COVID 19, Simulations and Welfare
COSWE Stata package 1.01
(Stata 16 is required)
Araar, A. // September 2020

In this brief note, we introduce some basic notions about the economic shocks of COVID19, as well as how to assess impacts on well-being. In addition, we try to introduce the COSWE Stata package, which is a set of well-formatted routines that may help to produce results quickly.

Well-being and their influencing factors

Under the money metric utility framework, welfare is mainly affected by changes in prices or in incomes. Further, it is assumed that, with moderate changes in income and prices, the total effect on well-being can be approximated to the aggregated sub-impacts. In our example, we assume that changes in sources of income are:

- Changes in received remittances;
- Changes in received incomes from the agricultural sector;
- Changes in received incomes from the industrial sector;
- Changes in received incomes from the sector of services;

Further, we assume that the COVID-19 affects food prices.

We use the term **factor** to name the source of the COVID-19 shock. For instance, in our example we will have five factors (1- Food Prices / 2- Remittances / 3-Agric. Personal Rev. / 4-Indus. Personal Rev / 5-Services Personal Rev). If we denote the welfare of household h at time t_1 by w_{h,t_1} we have that :

$$\Delta w_{h,t_1} = \sum_{i=1}^{I} f_i\left(\Delta F_{h,i,t_1}\right)$$

where $\Delta F_{h,i,t_1}$ denotes the variation in factor i between t_0 and t_1 for household h. f_i is the approximation function linking the money metric welfare and factor i.

Duration in variation of factors and well-being

The duration of the impact on welfare depends on the duration of changes in factors. For example, if ΔF_{t_1} is the observed variation between $t_0 \leftrightarrow t_1$, and ΔF_{t_2} is that between $t_0 \leftrightarrow t_2$, then, the extent of the impact on welfare varies over time. One may be interested in measuring the impact in the short or the long term. The calculation of the impact on welfare is the same, except that variations in factors differ depending on the time length.

Food prices and welfare

To calculate the impact of price changes on welfare (per capita expenditure), we use the first order Taylor approximation, which is:

$$\Delta w_{food,h} = -e_{food,h}\Delta p_{food}$$

Where $e_{food,h}$ is the food expenditures of household h and Δp_{food} is the proportional change in food prices.

Labor revenues

For household welfare, the main COVID19 economic shock is through the decrease of its labor incomes. Obviously, the intensity of such shock will depend on different aspects, as the:

- Vulnerability of sector, economic branch and type of job (for instance, transportation, tourism, coffee and restaurants, leisure industry, hairdressers and beauticians, etc.).
- Levels of the labor personal incomes by active household members.
- Duration and intensity of labor income shocks (losing his job is similar to a reduction of 100% in income).

For simplicity, in our example model, we will focus on the three main economic sectors (Agriculture, Industry and Services).

The total household income is equal to the sum of revenues of their active members. If we denote the average income of household members h who operate in sector s in time t by $r_{h,s,t}$, and if the number of these members by $n_{h,s,t}$, then, the total household income is:

$$R_{h,t} = \sum_s n_{h,s,t} r_{h,s,t}$$

Relative to the initial period (time t_0), we have that:

$$\Delta R_{h,t} = \sum_s n_{h,s,t} \Delta\gamma_{,s,t} R_{h,s,t_0}$$

Where $\Delta\gamma_{,s,t}$ is the proportional change in average personal incomes in sector s between t_0 and t_1. We use secondary information (or hypotheses) to estimate this proportional variation. For instance, duration of confinement relative to the period t_0-t_1, type of labor (e.g., public workers will continue to receive their salaries), etc.

Personal revenues and missing values

In our fictive example, which it is composed of 1600 sampled households, there are 908 with missing or non-reported incomes. Thus, it is important to treat missing values before computing impact of COVID19 on personal incomes, and then, on welfare measurement (for instance, per capita income or expenditure). Theory and literature on the treatment of missing values is abundant. However, and for our purpose, we present in what follows a simple and more efficient approach. Precisely, we suggest applying the hotdeck approach by welfare deciles of rural and urban groups, and also economic branch. Precisely, the steps of this approach are:

- Identify the decile groups for each of the rural and urban regions.
- Replace each missing value with an income randomly selected within the same group and among those without missing incomes (group by-> rururb/decile/branch).

The hotdeck method has the advantage of not generating negative predictors and of preserving income variance.

Household samples without incomes

As indicated above, COVID19 affects largely personal incomes. However, in many developing countries, household incomes are not collected, or more often, they are collected but with large error sizes. In contrast, these surveys put more attention in collecting information on household expenditures. Also, in these developing countries, most of households spend all of their labor incomes on goods and services, and their needs do not enable them to save money. As a first assumption, one can say that the total household expenditures can be a good proxy of the total household incomes in these developing countries. Of course, one can deduct from these total expenditures the other sources of income, as the remittances, the governmental helps, consumption in kinds, etc. In general, we also collect information of the main activity of each household member and if the latter works or not. A simple approach to reconstruct the personal income of each of active household member includes the following steps:

1- Identifying households with only one active household member;
2- For each of the main activities, running a regression model (OLS or Heckman) that links total expenditures and a set of individual characteristics (age/gender/education/,etc.). Note that, since we consider only those with one active number, the total household expenditures is perceived as his/her personal income. The IMR can be added to control for the potential selection bias (heterogeneity between households with one worker and the rest).
3- Predicting personal incomes for each active member.
4- Computing the predicted total household income.
5- Estimating the income share of each active number within each household.
6- Attributing personal incomes, and this, based on total household expenditures and the predicted personal income shares.

Punctual and cumulative impacts

By punctual effect, we refer to the effect in a given date/trimester of our simulation. In our simulation, we will focus on three quarters after COVID-19 (Effects T1, T2 and T3). For these punctual effects, we compare between the levels of welfare in T0 and in one quarter after COVID-19. For instance, the punctual impact in T3 can be zero if the change in factors with respect to T0 is zero. For the cumulative impact, we focus instead on the average impact between T0 and a given quarter.

Example and Stata routines

https://dasp-two.vercel.app/temp/coswe.rar

In our fictive example, we assume that COVID19 shocks and their corresponding benefits are -will be- manifested through changes in the following four main factors:

1- Food prices;
2- Remittances;
3- Personal incomes;
4- COVID cash transfers.

Experts did not have the same expectations about proportional changes in factors, especially for the second and third trimesters. For that case, it is asked to study two potential scenarios of changes, the optimistic and the pessimistic. The following dashboard can be used to insert the proportional changes of each factor by trimester. This information will be used by Stata to compute impacts on well-being.

	F1: Impacts on food prices					
	Scenario 1: OPTIMISTIC			Scenario 2: PISSIMISTIC		
	1st Trimester	**2nd Trimester**	**3rd Trimester**	**1st Trimester**	**2nd Trimester**	**3rd Trimester**
Changes in food prices	0.015	0.010	0.005	0.023	0.017	0.006
	F2:Impacts on Remittances					
	Scenario 1: OPTIMISTIC			Scenario 2: PISSIMISTIC		
	1st Trimester	**2nd Trimester**	**3rd Trimester**	**1st Trimester**	**2nd Trimester**	**3rd Trimester**
Changes in internal remittances	-0.050	-0.025	0.000	-0.100	-0.050	-0.050
	F3: Impacts on personal incomes					
	Scenario 1: OPTIMISTIC			Scenario 2: PISSIMISTIC		
Branch	**1st Trimester**	**2nd Trimester**	**3rd Trimester**	**1st Trimester**	**2nd Trimester**	**3rd Trimester**
1 Agriculture	-0.010	-0.007	-0.002	-0.012	-0.009	-0.003
2 Breeding & fishing	-0.010	-0.007	-0.003	-0.012	-0.009	-0.004
3 Industry & extractions	-0.030	-0.021	-0.006	-0.036	-0.026	-0.010
4 Others industry	-0.030	-0.024	-0.005	-0.036	-0.030	-0.008
5 Construction	-0.100	-0.080	-0.024	-0.120	-0.100	-0.038
6 Trade	-0.130	-0.091	-0.027	-0.156	-0.114	-0.044
7 Restaurants & Hotesl	-0.250	-0.150	-0.045	-0.300	-0.188	-0.072
8 Transpotation & communicaton	-0.280	-0.196	-0.059	-0.336	-0.245	-0.094
9 Education & health	-0.010	-0.008	-0.002	-0.012	-0.010	-0.004
10 Personal services	-0.080	-0.056	-0.017	-0.096	-0.070	-0.027
11 Other services	-0.070	-0.049	0.000	-0.084	-0.061	-0.001
	F4: COVID Transfers					
	Scenario 1: OPTIMISTIC			Scenario 2: PISSIMISTIC		
COVID Transfers	**1st Trimester**	**2nd Trimester**	**3rd Trimester**	**1st Trimester**	**2nd Trimester**	**3rd Trimester**
1 Agriculture	0	0	0	0	0	0
2 Breeding & fishing	0	0	0	0	0	0
3 Industry & extractions	0	0	0	0	0	0
4 Others industry	0	0	0	0	0	0
5 Construction	0	8000	7000	0	8000	7000
6 Trade	0	26000	26000	0	26000	26000
7 Restaurants & Hotesl	0	30000	30000	0	30000	30000
8 Transpotation & communicaton	0	40000	40000	0	40000	40000
9 Education & health	0	0	0	0	0	0
10 Personal services	0	0	0	0	0	0
11 Other services	0	0	0	0	0	0

The Stata COSWE package

This package is in its primitive stage and it is composed of a set of do files that users can update to their study cases. The zipped folder COSWE contains the data a set of do files. In what follows, we introduce this package through the main.do file.

The data file

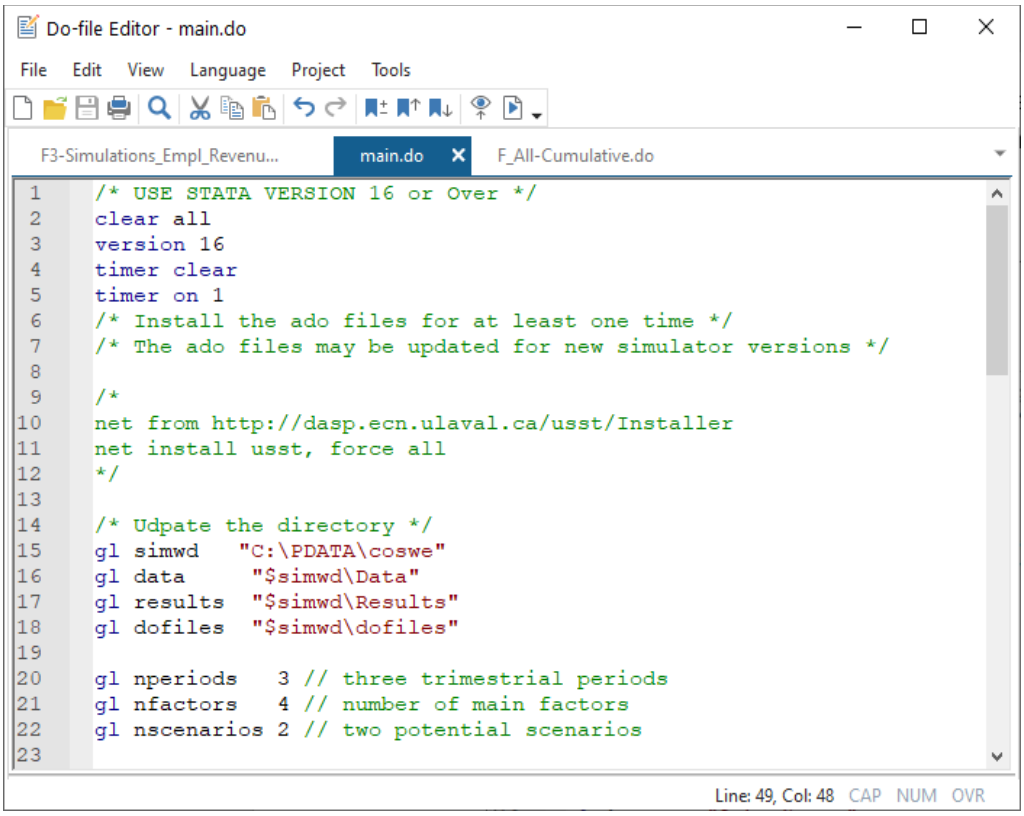
The fictive data of the example is composed of 1600 observations. We find usual variables, and it may be easy to keep the same names of variables for the other applications. The main variables are:

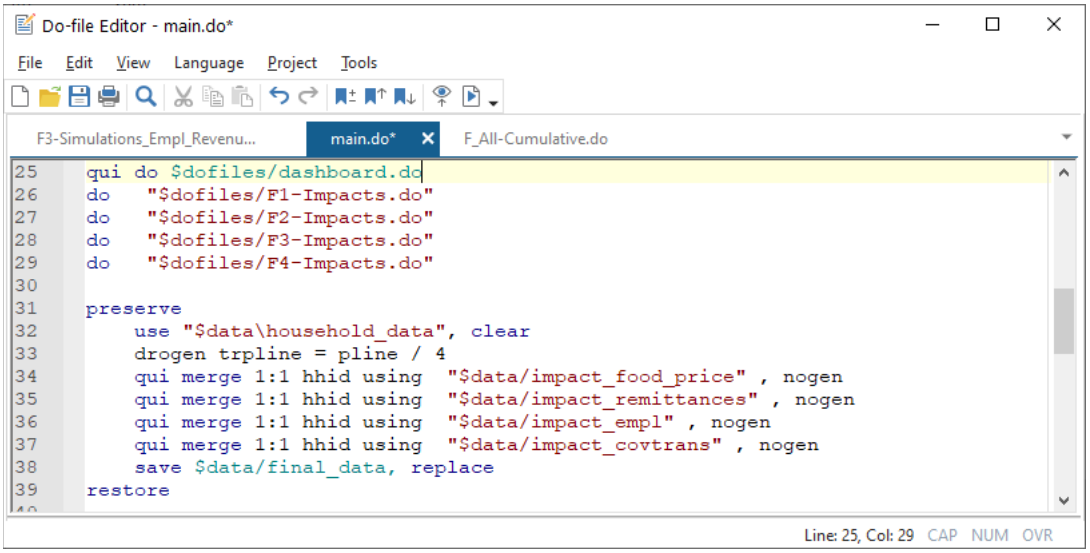
- **welfare** : the indicator of welfare (per capita expenditures or per capita income);
- **hhsize** : the household size;
- **sweight** : the sampling weight. It is important to initialize the sampling design to indicate the sampling weight and maybe the other sampling information. The package will use the sampling design information to weight observations or to perform accurate statistical inferences.
- **pline** : the poverty line.

The main.do file.

The head part of the main.do file serves to:

- Download a set of ado files that are used intermediately by this simulator (activate lines 10 and 11 one execution time). In addition, the user must indicate the working directory where the unzipped folder is saved (line 15). In addition, the working directory is organised and contains three sub-folders (Data | Results | dofiles).
- To indicate the number of periods, the number of main factors and the number of scenarios (lines 20 to22).





The execution of the do file dashboard.do enables to load information from the Excel file on changes in factors. The information becomes stored in matrices (information on each factor in a distinct Stata matrix).

The do files F*-Impacts (lines 26-29) serve to compute impacts of each of the factors of interest by trimester and by scenario. After running the dofile F1-Impacts, the routine will generate the data file **impact_food_price.dta** that contains in part the following variables:

variable name	type	format	label	variable label
F_1_1_1	double	%10.0g		Impact of food price in trimester 1 and scenario 1
C_1_1_1	double	%10.0g		Trimestrial welfare with the impact of food price in trimester 1 and scenario 1
C_1_0	float	%9.0g		Initial trimestrial per capita welfare
F_1_2_1	double	%10.0g		Impact of food price in trimester 1 and scenario 2

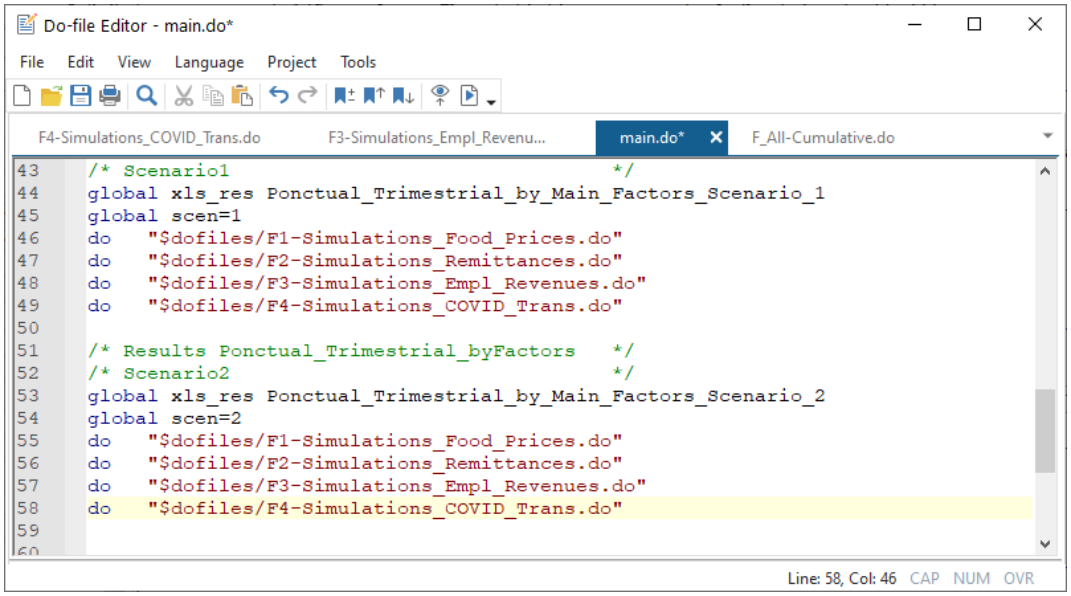
The variable **F_i_s_t** is the per capita impact implied by the change if factor $i \in \{1,2,\cdots,5\}$ in scenario $s \in \{1,2\}$ in trimester $t \in \{1,2,3\}$.

- For the household h, the aggregated punctual impact in trimester t and scenario s est :

$$PF_{h,s,t} = \sum_{i=1}^{5} F_{h,i,s,t}$$

- The impact over a given number of trimesters or within the period t_o to t_R and scenario s is :

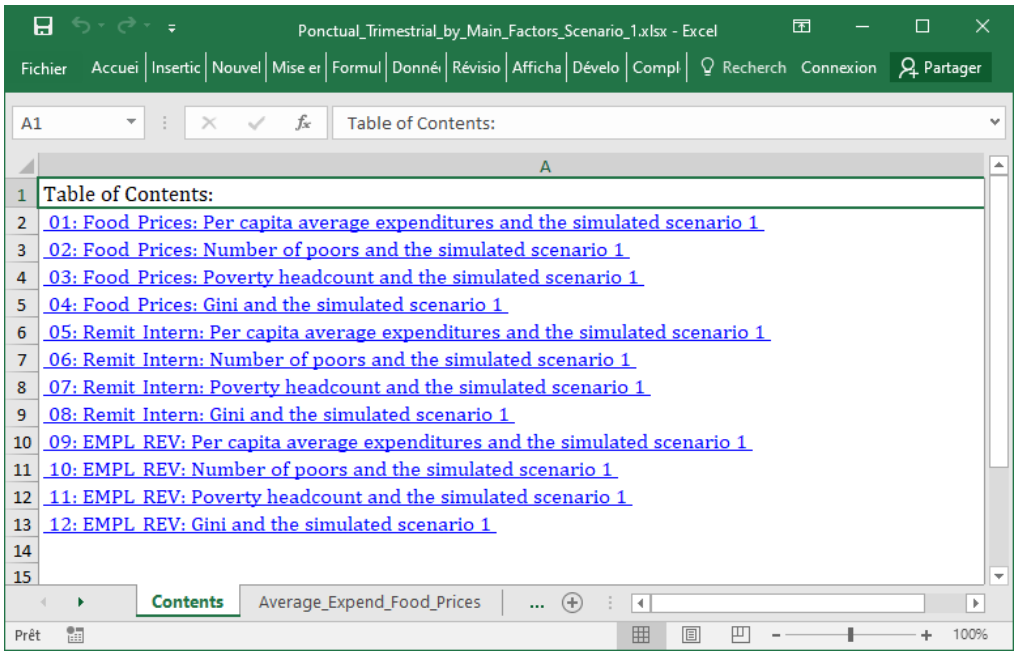
$$CF_{h,s,t_R} = \sum_{v=1}^{v=R} PF_{h,s,v} \,/R$$



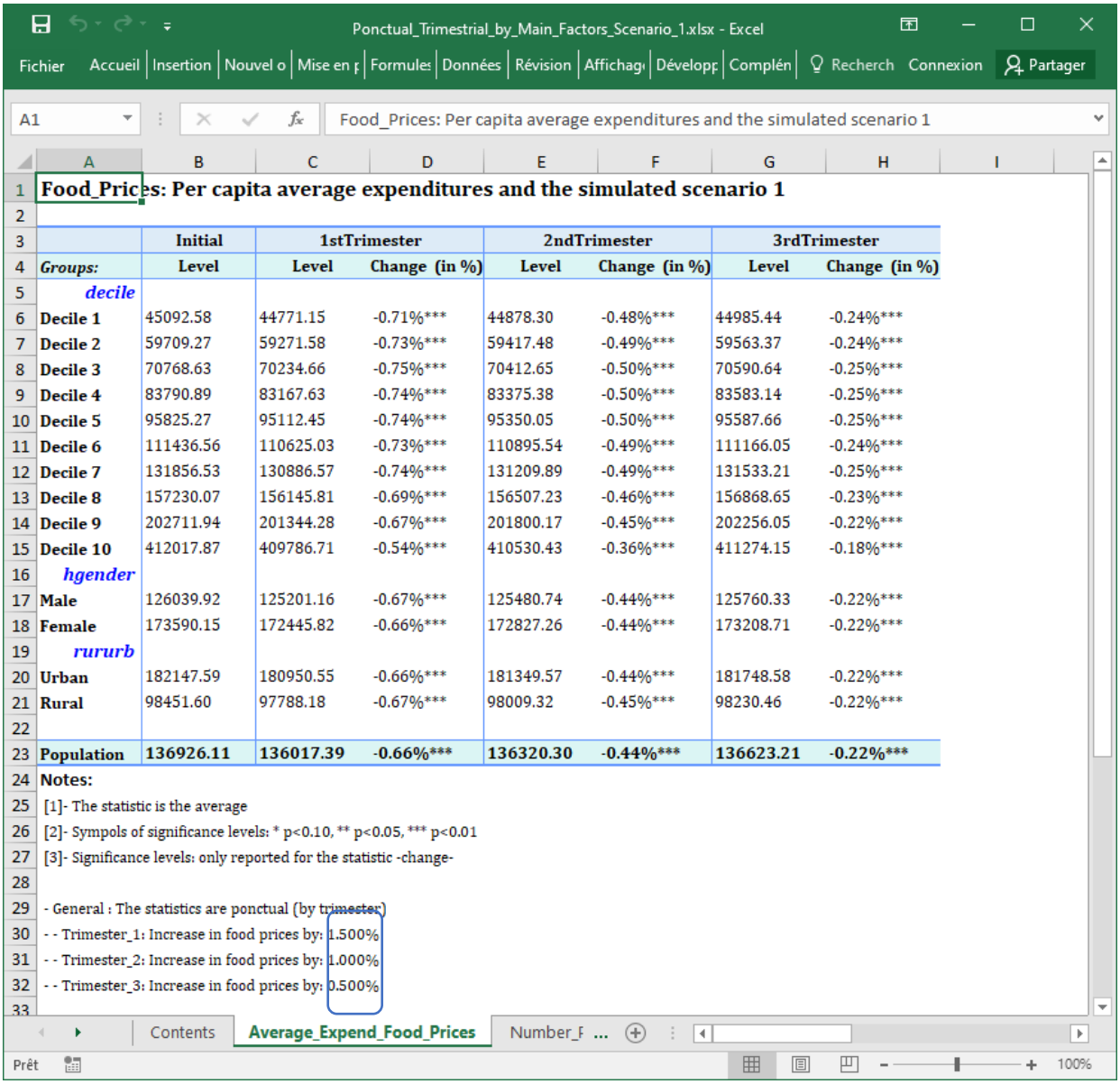
The global instance popgroups in line 42 contains the population groups that we aim to produce for the results (by economic branch of the household head / by household head gender / by rural and urban areas (we can other forms of the population groups)).

The dofiles ***F*-Simulations…..do*** use the variables (**F_i_s_t**) to compute a set of statistics (average per capita // Number of poor // poverty headcount // Gini index). The computation is done by trimester and by population groups (the user can indicate the population groups in the global instance popgroups (line 49)).

- The results will be saved in the following Excel file: **Ponctual_Trimestrial_by_Main_Factors_With_Elas_Scenario_1 .**
- It is necessary to indicate that the **global scen = 1** to produce the results of the first scenario (see the line 51).



EXEMPLE of Results



Ponctual_Trimestrial_by_Main_Factors_Scenario_1.xlsx - Excel

Food_Prices: Per capita average expenditures and the simulated scenario 1

	Initial	1stTrimester		2ndTrimester		3rdTrimester	
Groups:	Level	Level	Change (in %)	Level	Change (in %)	Level	Change (in %)
decile							
Decile 1	45092.58	44771.15	-0.71%***	44878.30	-0.48%***	44985.44	-0.24%***
Decile 2	59709.27	59271.58	-0.73%***	59417.48	-0.49%***	59563.37	-0.24%***
Decile 3	70768.63	70234.66	-0.75%***	70412.65	-0.50%***	70590.64	-0.25%***
Decile 4	83790.89	83167.63	-0.74%***	83375.38	-0.50%***	83583.14	-0.25%***
Decile 5	95825.27	95112.45	-0.74%***	95350.05	-0.50%***	95587.66	-0.25%***
Decile 6	111436.56	110625.03	-0.73%***	110895.54	-0.49%***	111166.05	-0.24%***
Decile 7	131856.53	130886.57	-0.74%***	131209.89	-0.49%***	131533.21	-0.25%***
Decile 8	157230.07	156145.81	-0.69%***	156507.23	-0.46%***	156868.65	-0.23%***
Decile 9	202711.94	201344.28	-0.67%***	201800.17	-0.45%***	202256.05	-0.22%***
Decile 10	412017.87	409786.71	-0.54%***	410530.43	-0.36%***	411274.15	-0.18%***
hgender							
Male	126039.92	125201.16	-0.67%***	125480.74	-0.44%***	125760.33	-0.22%***
Female	173590.15	172445.82	-0.66%***	172827.26	-0.44%***	173208.71	-0.22%***
rururb							
Urban	182147.59	180950.55	-0.66%***	181349.57	-0.44%***	181748.58	-0.22%***
Rural	98451.60	97788.18	-0.67%***	98009.32	-0.45%***	98230.46	-0.22%***
Population	136926.11	136017.39	-0.66%***	136320.30	-0.44%***	136623.21	-0.22%***

Notes:

[1]- The statistic is the average

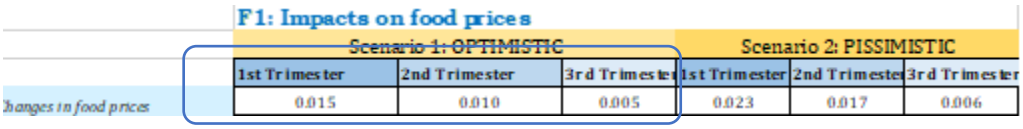
[2]- Sympols of significance levels: * p<0.10, ** p<0.05, *** p<0.01

[3]- Significance levels: only reported for the statistic -change-

- General : The statistics are ponctual (by trimester)
- - Trimester_1: Increase in food prices by: 1.500%
- - Trimester_2: Increase in food prices by: 1.000%
- - Trimester_3: Increase in food prices by: 0.500%

Contents | Average_Expend_Food_Prices | Number_F ...

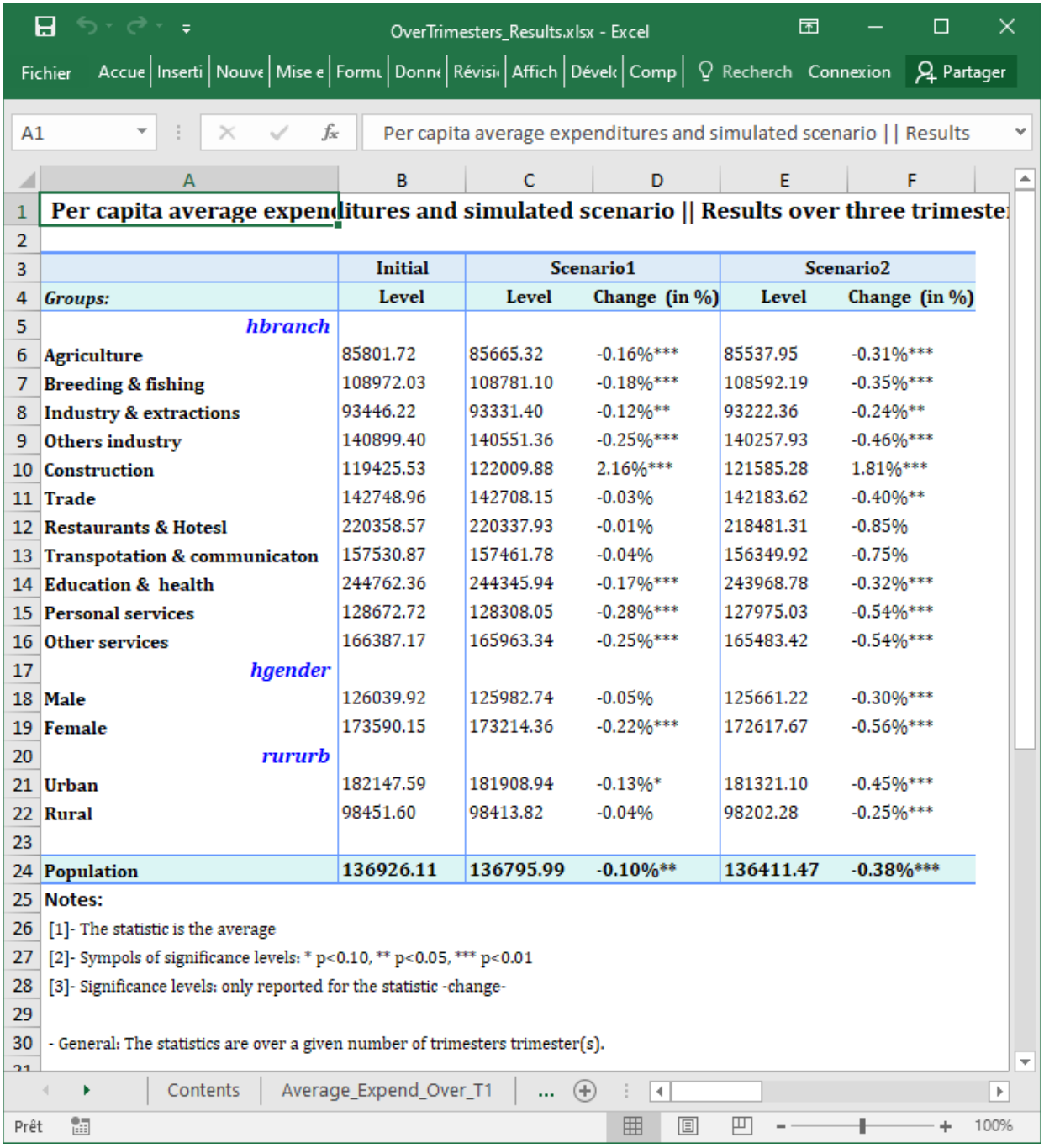
Prêt



F1: Impacts on food prices

	Scenario 1: OPTIMISTIC			Scenario 2: PISSIMISTIC		
	1st Trimester	2nd Trimester	3rd Trimester	1st Trimester	2nd Trimester	3rd Trimester
Changes in food prices	0.015	0.010	0.005	0.023	0.017	0.006

- The coswe produces nice excel tables (Stata-mata programming).
- It produces the statistical significance of changes (see the stars).
- Etc.



Per capita average expenditures and simulated scenario || Results over three trimeste

	Initial	Scenario1		Scenario2	
Groups:	**Level**	**Level**	**Change (in %)**	**Level**	**Change (in %)**
hbranch					
Agriculture	85801.72	85665.32	-0.16%***	85537.95	-0.31%***
Breeding & fishing	108972.03	108781.10	-0.18%***	108592.19	-0.35%***
Industry & extractions	93446.22	93331.40	-0.12%**	93222.36	-0.24%**
Others industry	140899.40	140551.36	-0.25%***	140257.93	-0.46%***
Construction	119425.53	122009.88	2.16%***	121585.28	1.81%***
Trade	142748.96	142708.15	-0.03%	142183.62	-0.40%**
Restaurants & Hotesl	220358.57	220337.93	-0.01%	218481.31	-0.85%
Transpotation & communicaton	157530.87	157461.78	-0.04%	156349.92	-0.75%
Education & health	244762.36	244345.94	-0.17%***	243968.78	-0.32%***
Personal services	128672.72	128308.05	-0.28%***	127975.03	-0.54%***
Other services	166387.17	165963.34	-0.25%***	165483.42	-0.54%***
hgender					
Male	126039.92	125982.74	-0.05%	125661.22	-0.30%***
Female	173590.15	173214.36	-0.22%***	172617.67	-0.56%***
rururb					
Urban	182147.59	181908.94	-0.13%*	181321.10	-0.45%***
Rural	98451.60	98413.82	-0.04%	98202.28	-0.25%***
Population	**136926.11**	**136795.99**	**-0.10%****	**136411.47**	**-0.38%*****

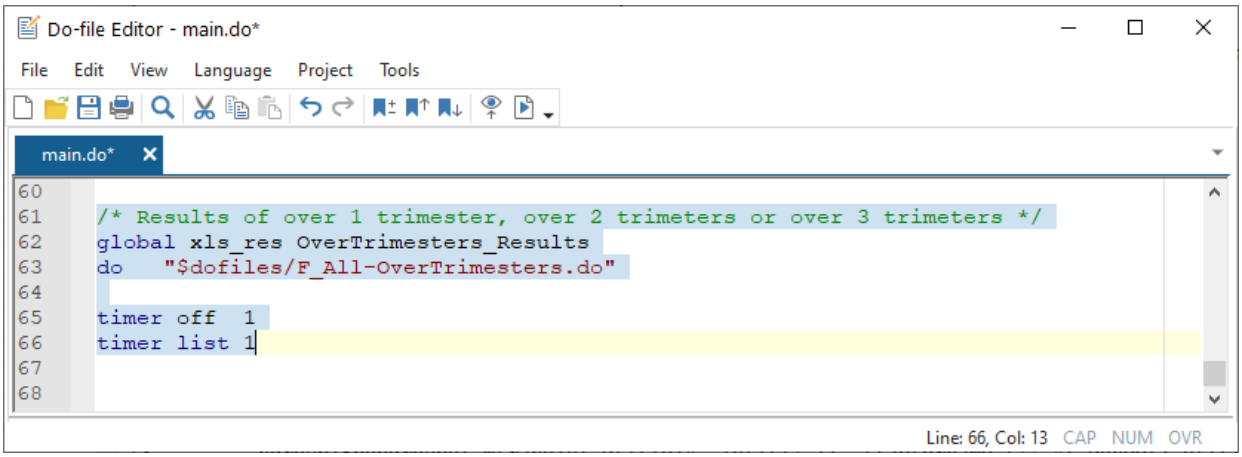
Notes:

[1]- The statistic is the average

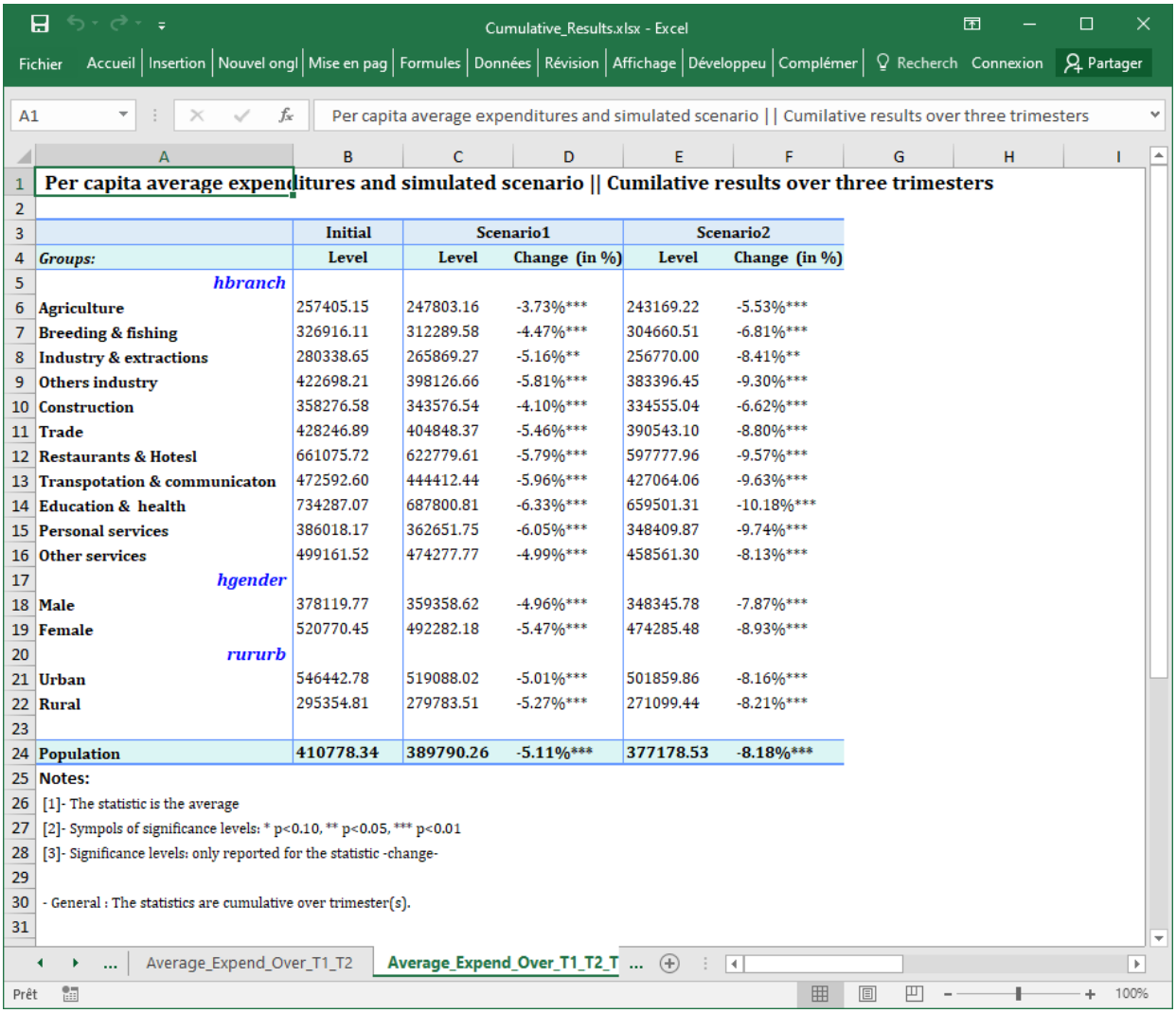
[2]- Sympols of significance levels: * p<0.10, ** p<0.05, *** p<0.01

[3]- Significance levels: only reported for the statistic -change-

- General: The statistics are over a given number of trimesters trimester(s).



After running the do file : do "$path_do/F_All-OverTrimesters.do", we will have another Exel file of results for the impacts in average. What follows is an example of results.



Cumulative_Results.xlsx - Excel

Per capita average expenditures and simulated scenario || Cumilative results over three trimesters

Per capita average expenditures and simulated scenario || Cumilative results over three trimesters						
	Initial	Scenario1		Scenario2		
Groups:	Level	Level	Change (in %)	Level	Change (in %)	
hbranch						
Agriculture	257405.15	247803.16	-3.73%***	243169.22	-5.53%***	
Breeding & fishing	326916.11	312289.58	-4.47%***	304660.51	-6.81%***	
Industry & extractions	280338.65	265869.27	-5.16%**	256770.00	-8.41%**	
Others industry	422698.21	398126.66	-5.81%***	383396.45	-9.30%***	
Construction	358276.58	343576.54	-4.10%***	334555.04	-6.62%***	
Trade	428246.89	404848.37	-5.46%***	390543.10	-8.80%***	
Restaurants & Hotesl	661075.72	622779.61	-5.79%***	597777.96	-9.57%***	
Transpotation & communicaton	472592.60	444412.44	-5.96%***	427064.06	-9.63%***	
Education & health	734287.07	687800.81	-6.33%***	659501.31	-10.18%***	
Personal services	386018.17	362651.75	-6.05%***	348409.87	-9.74%***	
Other services	499161.52	474277.77	-4.99%***	458561.30	-8.13%***	
hgender						
Male	378119.77	359358.62	-4.96%***	348345.78	-7.87%***	
Female	520770.45	492282.18	-5.47%***	474285.48	-8.93%***	
rururb						
Urban	546442.78	519088.02	-5.01%***	501859.86	-8.16%***	
Rural	295354.81	279783.51	-5.27%***	271099.44	-8.21%***	
Population	410778.34	389790.26	-5.11%***	377178.53	-8.18%***	

Notes:

[1]- The statistic is the average

[2]- Sympols of significance levels: * p<0.10, ** p<0.05, *** p<0.01

[3]- Significance levels: only reported for the statistic -change-

- General : The statistics are cumulative over trimester(s).

Average_Expend_Over_T1_T2 | Average_Expend_Over_T1_T2_T ...

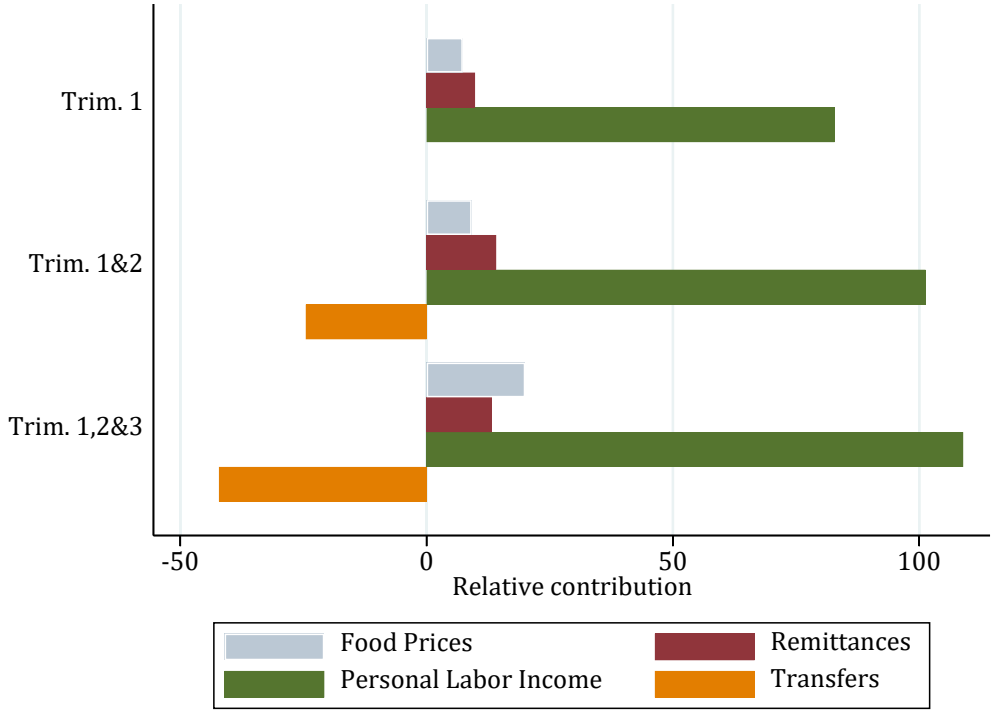
Prêt 100%

Estimating contribution of factors to the total change in poverty.

By focussing on average the impact over the different transfers (CF_{h,s,t_R}) it is asked to estimate the relative contribution of each on the main factors to the total change in poverty. Because of the non-linearity of the linkage between poverty indices and income-sources/factors, we propose to use of the Shapley approach. Under the Shapley framework, the characteristic function becomes the change in FGT poverty, and elements become changes in well-being with a set of main factors. We produced a new ado Stata file for this end with the name of ddfgts. For the Shapley approach, see also the following references:

- http://dad.ecn.ulaval.ca/BM_ALG/files/I-Shapley-Araar.pdf
- http://dad.ecn.ulaval.ca/pdf_files/shap_dec_aj.pdf

Consult the do file: deco_change_poverty.do



GIC curvers and COVID19 shocks

Consult the do file **GIC_Curves.do**