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Abstract

In this paper the likely impact of trade liberalization on income polarization is quantified based on a micro-simulation approach and using the Duclos, Esteban and Ray (2004) polarization index. It is found that trade liberalization softens the increasing path of polarization registered in the business-as-usual.

ملخص

في هذه الورقة، يتم اعداد تحليلا كميا للتأثير المحتمل لتحرير التجارة على استقطاب الدخل من خلال منهج محاكاة مصغر وباستخدام مؤشر الاستقطاب الذي وضعه دوكلو واستيبان وراي (2004). و تبين أن تحرير التجارة يخفف من الاستقطاب المتزايد المسجل في سير الأعمال المعتاد.

1. Introduction

A society is deemed polarized when, given a relevant characteristics such as religion, income, race or education, its population is clustered around a small number of distant, homogenous and sizable poles. Polarization is viewed then as a sum of antagonisms between individuals that belong to different groups. Such antagonisms arise when a considerable number of individuals feel some degree of identification with the members of one group with whom they share one or some attributes, while at the same time they feel alienated (distant) from the members of other(s) sizable groups. The three elements, size group, identification and alienation, are then the ingredients to produce antagonisms among the population. Higher identification and higher alienation raise polarization and higher polarization fuels social tension and violence as well as political instability. A two-class society with a sharp inter-class distance is indeed more prone to explode than a multi-class society with shorter distance from one class to the next.

Albeit sociologists and political scientists are very much familiar with the phenomenon of polarization, the latter did not pique the curiosity of economists until the beginning of the 1990's and hitherto economists' discussion of social fairness and cohesion turned only around the concept and measurement of inequality. Polarization has been rigorously conceptualized and formalized with the work of Esteban and Ray (1991, 1994), Foster and Wolfson (1992), Wolfson (1994) and Duclos, Esteban and Ray (2004) and its measurement has mostly been applied to developed countries.

The aim of this paper is to quantify the impact of trade liberalization on polarization in Tunisia. As pointed out by Bibi and Nabli (2010), the analysis of income distribution in the Arab region focuses solely on the inequality and poverty aspects and little is known about polarization and those studies that quantify the impact of trade liberalization on income distribution limit the scope of their analysis to the induced change in inequality and/or poverty. As polarization and inequality may go in opposite directions and as polarization feeds social tension, it is worthwhile to measure its magnitude. To some extent, Bouassida and El-Lahga (2010) fill in the vacuum by providing the pattern and trend of polarization in the Arab region using households' surveys. The contribution of this paper is to complement Bouassida and El-Lahga's (2010) analysis on polarization by proposing a top-down micro-simulation approach that has not been implemented in so far for the analysis of polarization. More specifically, we use a spatial dynamic computable general equilibrium model that communicates with a micro-simulation module in order to measure the level of polarization.

The remainder of the paper is organized as follows. The first section details the methodology, the second section describes the pattern and trend of polarization in Tunisia between 1985 and 2000 and the third section presents the simulation results. The final section offers a conclusion.

2. Methodology

To quantify the trade liberalization impact on polarization, we implement a layered micro-simulation approach and proceed into two steps. In the first step, a recursive-dynamic multi-regional CGE model produces the impact of freer trade on commodities prices and households' income. This information is then used to feed a micro-simulation module that permits the calculation of polarization. For the sake of clarity, we linger on the micro-simulation model and briefly discuss the CGE model features, which more details could of, can be found in Chatti et al. (2010).

The CGE model comprises six regions and explicitly details production, consumption, exports, local sales and investment on a regional basis. Production technology is of the traditional standard nested constant returns to scale form with intermediate goods combing through a Leontief function, whereas labour, capital and land are imperfect substitutes and combine through CES forms. Labour in addition is a CES composite over four labour categories defined by level of education: illiterate, primary, secondary and university.

The regional supply of each labour category is taken to be inelastic within each time period, but adjusts between periods with migration and natural population growth. Labour mobility is assumed perfect across industries within a region, generating a unified regional labour market for each labour category, but partial between regions and do not upgrade skills. Migration between regions relative to lagged labour force and differentiated by level of education is a linear function, which is positively related to relative wage while negatively associated to relative unemployment (see Harrigan and McGregor (1989), McGregor, Swales and Yin (1995)).

Regional unemployment by level of education results from real wage rigidity, which induces excess supply of labour. In each region, the supply of land, a factor exclusively used in agriculture, is also inelastic within period, but adjusts between periods at the same rate as the population growth. As to the current period capital stock, it is sectorally fixed within each period, but is updated using the depreciated lagged capital stock and previous investment expenditures. The decision to invest is a constant elasticity function that depends positively on the after tax return of capital relative to the costs of funds. Technical progress is the final source of economic growth, which has two components. The first is an initial total factor productivity growth rate, which is determined exogenously so as to track Tunisia's regional growth trends after accounting for changes in labour, capital and land supply change. The second component is endogenous and associated with the size of regional exports, which represents a positive externality having a productivity enhancing effect (see De Melo and Robinson (1990)). The aim of this externality mechanism is to capture the dynamic dimension of international trade and its effect on economic growth.

Income distribution is accounted for by defining sixteen households groups in each region. The criteria for households' classification are occupation (managers/farmers/agricultural worker/non-agricultural worker), the level of education (illiterate/primary/secondary/university) and the region of residence of the head of the household. Households' receive income from returns on primary factors (land, labour and capital payments) obtained from industries of the same region and from government and rest of the world transfers. After paying income taxes, the households' disposable income is allocated between transfers, interest payments, savings and consumption expenditures, in a fixed share. Commodity expenditures are derived from a Cobb Douglas (CD) utility function.[1] The discrepancy between income and expenditures for households is evacuated through fixed intra-households transfers. For any shock, the CGE model provides the new vector of commodities price as well as the level of income of each household group. These are then used to nourish the following micro-simulation model, developed by Bibi and Chatti (2007), and estimate polarization change.

The micro-simulation model consists of calculating a welfare indicator given by the equivalent income for each of the household unit from the households' survey using transmitted information from the CGE model. Given the assumption of a Cobb-Douglas utility function in the CGE model, we infer the resulting equivalent income following King (1983) guidelines.

The approach works as follows. In the first step, the CGE model provides an estimation of the consumption goods prices, $\mathbf{p}_t$, resulting from any economic change. As well as the growth rate of each of the ninety-six household groups average nominal income, g_t^h, with $h=1,96$.[2]In a second step, these results are applied to assess the real income of each household in the sample. Since households within the same group h do not have the same budgetary share for each good, the real income resulting from the transmitted information varies from one household to the other even for those belonging to the same group.

More precisely, each household m within a group $h$is assumed to have an original income per capita $Y_0^{h,m}$ and face the price system $\mathbf{p}_0$ in the baseline year. From one year to the other, each household in the sample faces a new vector of prices and income ($\mathbf{p}_t$,$Y_t^{h,m}$). Since we aim to characterize the dynamic of households' and social welfare over time under different scenarios, we consider the baseline price vector ($\mathbf{p}_0$) as the reference price system.[3] Then, we define as King (1983) the concept of *equivalent income,* that is for a given budget constraint ($\mathbf{p}_t$, Y_t), the equivalent income is defined as the income level which allows to reach, at $\mathbf{p}_0$, the same utility level as can be reached under the given budget constraint. Formally, we have:

$$v(\mathbf{p}_0, Y_e(\mathbf{p}_0, \mathbf{p}_t, Y_t)) = v(\mathbf{p}_t, Y_t) \quad (1)$$

where $v(.)$ is the indirect utility function, $\mathbf{p}_t$ is a vector of price system at t, and Y_t is the per capita household's nominal income. Since $\mathbf{p}_0$ is fixed across all households, $Y_e(.)$ is an exact monetary metric of actual utility $v(\mathbf{p}_t, Y_t)$ because $Y_e(.)$ is an increasing monotonic transformation of $v(.)$. Thus, inverting the indirect utility function results into the *equivalent income*, $Y_e(\mathbf{p}_0, \mathbf{p}_t, Y_t)$.

The predicted price and income changes provided by the CGE model are taken as given in the micro–simulation model. Since we assume that the nominal income growth rate is

[1] The households' commodity expenditures, derived from the households' survey, are made up of more aggregated composite goods compared with the representative household consumption from the input-output table. Correspondingly, a mapping is made between the two, using CES specification.

[2]The assumption of a common nominal income shift for all households within the same representative group represents a limitation of this approach. It can be easily relaxedifwe have more information about the different sources of income for each household unit.

[3]Following King (1983), the choice of the reference price system is to some extent arbitrary, although for the analysis based on computable general equilibrium models, the baseline price vector, $\mathbf{p}_0$, is a natural choice. The reason for this is that any comparison must use a common reference price system.

invariant within each household group (but variant within groups) and equal to g_t^h, we have in the sample:

$$Y_t^{h,m} = (1+g_t^h)Y_0^{h,m} \quad (2)$$

By (2), and assuming a Cobb-Douglas utility function, we can compute the indirect utility function, $v(.)$, for each household in the sample using the following formula:

$$v(\mathbf{p}_t, Y_t^{h,m}) = \frac{1}{(1+g_t^h)Y_0^{h,m}} \prod_{i=1}^{I} (p_{i,t})^{w_i^{h,m}} \quad (3)$$

where $p_{i,t}$ is the price of good i at the period t and $w_i^{h,m}$ is the budget share devoted to the good i by the household m within the group $h$and given by the households' sample. Using (1) and (3), the equivalent income function of each household unit in the sample at each period t is then given by:

$$Y_e(\mathbf{p}_0, \mathbf{p}_t, Y_t^{h,m}) = \prod_{i=1}^{I} \left(\frac{p_{i,0}}{p_{i,t}} \right)^{w_i^{h,m}} (1+g_t^h)Y_0^{h,m} \quad (4)$$

The above micro-simulation model has been used hitherto to assess the impact of trade liberalization on poverty and inequality. The analysis is herein extended to perform the impact of trade liberalization on polarisation.

Every society can be thought of as an amalgamation of groups, where two individuals drawn from the same group are similar and form different groups relative to the given set of attributes. In Esteban and Ray (1991, 1994) polarisation of a distribution of individual attributes is viewed as exhibiting the following basic features:

It is a matter of groups – isolated individuals should have little weight.

1. There must be a high degree of homogeneity within each group, which leads to identification.
2. There must be a high degree of heterogeneity across groups, which leads to alienation.
3. There must be a small number of significantly sized groups.

Since we focus on "pure income polarization", that is on indices of polarization for which individuals identify themselves only with those with similar income levels, we rather base our analysis on Duclos, Esteban and Ray (2004) polarisation index – *DER* from now on – who provide a rigorous axiomatic development of the polarization concept for the case in which the relevant (continuous) distributions can be described by density functions.[4]

Given a set of axioms, the *DER* polarization index, which is driven by the interplay of two forces: identification with one's own group and alienation vis-à-vis others, is defined as the addition of all effective antagonisms and can be expressed as follows:

$$P_\alpha(f) = \iint f(x_e)^{1+\alpha} f(y_e) |y_e - x_e| dy_e dx_e \, , \quad (5)$$

[4]The *DER* polarization index is a natural extension of the Esteban and Ray (1991, 1994) polarization index to the case of continuous distributions.

where $f(y_e)$ denotes the density function at y_e capturing the "identification" component of the polarization associated to the size of the group and α refers to the weight given to identification in the polarization index, with α lying between .25 and 1. In (5), $|y_e - x_e|$ represents the alienation component or the distance an individual located at x_e feels vis-à-vis another located at y_e.

In the above particular form, polarization depends on the separate contributions of alienation and identification and on their joint co-movement. Increased alienation is indeed associated with an increase in income distances, whereas increased identification would manifest itself in a sharper definition of groups, i.e., the already highly populated points in the distribution becoming even more populated at the expense of the less populated. Finally, when taken jointly, these effects may reinforce each other in the sense that alienation may be highest at the incomes that have experienced an increase of identification, or they may counterbalance each other.

It is not possible to move these three factors around independently, but the *DER* polarization index may be re-written as a product of an average α-dependant identification $\bar{i}_\alpha$, an average alienation $\bar{a}$ and the normalized covariance between identification and alienation ρ:[5]

$$P_\alpha(f) = \bar{a}\bar{i}_\alpha(1+\rho) \qquad (6)$$

where:

$$\bar{i}_\alpha = \int f(y_e)^{1+\alpha} dy_e,$$

$$\bar{a} = \iint |y_e - x_e| dF(x_e) dF(y_e)$$

$$\rho \equiv \frac{\mathrm{cov}_{i_\alpha, a}}{\bar{i}_\alpha \bar{a}} = \frac{1}{\bar{i}_\alpha \bar{a}}\left[\int f(y_e)^{1+\alpha} a(y_e) dy_e - \bar{a}\bar{i}_\alpha\right]$$

For the sake of empirical estimation and for every distribution function F with associated density f and mean μ, (5) can be re-written as:

$$P_\alpha(F) = \int_{y_e} f(y_e)^\alpha a(y_e) dF(y_e)$$

with $a(y_e) \equiv \mu + y_e[2F(y_e) - 1] - 2\int_{-\infty}^{y_e} x_e dF(x_e)$. If we have a random sample with independent and identically n distributed observations of incomes ordered from smallest to highest, a natural estimator of $P_\alpha(F)$ is:

$$P_\alpha(\hat{F}) = n^{-1}\sum_{i=1}^{n} \hat{f}(y_{e_i})^\alpha \hat{a}(y_{e_i}),$$

where $\hat{a}(y_{e_i})$ is given as:

[5]The average alienation is twice the Gini coefficient.

$$\hat{a}\left(y_{e_i}\right) = \hat{\mu} + y_{e_i}\left[n^{-1}(2i-1)-1\right] - n^{-1}\left[2\sum_{j=1}^{i-1} y_{e_j} + y_{e_i}\right]$$

$\hat{\mu}$ is the sample mean, and $\hat{f}\left(y_{e_i}\right)^{\alpha}$ is estimated non-parametrically using kernel estimation procedures.

3. Simulation Results

The spatial dynamic CGE model is calibrated so as to fit the 2004 regional social accounting matrix (SAM), constructed based on a wide range of data from different external sources. These include the 2004 national accounts and input-output table, a sample of 6,000 households units from the 2000 Tunisian households' survey, a panel of 2,500 enterprises covering the period 1997-2006, the 2004 Tunisian population census and a sample of 49,138 employees from the 2005 employment survey. The regional SAM includes accounts for six regions: Tunis, North-East, North-West, Center-East, Center-West and South. In each region, there are thirty activities and commodities, six primary factors, sixteen household groups and thirty enterprises.[6]

The CGE model is implemented to perform three scenarios. The first scenario represents a baseline against which other simulations of trade liberalization could be compared. This scenario in addition tracks economic growth in a business as usual (BAU) trend of the economy, where regional unemployment rates and interregional migration flows remain stable and labour supply grows at an exogenous rate. In the baseline scenario, total factor productivity (TFP) is calibrated endogenously so as to replicate exogenous and constant regional rates of domestic product over the period 2004–2015. In the baseline, Tunisia's GDP grows at an average rate of 5 percent per year over the period 2004 – 2005, with the Center-East providing the highest rate of growth (5.8 percent) and the North-West the lowest one (4 percent). In the second scenario we consider a progressive and neutral removal of all existing tariffs on imports over the period 2004 –2015. In the third scenario, we account for the trade-related growth spillovers and endogenize the process of technological change. Following de Melo and Robinson (1990), we presuppose that there are some productivity effects which are tied to the volume of exports in each region and associated both to the learning effect and positive externality; the most exporting regions exhibit then the highest productivity gains.

The simulation results of polarization are reported in Table 1. They indicate the level of *DER* polarization index with α set equal to .75. As to figure 1, it pictures the trend of polarization for each region and the whole country under the different simulated scenarios over the period 2004–2015.

The results reveal that in the baseline scenario, polarization rises in all the regions over the period of interest. In 2004, the reference year, the Center East and Tunis are the two regions with the highest polarisation level, respectively equal to 21.63 % and 21.58 %, and the North West and South are the least polarized regions, with DER index equal to 20.51 % and 20.61 %. At the end of the period however, polarization increases in all the

[6]Consistency between the national accounts data and the various micro-data is achieved by applying cross-entropy techniques, as discussed in Robinson et al. (2001).

regions and climb in the whole country from 21.45 % to 22.64 %, which represents an average annual growth of 0.5 %. Polarization increases the most in the Northwest and the south, as the two regions stand with the highest average annual growth of polarization respectively equal to 0.9 % and 0.6 % per year. More particularly, the northwest rank jumps from six to two. On the other hand, Tunis, the Northeast and the Center West are the three regions that worsen the least, with polarisation increasing respectively by 0.3 %, 0.4 % and 0.1 %.

With the removal of tariffs on imports, polarization slightly improves in all the regions compared to the BAU. At the national level and at the end of the period, polarization reaches 22.54 % with freer trade, which represents a fall of 0.5 % vis-à-vis, the BAU. At the regional level and compared with the baseline-end-period results, polarization improvement is somewhat low in Tunis and high in the Northwest (with a 0.7 % decrease). For all the remaining regions, polarization ranking does not change with free trade and the improvement varies between 0.2 % and 0.7 %.

When in addition accounting for the dynamic effects of trade liberalization, through positive export externality, polarization at the national level falls to 22.46 % at the end of the period. Albeit this number is higher than the starting year, it represents a 0.8 % decrease compared with the baseline end-year polarization level and an average annual increase of solely 0.4 % in contrast with 0.5 % per year in the BAU. The ranking of polarization by region in this scenario is the same as the end-period baseline.

Tracing out, in figure 1, the trend of polarization between 2004 and 2015, shows that the path of polarization with trade liberalization follows the same slope as the BAU in the whole country as well as Tunis, the Northeast and the South. The path of polarization under free trade is divergent from the BAU in the Northwest, but its trajectory joins the latter slope by 2007. In the Center-East however the polarization trend under freer-trade presents a large gap vis-à-vis the BAU.

4. Conclusion

The aim of the paper is to quantify the likely effects of trade liberalization on income polarization. To this end, a regional dynamic CGE model has been built to assess the effects of trade reform on commodities prices and incomes in the different regions in Tunisia. This information then has been used to infer the *DER* polarization index, for the different regions and at different points in time between 2004 and 2015.

Simulations results show that polarization worsens over time in all the regions in the business as usual scenario, where the dynamic of the economy is fuelled by investment, population growth and migration and exogenous technical progress. Trade liberalization however softens such increasing trends allowing somewhat to curb income polarization in the different regions and prevent potential social unrest. Polarization is and remains the highest in the urban Tunis and Center-East, while unexpectedly become lowest in the Center-West, the region characterized by the highest poverty rate in the country.

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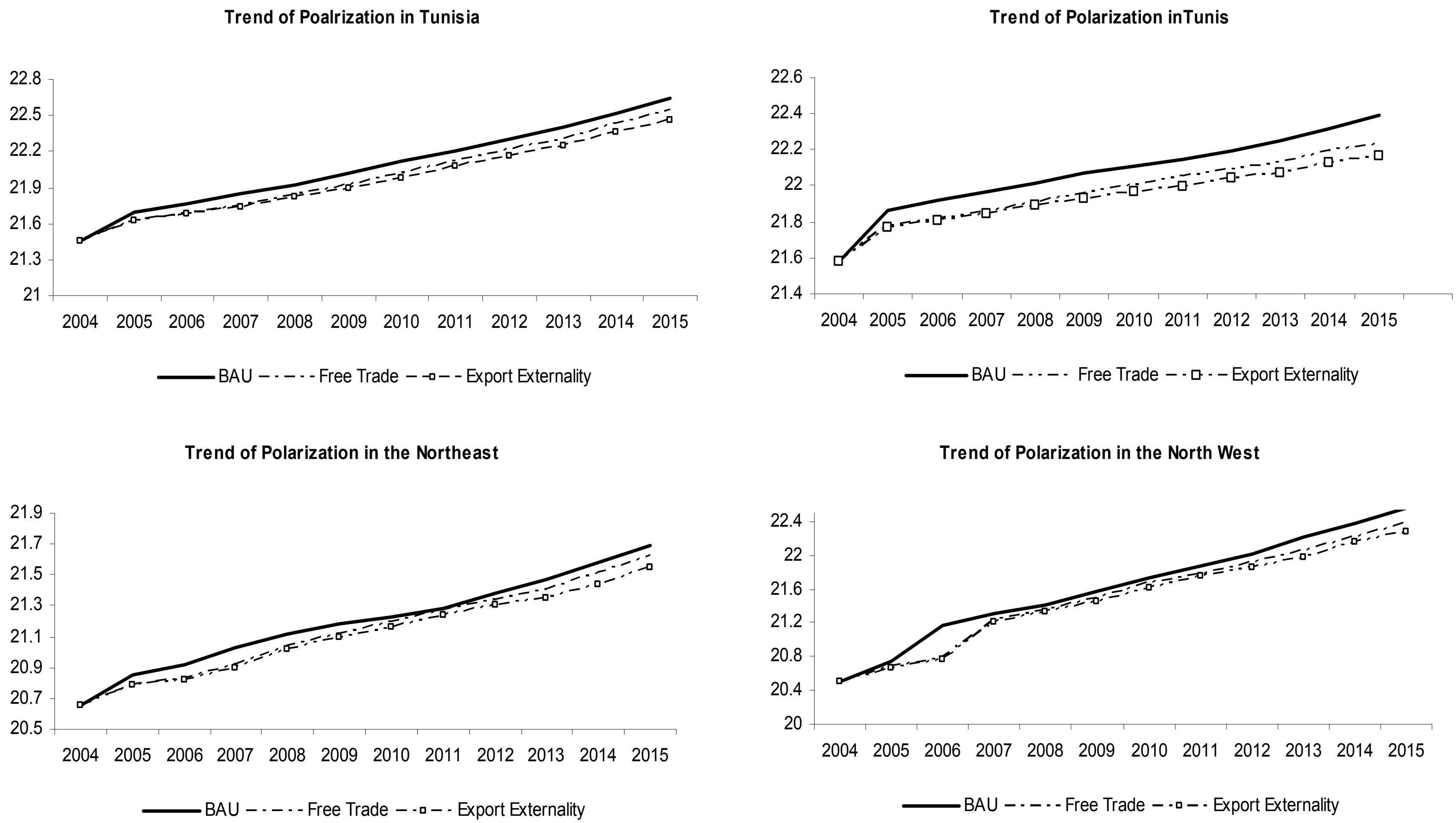
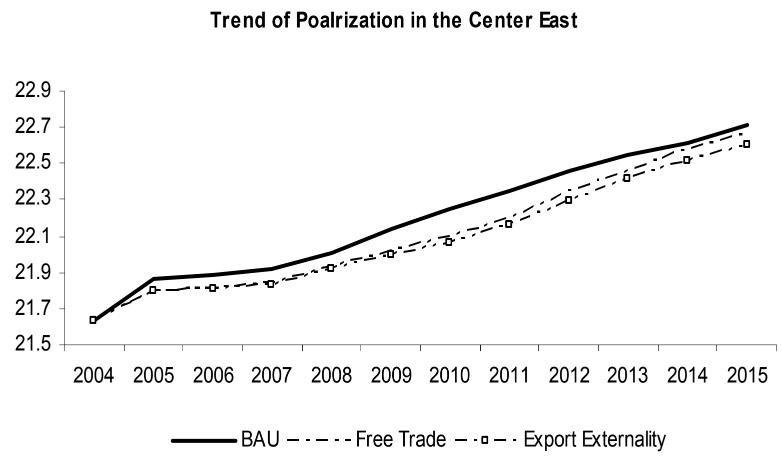
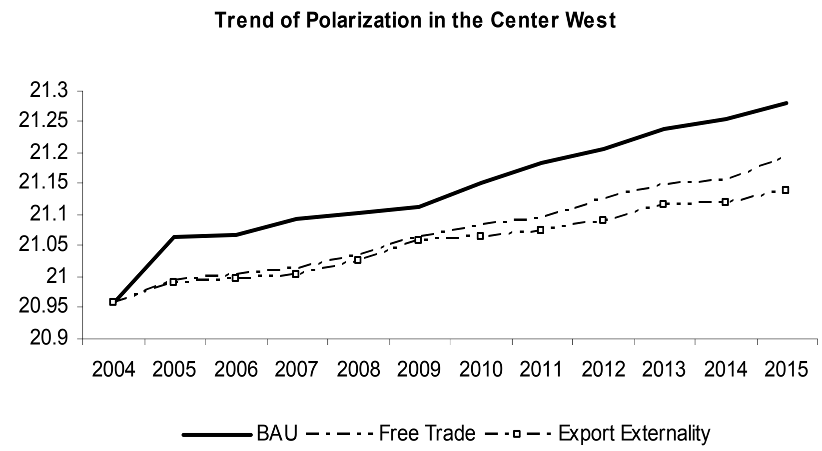
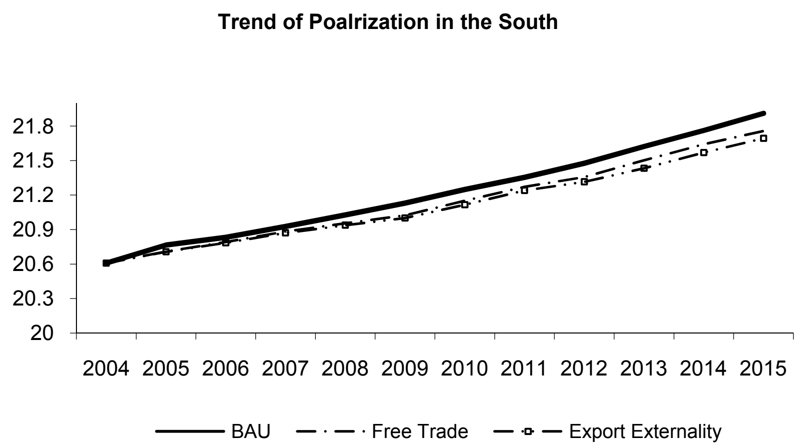
Figure 1: Trend of Regional Polarization, between 2004 – 2015, under the Different Scenarios of Trade Liberalization









Notes: BAU refers to the business-as-usual scenario; Free Trade refers to the scenario of complete and progressive removal of tariffs; and Export Externality refers to dynamic effect of trade openness in addition to progressive tariff removal.
Source: Author's calculations.

Table 1: Polarization Results (%)

	2004		Final year polarisation rate, 2015 (%)					
					Deviation from baseline			
			Baseline scenario		Tariff removal		Tariff removal and export externality	
	DER index	DER rank	DER index	DER rank	DER index	DER rank	DER index	DER rank
Tunisia	21.45		22.64		22.54		22.46	
Tunis	21.58	2	22.39	3	22.23	2	22.16	3
Northeast	20.65	4	21.69	5	21.62	5	21.55	5
North-West	20.51	6	22.55	2	22.38	3	22.28	2
Center-East	21.63	1	22.72	1	22.66	1	22.6	1
Center-West	20.96	3	21.28	6	21.15	6	21.14	6
South	20.61	5	21.91	4	21.76	4	21.69	4

Notes: Regional polarization is ranked form high to low.
Source: Author's calculations.