The Impact of the World Economic Downturn on Syrian Economy, Inequality and Poverty

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Abstract

The aim of this study is to assess the potential effects of the world economic crisis on the Syrian economy, the income distribution, and poverty. For this purpose, multi-level analysis approaches are followed to capture the extent of these effects on GDP, foreign balance, unemployment, inequality, and poverty. The first level rests on a Syrian macroeconometric model. The second level uses a Computable General Equilibrium (CGE) model. Both of the two first levels are focused on the macroeconomic effects of the global downturn. The distributional effects are captured using a microsimulation framework which relies, on the one hand, on the prices and income changes predicted by the CGE model and, on the other hand, on the 2006/7 Syrian household survey. The first results reveal that the international economic decline is expected to impact negatively on growth, employment and poverty. However, their distributional effects are expected to be very weak.

0. Introduction

The expansionary monetary and fiscal policies in the industrialized countries, materialized by low interest rates and high public expenditures, with sub-prime and speculative lending as well as weak financial regulatory systems, especially in the US, led to a credit crisis in 2008, which has morphed into recession across advanced economies and spread to the developing countries.

The global economic downturn manifested its impact on the Syrian economy through a fall of the rest of the world demand for the Syrian exports. Production of manufacturing and mining products fell in response to the decline in foreign demand. Concomitantly, the agriculture sector is undergoing a serious drought which is expected to impact negatively on the agricultural production and put under pressure the balance of payments.

In recognition to the seriousness of global economic downturn and drought, the Syrian State Planning Commission and the UNDP are undertaking a study on their potential negative effects on the population welfare. The principal objectives are to study the potential short-term impact of the global economic decline on the domestic economy; inequality and poverty, on the one hand. On the other hand, responses scenarios which the government could take to mitigate these potential effects should be analyzed. This study seeks to rigorously address these objectives through:

1. A Syrian macroeconometric model.
2. A Computable General Equilibrium (CGE) model.
3. A microsimulation model.

The primary findings reveal that the current drought is expected to be more damaging to the Syrian economy than the world economic downturn. Both of these shocks would not have a significant impact on inequality. However, their negative impact on poverty, mainly as a result of drought, would be very important. The devaluation of the Syrian pond as a policy response to the global economic crisis would reduce their negative effects on the Syrian current account. However, this policy is expected to exacerbate the poverty rise.

The rest of the report is organized as follows. Section 1 presents the potential effects of the world crisis on the overall production, employment, and the current account as predicted by the macroeconometric model. Section 2 describes the CGE model and presents the macroeconomic results of different scenarios of economic changes simulated. Section 3 quantifies the effects of price changes predicted by the CGE model on poverty and inequality using a microsimulation model based upon the 2007 Syrian household survey. Section 4 provides some concluding remarks.

1. Macro-econometric level analysis

To predict the potential effects of the international economic crisis on the Syrian economy, the first level analysis is based upon a macroeconometric model. Zwiener and Logeay (2004) had started working on a macro-econometric model of the Syrian economy, which can be used both for medium-term forecasts and for economic policy simulations. In close co-operation with Syrian partners from various institutions, particularly the State Planning Commission (SPC), they developed the model and documented their results in May 2005. Since then, the model had been used (with slight changes) by the Syrian partners in the SPC.

The updated econometric model of the Syrian economy covers the period from 1970 until 2007. It is based on data from Syrian institutions, mainly the Central Bureau of Statistics, the Syrian Central Bank and the Ministry of Finance. It consists of 32 stochastic equations and 26 definitions, covering the production side of real GDP, nominal GDP by expenditure, the government budget, wages, prices and employment. The oil price in USD, the exchange rate and oil production are the main exogenous variables. By contrast to the previous version of the model, the majority of the stochastic equations follow now an error-correction approach. This improvement naturally yields a better long-term forecast quality.

1.1. Model estimation

As in the previous version of the macro-econometric Syrian model, the equations are estimated using ordinary least squares (OLS) technique. Whereas the dependent variables were formerly estimated in levels (using sufficient lags to avoid auto-correlation), 26 out of 32 stochastic equations follow an error-correction approach, which is explained in detail in the next section. The stable long-run relationship expressed by the error-correction term is a great advantage for forecasts over a longer time horizon. This is precisely why the updated macro-econometric model of the Syrian economy relies on error correction equations wherever possible.

1.1.1. The error-correction framework

The macroeconometric methodology we use is appropriate for time series data which either show a trend or have an increasing variance. Most of the macro-economic time series data show such characteristics. They are integrated of the order one. They are non-stationary and it is generally agreed that they follow a stochastic trend. They are characterized by asymptotically infinite variance and auto-correlations. These entail that a shock has a permanent effect on the series and thus the series tend to “wander” away from a deterministic path without a tendency to return.

Co-integration means that two or more series ”wander together”. While each of the series is influenced by the permanent effects of shocks, there exists a long-run equilibrium relationship between them and a mechanism that forces them back to this equilibrium.

Technically speaking, two or more series are co-integrated if they are integrated of degree $I(d)$ and there exists a linear combination between them, that is to say, $I(d\text{-}b)$. In the bivariate case with d=b=1, this means that if there are two economic time series, Y_t and X_t say, that are $I(1)$ and there is a relationship $Z_t = Y_t - aX_t$ that is $I(0)$, they are co-integrated with co-integrating vector [1-a] and Z_t is called the equilibrium error.

The concept of co-integration has become central in econometric time series analysis. One reason is that the equilibrium concept implied closely relates to the theoretical equilibrium view of the economy. Since most economic time series data are taken to be $I(1)$, most of economic time series are non stationary series[1], theoretically established equilibrium relations between them imply a co-integrating relationship if the theory is indeed empirically valid(i.e. Z_t is I(0), stationary). Non-co-integration would lead to $I(1)$ error terms Z_t (i.e. Z_t is I(1), non-stationary). And this basically means that no equilibrium exists since the errors are permanently deviating from zero.

Econometrically speaking, the analysis of the relationship between two or more co-integrated $I(1)$ time series data can be performed within an error correction framework. This approach is a re-parameterization of an autoregressive distributed-lag equation that explicitly takes into account the long-run equilibrium relation as well as the short-term dynamics of the series.

An error correction model (ECM) for Y_t as endogenous variable and X_t as exogenous variable can be written as:

$$\Delta(Y_t) = \delta + \underbrace{\gamma\left[Y_{t-1} - \mathrm{det} - aX_{t-1}\right]}_{\text{error correction term}} + \underbrace{\sum_{i=1}^{p}\alpha_i\Delta(Y_{t-i}) + \sum_{j=1}^{q}\beta_j\Delta(X_{t-j})}_{\text{short-term dynamics}} + \varepsilon_t$$

Δ difference operator

det deterministic components (constant, trend, seasonal dummies etc.)

δ constant

γ speed of adjustment parameter

ε_t white noise error term

The change in Y_t is influenced by last period‘s deviation from the theoretically founded equilibrium relationship between the two economic time series and lagged difference terms of the endogenous and exogenous variables. The number of lagged difference terms is chosen such as to make the error term white noise. One can see that

[1] - A time series X(t): t=1,….n is called to be stationary if it's statistical properties do not depend on time.

the OLS regression provides consistent parameter estimates as all elements are $I(0)$ by definition if the two $I(1)$ variables are co-integrated.

The following methodology was employed to build the macroeconometric model:

- relationship(s) between the variables under concern were taken from the economic theory;
- the empirically verified equilibrium relationship was used to construct an ECM;
- the stability and forecasting properties of the ECM were tested and, when need be, a re-specification of the model was performed;
- the performance of each ECM in the complete system was analyzed and, if necessary, a re-specification was performed.

There are several possibilities to test for (co-)integration. To check the time series properties, the Augmented Dickey Fuller (ADF) Test can be used.[2] Co-integration can also be checked in the final ECM used in the model.

This kind of test was proposed by Banerjee et al. (1998) and makes use of the *t*-statistic of the speed of adjustment parameter. The argument from above that each element in the ECM has to be $I(0)$ if Y and X are co-integrated can be turned around: if all elements in the ECM are $I(0)$, then Y and X must be co-integrated. If X is exogenous, then the estimated value of γ must be significantly different from 0 to ensure that the adjustment to equilibrium takes place. This means that the Null Hypothesis of non-co-integration implies a value of $\gamma = 0$.

Furthermore, a battery of specification tests was performed as well as a stability analysis and a detailed forecast evaluation. Once an equation for an endogenous variable was satisfactorily specified, the definition equations were added and all equations were put together to form the model. Finally, each equation was analyzed, now with regard to its performance in the complete model.

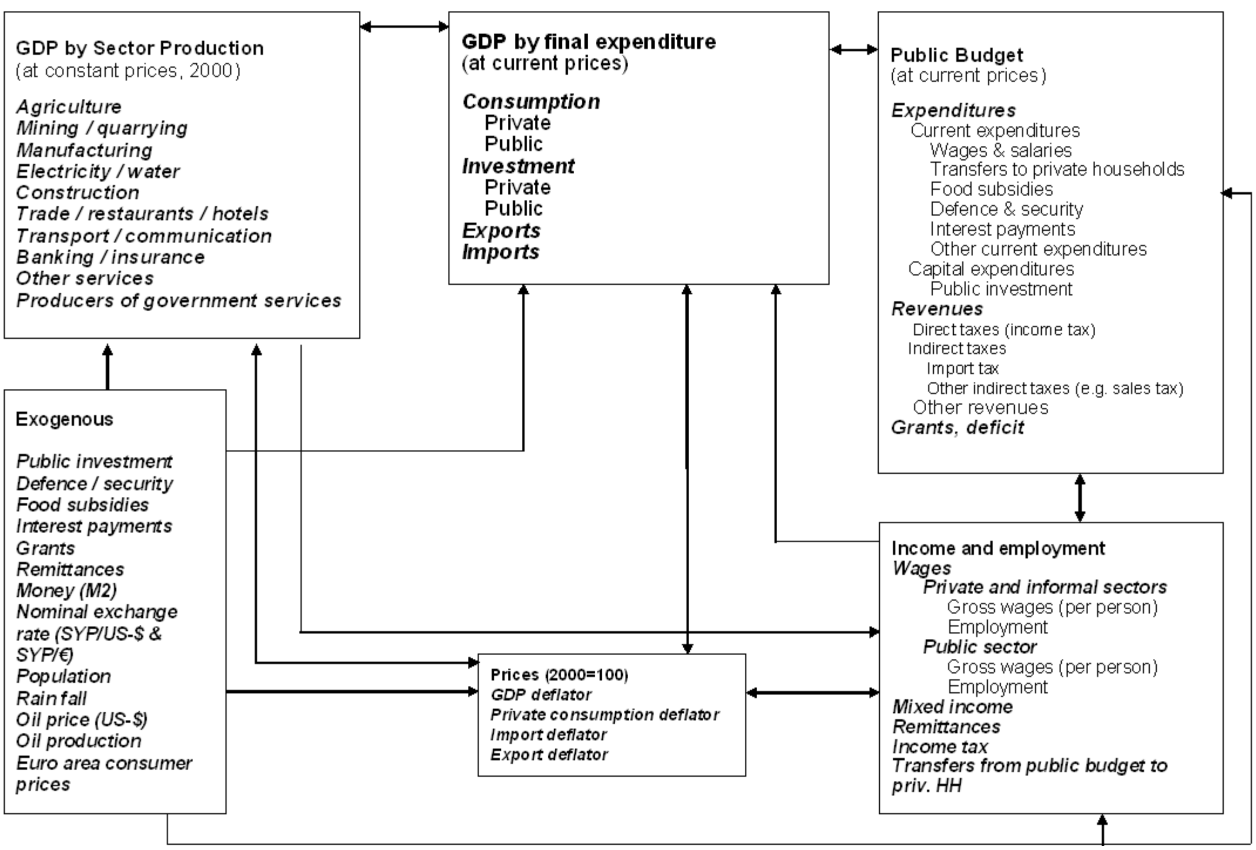
[2] See, among many others, Greene (2003) for more details about this test.

1.1.2. Model structure

The structure of the model is in part predetermined by data-availability. GDP by type of activity (production approach) is explained at constant prices of the year 2000. The expenditure side of GDP is estimated at current prices. The model estimates revenues and expenditures of the government at current prices and thus provides an assessment of the government deficit including and excluding grants. The data base allows only a limited reflection of price developments, as price deflators exist only for a few aggregates.

Wages and employment are included both for the private (formal and informal) sector and for the government sector. The resulting estimates of income are used to estimate private final consumption expenditure.

Structural macro-econometric model of the Syrian economy



1.2. Model results

1.2.1. Medium-term projection

The model includes 58 endogenous variables and 17 exogenous variables, ranging from rainfall in Aleppo to foreign grants to the Syrian government.[3] Therefore, a number of assumptions were made for the period ahead. Due to insufficient disaggregation in the data, the effects of oil price changes could not be fully captured in the export and import equations. This made the use of additional factors in the trade equations necessary.

After a steep increase in 2008, the oil price is sharply declining in the current year due to sluggish global demand. From 2010, a gradual increase is assumed, reflecting the recovery of the world economy as well as an increasing oil production cost.

In the near past, the Syrian pound appreciated against the US dollar by roughly 10 percent in 2007.[4] From 2009 onwards, the exchange rate is held constant. Oil production continues to decline and the Syrian population (not including Iraqi refugees) will grow steadily by roughly 2.39 percent per year.

As a result of the declining world demand in the current crises by 10%, the Syrian economy will face a small real growth rate of 2.2% in GDP during the year 2009. Given the population growth rate of 2.39 percent per year, this corresponds to a negative per capita growth of -0.2% in 2009. In 2008, consumer price inflation reached double digit levels due to both cuts in subsidy in food and energy price increases. But consumer price inflation would be much lower from 2009 onwards. Due to the decline in oil prices and the world economic slump, both exports and imports will fall sharply in 2009, but recover thereafter.

In the event of continuing the current circumstances, potential effects of the global financial crisis on the Syrian economy are reflected by the followings:

[3] Excluding dummy variables, which are also exogenous but not counted for.
[4] State Planning Commission estimation.

- The growth rate of GDP at constant prices will be reduced to 4 percent at the crisis's edge and continued to decline to 2.2 percent in 2009. For 2010 and 2011, GDP's growth rate is expected to improve to reach about 3.9 percent on average.
- Agriculture sector grew at a negative rate in 2007 and growth started to deteriorate during 2008 to reach minus 18 percent. This bad performance is due to weather conditions and harsh climatical conditions that ravaged the region during this period. Then, this sector is expected to attain the growth rate of 8 percent on average during the period 2009 -2011.
- The manufacturing sector achieved a significant growth in 2008, because of its growing at a positive rate of 34 percent. Unfortunately, this growth pattern is expected to quickly and severely deteriorate to reach minus 20.8 percent in 2009. In the next two years, it is expected that this sector will achieve a positive growth rate of 6.6 percent on average.
- The growth of government services following the international downturn is expected to decline after a significant growth in 2007 by 28.9 percent to reach its lowest level, i.e. 0.5 percent in 2009. Subsequently, it is expected to grow by minus 6.2 percent on average during the next two years.
- The inflation rate (growth rate in the consumer price index) reached its highest level of 15.7 percent in 2008 due to higher world prices (mainly food and oil). In the coming years, it is expected to reach 1.3 percent on average and prices will be almost stable during the coming period.
- Global demand for Syrian goods and services declines during 2009 by 10 percent, and is expected to improve during the next two years to reach 2.1 percent on average. The relative prices of imports are expected to increase at a higher rate than the increase of the relative prices of exports.
- The budget deficit of the government as a share of the GDP is almost semi-fixed and is expected to reach its highest level of 4.9 percent in 2010. Then it is expected to decline to 3.2 percent in 2011.

- After its lowest level of 8.4 percent in 2007, the unemployment rates are expected to reach 10.7 percent and 11.1 percent during the next two years, i.e., 2010 and 2011, respectively. These findings are driven by the expected return of Syrian workers from abroad as a result of the world economic crisis.
- Despite of its growth rate by 10.2 percent on average during 2007-2009, the growth rate in public investment during the next two years is expected to decrease to 8.9 percent and 2.4 percent for the years 2010 and 2011, respectively.
- The total revenue is expected to grow at an average rate of 8.8 percent in the next two years and by a higher growth rate than the growth rate of total expenditure, which is expected to decline to 5.3 percent for the same period.
- Private investment evaluated in current prices has achieved a remarkable growth of 29.1 percent in 2008 and continued to grow by 21 percent in 2009. However, it is expected that this growth will decline to reach 6.6 percent on average during 2010 and 2011.

Table 1.1: Predicted growth of macroeconomic aggregates

Growth rate		2007	2008	2009	2010	2011
Total expenditure	B as U	3.5	13.8	8.8	8.0	5.3
	Scenario 1	3.5	14.0	8.2	6.7	4.0
	Scenario 2	3.5	13.9	8.4	7.3	5.1
Total revenue	B as U	5.5	11.8	7.4	11.5	10.4
	Scenario 1	5.5	11.6	6.4	9.2	8.3
	Scenario 2	5.5	12.5	6.6	10.3	9.8
Public investment	B as U	10.4	9.8	10.9	9.8	3.4
	Scenario 1	10.4	9.7	10.5	8.9	2.4
	Scenario 2	10.4	10.0	10.6	9.4	3.2
Private consumption	B as U	7.3	20.0	11.3	12.4	9.1
	Scenario 1	7.3	18.7	6.0	7.4	8.9
	Scenario 2	7.3	17.4	7.9	10.1	12.0
Private investment	B as U	20.7	29.1	22.3	10.5	11.1
	Scenario 1	20.7	29.1	21.0	7.3	6.0
	Scenario 2	20.7	29.1	21.8	9.0	8.0
Nominal imports	B as U	15.8	19.2	9.6	11.1	12.2
	Scenario 1	15.8	7.7	2.5	3.5	1.5
	Scenario 2	15.8	24.4	10.9	8.0	9.0
Nominal exports	B as U	5.2	13.2	4.5	6.8	2.6
	Scenario 1	5.2	15.7	-0.2	0.7	3.5
	Scenario 2	5.2	12.2	0.9	4.1	8.8
Nominal GDP	B as U	18.9	10.0	10.8	11.4	9.3
	Scenario 1	18.9	5.5	7.4	6.8	6.5
	Scenario 2	18.9	10.6	9.1	8.6	10.8
Real imports	B as U	11.3	10.4	9.3	6.3	5.4
	Scenario 1	11.3	0.9	7.2	7.4	6.0
	Scenario 2	11.3	-8.9	6.1	6.6	5.9
Real exports	B as U	1.4	12.6	7.2	7.4	6.0
	Scenario 1	1.4	1.7	6.1	6.6	5.9
	Scenario 2	1.4	12.4	7.1	7.5	6.2

Source: Syrian macroeconometric model

Table 1.1 (continued): Predicted growth of macroeconomic aggregates

Percentage growth rate		2007	2008	2009	2010	2011
Real GDP_00	B as U	6.3	7.7	6.2	6.5	5.2
	Scenario 1	6.3	4.1	2.2	3.3	4.5
	Scenario 2	6.3	4.5	2.4	3.5	4.6
Agriculture	B as U	-11.3	5.2	4.2	16.7	1.7
	Scenario 1	-11.3	-17.9	7.8	12.0	4.1
	Scenario 2	-11.3	-17.9	7.8	12.0	4.1
Manufacturing	B as U	19.2	15.9	29.1	24.6	16.3
	Scenario 1	19.2	33.8	-20.8	8.0	5.3
	Scenario 2	19.2	37.0	-20.1	7.8	6.1
Mining	B as U	-9.1	5.6	-2.6	-3.4	-3.4
	Scenario 1	-9.1	5.6	-2.6	-3.4	-3.4
	Scenario 2	-9.1	6.7	-2.6	-3.4	-3.4
Gov. Services	B as U	28.9	10.6	0.5	-15.5	3.4
	Scenario 1	28.9	10.6	0.5	-15.8	3.5
	Scenario 2	28.9	10.6	0.4	-15.6	3.7
Other Services	B as U	14.0	7.4	7.3	7.2	6.6
	Scenario 1	14.0	7.1	6.4	6.4	6.4
	Scenario 2	14.0	7.0	6.8	6.7	6.5
Per capita GDP SYP	B as U	5.0	4.0	3.7	4.1	2.8
	Scenario 1	5.0	0.6	-0.2	0.9	2.0
	Scenario 2	5.0	0.8	0.0	1.0	2.1
Prices						
CPI_00	B as U	5.2	13.2	4.5	6.8	2.6
	Scenario 1	5.2	15.7	-0.2	0.7	3.5
	Scenario 2	5.2	12.2	0.9	4.1	8.8
Import price index_00	B as U	12.9	17.0	3.1	3.9	5.4
	Scenario 1	12.9	17.0	-3.0	-1.7	0.4
	Scenario 2	12.9	17.0	3.1	2.8	3.5
Export price index_00	B as U	14.2	5.9	2.2	3.5	5.8
	Scenario 1	14.2	5.9	-3.3	-2.9	-4.1
	Scenario 2	14.2	10.7	3.5	0.5	2.7

Source: Syrian macroeconometric model

Table 1.2.: Predicted evolution of some macroeconomic aggregates

Percent share in GDP		2007	2008	2009	2010	2011
Total expenditure	B as U	26.4	27.3	26.8	26.0	25.0
	Scenario 1	26.4	28.5	28.7	28.7	28.0
	Scenario 2	26.4	27.2	27.0	26.7	25.3
Total revenue	B as U	22.7	23.1	22.3	22.4	22.6
	Scenario 1	22.7	24.0	23.8	24.3	24.7
	Scenario 2	22.7	23.1	22.6	22.9	22.7
Budget deficit	B as U	-3.7	-4.2	-4.4	-3.6	-2.4
	Scenario 1	-3.7	-4.5	-4.9	-4.3	-3.2
	Scenario 2	-3.7	-4.1	-4.4	-3.8	-2.6
Public investment	B as U	9.6	9.6	9.6	9.5	9.0
	Scenario 1	9.6	10.0	10.3	10.5	10.1
	Scenario 2	9.6	9.6	9.7	9.8	9.1
Private consumption	B as U	59.7	65.1	65.4	66.0	65.8
	Scenario 1	59.7	67.1	66.3	66.6	68.1
	Scenario 2	59.7	63.3	62.6	63.5	64.2
Private investment	B as U	12.1	14.2	15.6	15.5	15.8
	Scenario 1	12.1	14.8	16.6	16.7	16.6
	Scenario 2	12.1	14.1	15.7	15.8	15.4
Nominal imports	B as U	37.8	44.4	45.1	44.8	45.5
	Scenario 1	37.8	45.6	45.0	44.1	43.6
	Scenario 2	37.8	44.0	45.4	45.7	44.4
Nominal exports	B as U	38.6	41.8	41.4	41.3	42.4
	Scenario 1	38.6	39.4	37.6	36.5	34.7
	Scenario 2	38.6	43.4	44.2	43.9	43.2

Source : Syrian macroeconometric model

1.2.2. Effects of a devaluation

The medium-term projection presented above (B as U and Scenario 1) rests on the assumption of a constant relation of the Syrian Pound against the US-dollar. A devaluation of the exchange rate would affect the Syrian economy quite differently. To examine the impact of such devaluation on the Syrian economy, a simulation experiment with the macroeconometric model is explained in scenario 2. In this experiment, a 10 percent devaluation of the Syrian Pound against the US dollar and the Euro from the year 2008 onwards is simulated. Table 1.1 and 1.2 summarize the findings of such scenario. The findings of Scenario 2 are described against those of the Business as Usual and Scenario 1 situation in which the exchange rate does not change. Until now, the impact of oil in overall exports is still large. According to the macroeconometric model, a ten points of percentage devaluation of the Syrian Pound would increase the export prices by close to 4.1 percent in 2009 while nominal exports would increase by more than 4.5 percent. Therefore, some additional real exports of goods and services would be induced by the improved international competitiveness.

At the same time, the devaluation would make imported goods more expensive in Syria. The import prices would increase, but by around only 3.5 percent in 2009. According to the macroeconometric model, there is no full pass-though effect on import prices after devaluation. This means that either the foreign companies or the Syrian import companies are not able to increase the import prices by the same amount as the currency devaluates. Nominal imports would increase by 11 percent in 2009, leaving real imports little bit less after a devaluation. As a result, overall nominal GDP would increase by around 9 percent, while real GDP growth rate would be 2.4 percent. The largest impact in the sector development could be observed in industry where a 7 percent increase would be seen in the long run. In the short run however, there would be a negative effect. The consumer price index would be higher after the devaluation.

2. General equilibrium analysis

Computable general equilibrium (CGE) models characterize the economy as a set of inter-related markets for goods and factors. The number of markets depends on data desegregation. Each market is a meeting place of demand and supply of goods or factors, which are derived from optimization behavior of economic actors and mirror optimal allocation of scarce resources.

Each market balances, when demanders and suppliers agree about an equilibrium price that clears the market. Prices are generally flexible and endogenously determined; they adjust to clear the market after a shock. Due to such flexibility, CGE models find their roots in the Walrasian neo-classical economic theory.

Since they represent all the markets in the economy, CGE models capture the transmission effects from one market to the others; resulting from an exogenous shock like a change in world prices or government intervention through taxes, subsidies and/or transfers. All these features let the CGE models be an ideal framework to quantify the effects of any exogenous shock on resource allocation and identify the potential winners and losers.

CGE models are schematized by an explicit mathematical statement of theoretical models with endogenous and exogenous variables as well as parameters and they are composed of (i) explicit specification of demand and supply functions, (ii) equilibrium conditions between total demand and supply on each market, and (iii) macroeconomic closures or balances such as: trade balance, saving-investment balance and government and households' income-expenditure balance.

The extreme complexity of the linkages between the 2008 global downturn and the Syrian economic and social indicators such as production, unemployment, exportation, poverty and inequality motivates the use of a CGE model. In order to infer poverty and inequality indicators, the CGE model communicates with a micro-simulation model based on the 2006 Syrian household income and expenditure survey. This is a top down approach, where the CGE model provides the prices, expenditures, and income variations resulting from a simulated exogenous change in world demand and prices. These changes will then be used in turn to communicate with the micro-simulation model that allows estimating poverty and inequality changes.

In this section, the main features of the CGE model used to estimate the impact of the world economic crisis on the Syrian macroeconomic and distribution aggregates are described. The model is a prototype of the IFPRI standard static CGE model (Löfgren et al. (2002)), which has been already implemented to estimate the impact of the Syrian agricultural sector liberalization in 2004.

To address the issues raised by this study, we have amended the IFPRI's model to explicitly account for both labor unemployment and downward sloping export demand. In addition, the model is calibrated to data from the recent 2007 social accounting matrix (SAM), in which the Syrian economic activity is desegregated into seven production sectors: two agricultural and five industrial.

2.1. Market equilibrium conditions and macroeconomic closures

The CGE model distinguishes six market equilibrium conditions and three macroeconomic closures.

There are three factor markets equilibrium conditions. The supply of land, capital and labor on their respective market is exogenous, reflecting fixed factor endowments in the short-run. As we shall describe below, factor demands are derived from the producers profit maximization in each sector. In the original CGE model, land, capital, and labor prices are flexible and adjust to balance the supply and the sum of demands by all the sectors. In order to predict the potential effects of the global economic crisis on unemployment, we have introduced in the model some rigidity in the real wage setting and we have recalibrated the model so as to generate an unemployment rate equal to 9.6 percent in the baseline situation. Therefore, due to real wage rigidity, total labor supply does not equal total demand by all sectors; unemployment appears then to fill the gap between labor demand and supply and the labor market equilibrium condition is:

$$\overline{QFS}_f\left(1-UNEMP_f\right)=\sum_a QF_{f,a} \tag{1}$$

Besides, the model includes a market for imports and exports of each good. The rest of the world (ROW) import supply is perfectly elastic and the world prices of import are fixed. However, for the purpose of this study, a second modification is introduced to the original CGE model. Indeed, we have explicitly introduced new demand functions, which characterize the export demand behavior of the ROW. This is a policy relevant improvement of the model as one possible channel of transmission of the global economic crisis to the Syrian economy would be through a fall of in the ROW demand for the Syrian exports. Naturally, we assume that the export demand of the ROW is downward sloping as illustrated by the following equation

$$QE_C = QE0_C\left(\frac{PWE_C}{PEFOB_C}\right)^{\varepsilon_C}, \tag{2}$$

where QE_C, $PEFOB_C$, PWE_C, $QE0_C$ represent respectively the world export demand for good *C*, the local price for the exported good *C*, the world exogenous price of good *C* and the initial level of export demand. As to ε_C, it represents the elasticity of export demand. For the purpose of this study, it is calibrated for each tradable commodity such that the elasticity of export earnings, with respect to the real exchange rate, is approximately equal to unity. We rely for the value of this elasticity on Weeks (2009) and on the results of the Syrian macroeconometric model, described in section 1. The calibrated elasticities of export demand vary then between one for the agricultural products to two for the manufactured products and services. This means that the Syrian economy is facing elastic export demand. For instance, if we inspect the effects of 10 percent depreciation of the Syrian pound, the CGE model predicts a rise in real exports by 7.8 percent, a fall in real imports by 9.4 percent, and a reduction in nominal imports by 0.3 percent.

As to the import demand, it is derived from the minimization of internal absorption subject to the Armington constant elasticity of substitution (CES) function, while the export supply is derived from the maximization of total sales subject to the constant elasticity of transformation (CET) function. Equilibrium on the import and export markets requires that excess demands for imports and exports equal zero.

The last market equilibrium condition refers to the equality between domestic demand and supply. The domestic demand (supply) is derived by applying the same methodology as the import (export) demand (supply).

Turning to the macroeconomic closures or balances, they are constraints that have to be satisfied by the economic system, but are not considered in the optimizing decision of any micro agent (Robinson 1989).

There are three macroeconomic balances: the (current) government balance, the external balance (the current account of the balance of payments, which includes the trade balance), and the savings-investment balance. The mechanism by which the model satisfies these constraints is referred to as the "closure rules."

1. *The Government Balance* needs to have government savings as a flexible residual with all fixed tax rates for domestic institutions.
2. *The External Balance.* The presence of the rest of the world in the model requires an explicit treatment of how the flow of foreign exchange outflows and inflows are equilibrated. Typically, the real exchange rate, defined as the relative price of traded to non-traded goods is the equilibrating variable, while foreign savings (or net foreign capital transfers) is fixed. For the purpose of this study however, an alternative closure rule is chosen, where the exchange rate is fixed, whereas the foreign savings is flexible.
3. *The Savings-Investment (S-I) Balance.* Two common closures for the S-I balance are the savings-driven and the investment-driven closures. Under the savings-driven closure, savings rates are fixed and investment demand adjusts to match the level of savings (a neoclassical closure) while for the investment-driven closure investment demand is fixed and the value of savings adjust (a "Johansen" closure). The former closure is retained to perform our analysis.

2.2. Production structure

Production function or technology is characterized by two-level nesting and constant returns to scale over inputs. At the first level, there is a Leontief input-output production function. At this level, firms use a composite of primary factors of production and many composite intermediate inputs (one composite for each sector of production). Gross output is then produced by combining, in fixed proportions, intermediates goods and primary factors composite. Since neither the composite primary factor cannot be substituted for the composite intermediate, nor can intermediates of one sector be substituted for intermediate of another, the production function at level one is strongly separable.

At the second level, each of the composite functions is defined. In all sectors, except agriculture, the primary factor of production is a composite of capital and labor. In agriculture however, land represents a third specific primary factor that substitutes to labor and capital. Capital and labor are mobile across all sectors and immobile across countries.

Primary factors of production substitute smoothly for each other through a CES value-added function, which parameters vary across sectors.

Factor demands and production supply functions are obtained from the maximization of profit in a setting of perfect competition. The latter functions are homogenous of degree zero, reflecting the assumption of non monetary illusion.

Firms, producing tradable goods, also decide on how to allocate their sales between the local and international markets. The substitution possibilities in production are allowed through a CET function, which extends to exports the idea of product differentiation commonly used for imports in general equilibrium models. The allocation of a given output between domestic and export sales is the result of revenue maximization subject to the CET function. The derived export (local) supply function depends positively on the relative price of the export (domestic) good.

2.3. Institutions and demand structure

The CGE model distinguishes nine composite consumption good, which are the sum of households, government and investors final consumption demands as well as all producers' intermediate composite goods demands. Each composite consumption good is assumed to be a CES aggregation of imported and domestic goods. The latter are deemed imperfect substitutes by the local demanders. The demands for imported and domestic goods are the result of cost minimization by the local demanders (firms, government, households, and investors) subject to the Armington CES aggregation. They are decreasing with their own relative prices and are homogenous of degree zero.

Firms demand composite goods, imported and local, for intermediate use according to a Leontief input-output technology; i.e., the coefficients of intermediate goods in production are fixed. The model also explicitly features the expenditures flows arising from households and government behavior, as well as the activities of private investors.

Government revenue is derived from the collection of taxes on revenues, tariffs and consumption. It is then allocated between consumption expenditures, saving and transfers to households in fixed proportion.

The investment demands for the different composite goods by sector of origin are also assumed to be in fixed shares of total investment demand, which is equal to total saving.

2.4. The household block

Since this study also focuses on the redistributive effects of the global economic crisis, the integration of as many households as there are in the Syrian household survey directly into a CGE model would have been the ideal approach to predict the potential effects of the global economic downturn on poverty and inequality. This is indeed the best way to keep all the information about the households' heterogeneity with regards to their endowment pattern and consumption. This is not however the route followed in this study since the Syrian CGE model we use includes only ten households, where each one represents 10 percent of the total Syrian households (and not necessarily 10 percent of the population as Table 2.1 reveals).

The household block is then disaggregated into ten household groups. To build this block, the 2007 household survey has been used to rank the 12,000 individual households in an increasing order of their total expenditure *per capita*. These households have been then split into ten groups, with each group representing 10 percent of the total households in Syria. This enables to estimate straightforwardly the share of each group in the national expenditure by commodity and in total expenditure. These shares are subsequently used to allocate the household consumption from the social accounting matrix between the 10 households of the CGE model. Table 2.1 portrays the characteristics of each group, including their population share, their share in national expenditure, and their mean household size.

Table 2.1: Some characteristics of the household groups

	Share of households	Share of individuals	Household size	Expenditure share	Food share
Group 1	10	13.87	7.93	5.17	6.35
Group 2	10	12.61	7.21	6.53	7.62
Group 3	10	11.93	6.82	7.41	8.5
Group 4	10	10.94	6.25	7.95	8.82
Group 5	10	10.23	5.85	8.58	9.33
Group 6	10	9.64	5.51	9.37	10.04
Group 7	10	9.1	5.2	10.49	11.16
Group 8	10	8.41	4.8	11.77	11.83
Group 9	10	7.39	4,23	13.41	12.09
Group 10	10	5.86	3.35	19.32	14.25
Population	100	100	5.71	100	100

Source: Authors' calculation using 2006/7 Syrian household survey.

Each household group's revenue is based on salaries and/or distributed profits, in addition to government and ROW transfers.

Households' revenue is allocated in a first level between saving and total consumption expenditure, according to a constant fraction of disposable income. In a second level, households maximize utility subject to total consumption expenditure in order to choose the optimum level of consumption of each of the nine composite consumption good. Households' preferences are represented by a Stone-Geary utility function leading to a linear demand system (LES) over the nine composite goods, reported in Table 2.2.

2.5. Policy scenarios and results

The global economic crisis comes at a time when Syria is suffering the adverse consequences of a drought. The drought worsens the performance of the agricultural sector, which accounts for one fifth of Syrian GDP in 2007. There are fears that drought exacerbates heavily the negative consequences of the global economic downturn on the Syrian economy. Giving this context, we have performed five simulations:

- **Scenario 1** represents a 10 percent collapse in global demand for Syrian non-agricultural products. The Syrian agricultural goods do not bear constraints on the export market.
- **Scenario 2** simulates a 10 percent drop of agriculture total factor productivity, resulting from drought;
- **Scenario 3** is a combination of the preceding shocks defined in **Scenario 1** and **Scenario 2**;
- **Scenario 4** accounts for global demand decrease as well as nominal exchange rate depreciation;
- **Scenario 5** is **Scenario 4** supplemented by drought.

The simulation results are deeply influenced by the structure of the economy in the base year. Therefore, before exposing and interpreting the simulation results, we briefly present some of the Syrian economic structure indicators, based upon the 2007 social accounting matrix (SAM).

2.5.1. Syria's pattern of production and trade in 2007

The Syrian economy in 2007 is desegregated into seven sectors, from which only one is non tradable. The sectoral features of the economy in the reference year are summarized in Table 2.2. The first four columns indicate the production characteristics of each sector, while the last two columns show the outward orientation of each activity.

Table 2.2: Syria's pattern of production and trade in 2007 (%)

	QVA/GDP	QVA/QX	QL/QF	QM/QQ	QE/QX
Activities	(1)	(2)	(3)	(4)	(5)
Agricultural plant	12.5	69.2	26.6	12.0	15.3
Agricultural animal	7.8	69.2	35.6	4.7	9.2
Manufacturing	5.8	14.1	36.8	42.7	34.3
Mining	24.0	94.2	2.4	17.1	40.1
Energy	5.9	55.3	30.8	47.7	8.1
Government services	10.0	79.5	93.9	–	–
Other Services	33.9	62.9	24.4	15.1	17.9

Notes: Column (1) gives the activity contribution to GDP and column (2) reports the contribution of primary factors to sectoral production. As to columns (3) and (4), they summarize respectively the share of labour and capital in sectoral value-added. The outward orientation of each activity is resumed in column (5) by the share of imports in total absorption and in column (6) by the share of exported output.
Source: Authors' calculations from 2007 SAM.

The sectoral share in gross domestic product (GDP), reported in column (1), reveals that other services and mining account together for 57.9 percent of GDP. The contribution of agriculture to GDP is equal to one fifth, whereas the shares of manufacturing and mining are confined to roughly 6.0 percent of GDP.

The weight of primary factors versus intermediate goods in each sector production is indicated in column (2) by the ratio of value-added to gross output. Except for manufacturing, where the share of primary factors in production is equal to 14.1 percent, the remaining activities show weak inter-industry linkages, with intermediate goods shares in production lower than 45 percent. The primary factors reallocation between sectors is therefore expected to play relatively a strong role when explaining the output levels resulting from any simulated shock.

Aside from public services, none of the remaining activities is labour intensive as illustrated by column (3). Mining is leading by the ratio of capital to total factor inputs, with a value of capital equal 41 times that of labour.

The last two columns of Table 2.2 provide information on the trade orientation of each activity. Manufacturing shows the highest trade shares, with the ratio of imports to internal demand equal to 42.7 percent and the share of export in total production equal to 34.3 percent. Whereas the energy local production is highly competed by imports, the share of exported production is relatively weak and reaches 8.1 percent. Conversely, while mining products are strongly exported, with a ratio of exports to total production equal to 40.1 percent, they are not heavily competed by imports, with a share of imports in total mining demand equal to 17.1 percent. Manufacturing and energy products account besides for 68.1 percent of total imports, whereas mining and manufacturing products represent 72.8 percent of total exports.

Tuning to agricultural plant products and other services, the share of imports in total demand is roughly equal to the share of exports in output, ranging from 12.0 percent to 17.9 percent. The latter are the most inward oriented activities.

2.5.2. Simulations results

The aggregate and sectoral results of the five scenarios detailed above are presented in Tables 2.3 to 2.7. The aggregate results are a consequence of all the adjustments that occur at the sectoral level.

Scenario 1: World demand decrease

The contraction of the world demand for Syrian non-agricultural and tradable products induces a decline of real exports, as could be checked in Table 2.6. Overall, real exports fall by 4.17 percent. At the sectoral level, the export losses range from 3.02

percent in other services to 5.55 percent in mining, the most export oriented activity. For all these sectors, export losses translate into output and, also, value-added contractions.

In addition to the tradable non-agricultural activities, output contraction is also witnessed in agricultural animal and government services. Output decline varies from 0.08 percent in agricultural animal to 2.26 percent in mining. Everything elsewhere being equal, agricultural plant and other services are sheltered from the adverse effects of the global economic downturn. The latter activities indeed expand respectively by 0.32 percent and 1.85 percent. General consequences of activities slowdown are:

1. A decrease in factor demands in loosing sectors and a rise in the expanding ones. The quantity of freed factors depends on the relative factor intensity in production. The fall in labour demand resulting from world economic crisis varies between 0.38 percent in agricultural plant to 3.32 percent in mining.
2. A contraction in domestic sales. The supply of goods on the local market reduces for four activities: Agricultural animal (-0.2 percent), manufacturing (-0.15), mining (-0.1) and government services (-0.62). Excess supply for these goods dampens their prices and consumer substitute imports for local goods. Overall, real imports increase indeed by 0.74 percent. Given the decrease in world prices of export and the increase in domestic prices, the real exchange rate appreciates and the Syrian economy looses competitiveness.

As a consequence of output and value-added reduction and employment losses, real GDP falls by 0.07 percent whereas unemployment rate climbs and reach 10.1 percent. Further, exports contraction and imports expansion aggravates the balance of trade deficit, which augments by 5 percent in real terms.

Notice that our estimation of the fall in real GDP is far below the 0.8 percent decline projected by the macroeconometric model. In addition, the CGE simulation shows that the consumer price index decreases by 0.04 percent against 12.9 percent according to the macroeconometric model. The two models provide however comparable effects on unemployment rate, as it is predicted that it will rise to 10 percent.

Scenario 2: Drought

Since 2007, Syria is struggling with the worst drought in four decades. Total rainfall during October 2007 and May 2008 was much below average; it ranged from 25 percent to 85 percent of the average cumulative precipitation. In 2008, Syria had to import wheat for the first time after a shortage caused by a second year of drought. The Food and Agriculture Organization (FAO) calculates overall wheat and barley crops dropped by 47 percent and 67 percent respectively compared to the previous year.

To properly model the direct effect of drought on agriculture output, we have considered a 10 percent decrease in agricultural productivity. Table 2.3 shows the results of the macroeconomic effects of the drought. It can be seen that drought lowers Syrian GDP by 3.24 percent; 1.5 percent of GDP losses relate to reductions in value-added in agriculture, while the remaining 1.74 percent is contributed by other industries suffering negative indirect effects.

The drought is also projected to have considerable adverse effects on the Syrian labour market. It would cause an increase in unemployment by 39.5 percent as the demand for labour diminishes almost in all the contracting sectors, especially manufacturing (-6.6 percent) and private (-6.0 percent) as well as government services (-4.6 percent).

The reduced availability of agricultural products, following the decrease in their plant component by 8.3 percent and their animal component by 6.6 percent, pushes up their local prices. The domestic prices of agricultural plant and animal goods jump up by 7.8 percent and 8.0 percent, respectively. As a result, the overall consumer price index increases by 0.9 percent. This of course would adversely affect the purchasing power of all households, whose real consumption could reduce by 4.3 percent on average. The demand for investment would also decrease by 8.4 percent. The fall in total demand would affect local as well as imported goods. Imports volume indeed would decrease by 4.6 percent.

Scenario 3: Drought and fall in world demand

The third simulation represents an adverse conjunction for the Syrian economy of drought and global economic downturn. The effects of these two shocks reinforce each other to exacerbate the negative effects on main economic indicators. The real GDP would fall in this case by 3.15 percent. Drought would contribute by 97.8 percent to GDP deterioration, and the remaining 2.2 percent would represent the contribution of the global economic crisis.

Unemployment would increase by 44.75 percent, scaling up the unemployment rate from 9.6 percent to 13.9 percent. 57 percent of the rise in unemployment would be attributed to drought while 43 percent would be attributed to global economic slowdown. Real exports would cut down by 5.93 percent, whereas real imports reduction would be 3.8 percent. Major exports diminution would be explained by the global economic crisis which contribution to exports decline would be 70 percent. However, despite the increase of imports with the global economic crisis, the drought would contribute to temper that effect since their negative effects on the different economic actors are larger than those negative effects which would result from global economic crisis.

Scenario 4: Nominal exchange depreciation and fall in world demand

The exchange rate depreciation is expected to reduce the international price of exports while increasing the domestic price of imports. Imports demand contracts, while exports supply expands and counteracts the fall of world demand for Syrian products.

The 10 percent devaluation of the Syrian pound, in a context of decreasing world demand, would bring down the imports by 8.68 percent while counteracting the negative impact on exports, which would increase by 3.41 percent. In this context, the depreciation would be favourable to agricultural plant, energy and mining. While agricultural plant would expand especially on the international market, energy and mining would expand their activity both on the local and international markets to respond to the potential expansion of domestic and foreign demands.

The Syrian Pound depreciation in the context of the global economic slowdown would have an adverse impact on the remaining sectors, which would experience a decrease of their production as can be seen from Table 2.4. On the one hand, as imports would become expensive, this would put pressure on production costs, which would increase. Since firms would pass on the bill to their customers, prices would increase whereas demands would decrease. On the other hand, because imports would become expensive, the purchasing power of customers would deteriorate and they would buy less both imported and domestic goods. Given that demands for domestic goods would be driven down, their prices would move upward to clear the markets.

On the whole, consumer price index would increase by 2.27 percent and unemployment by 35.85 percent to reach 13 percent. The real GDP would register 1.08 percent loss.

Both the CGE model and the macroeconometric model predict the same pattern of changes in consumer price index, export and import. Nevertheless, while the CGE model predicts real GDP decline resulting from the depreciation accompanying the world economic storm, the macroecometric model projects a positive real GDP growth over the period 2008 – 2011.

Table 2.3: Aggregate results

	BASE	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
				Percentage change		
Real GDP	2000.960	-0.07	-3.07	-3.15	-1.08	-4.14
Unemployment rate (%)	9.600	5.49	39.46	44.75	35.85	74.43
Consumer price index	0.997	-0.04	0.88	0.84	2.27	3.15
Real exchange rate	0.988	-1.33	-0.06	-1.40	6.71	6.65
Real Private consumption	1205.181	-1.09	-4.35	-5.44	-4.05	-8.30
Relative price of labour	1	1.40	4.84	6.37	4.05	9.08
Real Investment	618.999	8.01	-8.37	-0.34	-11.03	-18.73
Real imports	853.846	0.74	-4.56	-3.80	-8.68	-12.86
Real exports	771.857	-4.17	-1.76	-5.93	3.41	1.38
Trade	1625.703	-1.59	-3.23	-4.81	-2.94	-6.10
Private consumption/GDP (%)	60.230	-1.06	-0.50	-1.57	-3.00	-1.36
Investment/GDP (%)	30.935	8.09	-5.47	2.90	-10.05	-15.22
Trade/GDP (%)	81.246	-1.52	-0.17	-1.72	-1.88	-2.04
Foreign saving/GDP (%)	4.627	63.55	-22.71	43.01	-52.76	-71.30

Notes: **Scenario 1** is a 10% reduction of world demand; **Scenario 2** is a 10% reduction of agriculture total factor productivity; **Scenario 3** is Scenario 1+ Scenario 2; **Scenario 4** is Scenario 1+10percent depreciation of nominal exchange rate; **Scenario 5** is Scenario 3 + 10% depreciation of nominal exchange rate.
Source: Syrian CGE model.

Table 2.4: Activities results

	BASE	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Percentage change				
		Sectoral Production				
Agricultural plant	362.357	0.32	-8.30	-7.98	0.73	-8.18
Agricultural animal	226.816	-0.08	-6.63	-6.70	-0.13	-7.11
Manufacturing	819.287	-1.94	-4.31	-6.18	-1.03	-5.29
Mining	509.592	-2.26	1.51	-0.86	2.80	4.39
Energy	214.726	-0.23	-0.76	-0.99	2.23	1.48
Government services	252.307	-0.62	-4.40	-5.01	-3.81	-8.11
Other Services	1078.185	1.85	-3.35	-1.48	-4.50	-7.61
		Sectoral Value-Added				
Agricultural plant	250.847	0.32	-8.30	-7.98	0.73	-8.18
Agricultural animal	157.017	-0.08	-6.63	-6.70	-0.13	-7.11
Manufacturing	115.596	-1.94	-4.31	-6.18	-1.03	-5.29
Mining	479.868	-2.26	1.51	-0.86	2.80	4.39
Energy	118.724	-0.23	-0.76	-0.99	2.23	1.48
Government services	200.662	-0.62	-4.40	-5.01	-3.81	-8.11
Other Services	678.247	1.85	-3.34	-1.48	-4.50	-7.61

Notes: **Scenario 1** is a 10 % reduction of world demand; **Scenario 2** is a 10 % reduction of agriculture total factor productivity; **Scenario 3** is Scenario 1+ Scenario 2; **Scenario 4** is Scenario 1+10 % depreciation of nominal exchange rate; **Scenario 5** is Scenario 3 + 10 % depreciation of nominal exchange rate.
Source: Syrian CGE model.

Table 2.5: Labour and capital demand results

	BASE	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
				Percentage change		
				Labour Demand		
Agricultural plant	75.036	-0.38	-0.29	-0.65	-1.27	-2.25
Agricultural animal	57.177	-0.80	1.25	0.42	-2.15	-1.30
Manufacturing	105.076	-2.63	-6.56	-9.06	-3.00	-9.34
Mining	11.37	-3.32	-2.17	-5.52	-0.34	-2.46
Energy	38.216	-1.00	-3.32	-4.31	0.01	-3.27
Government services	187.599	-0.69	-4.62	-5.29	-4.00	-8.50
Other Services	175.788	1.00	-6.07	-5.08	-6.76	-12.33
				Capital Demand		
Agricultural plant	158.078	0.74	3.55	4.38	1.92	4.78
Agricultural animal	103.536	0.31	5.15	5.51	1.00	5.81
Manufacturing	180.124	-1.53	-2.96	-4.45	0.14	-2.82
Mining	468.468	-2.24	1.60	-0.74	2.88	4.56
Energy	85.827	0.11	0.41	0.53	3.23	3.69
Government services	12.193	0.43	-0.95	-0.50	-0.90	-1.91
Other Services	544.845	2.13	-2.45	-0.28	-3.76	-6.02

Notes: **Scenario 1** is a 10 % reduction of world demand; **Scenario 2** is a 10 % reduction of agriculture total factor productivity; **Scenario 3** is Scenario 1+ Scenario 2; **Scenario 4** is Scenario 1+10 % depreciation of nominal exchange rate; **Scenario 5** is Scenario 3 + 10 % depreciation of nominal exchange rate.
Source: Syrian CGE model.

Table 2.6: Trade results

	BASE	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Percentage change				
		Imports				
Agricultural plant	41.677	-0.48	-0.93	-1.36	-10.32	-11.15
Agricultural animal	10.143	-0.85	0.34	-0.51	-9.63	-9.26
Manufacturing	401.852	0.57	-5.29	-4.68	-8.64	-13.54
Mining	63.072	-0.06	-3.23	-3.29	-6.81	-9.82
Energy	179.769	-0.11	-3.30	-3.41	-5.54	-8.64
Other Services	157.332	2.87	-5.93	-3.07	-12.64	-17.83
		Exports				
Agricultural plant	55.554	1.35	-17.32	-16.13	16.19	-4.24
Agricultural animal	20.839	1.10	-16.61	-15.64	15.83	-3.74
Manufacturing	280.826	-5.42	-2.72	-8.00	1.43	-1.31
Mining	204.413	-5.55	3.42	-2.32	3.89	7.47
Energy	17.401	-4.51	1.97	-2.61	4.37	6.45
Other Services	192.824	-3.02	-0.11	-3.08	0.65	0.58

Notes: **Scenario 1** is a 10 % reduction of world demand; **Scenario 2** is a 10 % reduction of agriculture total factor productivity; **Scenario 3** is Scenario 1+ Scenario 2; **Scenario 4** is Scenario 1+10 % depreciation of nominal exchange rate; **Scenario 5** is Scenario 3 + 10 % depreciation of nominal exchange rate.
Source: Syrian CGE model.

Table 2.7: Local market

	BASE	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
		Percentage change				
		Domestic sales				
Agricultural plant	306.803	0.13	-6.73	-6.55	-2.23	-8.91
Agricultural animal	205.977	-0.20	-5.66	-5.83	-1.84	-7.46
Manufacturing	538.461	-0.15	-5.14	-5.25	-2.33	-7.40
Mining	305.179	-0.10	0.21	0.11	2.06	2.29
Energy	197.325	0.14	-1.00	-0.85	2.04	1.04
Government services	252.307	-0.62	-4.40	-5.01	-3.81	-8.11
Other Services	885.361	2.89	-4.06	-1.13	-5.64	-9.46
		Domestic prices				
Agricultural plant	1	-0.76	7.83	6.99	-1.25	6.62
Agricultural animal	1	-0.81	8.01	7.12	-0.81	7.33
Manufacturing	1	0.91	-0.20	0.74	1.19	0.95
Mining	1	0.06	-4.28	-4.23	-1.82	-6.03
Energy	1	-0.32	-2.89	-3.21	-0.11	-3.01
Government services	1	-0.07	0.34	0.27	2.24	2.57
Other Services	1	-0.03	-2.43	-2.44	-0.09	-2.56

Notes: **Scenario 1** is a 10 % reduction of world demand; **Scenario 2** is a 10 % reduction of agriculture total factor productivity; **Scenario 3** is Scenario 1+ Scenario 2; **Scenario 4** is Scenario 1+10 % depreciation of nominal exchange rate; **Scenario 5** is Scenario 3 + 10 % depreciation of nominal exchange rate.
Source: Syrian CGE model.

3. The household level analysis using microsimulation model

To predict the potential effects of the international economic decline on the level and the distribution of welfare across the Syrian households, a definition of a well-being indicator has to be agreed upon. This is an important and controversial subject and would require a separate study on its own. One can however note that in the context of measuring welfare in a developing country like Syria, there are several reasons in favor of using an indicator based on expenditures rather than income.[5] In line with most other studies, we rely on an expenditure proxy to predict the potential distributional effects of the global downturn. Further, we use interchangeably the terms income and expenditure to design the households' expenditure.

We assume that the potential effects of the economic slump can be completely characterized in terms of its effects on households' expenditure and prices. From the 2007 household survey, we have observations on initial distribution of expenditure (income, for short) across a representative sample of households.

Since the CGE model does not include as many households as the household survey but only ten representative households (as described in subsection 2.4), then the only option available for this study is to proceed to a layered CGE-microsimulation analysis. The procedure works as follows. For each simulation scenario concerning the factors shifting the world crisis to Syrian economy (fall in global demand, world prices of Syrian exports, volume of remittances, etc.), the CGE model provides estimates of the new consumer prices, $\mathbf{p}_s$, and commodity expenditures made by the ten representative households. These results are used in the microsimulation model to calculate the predicted change in the real expenditure of each household in the representative 2007 household survey, and therefore the variation in any poverty or social welfare index.

To show how this can be done, let

1. $\mathbf{y}_r = (y_{r,1}, \ldots, y_{r,h}, \ldots, y_{r,H})$ be a vector of households' expenditure (income, for short) in the reference situation (prevailing before the world crisis) from a

[5] The main argument of preferring expenditure rather than income is that, by the permanent income hypothesis, consumption is a better indicator of lifetime welfare than is current income. Since expenditures are usually considered as a better approximation of consumption than current income, it can be justified as a good indicator of individual's welfare [Slesnick (1998) and Jorgenson (1998)].

household survey of H households (observations) and N individuals ($N = \sum_{h=1}^{H} n_h$) where n_h is the size of the household h;

2. $\mathbf{w} = (w_1, \ldots, w_h, \ldots, w_H)$ be a vector of households' weight. Then, $\mathbf{N} = \sum_{h=1}^{H} w_h n_h$ is an estimate of the population size;
3. $\mathbf{p}_r(p_{r,1}, \ldots, p_{r,h}, \ldots, p_{r,H})$ be a vector of K prices in the reference situation which prevails prior to the transmission of the world economic decline to the Syrian economy;
4. $\mathbf{p}_s(p_{s,1}, \ldots, p_{s,h}, \ldots, p_{s,H})$ be a vector of K prices resulting from the CGE simulation s, where $p_{k,s}$ is the predicted price of commodity k;
5. $\mathbf{q}_{r,h}(q_{r,1}, \ldots, q_{r,h}, \ldots, q_{r,H})$ be a vector of K quantities of commodities purchased by the household h in the reference situation; and,
6. η_h be the number of equivalent adults living in a household h (η_h could be equal to n_h if we ignore differences in needs between adults and children and economies of scale attributed to intra-household consumption).

The living standards of a household h in the reference situation is then given by $x_{r,h}$, the expenditure (income, for short) level *per equivalent adult*:

$$x_{r,h} = \frac{y_{r,h}}{\eta_h} \tag{3}$$

such that $\mathbf{x}_r = (x_{r,1}, x_{r,h}, \ldots, x_{r,H}; n_1, \ldots, n_h, \ldots, n_H)$ denotes then the vector of income *per equivalent adult*.

Arguably, spatial price indices, which take into account of the variability of the living standards cost across the Syrian regions, should be applied to the income distribution prior to any aggregation procedure. Unfortunately, Syrian data does not provide such indices. To get around this issue, the income distributions will be adjusted by the households' specific poverty line, denoted by z_h, estimated by El-Laithy and Abu-Ismail (2005).[6] These estimates take indeed into account of the spatial variability cost of

[6] Recall that the poverty line yields the "reasonable minimum" cost of a level of consumption of goods and services deemed to constitute a "reasonable minimum" for each adult person to escape poverty. The use of the regional poverty lines as a proxy of the spatial variation of prices is adopted for instance by Jolliffe et

the main commodities consumed by the poor and the differences in the households needs due to their different size and composition. Thus, the living standards of a household *h* in the reference situation is rather given by

$$x_{r,h} = 100\frac{y_{r,h}}{z_h} = 100\frac{y_{r,h}/\eta_h}{z_h/\eta_h} \tag{4}$$

such that $\mathbf{x}_r = (x_{r,1}, x_{r,h}, \ldots, x_{r,H}; n_1, \ldots, n_h, \ldots, n_H)$ denotes henceforth the vector of *real* income *per equivalent adult* in the reference situation and $z = 100$ is the *real* poverty line *per equivalent adult*, no matter the households' region of residence.

3.1. The potential effects of the economic downturn on the nominal expenditure

It is assumed within the microsimulation framework that, in the reference situation prevailing before the international economic crisis, each household *h* within a group *j* has an income level *per equivalent adult* equal to $x_{r,h}$ and faces the price system $\mathbf{p}_r$. Following the change in the economic environment, each household faces a new vector of prices and income $(\mathbf{p}_s, x_{s,h})$ where $x_{s,h} = (1 + g_s^j)\, x_{r,h}$. Indeed, as we use a layered (but not integrated) CGE microsimulation model, the nominal growth rate in the households' income, i.e., g_s^j, varies only between groups but not within groups. This is of course the major limit of the layered CGE-microsimulation as both the level and the sign of the growth rates may vary a lot even across the households of the same income group. However, the real expenditure change will vary even within households groups as shown in the subsection we are going to develop.

3.2. The predicted effects of the crisis on the distribution of real income

To capture the effects of price changes on the distribution of real income, the easiest approach is to assume the uniformity of the price changes over the households, regardless of their consumption pattern and socio-demographic characteristics. For this,

al. (2004) to study regional poverty in Egypt and Bibi (2006) to study the pro-poorness of the growth pattern in Tunisia.

let π^r_s be the consumer price index (CPI) which indicates the average price change following the simulation s

$$\pi_s^r = \frac{\sum_{h=1}^{H}\sum_{k=1}^{K} w_h p_{s,k} q_{r,k,h}}{\sum_{h=1}^{H}\sum_{k=1}^{K} w_h p_{r,k} q_{r,k,h}} \tag{5}$$

By definition, $\pi^r_r = 1$ and π^r_s may be lower or greater than 1 according to whether the CGE model predict a fall or a rise in the consumer prices on average. The expected purchasing power of each household at any given situation could then be approximated by

$$\begin{aligned} \Gamma_{r,h} &= \frac{x_{r,h}}{\pi_r^r} = x_{r,h} \\ \Gamma_{s,h} &= \frac{x_{s,h}}{\pi_s^r} = \frac{(1+g_s^j)x_{r,h}}{\pi_s^r} \end{aligned} \tag{6}$$

Clearly however, this is not the best approach due to the diversity in the households' consumption pattern. In reality, the impact of price changes should vary across households. It is well known, for instance, that the poor devote a larger budget share to food than the non-poor. This means that the food price rise hurts more the poor than the non-poor. To take into account the variability of prices change effect across households, it is important to calculate consumer price indices that are specific to each household.

To achieve this goal, we rely on the King's (1983) approach to define the concept of *equivalent income*. For a given budget constraint ($\mathbf{p}_s$, $x_{s,h}$), the equivalent income is defined as that income level which, at the reference price system $\mathbf{p}_r$, yields the same utility level as that utility level reached under ($\mathbf{p}_s$, $x_{s,h}$)

$$v(\mathbf{p}_r, \Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h})) = v(\mathbf{p}_s, x_{s,h}) \tag{7}$$

where $\mathbf{p}_r$, $\mathbf{p}_s$, and $x_{s,h}$, are as defined above, $v(.)$ is the indirect utility function, and $\Gamma_h(.)$ is the *equivalent income* function that is specific to the household h. Since $\mathbf{p}_r$ is fixed across all households, $\Gamma_h(.)$ is an exact monetary metric of actual utility $v(\mathbf{p}_s, x_{s,h})$ because $\Gamma_h(.)$ is an increasing monotonic transformation of $v(.)$. Thus, inverting the indirect utility function, the *equivalent income*, $\Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h})$ is obtained as

$$\begin{aligned}\Gamma_{r,h} &= \Gamma_h(\mathbf{p}_r, \mathbf{p}_r, x_{r,h}) = x_{r,h} \\ \Gamma_{s,h} &= \Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h}) = x_{r,h} - EL_{s,h}\end{aligned} \quad (8)$$

where $\Gamma_{r,h}$ and $\Gamma_{s,h}$ stand henceforth for the equivalent income pre- and post-environment-change, respectively and $EL_{s,h}$ is the *equivalent loss*.[7] Enduring the world crisis is then equivalent to taking from each household an amount of income equal to their equivalent loss. Saying differently, the *equivalent loss* is that sum of money which the household *h* would be willing to sacrifice in its initial position to avoid the potential negative effects of the international economic decline.

Ideally, a complete demand system should be estimated to derive the equivalent income functions. This is not the route followed in this study. Instead, like in the CGE model, we will assume *K*-commodity Stone-Geary preferences with the indirect utility function

$$v(\mathbf{p}, x) = \frac{x - \sum_{k=1}^{K} p_k \gamma_k}{\prod_{k=1}^{K} p_k^{\beta_k}} \quad \text{with } \sum_{k=1}^{K} \beta_k = 1 \quad (9)$$

where γ_k is the subsistence requirements for the commodity *k* and β_k is the proportion of the residual income (i.e, $x - \sum_{k=1}^{K} p_k \gamma_k$) allocated to the consumption of *k* once the committed expenditure ($p_k \gamma_k$) is bought. From (7) to (9), the equivalent income function for a household *h* following the scenario *s* is given by:

$$\Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h}) = \sum_{k=1}^{K} p_{r,k} \gamma_k + \frac{x_{s,h} - \sum_{k=1}^{K} p_{s,k} \gamma_k}{\prod_{k=1}^{K} \left(\frac{p_{s,k}}{p_{r,k}} \right)^{\beta_{k,h}}} \quad (10)$$

When the households' preferences are described by Stone-Geary utility function, the equivalent income function has a clear interpretation in terms of real income. If the $\sum_{k=1}^{K} p_{s,k} \gamma_k$ represents the subsistence requirements, only the residual income

[7] The equivalent lose could be negative for the households who are expected to gain following the world economic decline.

$x_{s,h} - \sum_{k=1}^{K} p_{s,k}\gamma_k$ is available for discretionary allocation and this is deflated by the household's specific consumer price index ($\pi_{s,h}^{r} = \prod_{k=1}^{K}\left(\frac{p_{s,k}}{p_{r,k}}\right)^{\beta_{k,h}}$) to express it in the reference price system. Adding then to the real residual income the initial cost of the subsistence requirements yields the equivalent income. When the subsistence requirements for all commodities are low, $\sum_{k=1}^{K} p_{s,k}\gamma_k$ is close to 0, $\beta_{k,h}$ becomes the budget share devoted by *h* to the commodity *k*, and the equivalent income function reduces to that generated by the Cobb-Douglas preferences

$$\Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h}) = \frac{x_{s,h}}{\pi_{s,h}^{r}} \quad \text{where} \quad \pi_{s,h}^{r} = \prod_{k=1}^{K}\left(\frac{p_{s,k}}{p_{r,k}}\right)^{\beta_{k,h}} \tag{11}$$

One of the most striking features of the Cobb-Douglas preferences and, to a lesser extent, of the Stone-Geary preferences (which lead to the linear expenditure system), is the fact that the inference of the household's specific consumer price index $\pi_{s,h}^{r}$ is straightforward. In the former case, $\beta_{k,h}$ simply corresponds to the budget share devoted by *h* to the commodity *k*. In the latter case, $\beta_{k,h}$ cannot be computed in absence of any information about the level of γ_k.[8] From the restrictions imposed by the consumer theory however, we know that for any household, $x_{r,h}$ should not be lower than $\sum_{k=1}^{K} p_{r,k}\gamma_k$ and that $\frac{q_{r,k,h}}{\eta_h}$ should never be lower than γ_k to ensure that the households' demand functions are derived from constrained utility maximization. The easiest way to fulfill these conditions is to set γ_k at the minimum consumption level *per equivalent* adult of the commodity *k* across the households

$$\gamma_k = \min\left(\frac{q_{r,k,1}}{\eta_1}, \ldots, \frac{q_{r,k,h}}{\eta_h}, \ldots \frac{q_{r,k,H}}{\eta_H}\right), \ \forall k = 1, \ldots, K. \tag{12}$$

Finally, the values of the $\beta_{k,h}$ can be calculated using this formula

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[8] Ideally, the parameters γ_k and $\beta_{k,h}$ should be estimated econometrically. This requires however the use of panel data which record living standards information on the same sample of households observed over multiple time periods.

$$\beta_{k,h} = \frac{p_{r,k}(\frac{q_{r,k,h}}{\eta_h} - \gamma_k)}{x_{r,h} - \sum_{k=1}^{K} p_{r,k}\gamma_k} \quad (13)$$

Now that we have derived different distributions of the equivalent income, we can predict the potential effects of the world crisis on poverty and inequality. To do this is precisely the goal of the study's next section.

3.3. Distributive analysis of the global crisis effects

As described in section 2, five scenarios are simulated within the CGE framework analysis:

- The Scenario 1 (s=1) assumes only a fall in the world demand of the Syrian exports by 10 percent;
- The Scenario 2 assumes that recent drought experienced by Syria entails a fall in the total factor productivity of the agriculture sector by 10 percent;
- The Scenario 3 combines the joint effects of the Scenarios 1 and 2;
- The Scenario 4 assumes a devaluation of 10 percent to counter the effects of the international fall in the demand of Syrian exports (as described in the Scenario 1);
- The Scenario 5 assumes a devaluation of 10 percent to counter the join effects summarized by the Scenario 3.

The potential effects of each of these scenarios on the nominal households' expenditure are summarized in Table 3.1 while their effects on the consumer prices are reported in Table 3.3.

Table 3.1: Potential effects of economic decline, drought and devaluation on the households' nominal expenditure

	Reference	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Household 1	100	99.02	96.58	95.61	98.26	94.83
Household 2	100	99.03	96.58	95.62	98.27	94.83
Household 3	100	99.00	96.56	95.57	98.21	94.75
Household 4	100	98.94	96.53	95.47	98.20	94.71
Household 5	100	98.97	96.54	95.51	98.21	94.73
Household 6	100	98.93	96.53	95.47	98.19	94.71
Household 7	100	98.94	96.51	95.45	98.17	94.67
Household 8	100	98.87	96.46	95.34	98.13	94.58
Household 9	100	98.82	96.42	95.24	98.07	94.49
Household 10	100	98.68	96.27	94.95	97.92	94.21

Table 3.2: Potential effects of the economic decline, drought and devaluation on the consumer prices

	Reference	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Agricultural plant	100	99.33	106.86	106.14	100.05	107.02
Agricultural animal	100	99.23	107.63	106.77	99.68	107.45
Manufacture	100	100.52	99.89	100.42	104.88	104.74
Mining	100	100.05	96.45	96.49	100.13	96.57
Energy	100	99.83	98.48	98.31	104.61	103.03
Government services	100	99.93	100.34	100.27	102.24	102.57
Other services	100	99.97	97.93	97.93	101.38	99.26

To describe how inequality and poverty could be affected by the changes displayed by Tables 3.1 and 3.2, we must also obviously address their measurement. We consider each of these two issues in turn.

3.3.1. The potential inequality effects

To portray the inequality effects of the world economic crisis, it is perhaps important to note that the literature offers many ways of measuring the extent of the *change* in the living standards dispersion. Popularized by Dalton (1920), the *Gini* index of inequality is the most extensively used measure of welfare distribution, which can be calculated as

$$I^{Gini}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)=\frac{1}{2\mathbf{N}(\mathbf{N}-1)\overline{\Gamma}_t}\sum_{h=1}^{H}\sum_{l=1}^{H}\left|\Gamma_h(\mathbf{p}_r,\mathbf{p}_t,x_{t,h})-\Gamma_l(\mathbf{p}_r,\mathbf{p}_t,x_{t,l})\right|,\quad \forall t=r,s,... \qquad (14)$$

where $\overline{\Gamma}_t$ is the mean equivalent income of the pertinent distribution (pre- or post-crisis). Thus, using the above function, one can straightforwardly capture the potential impact of the global economic crisis as

$$\Delta I^{Gini}=I^{Gini}(\mathbf{p}_r,\mathbf{p}_s,\mathbf{x}_s)-I^{Gini}(\mathbf{p}_r,\mathbf{p}_r,\mathbf{x}_r) \qquad (15)$$

The use of the *Gini* index is very common for two reasons. First, it is due to the intuitive interpretation of $I^{Gini}(\mathbf{x})$ as the average distance between all possible pairs of normalized incomes in the population. Second, it could be derived from the Lorenz curve; which yields the cumulative percentage of total income held by any cumulative proportion ρ of the population, when individuals are ordered in increasing equivalent income values. The *Gini* index can alternatively be given by the ratio of the area between the Lorenz curve and the perfect equality 45° line to the whole area below the 45° line. Thus, the *Gini* value lies between 0, in the case of full equality, and 1 when one member of the population holds all of the available resources.

Other alternative inequality measures could also be used to judge the impact of the world crisis on the welfare distribution. Indeed, and as pointed out by Atkinson (2003), it is perfectly possible for the distribution to change significantly but for the Gini coefficient to remain unchanged. There could be redistributive forces working in different directions at different points. This is a sufficient to use more than a unique inequality index to characterize the potential effects of the world economic decline. Shorrocks (1984) and Cowell (2000) show that any inequality statistic that fulfills some desirable principles such as the *Pigou-Dalton transfer* principle, which states that a mean preserving transfer from a poor to a rich person is inequality decreasing, is a member of the Generalized Entropy (GE) class of inequality indices

$$I_\theta^{GE}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)=\frac{1}{\theta^2-\theta}\left[\frac{1}{\mathbf{T}}\sum_{h=1}^{H}w_h n_h\left(\frac{\Gamma_h(\mathbf{p}_r,\mathbf{p}_t,x_{t,h})}{\bar{\Gamma}_t}\right)^\theta-1\right],\ \forall t=r,s,...\ \theta\neq 0,1 \quad (16)$$

In contrast to the Gini index which lies between 0 and 1, the values of GE range from zero (perfect equality) to infinity (high level of inequality). The parameter θ can take any integer value. It captures the aversion to inequality or the distribution sensitivity of the index. The more used values of θ are 0, 1 and 2. For θ = 0, $I_0^{GE}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)$ is simply the mean logarithm deviation given by:

$$I_0^{GE}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)=\frac{1}{\mathbf{T}}\sum_{i=1}^{n}w_h n_h \ln\frac{\bar{\Gamma}_t}{\Gamma_h(\mathbf{p}_r,\mathbf{p}_t,x_{t,h})},\ \forall t=r,s,... \quad (17)$$

Notice that $I_0^{GE}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)$ is, in accordance with the *transfer sensitivity* principle, more sensitive to changes that occur in the bottom distribution. $I^{GE}(1)$ is the well-known Theil's (1967) index. It is formally defined as

$$I_1^{GE}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)=\frac{1}{\mathbf{N}}\sum_{h=1}^{H}w_h n_h \frac{\Gamma_h(\mathbf{p}_r,\mathbf{p}_t,x_{t,h})}{\bar{\Gamma}_t}\ln\frac{\Gamma_h(\mathbf{p}_r,\mathbf{p}_t,x_{t,h})}{\bar{\Gamma}_t},\ \forall t=r,s,... \quad (18)$$

However, for $\theta > 1$, GE measures are more sensitive to changes that affect the upper tail of the distribution which make them less appealing for distributional judgments.

Quantitative estimates of different inequality measures in the situation prevailed in 2007, referred to as the reference situation, and under the five scenarios through which the world economic crisis may impact on the welfare distribution are summarized in Table 3.3. These estimates are corrected from the spatial variability of prices over the different Syrian regions and the differences in the households needs due to their different size and composition as described by equation (4). Such corrections lead to a Gini index equal to 30.5 as Table 3.3 indicates. Note that if we use the *per capita* expenditure (instead of *per equivalent adult* expenditure) while ignoring the spatial-price adjustments, the Gini index will equalize 33.77 percent instead of the 30.05 percent reported in Table 3.3. Further standard errors for all the inequality indices and the inequality changes are captured to check whether inequality changes are the result of sampling variability or genuine transmission of the global slump to the Syrian economy. They are corrected for the design effects resulting from the fact that the Syrian survey is not collected following a simple random sampling design but rather a multi-stage sampling design which includes stratification and clustering.[9]

Table 3.3: Potential effects of the economic changes on inequality

	Reference	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Gini	30.05 (0.73)	29.98 (0.73)	30.18 (0.74)	30.11 (0.74)	29.89 (0.72)	30.14 (0.74)
Gini change	-	-0.065 (0.002)	0.14 (0.002)	0.07 (0.002)	-0.15 (0.001)	0.10 (0.02)
Entropy 0	14.69 (0.73)	14.62 (0.73)	14.83 (0.75)	14.76 (0.74)	14.53 (0.72)	14.79 (0.75)
Entropy 0 change	-	-0.063 (0.003)	0.14 (0.02)	0.07 (0.02)	-0.15 (0.01)	0.10 (0.02)
Entropy 1	17.28 (1.15)	17.20 (1.14)	17.52 (1.18)	17.43 (1.17)	17.06 (1.13)	17.48 (1.19)
Entropy 1 change	-	-0.081 (0.005)	0.23 (0.04)	0.14 (0.03)	-0.22 (0.02)	0.19 (0.04)
Entropy 2	28.99 (4.43)	28.82 (4.41)	29.74 (4.63)	29.56 (4.61)	28.41 (4.31)	29.73 (4.67)
Entropy 2 change	-	-0.16 (0.02)	0.75 (0.21)	0.57 (0.19)	-0.58 (0.12)	0.74 (0.26)

Note: Standard errors are between parentheses.

Broadly speaking, Table 3.3 shows that the global economic decline is not expected to impact greatly on the income distribution in Syria. This does not mean that inequality, as measured by the Gini index or the Entropy yardsticks, is not expected to change as a result of the international downturn. It does, by going either up or down, but at a very low magnitude. Further, even if Table 3.3 reveals that these changes are expected to be statistically significant, they cannot be deemed as “economically significant” in the terms of Atkinson (2003) for whom, only Gini variations greater than 3

[9] More details on the effects of stratification and clustering on the extent of standard errors are in Bibi and Nabli (2009). Note that the Distributive Analysis Stata Package (DASP) developed by Araar and Duclos (2007) allows to calculate readily standard errors, whatever the sampling design is.

points of percentage represent a real distribution shift.[10] Looking again at Table 3.3, one may remark that no scenario, even those which includes both international crisis and national drought, would entail an "economically significant" movement in Gini or Entropy inequality.

Notwithstanding, the most important change in the distributional pattern are not expected from the international crisis but from the national drought. Surprisingly enough, the international economic decline would even reduce disparity, albeit such reduction is not economically important (always lower than 0.6 points of percentage). However, the current drought experienced by Syria is expected to be inequality increasing but, as mentioned above, at a very weak speed even in the most pessimist scenario (Scenario 5).

It is common to observe that a given change in the income distribution may lead to different directions of the inequality measures. Although this is not the case for any of the five scenarios, the fact remains that the use of the supplementary use of the Lorenz curve is desirable. Lorenz curves provide indeed a more comprehensive and robust description of the potential impact of the global crisis than any summary statistics of disparity may yield. If the equivalent income values $\Gamma_h(\mathbf{p}_r, \mathbf{p}_t, x_{t,h})$ are ordered such that $\Gamma_h(\mathbf{p}_r, \mathbf{p}_t, x_{t,1})$ < … < $\Gamma_h(\mathbf{p}_r, \mathbf{p}_t, x_{t,H})$, with percentiles $\rho_l = \frac{\sum_{h=1}^{l} w_h n_h}{\mathrm{T}}$, then the discrete formulation of the Lorenz curve is given by:

$$L_t(\rho_l) = \frac{\sum_{h=1}^{l} w_h n_h \Gamma_h(\mathbf{p}_r, \mathbf{p}_t, x_{t,h})}{\mathbf{N}\bar{\Gamma}_t}, \quad \forall t = r, s, ... \tag{19}$$

The numerator sums the equivalent income of the lowest ρ_h proportion of the population. The denominator sums the income of all. Clearly then, $L_t(\rho_h)$ indicates the cumulative share of equivalent income held by the poorest ρ_h proportion of the population. If resources were equally distributed across the population, with everyone's

[10] In reality, Atkinson (2003) takes such a 3-percentage points as a minimum for an economically significant distributional shift while recognizing that this threshold is essentially arbitrary.

equivalent income is $\overline{\Gamma}_t$, the $L_t(\rho_h)$ curve would be the 45-degree-line, thus labeled the line of full (or perfect) equality. Thus, if we aggregate the deficit between the population share, ρ_h, and their income share, $L_t(\rho_h)$, across all values of ρ_h, we get the half of the Gini index

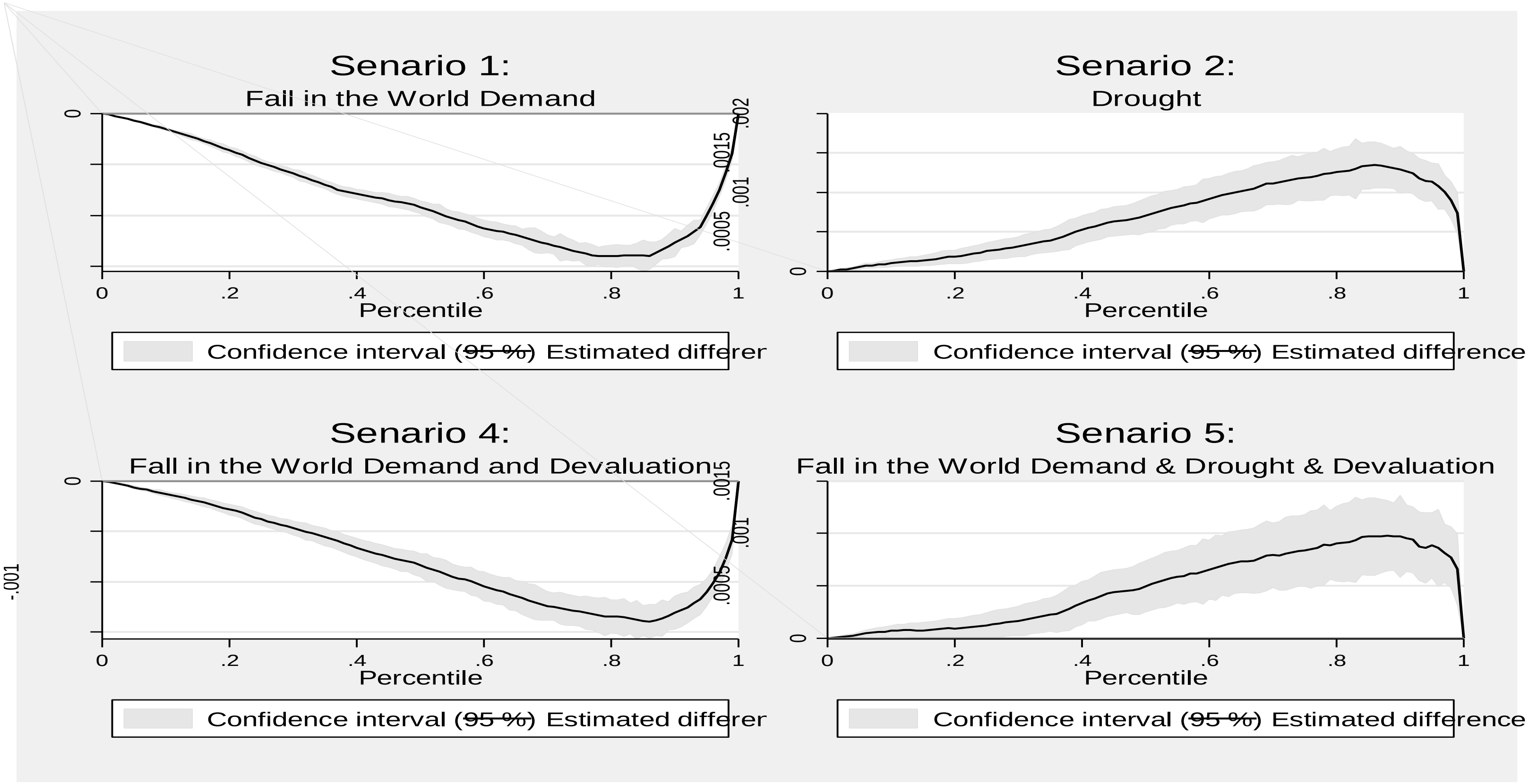
$$I^{Gini}(\mathbf{p}_r,\mathbf{p}_t,\mathbf{x}_t)=2\left(\frac{1}{H}\sum_{h=1}^{H}\left(\rho_h-L(\rho_{t,h})\right)\right),\ \forall t=r,s,... \tag{20}$$

A mean preserving transfer from a poor person (*h*, say) to a richer one (*l* > *h*) that keeps $\overline{\Gamma}_t$ constant has the consequence of moving away the Lorenz curve from the line of the hypothetic full equality.[11] This means that if the Lorenz curve $L_s(\rho_h)$ of the distribution $\Gamma_h(\mathbf{p}_r,\mathbf{p}_s,x_{s,h})$ lies nowhere above the Lorenz curve $L_r(\rho_h)$ of the distribution $\Gamma_h(\mathbf{p}_r,\mathbf{p}_r,x_{r,h})$ (or, saying differently, if $L_s(\rho_h)-L_r(\rho_h)$ is always non-positive), then any inequality statistic that is sensitive to equalizing transfers will unambiguously reveal that the world crisis will be potentially inequality increasing. However, if the two curves intersect (or, saying differently, if $L_s(\rho_h)-L_r(\rho_h)$ switches sign), then the computation of the potential inequality effects of the global crisis will critically depend on the choice of the inequality measure.

Figure 4.1 confirm the findings summarized in Table 3.3. These findings do not appear to be sensitive to the choice of inequality measures. It robustly rules out any potential negative effect on disparity which would result from the current turbulences of the international economy. Further, it robustly confirms that the current droughts are expected to be more inequality disturbing than the world crisis. Finally, the devaluation of the Syrian pound to face the international economic downturn is expected to improve the equalizing effects of the world crisis while exacerbating the disequalizing effects of drought.

[11] This is the so-called *Pigou-Dalton transfer principle*. This principle holds when the transfer is weak enough to prevent a simple re-ranking between the recipient and the donor.

Figure 4.1.: Robust evaluation of the inequality impact of economic changes



3.3.2. The potential poverty effects

Sen's (1976) influential work has generated a considerable literature on how measuring poverty and how capturing the potential effects of economic changes on the poor. We start with the popular Foster-Greer-Thorbecke (1984) (FGT) family of poverty indices, although an important aim of this study is also to show how we can use these peculiar indices to predict how many other indices would react to economic chocks. Let z be a real poverty line, that is, a line measured in terms of the reference prices $\mathbf{p}_r$. The FGT family is then defined as

$$P_\alpha(z) = \frac{1}{\mathbf{N}} \sum_{h=1}^{H} w_h n_h \left(\frac{z - \Gamma_h(\mathbf{p}_r, \mathbf{p}_t, x_{t,h})}{z} \right)_+^\alpha \quad \forall t = r, s... \tag{21}$$

where $f_+ = \max(0, f)$ and where α is a parameter that captures the "aversion to poverty" or the distribution sensitivity of the poverty index: a larger α gives a greater weight to a loss of income to the poorest than to the not-so-poor. The FGT indices are averages of powers of normalized poverty gaps, $\frac{z - \Gamma_h(.)}{z}$. As it is well known, $P_0(z)$ gives the incidence of poverty (the headcount ratio), $P_1(z)$ yields the average poverty gap (the intensity of poverty or the normalized deficit of poverty), and $P_2(z)$ is often described as the severity of poverty – it weights poverty gaps by poverty gaps. For $\alpha > 1$, $P_\alpha(z)$ is sensitive to the distribution of living standards among the poor, and when α becomes very large, approaches a Rawlsian measure.[12]

The potential effects of the global crisis on poverty could then be computed as

$$\Delta P_\alpha(z) = \frac{1}{\mathbf{N}} \left(\sum_{h=1}^{H} w_h n_h \left(\frac{z - \Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h})}{z} \right)_+^\alpha - \sum_{h=1}^{H} w_h n_h \left(\frac{z - \Gamma_h(\mathbf{p}_r, \mathbf{p}_r, x_{r,h})}{z} \right)_+^\alpha \right) \tag{22}$$

[12] See Rawls (1971).

Table 3.4: Potential effects of the economic changes on poverty

	Reference	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Incidence of poverty	12.32 (0.89)	12.72 (0.91)	14.88 (0.97)	15.46 (0.99)	14.79 (0.97)	17.58 (1.08)
$\Delta P_0(z)$	-	0.4 (0.08)	2.57 (0.21)	3.14 (0.24)	2.47 (0.20)	5.26 (0.36)
Intensity of poverty	1.96 (0.18)	2.06 (0.19)	2.52 (0.22)	2.64 (0.22)	2.49 (0.21)	3.07 (0.24)
$\Delta P_1(z)$	-	0.01 (0.01)	0.56 (0.04)	0.68 (0.05)	0.52 (0.04)	1.11 (0.07)
Severity of poverty	0.51 (0.058)	0.53 (0.06)	0.67 (0.07)	0.71 (0.07)	0.66 (0.07)	0.84 (0.08)
$\Delta P_2(z)$	-	0.028 (0.002)	0.16 (0.01)	0.20 (0.02)	0.15 (0.01)	0.33 (0.02)

Standard errors (corrected for the design effects) are between parentheses.

Table 3.4 reports the poverty impact of the 5 simulated scenarios for α = 0, 1, and 2 and for z =100 (recall equation (4)). It shows that the poverty impact of the world economic crisis (scenario 1) would not exceed 0.4 points of percentage for α = 0. In reality, the most important change in poverty statistics are not expected from the international crisis but from the national drought. The current drought experienced by Syria (scenario 2) is expected to increase the incidence of poverty by 2.57 points of percentage and the severity of poverty by 0.16 points of percentage. The devaluation of the Syrian pounds appears to be not pro-poor policy since, combined with the world economic slowdown and national drought (scenario 5), it would increases all the poverty indices from their initial level by roughly 50 percent.

Table 3.4 shows that the policy implications of the poverty change yielded by $\Delta P_\alpha(z)$ can potentially depend arbitrarily on the choice of a poverty line z and of a poverty measure. The application of well-known results from the stochastic dominance literature shows, however, that if $\Delta P_\alpha(z) \geq 0$ for a range of poverty lines that starts at 0 and extends to z^+, then the global economic crisis will necessarily be judged to be poverty increasing for any choice of poverty line within $[0, z^+]$ and for any choice of poverty index within a class of ethical order $\alpha + 1$. [13]

[13] See Atkinson (1987), Duclos and Makdissi (2004), and Bibi and Duclos (2005, 2007) for more details on this.

For $\alpha = 0$ (first-order poverty dominance), the test simply involves differences between the incidence of poverty. If $\Delta P_0(z)$ is non-negative for any choice of poverty line within $[0, z^+]$, then the world crisis can unambiguously be declared as potentially poverty increasing. Putting it differently, for any poverty threshold within $[0, z^+]$, the global crisis would potentially show a rise in all the poverty indices that belong to the class of ethical order 1. This class includes basically all of the poverty indices that have been proposed in the literature and that are in use.[14] When $\Delta P_0(z)$ is non-negative for any choice of poverty line which can be extended to infinity, i.e., $z \in [0, +\infty[$, then robust poverty findings about the potential poverty effects of the world crisis are also robust welfare findings.[15] This means that the global crisis would potentially show a fall in all the social welfare indices that belong to the class of ethical order 1, which includes basically all of the social welfare indices that fulfill the *anonymity* principle.[16]

If $\Delta P_0(z)$ switches sign for some poverty threshold within $[0, z^+]$, then the potential poverty effects of the global economic crisis are ambiguous. Some poverty lines and some poverty measures will show a risk of poverty rise following the crisis while others will indicate an opposite direction of poverty change. Two avenues can be followed to tackle this issue. The first is to reduce the size of the set of the potentially poor individuals by lowering z^+. The second avenue is to assess the potential poverty effects of the global crisis over a higher-order class of poverty indices.

For $\alpha = 1$ (second-order poverty dominance), the test simply involves differences between the intensity of poverty. If $\Delta P_1(z)$ is non-negative for any choice of poverty line within $[0, z^+]$, then the global crisis would potentially show a rise in all the poverty indices that belong to the class of ethical order 2, which includes basically all of the poverty indices that are member of the class of ethical order 1 with the notable exception of the headcount ratio.[17] If also $\Delta P_1(z)$ does not switch sign for any poverty line starting

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[14] The common feature of the poverty indices that belong to the first ethical class is that they fulfill the *focus* and the *anonymity* axioms. The former axiom states that changes in the living standards of the non-poor do not affect the poverty measure. The latter commands that poverty does not change if the distribution of $\Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h})$ is obtained from the distribution of $\Gamma_h(\mathbf{p}_r, \mathbf{p}_r, x_{r,h})$ by a permutation.

[15] More details are in Duclos and Makdissi (2004).

[16] The social welfare indices of the first ethical class do not vary if the distribution of $\Gamma_h(\mathbf{p}_r, \mathbf{p}_s, x_{s,h})$ is obtained from the distribution of $\Gamma_h(\mathbf{p}_r, \mathbf{p}_r, x_{r,h})$ by a permutation.

[17] Poverty indices of the class of ethical order 2 respect the Pigou-Dalton *principle*. Thus, they fall weakly following a mean-preserving redistributive transfer from a richer to a poorer individual.

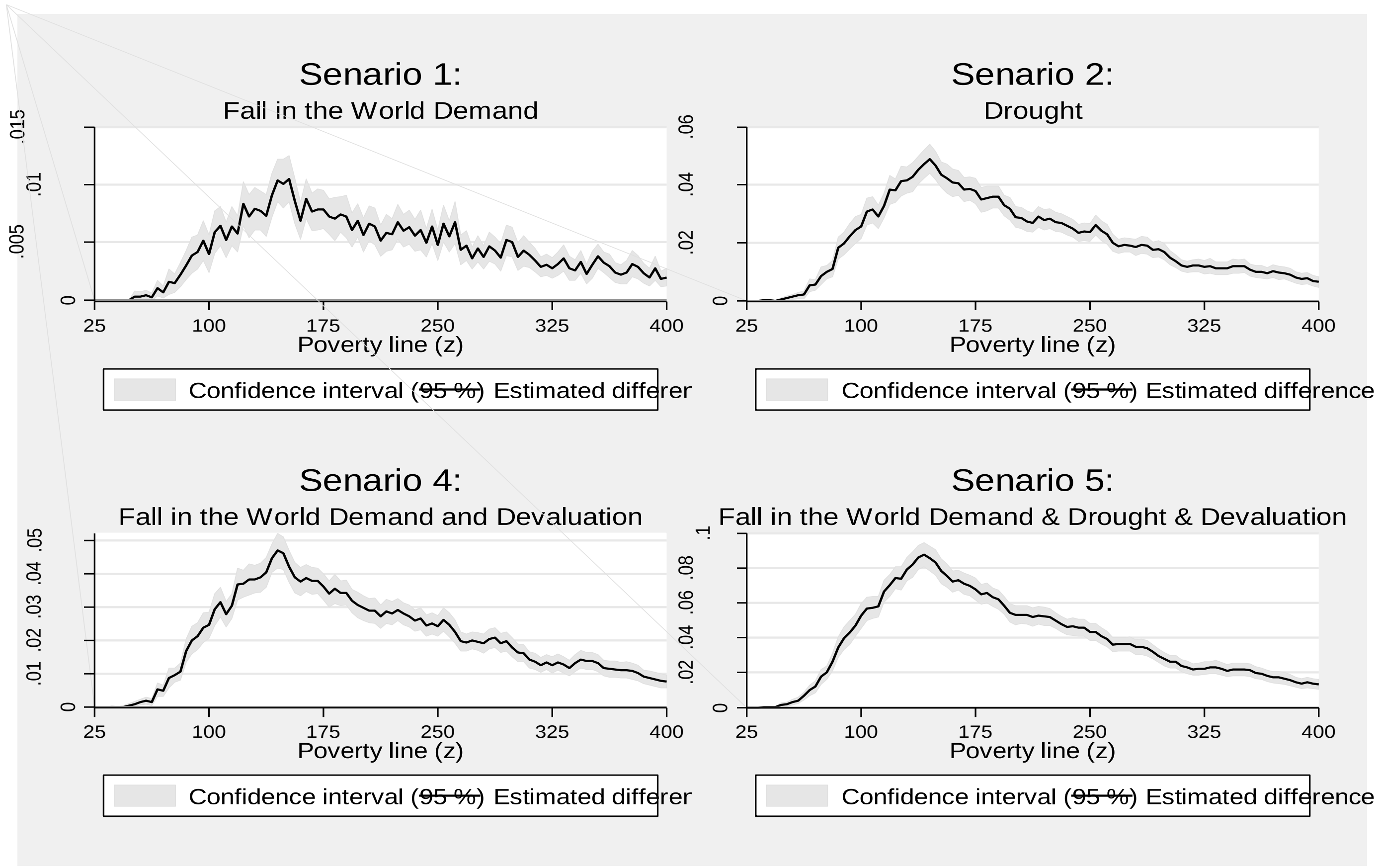
from 0 to infinity, then global crisis would potentially show a decline in all the social welfare indices that belong to the class of ethical order 2, which includes basically all of the social welfare indices that fulfill the Pigou-Dalton *transfer* principle.

Higher-order tests of the potential poverty effects of the global crisis can be analogously implemented if $\Delta P_1(z)$ switches sign within $[0, z^+]$; by putting appropriate restrictions on the properties that poverty measures should fulfilled.

One way to check robustly the poverty impact of the different scenarios presented above is simply to plot the different $\Delta P_\alpha(z)$ over the range of poverty lines starting from 0 to z^+. If the $\Delta P_\alpha(z)$ curves do not switch sign before z^+, then we can conclude robustly whether the economic shocks under analysis are poverty increasing.

Figure 4.2 displays the estimates of the $\Delta P_0(z)$ for the scenarios 1, 2,3, and 5 in order to make robust first-order judgments of their poverty effects. Hence, by plotting for each of these 4 scenarios the cumulative difference in percentages of the population below various poverty lines, we find that $\Delta P_0(z)$ could not be negative for anyone of them. Fixing the upper limit of the poverty line (z^+) to 400 percent of the reference (official) poverty line, Figure 4.2 shows indeed that the different simulated scenarios would be unambiguously poverty increasing. The lowest scale of the poverty rise would unambiguously be yielded by the scenario 1 while the highest one would be experienced under the simultaneous combination of the world crisis, drought and depreciation (scenario 5). Since the hypothesis of a poverty line exceeding the limit of 400 percent of the reference poverty line, there would be no reason to test at a higher ethical dominance order.

Figure 4.2.: First-order robust evaluation of the poverty impact of economic changes



4. Conclusion and policy recommendations

The global economic crisis of the mid-2008, which finds its epicentre in the western economies, is transmitted to developing countries through different channels. The recession in rich countries slows down their demand for goods and services and puts downward pressure on non-oil commodity prices. These two interrelated effects induce a substantial reduction in developing countries exports and a soaring of their current account deficit. In addition, the crisis would cause a fall in remittances and FDI flows to developing countries, constraining even more the availability of funds to face the crisis.

Syria is not sheltered from the turbulence occurring on the international markets and the country is expected to face a sharp decrease in demand for its commodities. The aim of this report is to quantify the potential impact of the global economic turmoil on the Syrian main economic indicators using both a macroeconometric and a computable general equilibrium model. As the crisis is likely to hurt the poor, the analysis is supplemented by a microsimulation model based on the 2007 Syrian households' expenditure survey to estimate the impact of the crisis on poverty and inequality.

The fall in the foreign demand of the Syrian exports is perhaps the most important channel through which the Syrian economy may be negatively affected by the global economic crisis. In this context, we simulate a 10 percent decline in international demand for Syrian products. As a consequence, the balance of trade deficit augments by 4.9 percent, while real GDP fall ranges from 0.2 percent to 0.8 percent. Labour market is also projected to slacken as unemployment rate intensifies and reaches 10 percent. Inequality and poverty are not expected to change significantly.

The depreciation of the Syrian pound could be one among many other instruments to face the global downturn. The devaluation is expected to reduce its value compared to foreign currencies, leading to a rise in exports and a fall in imports. This is possible when exports are sensitive to the price change and producers may rapidly react to allocate their production to the foreign market and when imports demand is relatively not elastic to the price change. However, If the demand for exports and imports is relatively inelastic, any devaluation will have a small impact on the value of exports and imports and then on economic growth.

Despite the world demand for Syrian exports is relatively elastic, the Syrian economy would not react enough to the devaluation of Syrian Pound to curb the negative impact of the world economic crisis on real GDP. The nominal depreciation of the Syrian pound results into an economic decline compounded by an inflationary spiral. The real GDP indeed decreases by 1.1 percent, while the consumer price index rises by 2.3 percent. Further, unemployment rate rises from 9.6 percent to 13 percent. While inequality remains almost unchanged, poverty headcount increases by roughly 2 points of percentage with the depreciation. The increase in exports would be enough below what is needed to face the negative impact of the fall in export demand. Sensitivity analysis based on different values of the import and export elasticities do not show any improvement in the effectiveness of the devaluation to face the world economic slowdown.

Clearly then, the devaluation of the Syrian Pound should be accompanied by other measures enhancing local demand to reap the potential benefits of the devaluation. For instance, we find that an increase in the governement expenditures by 15 percent would counteract the negative impact of the devaluation and the international crisis and faster recovery. This result would be driven by a rise in the real GDP by 0.4 percent and a fall in the unemployment from 9.6 percent to 8.8 percent.

In order to curb the adverse effects of the drought and devaluation on poverty, other government expenditures should presumably be planned. Arguably, they should be made through either food subsidy or targeted transfers. However, such scenarios of public spending rise will depend on the Syrian Government latitude to mobilize more public resources in order to enhance the local demand.

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