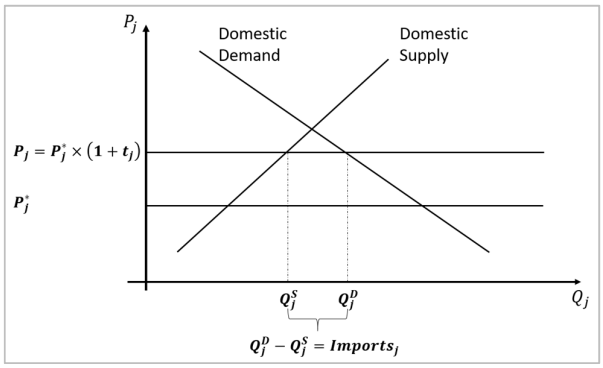
[8] Notice that the partial equilibrium approach implies that UTAS considers sectors in isolation from each other. Substitution effects between sectors are not taken into account. UTAS therefore captures predominantly short-term effects. Substitution effects that take longer to materialize and may kick in once firms start to respond to new price signals are not considered.

To implement equations (1) and (2), the magnitudes of both w_j and β_j need to be determined. In UTAS these depend on one of the following two modeling frameworks, which are discussed in turn.

3.1) Modeling framework A - Product homogeneity

The product homogeneity framework assumes that imported and domestically produced inputs within a sector are indistinguishable from each other. In this case, domestic upstream producers of inputs will compete with a fully elastic supply curve of imported inputs, as shown in Figure 1. Downstream producers will face input prices that are equivalent to each input's world market price plus its tariff. In this case the tariff pass-through on input prices will therefore be exactly 100 percent, hence $\beta_j = 1$. Note also that because domestic upstream producers compete against a fully elastic foreign supply, they will not be able to pass-on increasing costs to downstream sectors. Indirect effects of tariffs on upstream sectors emanating from value chain linkages will not have any impact on downstream sector costs. In the product homogeneity framework, w_{ij} will therefore be set taking into account only the direct I/O weight of sector j in sector i's total production output.

Figure 1: Price pass-through of an increase input tariffs under product homogeneity



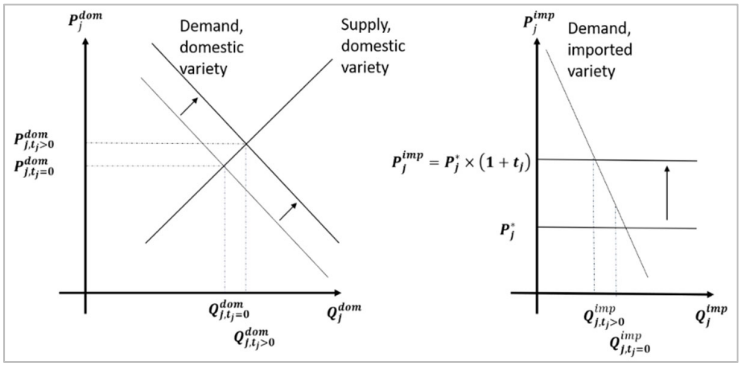
3.2) Modeling framework B - Product differentiation

The starting point for this modeling framework is the assumption that all inputs have exactly two varieties: an imported one and a domestically produced one. They are assumed to be imperfect substitutes of each other. The imposition of a tariff on the imported variety will cause demand for the imported variety to decline and the demand for the domestic variety to increase accordingly. Yet due to the imperfect substitutability assumption the pass-through effect of the tariff on the average price for the input will not be complete, hence $\beta_j < 1$. The specific size of β_j will depend on how the price of the domestically produced input responds to the tariff. UTAS allows us to consider two effects. First, it allows users to define the size of the substitution elasticity in each input sector j between the imported and domestic varieties. A higher elasticity of substitution will cause a larger shift in the demand for the domestic variety in response to a tariff, and thus a larger increase in the overall price of that input, than when the elasticity of substitution is low (see left panel of Figure 2). Second, it allows users to set elasticities of supply specific to the domestic supply of each input sector j. Higher elasticities of supply will imply a smaller pass-through than lower elasticities of supply.[9] Furthermore, product differentiation implies that upstream sectors do not compete against a perfectly elastic supply of imports and therefore have some ability to pass-on costs to downstream producers. This implies

[9] The formulae used to calculate β_j under the assumption of product differentiation is detailed in the appendix.

that downstream sectors will not only be affected through increase in inputs directly, but also indirectly through value-chain linkages, as upstream suppliers of inputs will hike their prices in response to higher tariff-related costs. In this framework, w_{ij} will therefore be set to reflect both the direct and the indirect I/O weight of sector j in sector i's total production output.

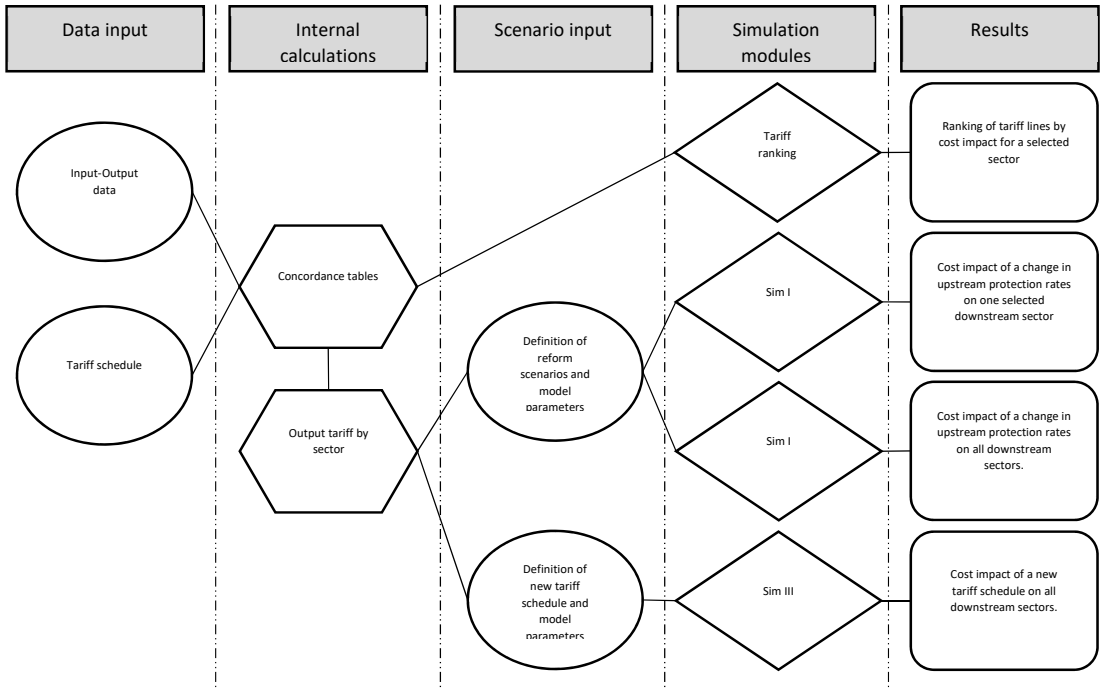
Figure 2: Price pass-through of an increase input tariffs under product differentiation



4) Data requirements and simulation modules

UTAS consists of a single Microsoft Excel file that facilitates both the data uploading process and implementation of simulations. The overall structure of the tool is illustrated in Figure 3. In this section we first describe the data requirements, followed by an explanation of available simulation modules UTAS has on offer.

Figure 3: UTAS flow chart



4.1) Data requirements

The data requirements of UTAS are relatively limited. The tool requires only two sets of data that are available in most countries: (i) a country's prevailing tariff structure by product and (ii) an input-output matrix that provides information on the direct intermediate input usage in each output sector. The tariff schedule details the ad-valorem tariff applying to the importation of each product at HS 10-, 8-, or 6-digit disaggregation.[10] The I/O tables can come in different forms, be more or less disaggregated, and build on distinct sector classification systems. Hence, for UTAS to be able to read an I/O table correctly, it will have to undergo a specific formatting process that converts the table into a matrix format with N output sector columns and J input sector rows, where $N = J$, as illustrated in Figure 4. In addition, the table will include three rows at the bottom of the matrix reporting totals for intermediate consumption, value added, and output of each sector. Users will have to make sure that each row and each column is identified by a corresponding sector code. UTAS can read three types of sector classification systems: GTAP, NAICS, and ISIC. Each classification system comes with a separate concordance table to match I/O sectors with tariffs at the HS product level. The three classification systems and their corresponding concordance tables are described in the subsection below.

Figure 4: I/O table format

Output Sector / Input Sector	Output sector 1	Output sector 2	…	Output sector N
Input sector 1	IC_{11}	IC_{21}	…	IC_{N1}
Input sector 2	IC_{12}	IC_{22}	…	IC_{N2}
…	…	…	…	…
Input Sector J	IC_{1J}	IC_{2J}	…	IC_{NJ}
Total intermediate consumption	$IC_1 = \sum_{j=1}^{J} IC_{1j}$	$IC_2 = \sum_{j=1}^{J} IC_{2j}$	…	$IC_N = \sum_{j=1}^{J} IC_{NJ}$
Total value added	VA_1	VA_2	…	VA_N
Total industry input	$Output_1$	$Output_2$	…	$Output_N$

Sector classifications in UTAS

The following classifications can be used in UTAS.

GTAP sectors

The GTAP classification system distinguishes between 57 sectors and is used in the construction of I/O tables of the Global Trade Analysis Project (GTAP). Although relatively aggregated at a sector level, these I/O tables are readily available for a wide range of countries and can be used where more disaggregated I/O tables are not available. Moreover, their standardized construction procedure allows for easy cross-country comparison of results.

The concordance table that is used to match GTAP sectors with HS product-level codes is based on the 'HS Combined to GTAP' concordance table of the World Bank Integrated Trade Solution (WITS) software available here: https://wits.worldbank.org/product_concordance.html.

NAICS sectors

[10] Tariff schedules can be defined in either of the different HS revisions (HS1988, HS1996, HS2002, HS2007, or HS 2012).

The North American Industry Classification System (NAICS) spans 385 sectors and is the standard used by the US Bureau of Economic Analysis (BEA) in producing its I/O tables for the US economy. The advantage of NAICS is that it allows users to simulate the impact of upstream tariffs on a very detailed sector disaggregation. The disadvantage is that few countries will have I/O tables based on NAICS. However, policy makers may want to benchmark the impact upstream tariffs using a foreign I/O table as basis for their simulations to better reflect the input cost structure of industries operating at the technology frontier and with limited tariff distortion. In such cases, the use of a US I/O table with an NAICS sector disaggregation may come in handy.

The concordance table that is used to match NAICS sectors with HS product-level codes is based on work by Pierce and Schott (2009) is available for download under the following link: http://faculty.som.yale.edu/peterschott/sub_international.htm.

ISIC Revision 3 sectors

The International Standard Industrial Classification System (ISIC) covers 145 different sectors and is a widely used standard to classify productive activities. In countries that use specific classification systems, concordance tables between national and ISIC industry codes are often readily available. Users may therefore want to use national I/O tables as a basis for their simulations by first converting them into ISIC Rev. 3 classification.

The concordance table that is used to match ISIC sectors with HS product-level codes is based on the 'HS Combined to ISIC Rev3' concordance table of the World Bank Integrated Trade Solution (WITS) software available here: https://wits.worldbank.org/product_concordance.html.

4.2) The UTAS simulation modules

UTAS includes four simulation modules that allow users to seek answers to four different policy questions related to the impact of tariffs on production costs. We discuss each in turn.

The *Tariff ranking* module allows users to establish which tariff lines of the HS tariff schedule have a particularly large impact on the cost structure in a particular sector. Based on the concordance tables of the respective sector classification chosen by the user, this tool generates a ranking of tariff lines at the HS 6-digit product level, where a top-ranked product implies that the prevailing protection accorded to this product has a particularly large cost impact on a selected output sector. The module is therefore intended to provide policy makers with a quick overview of how the tariff schedule and production costs intertwine across different sectors. It does not, however, quantify the impact of a particular tariff on sector costs. This is left to the modules described below.

Second, the *Sim I* module allows users to select a specific output sector i and analyze how a change in tariffs of sector i's ten most important input sectors would affect sector i's production costs. This is done in steps. A baseline upstream tariff for the selected sector i is first calculated in line with equation (1). The user can then consider an increase or a reduction in the tariffs on sector i's ten most important intermediate input sectors. UTAS subsequently calculates a new upstream tariff and a new effective protection rate based on the revised/simulated tariff schedule. The difference in the baseline and simulated figures is then used to establish the overall impact of the reform on sector i.

Third, rather than focusing on one priority sector alone, the *SIM II* module allows policy makers to examine how revising a tariff on one or several intermediate input sectors affects costs and effective protection rates across all output sectors. The tool calculates baseline upstream tariffs and effective protection rates for all sectors based on the data uploaded to UTAS. Users can then modify the prevailing tariff on specific input sectors. New upstream tariffs and effective protection rates are subsequently calculated based on the simulated tariff schedule for all output sectors. The difference between baseline and simulated values is then used to assess the overall cost impact of the reform across different sectors.

Fourth, at times policy makers will want to consider the impact of a change in tariffs defined at the product level. To this end, module *Sim III* allows users to define an entirely new tariff schedule and simulate how the change in the tariff schedule affects costs and effective protection rates across sectors. The tool then calculates two sets of upstream tariffs: the first on the basis of the original tariff schedule and the second on the basis of the new/revised tariff schedule. The difference in the two sets of upstream tariffs is then used to assess the cost impact of the tariff changes in each sector.

5) Using UTAS for trade policy analysis

How do changes in tariffs affect production costs and effective protection rates across sectors? This question lies at the core of UTAS. An in-depth understanding of the impact of tariff reform on downstream production costs and on effective rather than only nominal protection rates is important for countries seeking to boost their competitiveness. Yet while the academic literature provides important guidance on how intermediate input tariff reductions affect downstream firms' performance in terms of export competitiveness, productivity or diversification, the available research is not always easy to translate into quantifiable estimates for policy purposes in a timely manner. In this section we discuss two practical examples to illustrate how UTAS can be used to assist policy makers in analyzing the implications of tariff reforms, followed by a series of additional considerations that should be considered when using UTAS for policy simulations.

5.1) Declining tariffs on intermediate inputs in textiles and apparel manufacturing in Nepal

Textiles and apparel are Nepal's most important merchandise exports. Over the last decade, however, Nepal's exports of textiles and apparel have stagnated. In 2017 they amounted to US$342 million compared to US$362 a decade earlier, according to figures from UN Comtrade. A key trade policy question therefore is how growth in textiles and apparel can be reinvigorated to boost the country´s exports base. Key among possible measures is the reduction of tariffs and para-tariffs on intermediate goods to reduce production costs of domestic firms and promote adoption of cheaper or better quality inputs from wherever they are most efficiently sourced. In parallel, this should be combined with a gradual reduction in these sectors' output tariffs to lower effective protection levels accorded to these sectors, which will reduce the overall anti-export bias and promote a greater outward orientation of firms active in these sectors.

We use UTAS to assess the impact that such a strategy would have on the textiles and wearing apparel sectors and rely on data from GTAP to account for the production structure in these sectors in Nepal. Data on import duties are taken from the UN TRAINS. For simplicity, all our simulations are based on the product homogeneity modeling framework of UTAS, which assumes a complete tariff pass-through on domestic prices.[11] The following policy questions guide our exposition. Screenshots of UTAS are included to facilitate a step-by-step replication of our results in UTAS.

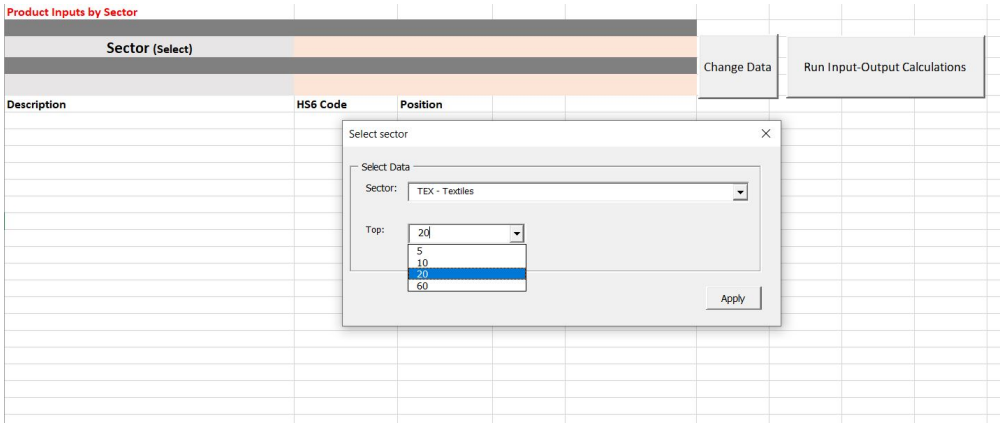
Q1: Which tariffs have the greatest impact on upstream production cost?

The *Tariff-ranking* module allows users to establish which tariff lines at the HS 6-digt level have the largest impact on a particular sector. We use the module to determine the 20 tariffs with the highest impact for the apparel and textiles sectors, respectively. In the *Tariff-ranking* module this is done by clicking on the 'Change Data' icon and selecting the appropriate sector and the number of tariff lines to be considered in the analysis (see Figure 5).

[11] Less restrictive assumptions are considered in the example of Section 5.2

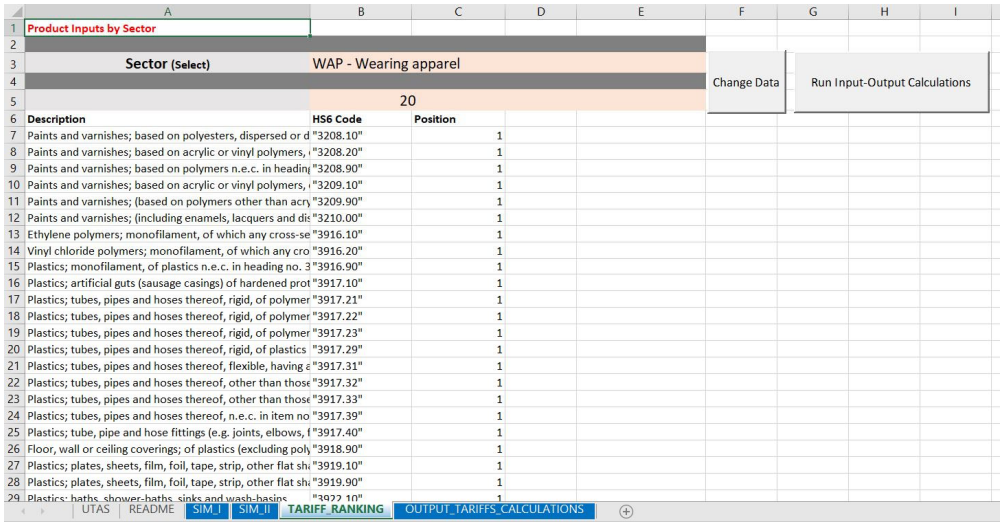
For wearing and apparel, there are 37 tariff lines that have the same maximum impact score and are thus all ranked in position one (see Figure 6). All these tariff lines belong to chapters 32 (i.e. tanning and dying extracts) and 39 (i.e. plastics and articles thereof). Meanwhile, for the textiles sector, the tariff lines with the highest impact score on the sector's upstream costs belong to chapter 57 (i.e. textiles and other textiles floor coverings).

Figure 5: Data selection in the UTAS Tariff-ranking module



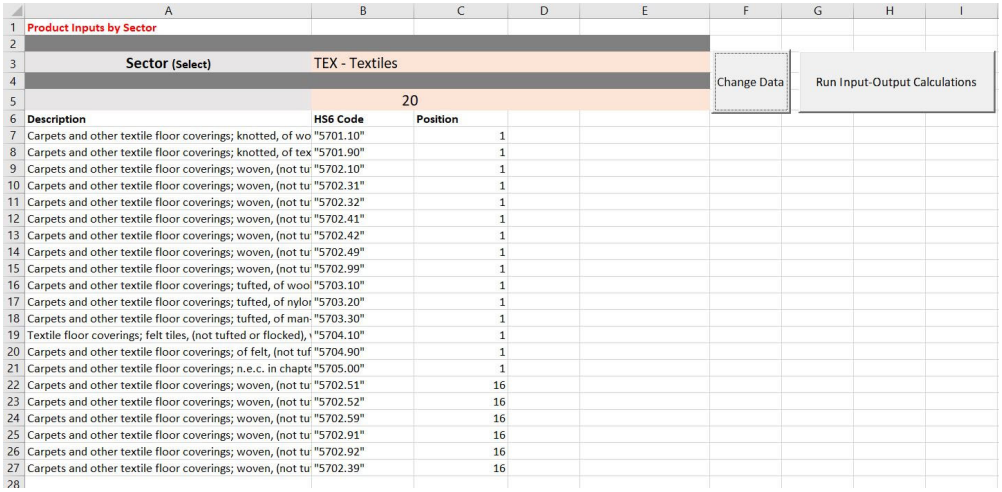
Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Figure 6: Tariffs with highest impact on upstream costs in the wearing apparel sector



Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Figure 7: Tariffs with highest impact on upstream costs in the textiles sector



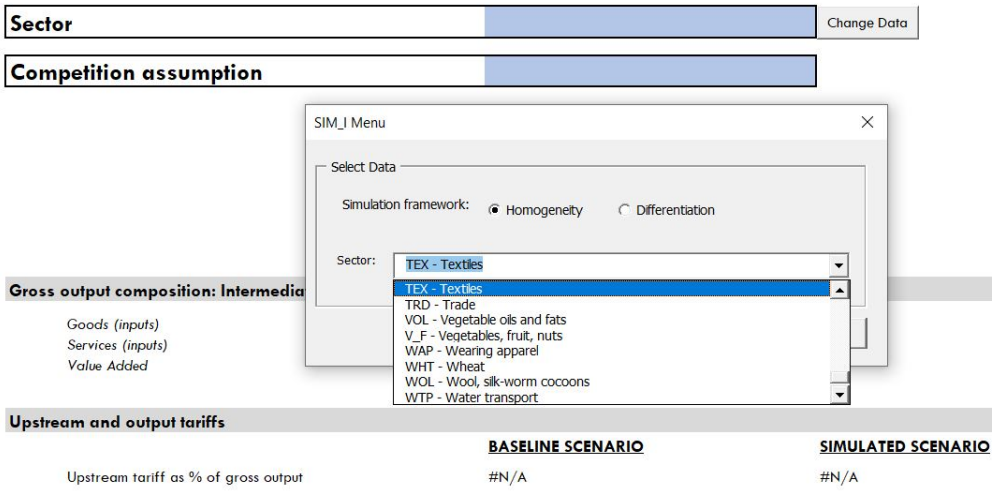
	A	B	C	D	E	F	G	H	I
1	Product Inputs by Sector								
2									
3	Sector (Select)	TEX - Textiles				Change Data		Run Input-Output Calculations	
4									
5		20							
6	Description	HS6 Code	Position						
7	Carpets and other textile floor coverings; knotted, of wo	"5701.10"	1						
8	Carpets and other textile floor coverings; knotted, of tex	"5701.90"	1						
9	Carpets and other textile floor coverings; woven, (not tu	"5702.10"	1						
10	Carpets and other textile floor coverings; woven, (not tu	"5702.31"	1						
11	Carpets and other textile floor coverings; woven, (not tu	"5702.32"	1						
12	Carpets and other textile floor coverings; woven, (not tu	"5702.41"	1						
13	Carpets and other textile floor coverings; woven, (not tu	"5702.42"	1						
14	Carpets and other textile floor coverings; woven, (not tu	"5702.49"	1						
15	Carpets and other textile floor coverings; woven, (not tu	"5702.99"	1						
16	Carpets and other textile floor coverings; tufted, of wool	"5703.10"	1						
17	Carpets and other textile floor coverings; tufted, of nylo	"5703.20"	1						
18	Carpets and other textile floor coverings; tufted, of man-	"5703.30"	1						
19	Textile floor coverings; felt tiles, (not tufted or flocked),	"5704.10"	1						
20	Carpets and other textile floor coverings; of felt, (not tuf	"5704.90"	1						
21	Carpets and other textile floor coverings; n.e.c. in chapte	"5705.00"	1						
22	Carpets and other textile floor coverings; woven, (not tu	"5702.51"	16						
23	Carpets and other textile floor coverings; woven, (not tu	"5702.52"	16						
24	Carpets and other textile floor coverings; woven, (not tu	"5702.59"	16						
25	Carpets and other textile floor coverings; woven, (not tu	"5702.91"	16						
26	Carpets and other textile floor coverings; woven, (not tu	"5702.92"	16						
27	Carpets and other textile floor coverings; woven, (not tu	"5702.39"	16						
28									

Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Q2: Which intermediate input sectors contribute most to downstream costs in textiles and apparel sectors?

This question can be answered using the *Sim I* module in UTAS. The first step involves selecting the simulation framework and the relevant sector for which the analysis is to be conducted. This is done by clicking on the 'Change Data' icon in the top right corner of the module (see Figure 8). The contribution of different intermediate input sectors to upstream tariff costs is then displayed in lines 32 to 41 of the module.

Figure 8: Simulation framework and sector selection in UTAS SIM I module



Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

For Nepal's apparel sector, there are eight input sectors that contribute upstream tariff costs (see Figure 9). Chemical/rubber/plastic products and textiles contribute 90 percent of the total upstream tariff costs of firms operating in the wearing apparel sector. For textiles, the intermediate sectors that affect upstream tariff costs are less concentrated, with nine different input sectors having an impact

on upstream tariff costs (see Figure 10). Tariffs on textiles contribute most of the upstream tariff burden, followed by the mineral products, metal products and chemical/rubber/plastic products.[12]

Figure 9: Contribution of intermediate input sectors to upstream tariff costs in wearing and apparel

Composition of upstream tariff by largest contributing sectors

#	Sector in NAICS	Baseline contribution to upstream tariff	Baseline Tariff	Share in input cost structure (US)
1	CRP - Chemical, rubber, plastic products	46.6%	8.3%	23.4%
2	TEX - Textiles	43.1%	10.8%	16.6%
3	NMM - Mineral products n.e.c.	8.3%	13.5%	2.6%
4	FMP - Metal products	1.6%	9.5%	0.7%
5	WAP - Wearing apparel	0.3%	19.0%	0.1%
6	LEA - Leather products	0.1%	11.9%	0.0%
7	COA - Coal	0.1%	5.0%	0.0%
8	P_C - Petroleum, coal products	0.1%	8.9%	0.0%
9	OME - Machinery and equipment n.e.c.	0.0%	7.9%	0.0%
10	OMF - Manufactures n.e.c.	0.0%	7.8%	0.0%

Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Figure 10: Contribution to intermediate input sectors to upstream tariff costs in textiles

Composition of upstream tariff by largest contributing sectors

#	Sector in NAICS	Baseline contribution to upstream tariff	Baseline Tariff	Share in input cost structure (US)
1	TEX - Textiles	37.2%	10.8%	16.4%
2	NMM - Mineral products n.e.c.	18.8%	13.5%	6.7%
3	FMP - Metal products	17.0%	9.5%	8.5%
4	CRP - Chemical, rubber, plastic products	12.6%	8.3%	7.2%
5	PFB - Plant-based fibers	10.5%	4.3%	11.7%
6	MVH - Motor vehicules and parts	2.7%	24.8%	0.5%
7	I_S - Ferrous metals	0.9%	10.7%	0.4%
8	COA - Coal	0.2%	5.0%	0.2%
9	P_C - Petroleum, coal products	0.1%	8.9%	0.0%
10	OME - Machinery and equipment n.e.c.	0.0%	7.9%	0.0%

Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Q3: How would apparel and textiles sectors benefit, if tariffs on intermediate input sectors were to be halved?

The *SIM I* module also allows us to consider what would happen, if baseline tariff rates were to be halved on all intermediate inputs in wearing apparel and textiles sectors. We do this by specifying a 'Simulated Tariff' that is half the baseline tariff in each input sector.[13] In line 19 of *SIM I*, UTAS then calculates the percentage point change of such a reduction in input tariffs. Figure 11 and Figure 12 illustrate this for each sector respectively. Starting with wearing apparel, we find that halving import tariffs on intermediate inputs would cause upstream tariff costs to decline only from 3.1 percent to 1.6 percent. In the textiles sector, upstream tariff costs fall from 4.2 percent to 2.1 percent.

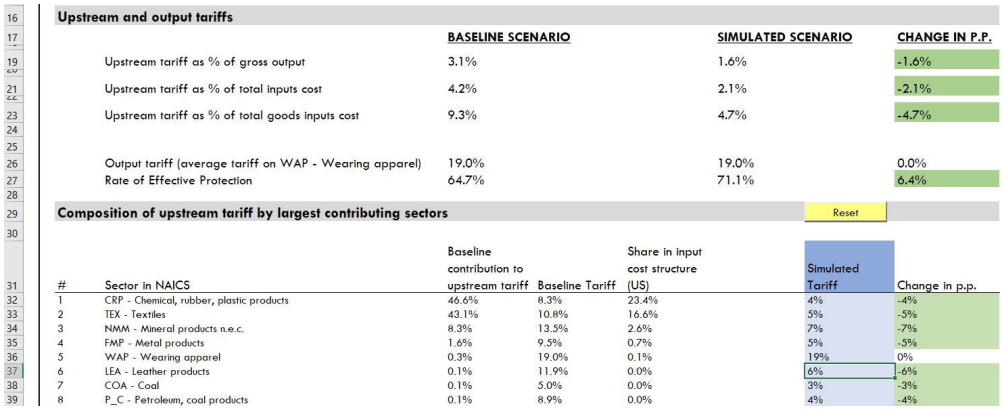
The effects are slightly larger when we look at effective protection rates in each sector, which are calculated in line 27 of *SIM I*. If output tariffs on wearing apparel are to remain unchanged (as assumed here), the reduction in upstream tariff costs would imply an increase in effective protection rates by

[12] This implies that in the case of textiles a significant portion of upstream tariff costs is explained by intra-sector input-output relationships. Ideally, one would therefore be able to further unpick these intra-sector links using more disaggregated I/O tables, subject to data availability constraints.

[13] Note that we do not apply the reduction in input tariffs on intra-sectoral inputs, i.e. when wearing apparel and textiles are an input to themselves.

6.4 percentage points. In the case of the textiles sector, the increase would amount to 10.2 percentage points. The magnitude of the effects seems to be larger in the case of upstream costs. Note, however, that measures of effective protection compare how a sector's output protection weighs up against the tariff costs it faces due to protection accorded to upstream sectors, relative to the sector's value added. Effects on effective protection are thus magnified, if value added in a sector is low.

Figure 11: Upstream tariffs and effective protection costs in wearing and apparel



Upstream and output tariffs

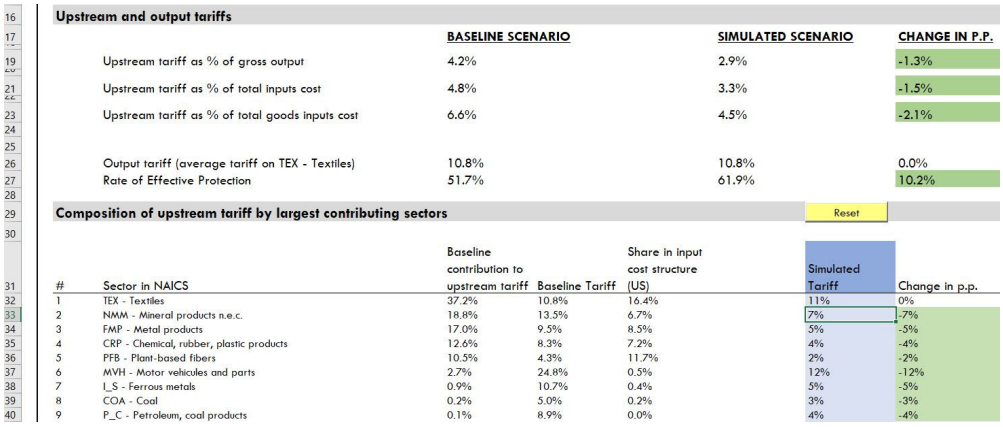
	BASELINE SCENARIO	SIMULATED SCENARIO	CHANGE IN P.P.
Upstream tariff as % of gross output	3.1%	1.6%	-1.6%
Upstream tariff as % of total inputs cost	4.2%	2.1%	-2.1%
Upstream tariff as % of total goods inputs cost	9.3%	4.7%	-4.7%
Output tariff (average tariff on WAP - Wearing apparel)	19.0%	19.0%	0.0%
Rate of Effective Protection	64.7%	71.1%	6.4%

Composition of upstream tariff by largest contributing sectors — Reset

#	Sector in NAICS	Baseline contribution to upstream tariff	Baseline Tariff	Share in input cost structure (US)	Simulated Tariff	Change in p.p.
1	CRP - Chemical, rubber, plastic products	46.6%	8.3%	23.4%	4%	-4%
2	TEX - Textiles	43.1%	10.8%	16.6%	5%	-5%
3	NMM - Mineral products n.e.c.	8.3%	13.5%	2.6%	7%	-7%
4	FMP - Metal products	1.6%	9.5%	0.7%	5%	-5%
5	WAP - Wearing apparel	0.3%	19.0%	0.1%	19%	0%
6	LEA - Leather products	0.1%	11.9%	0.0%	6%	-6%
7	COA - Coal	0.1%	5.0%	0.0%	3%	-3%
8	P_C - Petroleum, coal products	0.1%	8.9%	0.0%	4%	-4%

Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Figure 12: Upstream tariffs and effective protection costs in wearing and apparel



Upstream and output tariffs

	BASELINE SCENARIO	SIMULATED SCENARIO	CHANGE IN P.P.
Upstream tariff as % of gross output	4.2%	2.9%	-1.3%
Upstream tariff as % of total inputs cost	4.8%	3.3%	-1.5%
Upstream tariff as % of total goods inputs cost	6.6%	4.5%	-2.1%
Output tariff (average tariff on TEX - Textiles)	10.8%	10.8%	0.0%
Rate of Effective Protection	51.7%	61.9%	10.2%

Composition of upstream tariff by largest contributing sectors — Reset

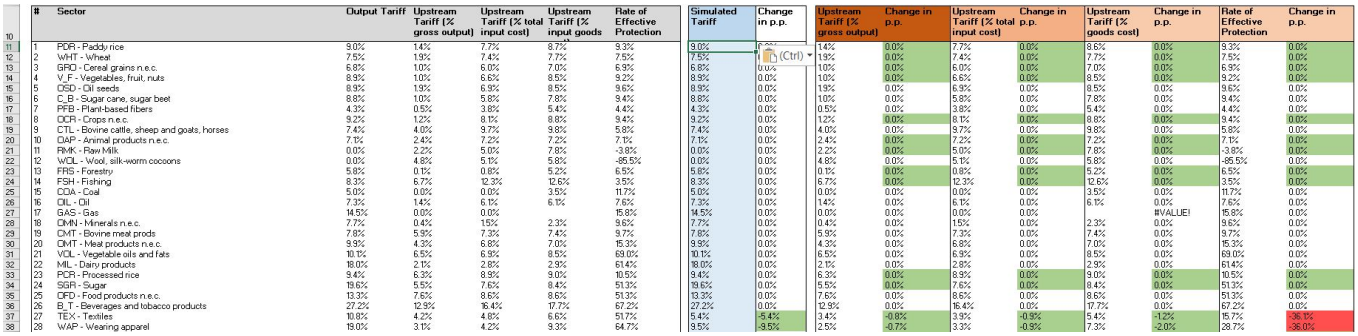
#	Sector in NAICS	Baseline contribution to upstream tariff	Baseline Tariff	Share in input cost structure (US)	Simulated Tariff	Change in p.p.
1	TEX - Textiles	37.2%	10.8%	16.4%	11%	0%
2	NMM - Mineral products n.e.c.	18.8%	13.5%	6.7%	7%	-7%
3	FMP - Metal products	17.0%	9.5%	8.5%	5%	-5%
4	CRP - Chemical, rubber, plastic products	12.6%	8.3%	7.2%	4%	-4%
5	PFB - Plant-based fibers	10.5%	4.3%	11.7%	2%	-2%
6	MVH - Motor vehicules and parts	2.7%	24.8%	0.5%	12%	-12%
7	I_S - Ferrous metals	0.9%	10.7%	0.4%	5%	-5%
8	COA - Coal	0.2%	5.0%	0.2%	3%	-3%
9	P_C - Petroleum, coal products	0.1%	8.9%	0.0%	4%	-4%

Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

Q4: How would other downstream sectors benefit if nominal tariffs on textiles and apparel were to be halved simultaneously?

We address this question with the help of module *SIM II*, which allows to analyze how a change in output tariff in one or several sectors affects all other sectors simultaneously. We specify a simulated output tariff equal to half the baseline tariff of 19.0 percent and 10.8 percent in the wearing apparel and textiles sectors respectively. Figure 13 shows the output generated in UTAS. The change in output tariffs in both the wearing apparel and textiles sectors specified in lines 37 and 38 of the module hardly has any repercussions in other downstream activities because of the limited forward linkages apparel and textiles have with other sectors. The decline in output tariffs would however generate a strong reduction in effective protection rates of 36 percent in both apparel and textiles sectors.

Figure 13: Potential impact of lower output tariffs in apparel and textiles sectors in downstream activities



#	Sector	Output Tariff	Upstream Tariff (% gross output)	Upstream Tariff (% total input cost)	Upstream Tariff (% input goods	Rate of Effective Protection	Simulated Tariff	Change in p.p.	Upstream Tariff (% gross output)	Change in p.p.	Upstream Tariff (% total input cost)	Change in p.p.	Upstream Tariff (% goods cost)	Change in p.p.	Rate of Effective Protection	Change in p.p.
1	PDR - Paddy rice	9.0%	1.4%	7.7%	8.7%	9.3%	9.0%		1.4%	0.0%	7.7%	0.0%	8.6%	0.0%	9.3%	0.0%
2	WHT - Wheat	7.5%	1.9%	7.4%	7.7%	7.5%	7.5%	0.0%	1.9%	0.0%	7.4%	0.0%	7.7%	0.0%	7.5%	0.0%
3	GRO - Cereal grains n.e.c.	6.8%	1.0%	6.0%	7.0%	6.9%	6.8%	0.0%	1.0%	0.0%	6.0%	0.0%	7.0%	0.0%	6.9%	0.0%
4	V_F - Vegetables, fruit, nuts	8.9%	1.0%	6.6%	8.5%	9.2%	8.9%	0.0%	1.0%	0.0%	6.6%	0.0%	8.5%	0.0%	9.2%	0.0%
5	OSD - Oil seeds	8.9%	1.9%	6.9%	8.5%	9.6%	8.9%	0.0%	1.9%	0.0%	6.9%	0.0%	8.5%	0.0%	9.6%	0.0%
6	C_B - Sugar cane, sugar beet	8.8%	1.0%	5.8%	7.8%	9.4%	8.8%	0.0%	1.0%	0.0%	5.8%	0.0%	7.8%	0.0%	9.4%	0.0%
7	PFB - Plant-based fibers	4.3%	0.5%	3.8%	5.4%	4.4%	4.3%	0.0%	0.5%	0.0%	3.8%	0.0%	5.4%	0.0%	4.4%	0.0%
8	OCR - Crops n.e.c.	9.2%	1.2%	8.1%	8.8%	9.4%	9.2%	0.0%	1.2%	0.0%	8.1%	0.0%	8.8%	0.0%	9.4%	0.0%
9	CTL - Bovine cattle, sheep and goats, horses	7.4%	4.0%	9.7%	9.8%	5.8%	7.4%	0.0%	4.0%	0.0%	9.7%	0.0%	9.8%	0.0%	5.8%	0.0%
10	OAP - Animal products n.e.c.	7.1%	2.4%	7.2%	7.2%	7.1%	7.1%	0.0%	2.4%	0.0%	7.2%	0.0%	7.2%	0.0%	7.1%	0.0%
11	RMK - Raw Milk	0.0%	2.2%	5.0%	7.8%	-3.8%	0.0%	0.0%	2.2%	0.0%	5.0%	0.0%	7.8%	0.0%	-3.8%	0.0%
12	WOL - Wool, silk-worm cocoons	0.0%	4.8%	5.1%	5.8%	-85.5%	0.0%	0.0%	4.8%	0.0%	5.1%	0.0%	5.8%	0.0%	-85.5%	0.0%
13	FRS - Forestry	5.8%	0.1%	0.8%	5.2%	6.5%	5.8%	0.0%	0.1%	0.0%	0.8%	0.0%	5.2%	0.0%	6.5%	0.0%
14	FSH - Fishing	8.3%	6.7%	12.3%	12.6%	3.5%	8.3%	0.0%	6.7%	0.0%	12.3%	0.0%	12.6%	0.0%	3.5%	0.0%
15	COA - Coal	5.0%	0.0%	0.0%	3.5%	11.7%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	11.7%	0.0%
16	OIL - Oil	7.3%	1.4%	6.1%	6.1%	7.6%	7.3%	0.0%	1.4%	0.0%	6.1%	0.0%	6.1%	0.0%	7.6%	0.0%
17	GAS - Gas	14.5%	0.0%	0.0%		15.8%	14.5%	0.0%	0.0%	0.0%	0.0%	0.0%		#VALUE!	15.8%	0.0%
18	OMN - Minerals n.e.c.	7.7%	0.4%	1.5%	2.3%	9.6%	7.7%	0.0%	0.4%	0.0%	1.5%	0.0%	2.3%	0.0%	9.6%	0.0%
19	CMT - Bovine meat prods	7.8%	5.9%	7.3%	7.4%	9.7%	7.8%	0.0%	5.9%	0.0%	7.3%	0.0%	7.4%	0.0%	9.7%	0.0%
20	OMT - Meat products n.e.c.	9.9%	4.3%	6.8%	7.0%	15.3%	9.9%	0.0%	4.3%	0.0%	6.8%	0.0%	7.0%	0.0%	15.3%	0.0%
21	VOL - Vegetable oils and fats	10.1%	6.5%	6.9%	8.5%	69.0%	10.1%	0.0%	6.5%	0.0%	6.9%	0.0%	8.5%	0.0%	69.0%	0.0%
22	MIL - Dairy products	18.0%	2.1%	2.8%	2.9%	61.4%	18.0%	0.0%	2.1%	0.0%	2.8%	0.0%	2.9%	0.0%	61.4%	0.0%
23	PCR - Processed rice	9.4%	6.3%	8.9%	9.0%	10.5%	9.4%	0.0%	6.3%	0.0%	8.9%	0.0%	9.0%	0.0%	10.5%	0.0%
24	SGR - Sugar	19.6%	5.5%	7.6%	8.4%	51.3%	19.6%	0.0%	5.5%	0.0%	7.6%	0.0%	8.4%	0.0%	51.3%	0.0%
25	OFD - Food products n.e.c.	13.3%	7.5%	8.6%	8.6%	51.3%	13.3%	0.0%	7.5%	0.0%	8.6%	0.0%	8.6%	0.0%	51.3%	0.0%
26	B_T - Beverages and tobacco products	27.2%	12.9%	16.4%	17.7%	67.2%	27.2%	0.0%	12.9%	0.0%	16.4%	0.0%	17.7%	0.0%	67.2%	0.0%
27	TEX - Textiles	10.8%	4.2%	4.8%	6.6%	51.7%	5.4%	-5.4%	3.4%	-0.8%	3.9%	-0.9%	5.4%	-1.2%	15.7%	-36.1%
28	WAP - Wearing apparel	19.0%	3.1%	4.2%	9.3%	64.7%	9.5%	-9.5%	2.5%	-0.7%	3.3%	-0.9%	7.3%	-2.0%	28.7%	-36.0%

Source: Output from UTAS based on GTAP data for Nepal and tariff schedule from WITS

5.2) Impact of a tariff reform in Pakistan

In mid-2019 Pakistan increased additional customs duties on several tariff lines with the objective of increasing tax revenues. Two key policy issues facing policy makers in Pakistan are therefore: (i) how the revenue increase from a hike in taxes on international trade compares against the negative effects such taxes have on firms' input costs and (ii) how this strategy exacerbates Pakistan's already strong anti-export bias due to the prevalence of high levels of effective protection.

We show how UTAS can be used to assess the downsides of increasing import duties in terms of their impact on production costs and effective protection rates. We consider Pakistan's 2019 duty increase to illustrate this and use GTAP I/O tables to account for Pakistan's production structure across sectors. To test the sensitivity of our results to the choice of modeling framework, we also consider results when allowing for product differentiation. This relaxes the assumption of product homogeneity and allows the same input to vary depending on whether it is being sourced locally or imported from abroad. We rely on a series of policy questions to guide our exposition and use screenshots from UTAS to facilitate the replication of results.

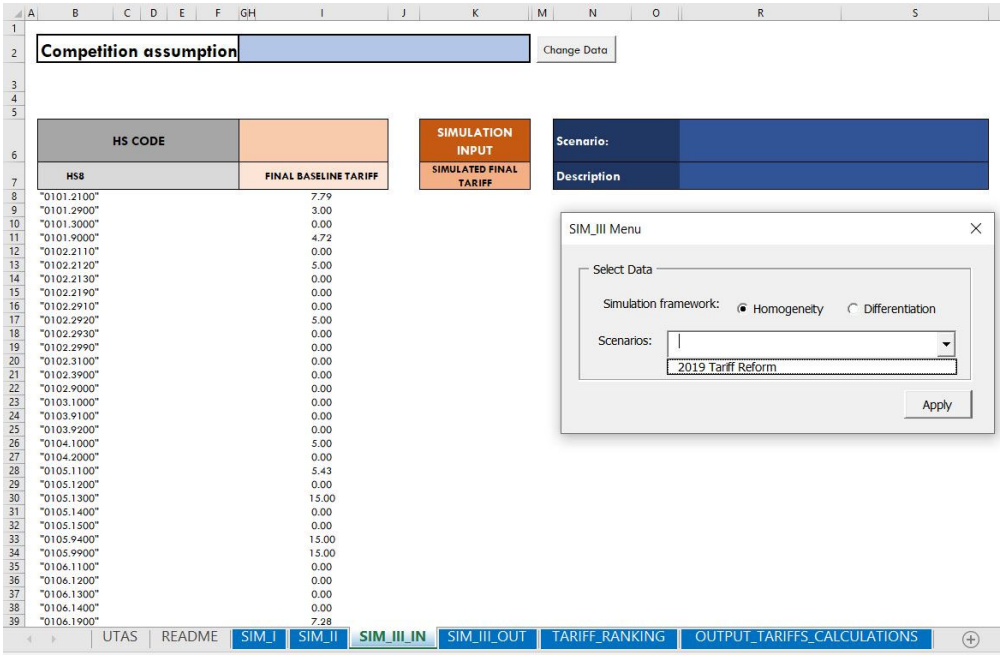
Q1: How did the reform affect nominal protection rates across sectors?

The average increase in customs duties foreseen in Pakistan's 2019 tariff reform amounted to 2.3 p.p. across all products (simple average).[14] How such a change in average tariffs varies across sectors, however, is often time-consuming to establish due to the high disaggregation of tariff schedules. We can use the *SIM III* module to shed a quick light on how the tariff increases compared across sectors. This is done by loading the reform schedule to the data handling worksheet of *SIM III* (i.e. SIM_III_IN), as shown in Figure 14, and subsequently choosing the appropriate simulation framework, which we first set to 'Homogeneity'. UTAS then calculates the change in the average output tariff in each sector (simple average) in the corresponding results worksheet of *SIM III* (SIM_III_OUT), as displayed in Figure 15.

The tariff hikes were highest for heavy manufacturing, followed by construction materials and light manufacturing. Primary sectors, however, were by and large excluded from the tariff hike, with some sectors even experiencing a decline in nominal duty rates.

[14] The weighted average by export volume is even smaller, amounting to only 1.03 percentage points.

Figure 14: Simulation framework and scenario selection in UTAS SIM III module



Source: Output from UTAS based on GTAP data for Pakistan and tariff schedules from FBR.

Figure 15: Impact of 2019 tariff reform on average output tariffs across sectors

#	Sector	Output Tariff	Upstream Tariff (% gross output)	Upstream Tariff (% total input cost)	Upstream Tariff (% input goods	Rate of Effective Protection	Output Tariff	Change in p.p.
1	PDR - Paddy rice	4.2%	4.3%	8.7%	8.7%	-0.3%	0.6%	-3.6%
2	WHT - Wheat	18.2%	2.3%	8.5%	8.6%	21.8%	18.2%	0.0%
3	GRO - Cereal grains n.e.c.	7.1%	3.2%	5.1%	8.7%	10.8%	7.1%	0.0%
4	V_F - Vegetables, fruit, nuts	10.5%	2.0%	4.2%	7.9%	15.3%	11.0%	0.5%
5	OSD - Oil seeds	3.7%	2.2%	4.9%	8.6%	2.6%	3.7%	0.0%
6	C_B - Sugar cane, sugar beet	0.0%	3.0%	8.4%	8.5%	-4.7%	0.0%	0.0%
7	PFB - Plant-based fibers	1.3%	3.5%	8.5%	8.5%	-3.7%	0.8%	-0.5%
8	OCR - Crops n.e.c.	6.0%	0.9%	5.0%	8.3%	6.3%	6.5%	0.4%
9	CTL - Bovine cattle, sheep and goats, horses	2.6%	4.9%	9.0%	11.0%	-4.8%	2.6%	0.0%
10	OAP - Animal products n.e.c.	3.4%	2.8%	5.7%	8.5%	1.4%	3.6%	0.1%
11	RMK - Raw Milk	0.0%	4.7%	9.7%	11.5%	-9.1%	0.0%	0.0%
12	WOL - Wool, silk-worm cocoons	2.4%	5.0%	6.3%	7.0%	-12.7%	2.4%	0.0%
13	FRS - Forestry	5.2%	1.1%	4.7%	9.6%	5.4%	5.1%	-0.2%
14	FSH - Fishing	2.6%	1.3%	2.8%	5.6%	2.4%	2.6%	0.0%
15	COA - Coal	4.0%	2.8%	3.0%	4.0%	18.2%	4.0%	0.0%
16	OIL - Oil	1.5%	2.2%	2.6%	4.3%	-3.7%	1.5%	0.0%
17	GAS - Gas	2.5%	2.2%	2.8%	4.2%	1.4%	1.0%	-1.5%
18	OMN - Minerals n.e.c.	3.8%	0.8%	1.4%	7.2%	6.9%	3.7%	-0.2%
19	CMT - Bovine meat prods	3.2%	0.3%	0.7%	4.6%	4.9%	3.2%	0.0%
20	OMT - Meat products n.e.c.	5.9%	0.3%	0.7%	4.9%	10.3%	7.2%	1.3%
21	VOL - Vegetable oils and fats	5.1%	7.3%	8.0%	12.8%	-28.7%	5.3%	0.2%
22	MIL - Dairy products	37.8%	0.4%	0.9%	5.0%	66.5%	43.4%	5.6%
23	PCR - Processed rice	3.3%	1.6%	2.4%	5.9%	5.0%	3.3%	0.0%
24	SGR - Sugar	19.1%	0.5%	0.7%	1.5%	82.7%	20.7%	1.6%
25	OFD - Food products n.e.c.	21.5%	5.3%	7.7%	13.6%	52.8%	24.2%	2.8%
26	B_T - Beverages and tobacco products	29.4%	2.1%	2.9%	7.4%	98.4%	31.6%	2.2%
27	TEX - Textiles	13.5%	2.4%	3.2%	5.3%	44.3%	16.3%	2.8%
28	WAP - Wearing apparel	20.6%	3.5%	3.7%	13.5%	397.1%	26.1%	5.6%
29	LEA - Leather products	20.8%	20.8%	20.9%	21.2%	6.2%	23.4%	2.6%
30	LUM - Wood products	15.6%	1.0%	5.3%	5.8%	17.3%	19.2%	3.7%
31	PPP - Paper products, publishing	15.9%	0.9%	1.3%	7.3%	52.0%	19.7%	3.8%
32	P_C - Petroleum, coal products	5.5%	1.7%	1.7%	1.8%	1106.9%	5.6%	0.0%
33	CRP - Chemical, rubber, plastic products	9.1%	3.0%	3.4%	10.0%	48.5%	9.9%	0.8%
34	NMM - Mineral products n.e.c.	19.6%	2.7%	3.0%	4.2%	164.6%	24.4%	4.8%
35	I_S - Ferrous metals	13.8%	2.1%	2.3%	3.0%	129.8%	15.0%	1.2%
36	NFM - Metals n.e.c.	4.1%	2.4%	2.6%	3.5%	17.2%	3.4%	-0.7%
37	FMP - Metal products	16.8%	0.7%	0.9%	6.4%	60.0%	20.5%	3.7%
38	MVH - Motor vehicules and parts	26.8%	1.2%	1.6%	9.1%	111.6%	36.4%	9.6%
39	OTN - Transport equipment n.e.c.	7.4%	0.8%	1.1%	9.2%	24.2%	9.5%	2.1%
40	ELE - Electronic equipment	9.3%	0.7%	0.9%	6.8%	36.5%	10.5%	1.2%
41	OME - Machinery and equipment n.e.c.	7.3%	0.8%	1.2%	7.8%	23.4%	8.8%	0.3%
42	OMF - Manufactures n.e.c.	17.9%	2.4%	2.8%	7.5%	106.5%	20.9%	2.9%
43	ELY - Electricity	3.0%	3.0%	3.6%	5.0%	-0.3%	3.0%	0.0%
44	GDT - Gas manufacture, distribution	0.0%	0.6%	0.7%	4.5%	-2.5%	0.0%	0.0%

Source: Output from UTAS based on GTAP data for Pakistan and tariff schedules from FBR.

Q2: How did the reform affect firms' production costs across sectors?

The *SIM III* module also establishes the impact of a tariff reform scenario on sectors' upstream costs. This is shown in Figure 16 based on Pakistan's 2019 tariff reform.

Some of Pakistan's key export industries experienced particularly high increases in production costs due to rising tariffs. Input costs in the manufacture of leather products, for instance, were estimated to have risen by 3 percentage points. This increase was driven by the relatively strong tariff hike on cattle farming and dairy farming, which was set to raise by 5.6 percentage points and which accounts to 53 percent of total input costs in the production of leather products. Other sectors that were also affected were the vegetables oils and fats and wearing apparel sectors. Here the estimated rise in input costs amounted to 1.3 and 0.7 percentage points, respectively. In the services sectors, the increases in input costs were also relatively pronounced. Note also that some sectors, mostly in agriculture, experienced falling input tariff costs. Overall, however, these declines were relatively small and limited to a small number of primary sectors only.

Figure 16: Impact of 2019 tariff reform on production costs across sectors

#	Goods Sectors ranked by largest reduction in upstream tariff (as % total input cost)	Baseline Upstream (% input	Simulated Upstream (% input	Change in p.p.
1	PCR - Processed rice	2.4%	1.7%	-0.7%
2	RMK - Raw Milk	9.7%	9.3%	-0.5%
3	CTL - Bovine cattle, sheep and goats, horses	9.0%	8.6%	-0.4%
4	WOL - Wool, silk-worm cocoons	6.3%	6.1%	-0.2%
5	OAP - Animal products n.e.c.	5.7%	5.5%	-0.1%
6	COA - Coal	3.0%	2.9%	-0.1%
7	GAS - Gas	2.8%	2.7%	-0.1%
8	OIL - Oil	2.6%	2.6%	0.0%
9	NFM - Metals n.e.c.	2.6%	2.6%	-0.03%
10	NMM - Mineral products n.e.c.	3.0%	3.0%	-0.03%
11	I_S - Ferrous metals	2.3%	2.3%	-0.01%
12	P_C - Petroleum, coal products	1.7%	1.7%	-0.01%
13	GDT - Gas manufacture, distribution	0.7%	0.7%	0.00%
14	CMT - Bovine meat prods	0.7%	0.7%	0.0%
15	OMT - Meat products n.e.c.	0.7%	0.7%	0.0%
16	ELY - Electricity	3.6%	3.6%	0.0%
17	MIL - Dairy products	0.9%	0.9%	0.0%
18	LUM - Wood products	5.3%	5.3%	0.1%
19	FMP - Metal products	0.9%	1.0%	0.1%
20	ELE - Electronic equipment	0.9%	1.0%	0.1%
21	SGR - Sugar	0.7%	0.8%	0.1%
22	OMN - Minerals n.e.c.	1.4%	1.5%	0.1%
23	OME - Machinery and equipment n.e.c.	1.2%	1.3%	0.1%
24	OTN - Transport equipment n.e.c.	1.1%	1.2%	0.1%
25	PPP - Paper products, publishing	1.3%	1.5%	0.1%
26	MVH - Motor vehicules and parts	1.6%	1.8%	0.2%
27	B_T - Beverages and tobacco products	2.9%	3.1%	0.2%
28	FSH - Fishing	2.8%	3.1%	0.2%
29	TEX - Textiles	3.2%	3.5%	0.3%
30	OFD - Food products n.e.c.	7.7%	7.9%	0.3%
31	OMF - Manufactures n.e.c.	2.8%	3.1%	0.3%
32	V_F - Vegetables, fruit, nuts	4.2%	4.6%	0.3%
33	OSD - Oil seeds	4.9%	5.4%	0.4%
34	OCR - Crops n.e.c.	5.0%	5.5%	0.4%
35	GRO - Cereal grains n.e.c.	5.1%	5.5%	0.4%
36	FRS - Forestry	4.7%	5.2%	0.6%
37	CRP - Chemical, rubber, plastic products	3.4%	3.9%	0.6%
38	C_B - Sugar cane, sugar beet	8.4%	9.1%	0.7%
39	WAP - Wearing apparel	3.7%	4.4%	0.7%
40	WHT - Wheat	8.5%	9.3%	0.7%
41	PDR - Paddy rice	8.7%	9.4%	0.8%
42	PFB - Plant-based fibers	8.5%	9.3%	0.8%
43	VOL - Vegetable oils and fats	8.0%	9.3%	1.3%
44	LEA - Leather products	20.9%	23.9%	3.0%

#	Service Sectors ranked by largest reduction in upstream tariff (as % total input cost)	Baseline Upstream (as % total	Simulated Upstream (as % total	Change in p.p.
1	OBS: Other business services	0.1%	0.1%	0.0%
2	WTR - Water: collection, purification and distribution	0.9%	1.0%	0.0%
3	ROS - Recreation & Other Services	1.9%	2.1%	0.3%
4	DWE - Dwellings	1.7%	2.0%	0.3%
5	WTP - Water transport	2.7%	3.0%	0.3%
6	CMN - Communications	2.6%	3.0%	0.4%
7	OFI - Other financial intermediation	2.9%	3.4%	0.5%
8	ISR - Insurance	2.9%	3.5%	0.6%
9	OSG - Other Services (Government)	4.0%	4.7%	0.7%
10	ATP - Air transport	7.2%	8.1%	0.9%
11	TRD - Trade	7.0%	8.1%	1.1%
12	OTP - Other Transport	6.8%	7.9%	1.1%
13	CNS - Construction: building houses factories offices a	13.1%	15.5%	2.3%
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Source: Output from UTAS based on GTAP data for Pakistan and tariff schedules from FBR.

Q3: How did the reform affect effective rates of protection across sectors?

The *SIM III* module also calculates changes in effective protection rates (see Figure 17). Note that the absolute magnitude of these effects is significantly larger than when considering the impact on production costs. The reason for this lies in the fact that effective rates of protection are calculated relative to value added. In sectors with low value added, effects are thus magnified.

Effective protection is estimated to have risen with the reform in most sectors. Effects were particularly large in both light and heavy manufacturing and construction materials. In the wearing apparel sector, for instance, the rate of effective protection increased by over 100 percentage points.[15] For the manufacture of vehicle parts, effective protection rose by 41 percentage points, and for mineral products, it rose by 47 percentage points. These results illustrate that even small changes in

[15] Note that in the wearing and apparel sector the EPR was already high before the reform. Relative to the pre-reform level, the EPR thus rose by only 28 percent.

import duty rates can have large effects on effective protection. Although nominal duty rates did not change much, the reform resulted in an important increase in effective protection accorded to key manufacturing sectors. The reform thus exacerbated Pakistan's already high anti-export bias, which is highly detrimental to the growth prospects of these sectors. High effective protection rates reduce the attractiveness of exporting. They also disincentivize firms from investing into more efficient production methods and technology. The reform therefore contributed to firms' tendency to remain more inward oriented and to shy away from competing with international peers operating at the technology frontier. The use of UTAS would have allowed policy makers to deep dive into such policy issues and therefore assess a wider set of policy trade-offs before the reform was adopted.

Figure 17: Impact of 2019 tariff reform on effective protection across sectors

#	Sector	Rate of Effective Protection	Change in p.p.
1	PDR - Paddy rice	-8.2%	-7.9%
2	WHT - Wheat	21.5%	-0.3%
3	GRO - Cereal grains n.e.c.	10.0%	-0.8%
4	V_F - Vegetables, fruit, nuts	16.6%	0.7%
5	OSD - Oil seeds	2.4%	-0.3%
6	C_B - Sugar cane, sugar beet	-5.1%	-0.4%
7	PFB - Plant-based fibers	-5.1%	-1.4%
8	OCR - Crops n.e.c.	6.7%	0.4%
9	CTL - Bovine cattle, sheep and goats, horses	-4.3%	0.5%
10	OAP - Animal products n.e.c.	1.8%	0.4%
11	RMK - Raw Milk	-8.6%	0.4%
12	WOL - Wool, silk-worm cocoons	-11.8%	0.9%
13	FRS - Forestry	5.0%	-0.4%
14	FSH - Fishing	2.2%	-0.2%
15	COA - Coal	19.7%	1.5%
16	OIL - Oil	-3.5%	0.2%
17	GAS - Gas	-5.8%	-7.3%
18	OMN - Minerals n.e.c.	6.3%	-0.5%
19	CMT - Bovine meat prods	4.9%	0.0%
20	OMT - Meat products n.e.c.	12.6%	2.3%
21	VOL - Vegetable oils and fats	-41.8%	-13.1%
22	MIL - Dairy products	76.4%	9.9%
23	PCR - Processed rice	6.4%	1.4%
24	SGR - Sugar	89.5%	6.9%
25	OFD - Food products n.e.c.	61.3%	8.5%
26	B_T - Beverages and tobacco products	105.8%	7.4%
27	TEX - Textiles	54.7%	10.3%
28	WAP - Wearing apparel	510.8%	119.7%
29	LEA - Leather products	-45.9%	-52.1%
30	LUM - Wood products	22.5%	4.5%
31	PPP - Paper products, publishing	64.8%	12.8%
32	P_C - Petroleum, coal products	1119.4%	12.6%
33	CRP - Chemical, rubber, plastic products	51.0%	2.5%
34	NMM - Mineral products n.e.c.	211.7%	47.2%
35	I_S - Ferrous metals	143.2%	13.4%
36	NFM - Metals n.e.c.	10.2%	-7.0%
37	FMP - Metal products	73.6%	13.6%
38	MVH - Motor vehicules and parts	152.7%	41.1%
39	OTN - Transport equipment n.e.c.	31.7%	7.5%
40	ELE - Electronic equipment	41.1%	4.7%
41	OME - Machinery and equipment n.e.c.	26.0%	2.6%
42	OMF - Manufactures n.e.c.	125.0%	18.5%
43	ELY - Electricity	-0.4%	-0.2%
44	GDT - Gas manufacture, distribution	-2.5%	0.0%

Source: Output from UTAS based on GTAP data for Pakistan and tariff schedules from FBR.

Q4: How does the choice of modeling framework matter for the results?

To test the sensitivity of our results to the choice of modeling framework, we repeat our simulation based on the product differentiation framework instead. We assume that the substitutability between imported and domestic varieties of the same product varies by sector, according to import-domestic substitution elasticities that we retrieve from GTAP. The elasticity of supply is set to 10 across all sectors. The subsection below on effects under product differentiation provides further details on how these effects with product differentiation are calculated.

Column K of Figure 18 reports the predicted percentage point change in the output price because of the tariff. Under product differentiation, the change in nominal tariffs is only partly passed on to output prices. Hence, for all sectors predicted price changes are smaller than when assuming product homogeneity (compare Figure 18 with Figure 15 above). Note, however, that the direction and the distribution of the price increases across sectors are similar in both frameworks.

The results between the two frameworks diverge more strongly when considering the impact on production costs, shown in Figure 19 (compare to Figure 16 above). When assuming product differentiation, UTAS considers both direct and indirect effects in calculating the change in input costs.

Higher costs of an input will not only affect producers relying on that input directly, but also affect producers further downstream that are affected indirectly through value chain linkages. As shown in Figure 19, the effects of the reform on input costs are thus estimated to be more widespread than under product homogeneity with all sectors negatively affected by an increase in costs.

Figure 18: Impact of 2019 tariff reform on average output tariffs across sectors under product differentiation

#	Sector	Output Tariff	Upstream Tariff (% gross output)	Upstream Tariff (% total input cost)	Upstream Tariff (% input goods	Rate of Effective Protection	Output Tariff	Change in p.p.
1	PDR - Paddy rice	0.1%	2.5%	5.0%	5.7%	-4.8%	0.0%	-0.1%
2	WHT - Wheat	3.1%	2.5%	9.3%	10.5%	0.8%	3.1%	0.0%
3	GRO - Cereal grains n.e.c.	1.2%	2.0%	3.1%	3.7%	-2.2%	1.2%	0.0%
4	V_F - Vegetables, fruit, nuts	2.3%	1.8%	3.9%	4.6%	0.9%	2.4%	0.1%
5	OSD - Oil seeds	0.9%	2.0%	4.5%	5.3%	-1.9%	0.9%	0.0%
6	C_B - Sugar cane, sugar beet	0.0%	2.5%	7.0%	7.9%	-3.9%	0.0%	0.0%
7	PFB - Plant-based fibers	0.2%	2.5%	6.0%	6.7%	-3.8%	0.1%	-0.1%
8	OCR - Crops n.e.c.	3.6%	2.0%	11.2%	13.1%	2.0%	3.9%	0.3%
9	CTL - Bovine cattle, sheep and goats, horses	0.0%	2.0%	3.7%	4.1%	-4.3%	0.0%	0.0%
10	OAP - Animal products n.e.c.	0.7%	1.7%	3.5%	4.0%	-2.0%	0.7%	0.0%
11	RMK - Raw Milk	0.0%	2.1%	4.3%	4.7%	-4.0%	0.0%	0.0%
12	WOL - Wool, silk-worm cocoons	2.2%	1.7%	2.2%	2.4%	2.1%	2.2%	0.0%
13	FRS - Forestry	0.6%	1.9%	7.9%	9.5%	-1.7%	0.6%	0.0%
14	FSH - Fishing	0.0%	1.0%	2.1%	2.5%	-1.9%	0.0%	0.0%
15	COA - Coal	3.6%	0.7%	0.8%	0.9%	43.8%	3.6%	0.0%
16	OIL - Oil	1.3%	0.8%	0.9%	1.1%	3.1%	1.3%	0.0%
17	GAS - Gas	0.1%	0.8%	1.0%	1.2%	-3.7%	0.0%	0.0%
18	OMN - Minerals n.e.c.	0.1%	1.1%	2.0%	2.7%	-2.3%	0.1%	0.0%
19	CMT - Bovine meat prods	0.0%	1.1%	2.7%	3.4%	-1.7%	0.0%	0.0%
20	OMT - Meat products n.e.c.	2.2%	1.1%	2.3%	2.9%	2.1%	2.8%	0.6%
21	VOL - Vegetable oils and fats	2.4%	2.3%	2.5%	2.8%	1.9%	2.5%	0.1%
22	MIL - Dairy products	1.2%	1.1%	2.6%	3.2%	0.1%	1.5%	0.3%
23	PCR - Processed rice	0.0%	1.2%	1.9%	2.2%	-3.5%	0.0%	0.0%
24	SGR - Sugar	0.4%	1.2%	1.5%	1.7%	-3.2%	0.5%	0.0%
25	OFD - Food products n.e.c.	0.7%	1.5%	2.2%	2.5%	-2.5%	0.8%	0.1%
26	B_T - Beverages and tobacco products	0.8%	1.1%	1.5%	1.9%	-1.0%	0.9%	0.1%
27	TEX - Textiles	7.9%	1.5%	2.0%	2.3%	25.5%	9.8%	1.9%
28	WAP - Wearing apparel	2.3%	1.6%	1.7%	2.2%	17.3%	3.2%	0.9%
29	LEA - Leather products	10.3%	1.1%	1.1%	1.2%	1270.5%	11.8%	1.6%
30	LUM - Wood products	3.5%	1.3%	7.0%	7.6%	2.6%	4.5%	1.0%
31	PPP - Paper products, publishing	6.2%	0.9%	1.3%	1.7%	18.4%	8.0%	1.7%
32	P_C - Petroleum, coal products	3.6%	1.0%	1.0%	1.1%	730.3%	3.6%	0.0%
33	CRP - Chemical, rubber, plastic products	5.0%	1.4%	1.6%	1.9%	28.4%	5.4%	0.5%
34	NMM - Mineral products n.e.c.	5.7%	1.2%	1.3%	1.5%	44.3%	7.4%	1.7%
35	I_S - Ferrous metals	14.1%	1.0%	1.1%	1.2%	145.7%	15.9%	1.8%
36	NFM - Metals n.e.c.	3.3%	0.9%	1.1%	1.2%	23.4%	2.7%	-0.6%
37	FMP - Metal products	6.8%	0.8%	1.1%	1.5%	22.3%	8.6%	1.8%
38	MVH - Motor vehicules and parts	16.2%	1.1%	1.4%	1.8%	65.8%	23.8%	7.7%
39	OTN - Transport equipment n.e.c.	4.0%	0.8%	1.1%	1.5%	11.7%	5.3%	1.3%
40	ELE - Electronic equipment	6.8%	0.8%	1.0%	1.4%	25.4%	7.7%	0.9%
41	OME - Machinery and equipment n.e.c.	4.8%	0.9%	1.2%	1.7%	12.8%	5.3%	0.6%
42	OMF - Manufactures n.e.c.	8.0%	1.0%	1.2%	1.5%	47.5%	9.5%	1.6%
43	ELY - Electricity	0.0%	1.5%	1.7%	1.9%	-9.2%	0.0%	0.0%
44	GDT - Gas manufacture, distribution	0.0%	0.8%	1.1%	1.4%	-3.6%	0.0%	0.0%

Source: Output from UTAS based on GTAP data for Pakistan and tariff schedules from FBR.

Figure 19: Impact of 2019 tariff reform on production costs under product differentiation

#	Goods Sectors ranked by largest reduction in upstream tariff (as % total input cost)	Baseline Upstream (% input	Simulated Upstream (% input	Change in p.p.
1	P_C - Petroleum, coal products	1.0%	1.1%	0.1%
2	I_S - Ferrous metals	1.1%	1.1%	0.1%
3	NFM - Metals n.e.c.	1.1%	1.1%	0.1%
4	ELY - Electricity	1.7%	1.8%	0.1%
5	NMM - Mineral products n.e.c.	1.3%	1.4%	0.1%
6	COA - Coal	0.8%	0.9%	0.1%
7	OIL - Oil	0.9%	1.1%	0.1%
8	ELE - Electronic equipment	1.0%	1.1%	0.1%
9	GAS - Gas	1.0%	1.1%	0.14%
10	FMP - Metal products	1.1%	1.3%	0.16%
11	LEA - Leather products	1.1%	1.2%	0.16%
12	OMF - Manufactures n.e.c.	1.2%	1.4%	0.16%
13	OTN - Transport equipment n.e.c.	1.1%	1.3%	0.17%
14	B_T - Beverages and tobacco products	1.5%	1.7%	0.2%
15	OME - Machinery and equipment n.e.c.	1.2%	1.4%	0.2%
16	GDT - Gas manufacture, distribution	1.1%	1.3%	0.2%
17	WOL - Wool, silk-worm cocoons	2.2%	2.4%	0.2%
18	PPP - Paper products, publishing	1.3%	1.5%	0.2%
19	MVH - Motor vehicules and parts	1.4%	1.6%	0.2%
20	OFD - Food products n.e.c.	2.2%	2.4%	0.2%
21	SGR - Sugar	1.5%	1.7%	0.2%
22	FSH - Fishing	2.1%	2.4%	0.2%
23	PCR - Processed rice	1.9%	2.1%	0.2%
24	TEX - Textiles	2.0%	2.3%	0.3%
25	CRP - Chemical, rubber, plastic products	1.6%	1.8%	0.3%
26	CTL - Bovine cattle, sheep and goats, horses	3.7%	4.0%	0.3%
27	OMN - Minerals n.e.c.	2.0%	2.3%	0.3%
28	RMK - Raw Milk	4.3%	4.6%	0.3%
29	WAP - Wearing apparel	1.7%	2.0%	0.3%
30	OAP - Animal products n.e.c.	3.5%	3.9%	0.3%
31	OMT - Meat products n.e.c.	2.3%	2.7%	0.4%
32	MIL - Dairy products	2.6%	2.9%	0.4%
33	GRO - Cereal grains n.e.c.	3.1%	3.5%	0.4%
34	CMT - Bovine meat prods	2.7%	3.1%	0.4%
35	VOL - Vegetable oils and fats	2.5%	2.9%	0.5%
36	V_F - Vegetables, fruit, nuts	3.9%	4.4%	0.5%
37	OSD - Oil seeds	4.5%	5.1%	0.6%
38	PDR - Paddy rice	5.0%	5.7%	0.6%
39	LUM - Wood products	7.0%	7.7%	0.7%
40	PFB - Plant-based fibers	6.0%	6.8%	0.8%
41	C_B - Sugar cane, sugar beet	7.0%	7.9%	0.9%
42	WHT - Wheat	9.3%	10.4%	1.1%
43	FRS - Forestry	7.9%	9.1%	1.2%
44	OCR - Crops n.e.c.	11.2%	12.6%	1.4%

#	Service Sectors ranked by largest reduction in upstream tariff (as % total input cost)	Baseline Upstream (as % total	Simulated Upstream (as % total	Change in p.p.
1	WTR - Water: collection, purification and distribution	1.5%	1.7%	0.2%
2	ROS - Recreation & Other Services	1.3%	1.6%	0.2%
3	OBS: Other business services	1.5%	1.8%	0.2%
4	OSG - Other Services (Government)	2.7%	3.1%	0.5%
5	ATP - Air transport	4.9%	5.5%	0.6%
6	CMN - Communications	4.1%	4.8%	0.7%
7	CNS - Construction: building houses factories offices a	4.0%	4.7%	0.7%
8	WTP - Water transport	9.0%	10.0%	1.0%
9	TRD - Trade	5.4%	6.4%	1.0%
10	OTP - Other Transport	6.2%	7.2%	1.0%
11	DWE - Dwellings	7.1%	8.3%	1.2%
12	ISR - Insurance	24.2%	29.0%	4.8%
13	OFI - Other financial intermediation	27.8%	33.1%	5.4%

Source: Output from UTAS based on GTAP data for Pakistan and tariff schedules from FBR.

Effects when there is product differentiation

The choice of the modeling framework determines how the imposition of import tariffs in a particular sector affects its output prices. When users decide to simulate effects with the product homogeneity framework, the average import tariff across all the products in a particular sector represents the percentage increase in the sector's output prices. A full pass-through on domestic prices is therefore assumed under this framework. By contrast, if the product differentiation framework is chosen, UTAS calculates the following three effects: (i) the increase of import prices on account of the tariff, (ii) the pass-through of the tariff on imports on the goods' domestic equivalent, and (iii) an overall price effect that combines (i) and (ii). While (i) is calculated simply as the average import tariff on products of a particular sector, (ii) and (iii) depend on user-defined substitution and supply elasticities as well as a sector's domestic consumption share (i.e. how much of a sectors' total consumption is sourced domestically).

UTAS considers first by how much the demand for the imported variety of the sector's output would increase, if all tariffs were to be abolished. This depends on the sector's elasticity of substitution. It then calculates by how much the hypothesized increase in the import demand would lead to lower demand for the sector's domestic output variety. This is done by assuming a Leontief production framework, where the increase in the demand for the imported variety at zero tariffs is exactly offset by an equivalent reduction in the demand for the domestic variety. Next, UTAS calculates how the demand shift from the domestic to the imported variety would translate into a lower output price for the domestic variety. The size of this effect is mediated by the sector's elasticity of supply. Last, the overall effect of the tariffs in the sector is calculated as a weighted average of the change in the output price for the imported and the domestic variety, where the hypothesized consumption shares of domestic versus imported sector produce at zero-tariffs are used as the respective weights.

Figure 20 and Figure 21 below illustrate these calculations for a few selected sectors based on Pakistan's pre-2019 reform duty rates. Imports of vegetables, fruit and nuts, for example, accrue a tariff of 10.5 percent. The pass-through of the tariff on domestic prices in this sector is relatively small, amounting to only 2.3 percent. This is because UTAS predicts only a small difference in the domestic consumption share on account of the tariff. By contrast, the pass-through effect on domestic prices is much larger in the textiles and motor vehicles sectors, where UTAS attributes a much larger increase in domestic consumption shares due to the prevalence of tariffs.

Figure 20: Price pass-through of tariffs in selected sectors under product differenciation

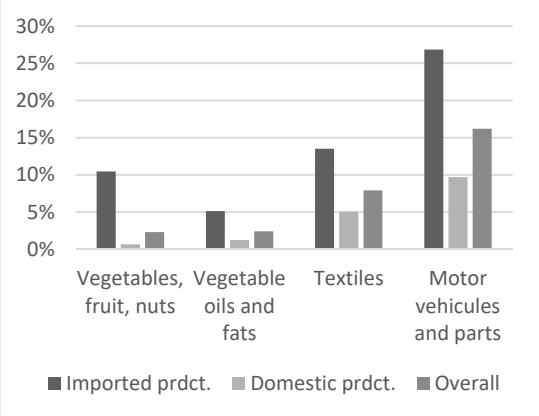
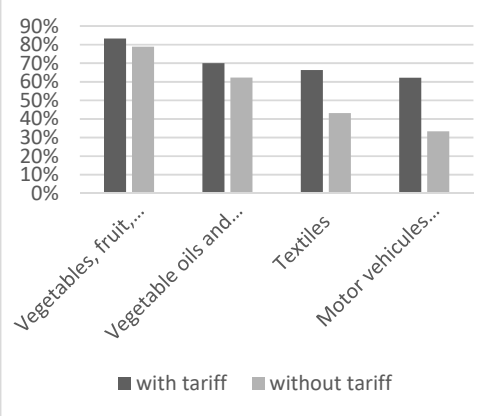


Figure 21: Domestic consumption share in selected sectors



Source: Authors' calculations using UTAS

5.3) Additional considerations

We highlight a series of additional practical considerations that UTAS users may find useful when planning their simulation exercises.

Choice of modeling framework

The choice of modeling framework should be guided by two main considerations. First, for users predominantly interested in modeling the effects of a tariff reform on a few selected sectors, the choice of framework should consider the homogeneity and the tradability of these sectors. For tradable sectors that produce relatively homogeneous goods, the perfect pass-through assumption of the product homogeneity is more suitable than for less homogeneous good that are more difficult to trade across borders (e.g. services). Second, data requirements are considerably higher for the product differentiation framework. Users are recommended to at least obtain domestic consumption shares for each sector before embarking on simulations under the product differentiation framework. This should also be combined with a careful sensitivity analysis based on alternative substitution and supply elasticities.

Duty exemptions and duty drawback schemes

In many developing countries, duty on imported intermediate products is exempt to encourage exports. To ensure that the estimations in UTAS are accurate, the baseline tariff schedule should thus ideally reflect effective (i.e. actually collected) tariffs and not statutory (i.e. de jure) tariffs. An 'effective' tariff schedule can normally be constructed using customs transactions data, which report the amount actually collected for each transaction at the import stage. In some countries, however, exemptions are not granted at the import stage but in the form of duty drawback schemes for exporters. Data on such schemes are much more challenging to collect, making it more difficult to factor in drawback schemes. When comprehensive duty drawback schemes are in place, UTAS will most likely overestimate the size of upstream tariffs on downstream costs for exporting industries. Note, however, that in most developing countries duty drawback schemes tend to work imperfectly. There are also large implicit costs associated with using them. This diminishes the possibility of estimation bias in UTAS even when drawback schemes are in place pro-forma.

Preferential trade agreements

Preferential trade agreements (PTA) with one or various trading partners are among the most frequent trade reforms. UTAS does not explicitly allow for differential tariff treatment across countries. Instead it relies on the specification of an average effective tariff collected across all countries. To model the impact of a PTA, users will therefore have to establish the impact of the PTA on the average effective tariff for each product outside the UTAS environment. This can be done by assuming a constant import share from PTA-affected trade partners and computing a corresponding pro-rata reduction in the average tariff for each product on account of the PTA.[16]

Restrictions of services trade

Trade restrictions of services trade are not explicitly considered in UTAS. Yet, if trade restrictions can be translated into ad-valorem equivalents, they can, in principle, be considered in UTAS, but will require some prior manipulation of the pre-set parameters of the tool. If this is done, UTAS will also consider services trade restrictions in calculating all trade-related upstream costs on downstream sectors.

[16] More advanced scenarios could also take into account trade diversion due to the PTA. This, however, would require knowledge on the substitution elasticity between the products of different origin.

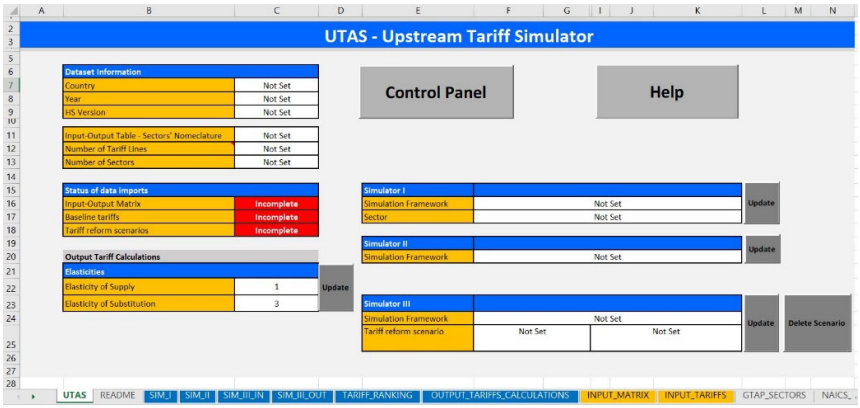
6) Conclusion

In modern production processes, the parts and components comprising a product are produced in multiple locations, crossing borders multiple times before they are assembled into the final product. Firms therefore increasingly rely on imported inputs to produce competitively. In fact, several studies have shown that the use of imported intermediates has been associated with improved firms' productivity and diversification patterns. Trade policy reform aimed at reducing the impact of tariffs in upstream sectors can therefore go a long way in improving firms' competitiveness and help them play a more active role in global value chains.

This paper presents UTAS: a novel tool developed by the World Bank to help policy makers assess the impact of tariff reforms on production costs across a variety of sectors in a flexible and time-efficient manner. It also allows users to compute effective protection rates. This is important because high levels of effective protection can result in a significant anti-export bias and reduce firms' incentive to export. Based on a simple modeling framework, the tool is intended to allow policy makers to consider how different tariff structures intertwine with firms' production costs, with the ultimate goal of supporting an informed discussion of the possible consequences of trade reform for the private sector. It allows users to combine country-specific input-output data across sectors with information on tariffs by HS code to quantify the impact of different tariff reform scenarios across different sectors, building on a user-friendly Microsoft Excel environment. The tool can be operated with only basic Excel knowledge and allows users to specify different assumptions to gauge the impact of direct and indirect effects of tariff reform scenarios on the costs of inputs across sectors.

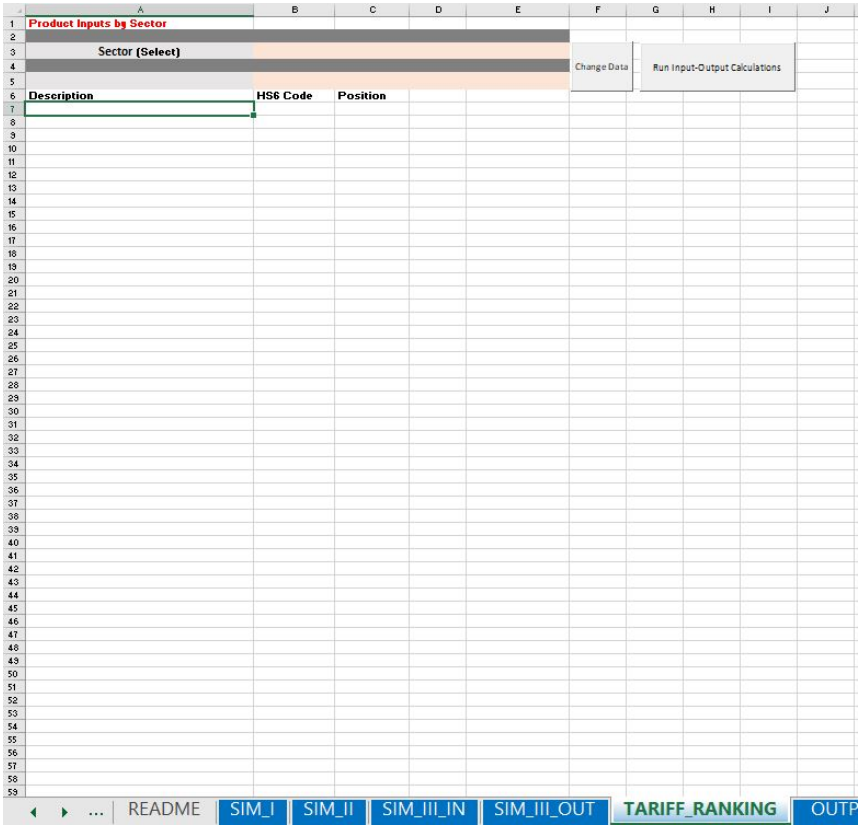
Appendix 1: Additional Screenshots of UTAS

Figure A1: Screenshot of UTAS control panel



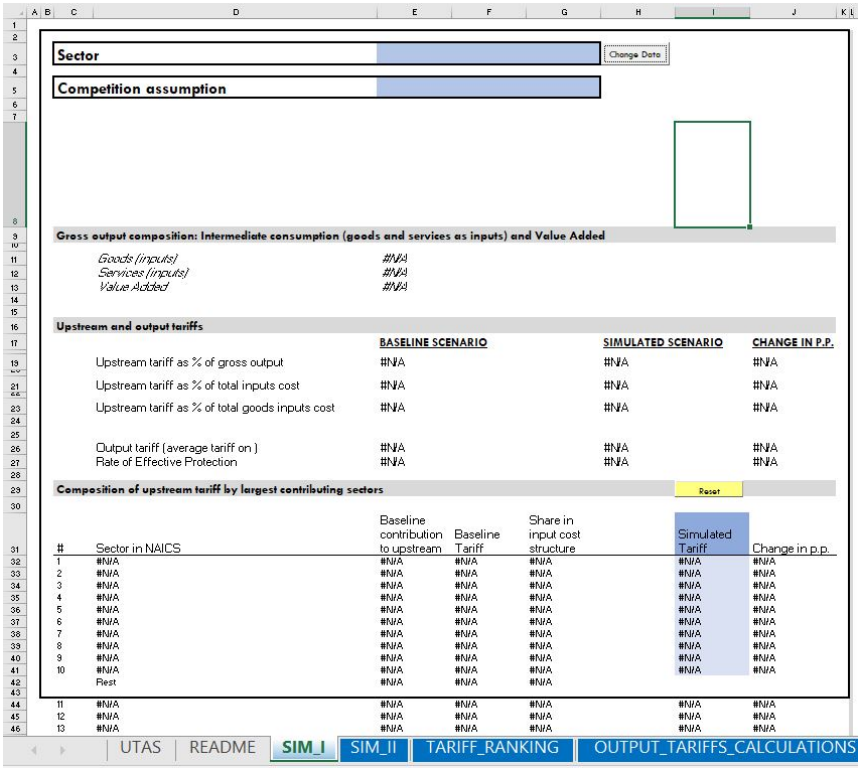
Source: World Bank UTAS

Figure A2: Screenshot of UTAS Tariff-Ranking module



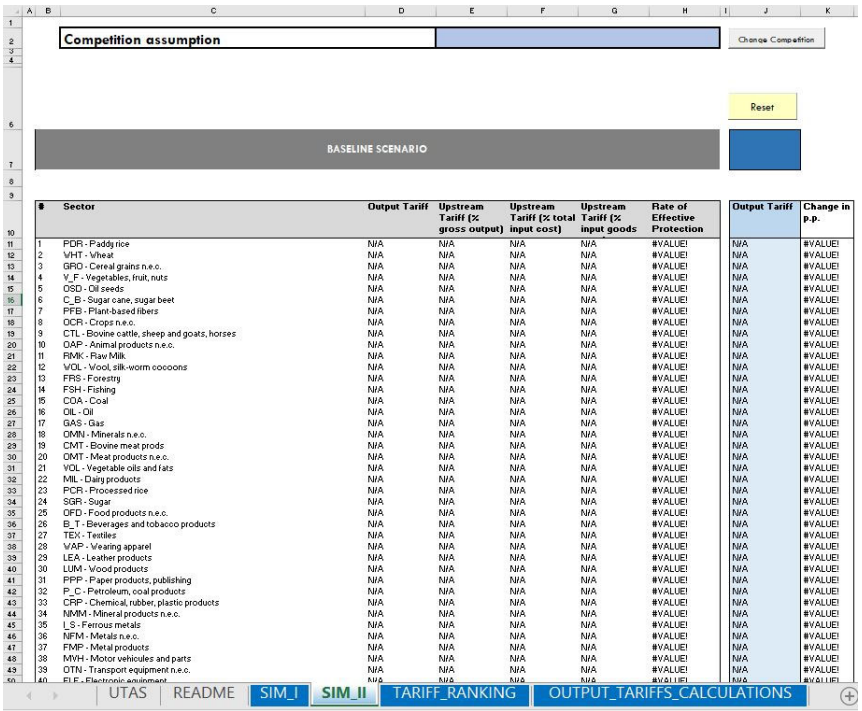
Source: World Bank UTAS

Figure A3: Screenshot of SIM I module



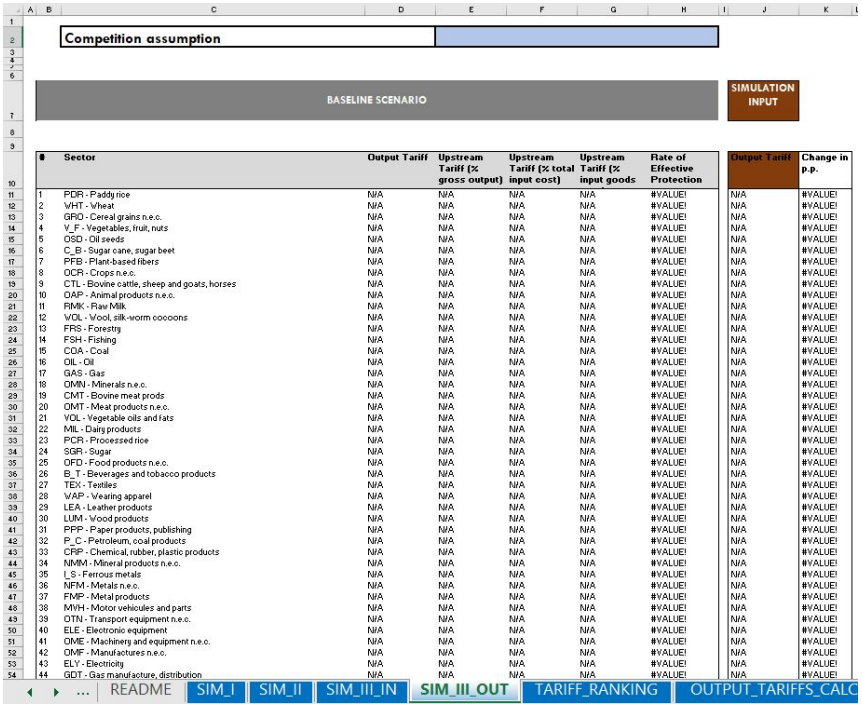
Source: World Bank UTAS

Figure A4: Screenshot of SIM II module



Source: World Bank UTAS

Figure A5: Screenshot of SIM III module



Competition assumption

	BASELINE SCENARIO						SIMULATION INPUT	
#	Sector	Output Tariff	Upstream Tariff (% gross output)	Upstream Tariff (% total input cost)	Upstream Tariff (% input goods	Rate of Effective Protection	Output Tariff	Change in p.p.
1	PDR - Paddy rice	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
2	WHT - Wheat	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
3	GRO - Cereal grains n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
4	V_F - Vegetables, fruit, nuts	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
5	OSD - Oil seeds	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
6	C_B - Sugar cane, sugar beet	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
7	PFB - Plant-based fibers	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
8	OCR - Crops n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
9	CTL - Bovine cattle, sheep and goats, horses	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
10	OAP - Animal products n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
11	RMK - Raw Milk	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
12	WOL - Wool, silk-worm cocoons	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
13	FRS - Forestry	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
14	FSH - Fishing	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
15	COA - Coal	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
16	OIL - Oil	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
17	GAS - Gas	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
18	OMN - Minerals n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
19	CMT - Bovine meat prods	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
20	OMT - Meat products n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
21	VOL - Vegetable oils and fats	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
22	MIL - Dairy products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
23	PCR - Processed rice	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
24	SGR - Sugar	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
25	OFD - Food products n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
26	B_T - Beverages and tobacco products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
27	TEX - Textiles	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
28	WAP - Wearing apparel	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
29	LEA - Leather products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
30	LUM - Wood products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
31	PPP - Paper products, publishing	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
32	P_C - Petroleum, coal products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
33	CRP - Chemical, rubber, plastic products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
34	NMM - Mineral products n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
35	I_S - Ferrous metals	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
36	NFM - Metals n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
37	FMP - Metal products	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
38	MVH - Motor vehicules and parts	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
39	OTN - Transport equipment n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
40	ELE - Electronic equipment	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
41	OME - Machinery and equipment n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
42	OMF - Manufactures n.e.c.	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
43	ELY - Electricity	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!
44	GDT - Gas manufacture, distribution	N/A	N/A	N/A	N/A	#VALUE!	N/A	#VALUE!

README | SIM_I | SIM_II | SIM_III_IN | SIM_III_OUT | TARIFF_RANKING | OUTPUT_TARIFFS_CALC

Source: World Bank UTAS

Appendix 2: Calculation of tariff pass-through under product differentiation and imperfect competition

Our point of departure to establish the tariff pass-through on input prices is the assumption that each intermediate input i comes in two forms that are differentiable from each other: an imported variety and domestic variety. Consider now that for the imported variety of input i downstream producers will have to pay an ad-valorem tariff of t above its world market price. The approach to the establishment of the pass-through of a tariff on the price of an input i, builds on being able to calculate what would happen to consumed quantities of the respective varieties of input i, if tariff t was to be abolished. We explain the framework in steps:

Step 1: The first step requires determining by how much the demand for the imported variety of i would increase in response to the elimination of the tariff t. To this end consider a demand relationship for imports of input i that takes the following form:

$$Q_0^{Imp} = \left(\frac{P_0^{Imp} - P_1^{Imp}}{P_1^{Imp}} \times \lambda^{(\alpha_1/0.5)} + 1\right) \times Q_1^{Imp} \quad (1)$$

where Q^{Imp} represents the imported quantity of an input and subscripts 1 and 0 denote demand with and without the tariff. The term $\frac{P_0^{Imp} - P_1^{Imp}}{P_1^{Imp}}$ represents the percentage fall in the price for the imported variety of input i, if the tariff t on input i was to be lowered to zero. The parameter $\lambda^{(\alpha_1/0.5)}$ measures the overall responsiveness of imports to a change in the import price. It depends on the elasticity of substitution between the domestic and foreign variety of input i $\lambda < 0$ and the share of the total demand for input i met by the domestic variety when $t > 0$ represented by α_1. The overall price responsiveness of demand for the imported variety is hence assumed to decrease the smaller the domestic consumption share, reflecting an increasing difficulty to substitute a domestic input variety when the domestic consumption share is already low.

The decline in the price of imports if t was lowered to zero is equal to:

$$\frac{P_0^{Imp} - P_1^{Imp}}{P_1^{Imp}} = \frac{-t}{1+t}, \quad (2)$$

Equation (1) thus simplifies to:

$$Q_0^{Imp} = \left(\frac{-t}{1+t} \times \lambda^{(\alpha_1/0.5)} + 1\right) \times Q_1^{Imp}., \quad (3)$$

which is equal to

$$\frac{Q_0^{Imp} - Q_1^{Imp}}{Q_1^{Imp}} = \frac{-t}{1+t} \times \lambda^{(\alpha_1/0.5)} \quad (4)$$

Equation (4) is our first key result and allows us to calculate the percentage increase in imports that would occur, if tariff t would be eliminated.

Step 2: The next step involves establishing how the increase for the imported variety of input i calculated in equation (4) would affect the demand for the domestic variety of i. For this, note that UTAS generates results assuming unchanged output levels regardless of the change in input costs. The tool therefore estimates the cost impact at constant output levels.[21] Consequently, an increase in the

[21] This is equivalent to assuming a Leontief production schedule across firms and sectors.

demand for the imported variety will be offset one-to-one with a reduction in the demand for the domestic variety. The change in the demand for the domestic variety of input i is therefore given by:

$$Q_0^{Dom} = \left((-\frac{Q_0^{Imp} - Q_1^{Imp}}{Q_1^{Imp}}) \times \frac{1-\alpha_1}{\alpha_1} + 1 \right) \times Q_1^{Dom} , \quad (5)$$

where Q^{Dom} represents demand for the domestic variety. α_1 stands again for the share of the total demand for input i met by the domestic variety when $t > 0$. We can now divide equation (5) by the total demand for input i to attain an expression for this share when $t = 0$:

$$\alpha_0 = \left((-\frac{Q_0^{Imp} - Q_1^{Imp}}{Q_1^{Imp}}) \times \frac{1-\alpha_1}{\alpha_1} + 1 \right) \times \alpha_1 , \quad (6)$$

Combining equation (6) with equation (4) implies that:

$$\alpha_0 = \left(\frac{t}{1+t} \times \lambda^{(\alpha_1/0.5)} \times \frac{1-\alpha_1}{\alpha_1} + 1 \right) \times \alpha_1 \quad (7)$$

Equation (7) gives us our second key results, as it defines by how much the domestic consumption share of input i would decrease with the elimination of the tariff, as consumers are induced to substitute the domestic for imported variety. In UTAS equation (7) is implemented on the basis of user-determined values for the tariff rate t, the value for the substitution elasticity λ, and the current domestic consumption share α_1.

Step 3: The subsequent step requires determining how a change in demand for the domestic variety would affect the market price of the domestic variety. We rely on the following supply relationship to determine this:

$$P_1^{Dom} = (\frac{Q_1^{Dom} - Q_0^{Dom}}{Q_0^{Dom}} \frac{1}{1+\mu} + 1) \times P_0^{Dom} \quad (8)$$

where P^{Dom} denotes the price for the domestic variety of input i with subscripts 1 and 0 denoting again post-tariff and pre-tariff levels, and μ represents the elasticity of supply.

Note now that analogous to equation (6) we can express the demand for the domestic variety after the application of the tariff as follows:

$$Q_1^{Dom} = (-t \times \lambda^{(\alpha_0/0.5)} \times \frac{1-\alpha_0}{\alpha_0} + 1) \times Q_0^{Dom} \quad (9)$$

This is the same as:

$$\frac{Q_1^{Dom} - Q_0^{Dom}}{Q_0^{Dom}} = -t \times \lambda^{(\alpha_0/0.5)} \times \frac{1-\alpha_0}{\alpha_0} \quad (10)$$

Combining equations (8) and (10), we attain the following result:

$$\frac{\Delta P^{Dom}}{P^{Dom}} = \frac{P_1^{Dom} - P_0^{Dom}}{P_0^{Dom}} = -t \times \frac{\lambda^{(\alpha_0/0.5)}}{1+\mu} \times \frac{1-\alpha_0}{\alpha_0} \quad (11)$$

Equation (11) defines by how much prices on the domestic variety increase on account of the prevailing tariff, whereas the increase in the imported price on account of the prevailing tariff is given by:

$$\frac{\Delta P^{Imp}}{P^{Imp}} = \frac{P_1^{Dom} - P_0^{Dom}}{P_0^{Dom}} = t \quad (12)$$

Step 4: The final step requires calculating the weighted increase in the price of input i on account of the tariff along the following formula:

$$\frac{\Delta P}{P} = \alpha_0 \times \left[\frac{\alpha_1}{\alpha_0}\left(1 + \frac{\Delta P^{Dom}}{P^{Dom}}\right) - 1\right] + (1 - \alpha_0) \times \left[\frac{1-\alpha_1}{1-\alpha_0}\left(1 + \frac{\Delta P^{Imp}}{P^{Imp}}\right) - 1\right] \quad (13)$$

Equation (13) defines by how much a tariff causes prices on input i to increase, where the overall price-pass through parameter β used to calculate upstream tariff costs UT is then defined as:

$$\beta = \frac{\Delta P/P}{t} \quad (14)$$

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