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Contribution of structural change to productivity growth: Evidence from Tunisia

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Contribution of structural change to productivity growth: Evidence from Tunisia

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Abstract

The objective of the paper is to analyze the dynamics of sectoral productivity growth in Tunisia and assess the contribution of structural change to these dynamics. Using sectoral and firm data we show that productivity increased at a relatively sustained pace in Tunisia in the last three decades, but that the contribution of structural change remained limited. Trade and labor market reforms did not seem to increase it. The main reasons are barriers to entry in some sectors, the inefficiency of factor markets, and the focus of the firms' upgrading program only on some selected sectors.

JEL: O14, 047, 055

Keywords: Productivity, Structural Change, Employment, Tunisia

Résumé

L'objectif de ce papier est d'analyser la dynamique de la croissance sectorielle de la productivité en Tunisie et d'évaluer la contribution du changement structurel à cette dynamique. En utilisant des données sectorielles et de firmes nous montrons que la productivité a augmenté à un rythme relativement soutenu au cours des trois dernières décennies, mais que la contribution du changement structurel est restée limitée. Les réformes de la politique commerciale et du marché du travail ne semblent pas l'avoir affectée. Les principales raisons sont les barrières à l'entrée dans certains secteurs, l'inefficacité des marchés des facteurs et la focalisation du programme de mise à niveau sur un petit nombre de secteurs.

Mots-clés : Productivité, changement structurel, emploi, Tunisie

JEL: O14, 047, 055

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I. Introduction

In *An Inquiry Into the Nature and Causes of the Wealth of Nations* (1776), Adam Smith considers that each stage of development is characterized by a given sectoral composition of the economy and that the evolution of this composition is a major requirement to reach higher stages (Silva and Teixeira, 2008). In the dual model of Lewis (1954), sectoral differences between modern and traditional sectors offer a reserve of improvement of aggregate productivity through the migration of labor from the subsistence sector to the high productivity sector. The empirical work of Kuznets (1971) confirms the link between productivity growth and the rate of shift in the production structure of the economy. Building on these contributions, McMillan and Rodrik (2011) consider structural change as the process through which labor and other resources move from traditional sectors into modern high productivity activities. This reallocation of resources can entail aggregate productivity growth, even if there is no productivity growth within sectors. The speed of the structural transformation is identified as the key factor of success of development strategies.

Tunisia presents an interesting setting in which to study the dynamics of structural change because it went through a program of domestic and foreign liberalization processes during the past twenty-five years. In the Mid-1980s, the Tunisian economy went through a deep economic crisis which culminated in 1986 with a severe balance of payments crisis. This led to the adoption of a structural adjustment plan under the Bretton Woods institutions' guidance. The objectives of this plan were to ensure a stabilization of the macroeconomic framework through a strong devaluation and tight monetary and fiscal policies (Naccache, 2006) and to liberalize the economy mainly through a gradual removal of the price control system and a higher integration in the world economy. Foreign agreements were used to reinforce this new path of liberalization: the accession to the GATT (1989), to the WTO (1994) and the free-trade agreement with the European Union (1995).

Trade liberalization remained relatively limited over the first period (1995-1999) as the government was preoccupied with maintaining social stability and preparing companies for competition. After 1995, the government adopted a more active liberalization policy, mainly with the free trade agreement with the EU entering gradually into force (1996-2008). Tunisia also undertook labor reforms with the goal of increasing labor market flexibility while maintaining some form of protection to workers. The main reforms of the labor code took place in 1994 and 1996, but with limited effectiveness according to the World Bank (2012) which classified Tunisia 181th among 183 countries in terms of dismissal conditions. A competition law and a new investment code were established respectively in 1991 and 1993, but the practice of cronyism, corruption, and rent extraction led to unequal access to business opportunities and limited competition.

What were the effects of these reforms on productivity within sectors and on the intersectoral mobility of resources? Were there reallocations from low productivity to high productivity sectors? Did these reallocations foster productivity growth? Did the competition law promote entry and exit of firms leading to higher productivity?

The methodology of this paper is based on productivity calculations at the sectoral and firm levels and regressions to explain the observed patterns of structural change in Tunisia. First we use sectoral data to investigate the evolution of labor productivity growth in Tunisia, its components (within sector productivity and structural change, following McMillan and Rodrik (2011)) and determinants in the 1983–2008 period. Sectoral data captures the reallocations that occurred and the potential misallocations of resources at the economy-wide level. We then use the National Annual Survey

Report to analyze structural change in the Tunisian manufacturing sectors, through the computation of total factor productivity using the approach of Olley and Pakes (1996).

The rest of the paper is organized as follows. Section 2 analyzes the evolution of productivity growth and employment shares using sectoral data. Section 3 presents the decomposition of productivity growth between intra-sectoral and structural change components and the results of the regressions on some variables such as trade liberalization. Section 4 presents the firms' survey-based productivity analysis. In section 5 we present some policy discussions and section 6 concludes.

II. Structural Change in Tunisia: Sectoral Data Analysis

We first look at the evolution of employment and value added shares in the different sectors to get an idea of the timing and the intensity of structural change in Tunisia during the last three decades. Then we compute sectoral productivity growth and the productivity gap during the same period. Finally, we compare the share of employment of each sector with its productivity as a percentage of average productivity.

The dataset

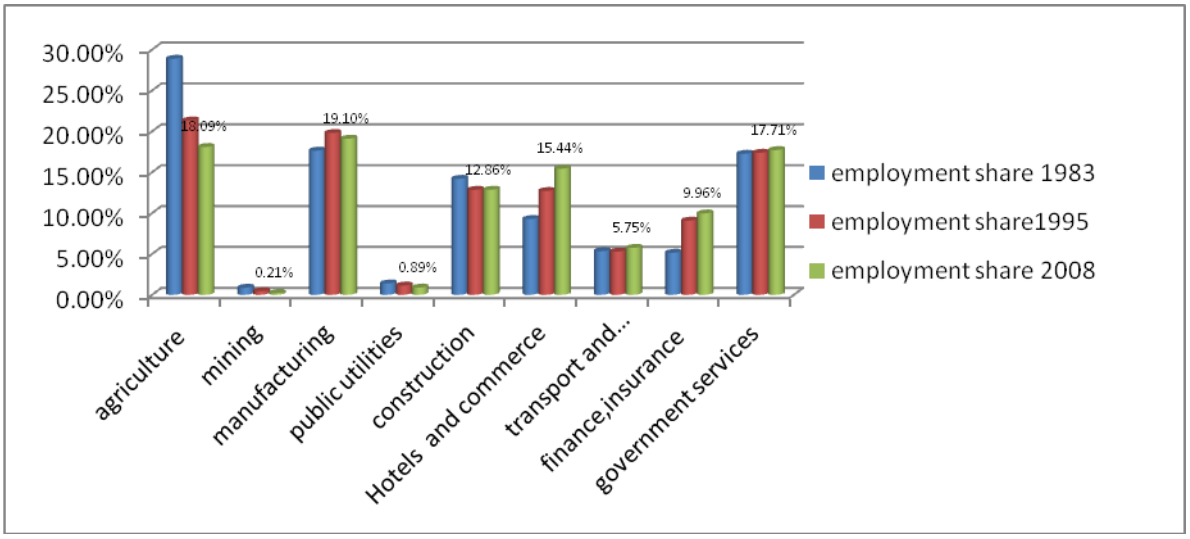
We use industry-level data over the period 1983-2008 from the *Institut Tunisien de la Compétitivité et de l'Economie Quantitative* (ITCEQ). The study period covers a first phase from 1983 to 1995 when the Tunisian market had partially opened up (after signing a FTA with the EU) through the relaxation of restrictions on imports of inputs and equipment. After 1995, a more active trade liberalization policy was adopted, as well as changes in domestic policies to try to adapt the economy to the new context.

The dataset covers the whole economy which we classify into nine sectors as defined in the ITCEQ classification and in the international standard industrial classification. The nine sectors are: agriculture and fishing, mining, manufacturing, public utilities, construction, hotels and commerce, transport and communication, finance insurance and other private services, government services.

The database used includes annual data on gross value added at constant (1990 prices) prices from 1983 to 2008. It also includes data on employment, which allows for the computation of labor productivity trends. Employment in our dataset is defined as ''all persons employed'', thus including wage-earners, as well as self-employed and family workers. Labor productivity was computed by dividing each sector's value added by the corresponding level of sectoral employment.

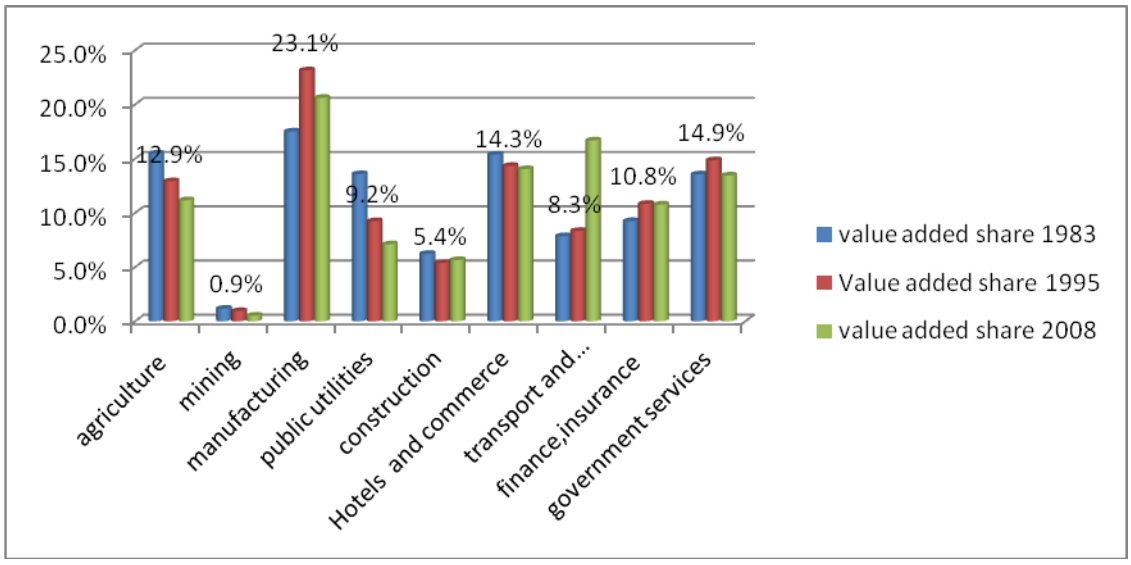
Employment and productivity evolution

Figure 1. Sectoral composition of employment 1983, 1995 and 2008



Source: Author's calculations

Figure 2. Sectoral composition of value-added, 1983, 1995 and 2008



Source: Author's calculations

Figures 1 and 2 present the sectoral composition of employment and value added for the years 1983, 1995 and 2008. Tunisia experienced a significant decline in agricultural employment and value added shares especially between 1983 and 1995. The share of employment in agriculture decreased from 29% in 1983 to 21% in 1995 and to 18% in 2008. Manufacturing experienced a modest increase in the share of employment from 17.5% in 1983 to 19% in 2008. Finance services experienced an expansion from 1983 to 1995 in terms of employment share and value added share but stagnated after 1995. Hotels and retail sectors experienced a significant increase in employment shares while their value added shares decreased during the same period. This means that these sectors became less productive over time.

Despite the stagnation in the employment share of the transport and telecommunication sector over the period of study, its value added share increased significantly between 1995 and 2008. This indicates that this sector became more productive over time. Technological innovations and the boom in demand for telecommunications services were some contributing factors for this evolution.

In sum, Tunisia experienced a modest structural change (a decline in agriculture employment and modest expansions in some services employment) particularly in the late 1980s and early 1990s but this structural change process slowed down after 1995. The employment shares did not change significantly after 1995 in the majority of sectors. These descriptive analyses and results will be further investigated in the next sections.

Table 1 presents productivity by sector; large differences in labor productivity are found across sectors. Productivity is high in public utilities (a capital-intensive sector) and in the mining sector where few people tend to be employed at very high labor productivity. The lowest productivity levels are observed in construction and agriculture. Thus, a positive impact of structural change on aggregate productivity would result from a reallocation of resources from agriculture and construction to manufacturing and services sectors (such as transport and communication).

Table 1. Productivity by sector

Sectors	**Mean (1983-2008)**	**Standard Deviation**	**Min**	**Max**	**Productivity Level 2005**	**Productivity Annual Growth Rate (1983-2008)**
Construction	**2.4**	0.5	1.8	3.4	3.3	**2%**
Agriculture	**3.9**	0.8	2.4	5.7	4.5	**2.6%**
Government services	**4.6**	0.6	3.6	5.7	5.2	**1.9%**
Manufacturing	**6.3**	1.2	4.5	8.1	7.8	**2.3%**
Hotels, restaurants, café and commerce	**6.6**	0.6	5.9	8.1	6.7	**-0.4%**
Finance, insurance other services	**7.3**	0.6	6.1	8.2	7.5	**-0.014**
Transport communication	**10.7**	4.3	6.6	21.9	17.0	**4.9%**

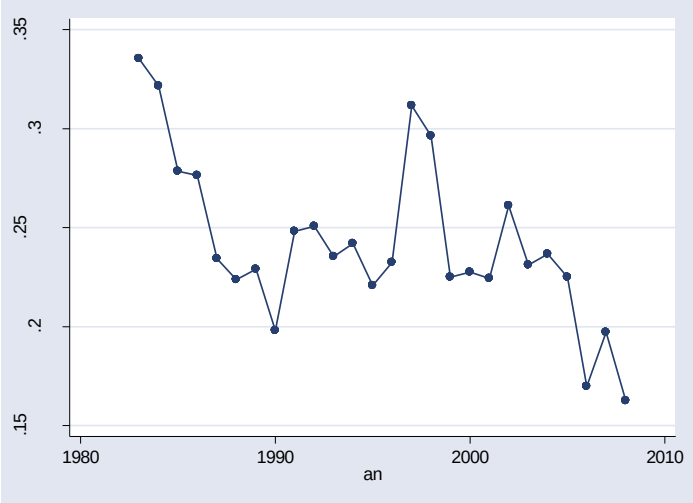
Mining	**12.4**	4.5	5.4	20.3	17.1	**4.6%**
Public utilities	**49.5**	7.8	39.8	62.7	60.5	**1.2%**
All	**5.8**	0.9	4.5	7.5	6.9	**2.%**

Source: Author's calculations

Note: The sectors are sorted according to their average labor productivity.

The productivity gap measures the dispersion of productivity between sectors for a given year. It corresponds to the coefficient of variation of labor productivity among sectors, which is equal to the standard-deviation of sectoral productivity to the average productivity.

Figure 4. The productivity gap



Source: Author's calculations

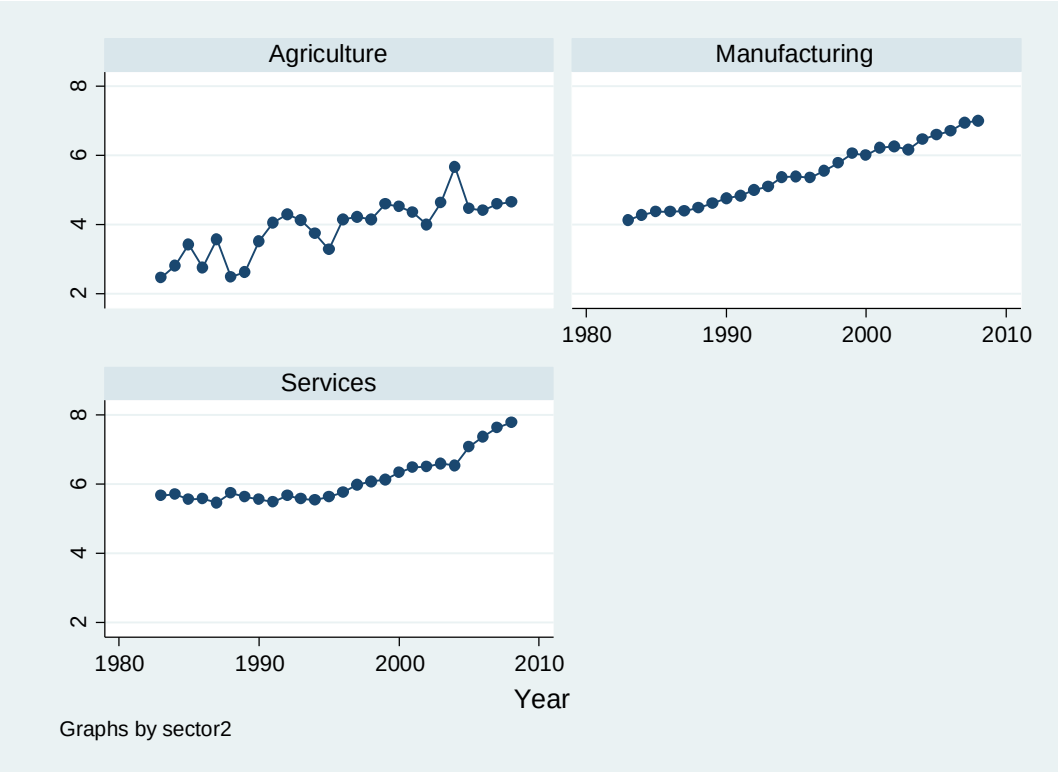
Figure 4 shows the evolution of the coefficient of variation (in log) of sectoral labor productivities. The productivity gap is characterized by a decreasing trend from 1983 to 2008, although we notice two peaks at the end of the nineties and in the 2002-2005 period. The most important decline in productivity gap between sectors is observed in the 1980s. The level of this coefficient in Tunisia is high relative to coefficients observed in high income countries and in Asian countries but close to those in African countries (McMillan and Rodrik, 2011) (0.047 in France, 0.058 in Italy, 0.12 in Thailand, 0.22 in Nigeria and about 0.23 in Tunisia in 2005).

Transport, communication and finance sectors are more productive than manufacturing, agriculture and construction. This high dispersion in productivity implies that job reallocations can contribute significantly to productivity growth.

The gaps in productivity levels are also large when we compare sectors with similar potential to absorb labor. The productivity gaps are high between manufacturing, construction and agriculture. Productivity gaps are also high between transport and communication, finance, and hotels.

We also calculate the annual productivity growth rate over the period 1983-2008 (table 1). Transport and Communication is the sector with the fastest productivity growth (4.85 percent per annum between 1983 and 2008). At the other extreme, hotels restaurants commerce, and finance insurance and other services experienced negative productivity growth rates over the same period.

Figure 5. Sectoral productivity evolution



Source: Author's calculations

Figure 5 shows the evolution of productivity in agriculture, manufacturing and services sectors over the 1983-2008 period. Productivity increased significantly in all three sectors over the period, particularly in manufacturing; for services, the main progress was observed in the 2000s due to the rise of productivity in the telecommunication sector.

Table 2. Sectoral share of employment and productivity

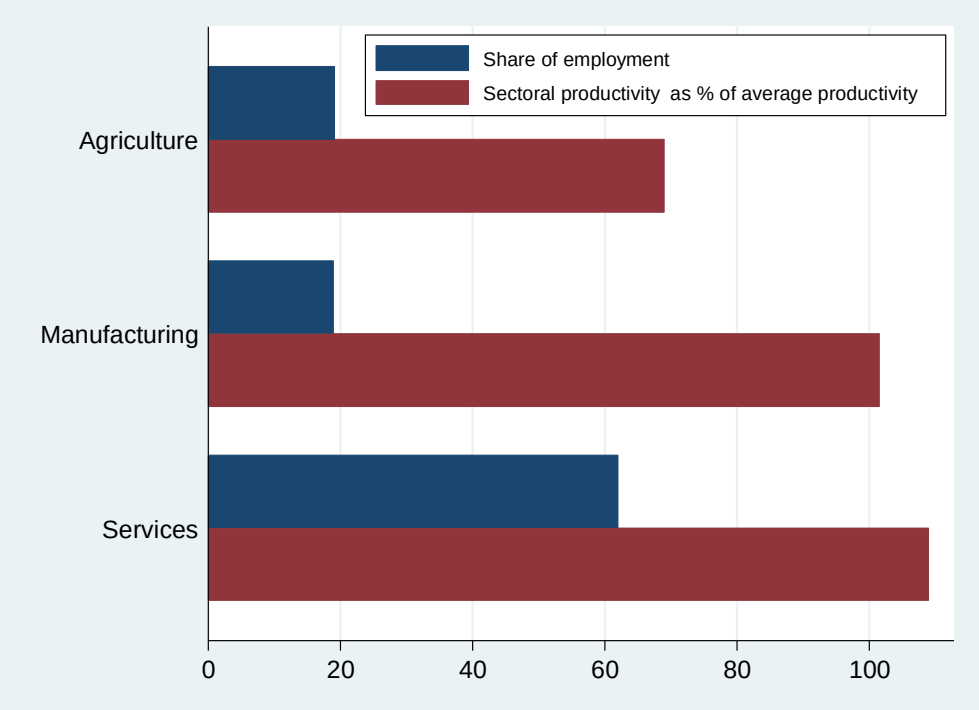
Sectors	**Employment Share (2005)**	**Sectoral Productivity as % of Average Productivity**
Hotels, restaurants, café and commerce	15.2%	109.49%
Agriculture and fishing	19.1%	68.74%
Construction	12.3%	44.13%
Finance, insurance and other business services	9.8%	108.16%
Government services	18.2%	79.57%
Manufacturing	18.9%	101.22%
Mining	0.2%	261.73%
Public utilities	0.9%	695.77%
Transport and communication	5.4%	256.06%

Source: Author's calculations

Table 2 presents simultaneously productivity and the share of total employment in the nine Tunisian sectors in 2005. The sectors with high relative productivity, such as transport and communication and

finance, are those with a very low share in employment. However, the sector with the highest employment share is agriculture where productivity is very low.

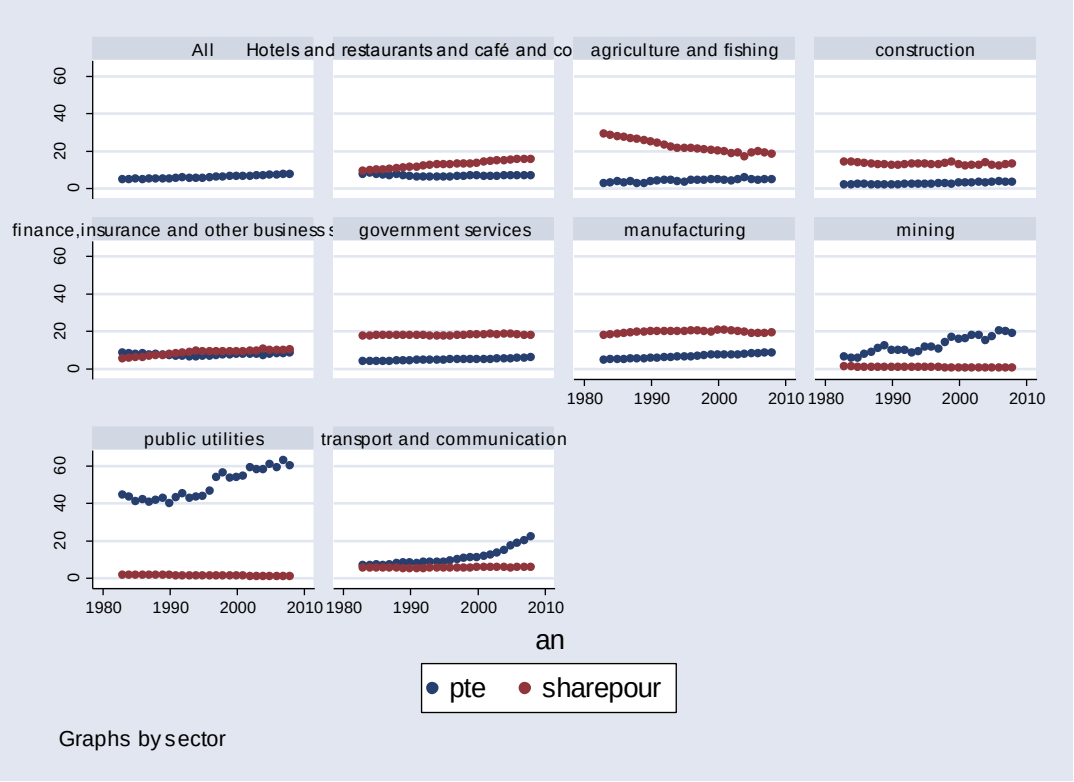
Figure 6. Sectoral share of employment and productivity



Source: Author's calculations

As illustrated in figure 6, Tunisia is still characterized by a large agricultural sector (with a share of about 20% of total employment). However, productivity in manufacturing is almost twice as high as that of agriculture, and productivity in transport and telecom is more than three times higher than in agriculture.

Figure 7. Productivity and share of employment evolution



Source: Author's calculations

Figure 7 shows simultaneously the evolution of productivity and share in employment in the nine Tunisian sectors over the 1983-2008 period. Sectors characterized by high productivity growth did not see their share in employment grow (transport and communication for instance), whereas sectors where the share in employment increased did not see their productivity rise (hotels and commerce).

III. Pattern of Structural Change in Tunisia (1983-2008)

We use the decomposition equation of labor productivity growth suggested by McMillan and Rodrik (2011) to calculate the within and the between components:

$$\Delta P_t = \sum_{i=1}^{n} \theta_{it-k} \Delta p_{it} + \sum_{i=1}^{n} p_{it} \Delta \theta_{it}$$

Where P_t and p_{it} refer to economy-wide and sectoral labor productivity levels, respectively, and θ_{it} is the share of employment in sector i at time t. Δ refer to changes between (t-k) and t.

Table 3 shows the within and between sector contributions to productivity growth in Tunisia during 1983–2008 period by sector and for the whole economy.

Table 3. Decomposition of productivity change by sector, 1983-2008

	Within	**Between** **(Structural Change)**	**Total**
Construction	0.18	-0.041	0.14
Agriculture	0.62	-0.46	0.16
Government services	0.37	0.029	0.39
Manufacturing	0.63	0.12	0.75
Hotels and restaurants and café and commerce	-0.063	0.42	0.39
Finance, insurance other services	-0.0011	0.39	0.39
Transport and communication	0.81	0.098	0.9
Mining	0.1	-0.12	-0.02
Public utilities	0.21	-0.29	-0.081
All (Tunisia)	**2.88**	**0.14**	**3.02**

Source: Author's calculations

Between 1983 and 2008 Tunisia experienced a productivity increase of almost 3 points, roughly all of which was accounted for by the within component via capital accumulation and technological change within sectors. The within contribution to growth is 2.88 points, close to the overall labor productivity growth, while the contribution of structural change is positive but small, 0.14 point. Structural change has contributed little to the overall growth in labor productivity despite inter-sectoral productivity gaps during the studied period.

One of the reasons could be the absence of sector specific incentives in the investment code of 1993 or in the upgrading program which began in 1996. The structural change component is significant in the finance and hotels sectors where it has been growth enhancing and in the agriculture sector where it has been growth reducing.

The manufacturing, transport and communication sectors have made the greatest contribution to the overall productivity growth via the within component. The mining and public utilities sectors have made small and negative contributions to the overall productivity growth.

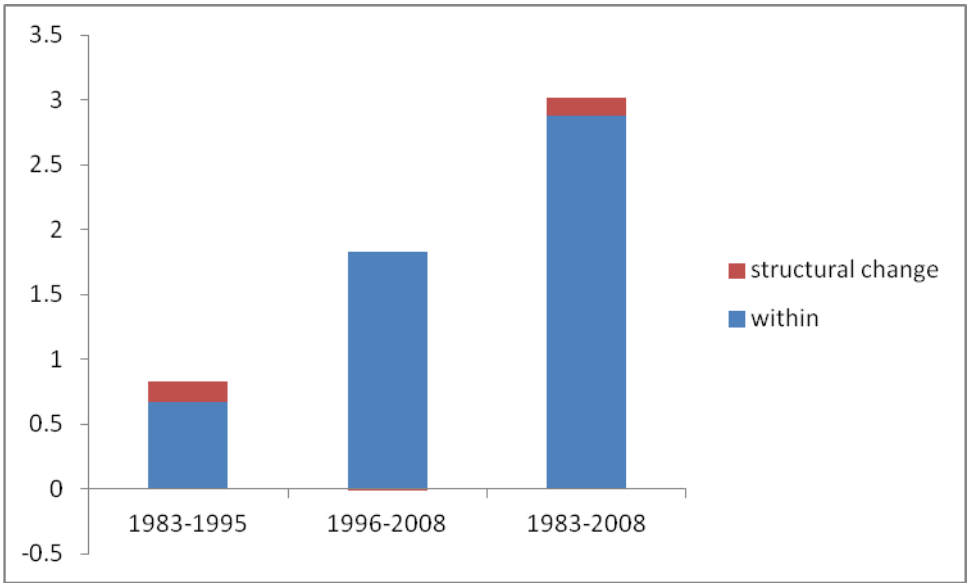
Table 4. Productivity decomposition in Tunisia across two periods

	Within	Between	Total
1983-1995	0.67	0.16	0.83
1996-2008	1.83	-0.004	1.82

Source: Author's calculations

Table 4 shows the within and between sector contributions to productivity growth in Tunisia across different periods. Between 1983 and 1995 Tunisia experienced a low productivity change of 0.83 points, to a great extent due to the within component (about 80%), the structural change component contributing by only 20%. After 1995, Tunisia experienced a greater productivity change of 1.82 points with structural contribution near zero. The structural change component went from 0.16 during 1983-1995 to -0.004 during the 1995-2008 period. The within component of productivity growth increased significantly.

Figure 8. Within and between contributions to productivity growth

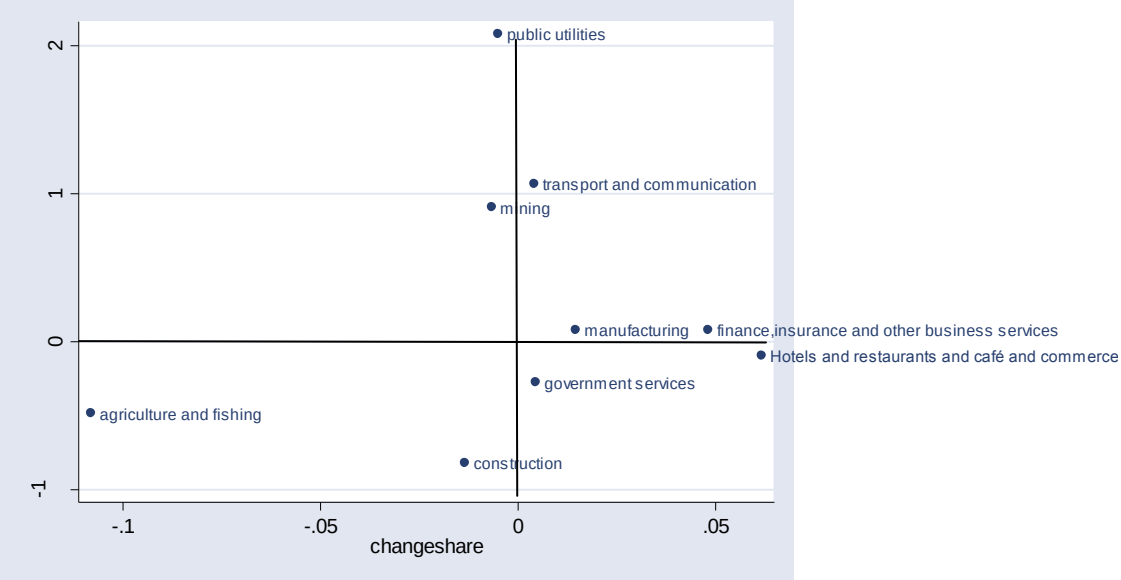


Source: Author's calculations

In sum, the contribution of structural change was very low until 2008. Productivity growth acceleration after 1995 is explained by productivity increases within sectors, and not by reallocation of labor to more productive sectors. This is in line with our previous results indicating a low change in employment shares for the majority of sectors except agriculture, where the employment share decreased over the studied period, and the finance and hotels sectors where the employment share increased despite the stagnation in productivity.

Productivity has grown in mining, public utilities and transport communication but the share of employment stagnated within these industries. Thus, there is no significant correlation between change in employment shares and relative productivity levels in different sectors as indicated by the following graph 9 (end of 2008).

Figure 9. Relative productivity of sectors against the change in their employment share



Source: Author's calculations

Figure 9 shows that the sector experiencing the largest employment growth is hotels and commerce which is among the least productive. On the other hand, the transport and communication sector is among the most productive but this sector experienced almost no employment change. The manufacturing sector experienced a small gain in the share of employment even though it is not very productive. The finance sector experienced a large employment gain but it is also relatively less productive. Agriculture is the sector with the largest relative loss in employment and it is also among the least productive sectors (with construction).

In sum, labor has moved slightly from the low productivity agriculture and construction sectors to modern sectors of the economy (finance, hotels…), but the productivity in these modern sectors was not high enough to produce overall growth enhancing productivity.

Table 5. Decomposition of productivity growth by region

	Annual growth rate of labor productivity %	**Component due to within %**	**Component due to structural change %**
***Tunisia* (1983-2008)**	**2.0**	**1.9**	**0.1**
LAC (90-2005)	1.35	2.24	-0.88
High income	1.46	1.54	-0.09
Africa	0.86	2.13	-1.27
Asia	3.87	3.31	0.57

Source: Authors' calculations and McMillan and Rodrik (2011)

Table 5 shows a comparison of structural change with other countries. The pattern of productivity growth in Tunisia is somewhat like the pattern in Asian countries where the structural change has made a positive but small contribution to the overall productivity. The

low structural change component in high income countries suggests that these countries have already defined their specialization pattern. The negative and high between component in African countries means that structural change was growth reducing in these countries; there was a move from high productivity sectors to less productive sectors.

Regression analysis: determinants of structural change

We carry out some regressions to try to explain the observed pattern of structural change in Tunisia.

We have 25 observations of the within component of productivity and structural change by year (1983-2008). We regress the structural change component on a labor market flexibility index and on some trade openness and foreign competition measures (customs duties (DD) and imports). We have to note that there are several difficulties in undertaking this analysis. One of these difficulties is the availability and consistency of data on policy reforms by sector. Another one is the fact that reforms are often implemented simultaneously and it is hard to disentangle and to isolate the effects of different reforms. For example, a second reform of the labor code happened in 1996, so we could consider this year as a dummy for labor flexibility. However, the free trade agreement with Europe entered into force the same year.

Table 6. Determinants of structural change magnitude

Explanatory factors	(1)	(2)	(3)
D96 (labor flexibility)	-0.078*** (-3.96)		
DD and taxes		0.01 (1.54)	
Imports			-0.000013** (-2.19)
Observations	25	25	25
R squared	0.4	0.093	0.17

Dependent variable: structural change component
Source: Author's estimations

Labor market flexibility

Labor market flexibility can contribute to the movement of jobs and workers from less competitive sectors to more competitive ones. The labor market in Tunisia operates under government regulations covering job security, minimum wage laws and collective bargaining. Firing a permanent worker in

Tunisia is a particularly time consuming process. Tunisia undertook labor code reforms in 1994 and in 1996 with the goal of increasing labor market flexibility while preserving some form of protection for workers.

For labor market rigidity we use an indicator variable (D96) which is equal to 1 after reforms (after 1996) and zero otherwise. The estimation results suggest that structural changes decelerated after 1996, which means that the labor market reforms had a negative impact on structural change. However, this approach (before-after) might attribute productivity variation originating from some other shocks occurring simultaneously with the labor code reform, to labor market reform.

Foreign competition: customs duties and taxes on imports

The theoretical literature is generally positive about the effects of a greater trade exposure on productivity. By reducing protection, trade liberalization lowers domestic prices, potentially forcing high cost and low productivity producers to exit the market and leads to more entrants with higher productivity. Melitz (2003) shows that trade liberalization leads to an exit of less productive firms and a reallocation of output to more productive plants, which contributes to sectoral productivity growth. Some contributions also analyzed empirically the impact of trade liberalization on productivity in developing countries. Fernandes (2007) finds a positive effect of trade openness on productivity. The less competitive industries seem to be the main beneficiaries of productivity growth. Bottini and Gasiorek (2009) also show a positive effect of trade openness on productivity. However, this increase in productivity has a negative impact on job creation and job destruction, which they explain by the government incentives to invest in capital intensive sectors.

The effective rate of protection average[3] in Tunisia fell from 555 in 1985 to 56 in 2001 for the agrofood sector, from 203 in 1985 to 67 in 2001 for the textile and clothing sector and from 203 in 1985 to 50 in 2001 for the chemical industries. Disaggregated by industry, the percentage declines in effective rates of protection, particularly between 1986 and 1990, are impressive in all industries.

Yet, according to our econometric results, the fall in tariffs and taxes on imports in Tunisia (openness and foreign competition) had no effect on structural change. The rise in imports in Tunisia had no impact[4] on structural change; import and foreign competition could lead some industries to contract and release labor to less productive activities and informality.

However, the fall in tariffs and taxes on imports (openness and foreign competition) had positive and significant effects on the within component. The rise in imports also had a positive and very significant impact on the within effect. Lower prices and easier access to foreign machinery and technology provided an incentive for firms to adopt new technology, subsequently increasing their productivity (within).

[3] The effective rate of protection is defined as the proportional increase in value added resulting from the imposition of protective measures**.** It measures the percentage by which value added can increase over the free-trade level as a consequence of a tariff structure. The effective rate of protection captures protection of intermediate and final goods. It also captures tariff or non-tariff protective measures. A negative rate implies that input industries are particularly favoured. These negative rates indicate higher tariffs on input imports than on final goods.

[4] We find a statistically significant negative effect but the coefficient is very low.

IV. Structural Change in the Manufacturing Sector (1997-2002): Micro Data Analysis

In this section we use micro data on Tunisian manufacturing firms to analyze productivity gaps and structural change across manufacturing sectors. The available data is taken from the National Annual Survey Report on Firms (NASRF) carried out by the Tunisian National Institute of Statistics (TNIS). The data covers firms from different manufacturing sectors over the period 1997-2002 (the only period at our disposal). The survey looks at firms' accounts. We consider the period 1997-2002 as an interesting time to capture the effects of trade and economic reforms. Indeed, economic impacts of several measures implemented in Tunisia to liberalize trade and the economy since 1986, were generally not clearly visible before 1997.

In the first stage, the dataset was "cleaned" from observations which could be seen as erroneous or which were clearly outliers. The empirical analysis was based on an unbalanced panel consisting of a sample of about 2,564 firms from the agro-food (IAA), the chemical (ICH), the ceramic (IMCCV), the electric (IME) and the textiles, wearing, leather and footwear (ITHC) industries and other manufacturing industries (IMD) (see table 7). These firms were observed over six consecutive years (1997-2002) to avoid the risk of false flows. The firm's activity is described by a one-digit Tunisian nomenclature of economic activities which leads to our six manufacturing sectors.

Table 7. Number of firms by industry

Industry	IAA	IMCCV	IME	IHC	ITHC	IMD	Total
Number of firms	319	189	407	201	1170	278	2564

Source: Institut national de la statistique (INS)

The dataset includes: value added (y) measured in constant prices (deflated by a four digit industry specific price deflator), tangible and intangible fixed assets, investment and labor (number of employees L). The number of employees is adjusted according to whether it is part time or full time equivalent employment.

To compute a capital stock proxy we followed Mairesse and Bronwyn (1996) by considering the tangible fixed assets deflated by the gross fixed capital formation deflator as a capital stock proxy.

The unbalanced panel dataset at our disposal also contains information on some firm characteristics such as: the "ownership", a private or a public firm, the percentage of foreign capital participation, the exporting rate (the percentage of foreign sales). Table 8 presents some descriptive statistics and suggests that, despite our panel containing firms of different sizes (from 1 to 4,177), on average the observed firms are small (102).

Table8: Descriptive Statistics

Variable	Mean	Std. Dev	Minimum	Maximum	Observations

Value added	799105.3	3814494	7.28	1.51e+08	8103
Capital	1648626	9628098	1	5.73e+08	8123
Labor	102.3484	203.7456	1	4177	8303

Source: Author's calculations

However with the unbalanced panel dataset at our disposal we are not able to distinguish between newly created firms and firms that simply enter the pool at a given period but were already operating in the period before. The same problem arises when a firm exits the panel. We do not know if it is because it ceased production or if it did not respond to the survey. Thus we cannot calculate the exit rate. Our database does not allow us to identify the new entrants in each industry or to track their exit over time.

Measuring TFP: Olley and Pakes (1996) procedure

To analyze structural change in the Tunisian manufacturing sectors, we first derive estimates of firm level total factor productivity (TFP) using the Olley and Pakes (1996) approach.

The traditional methodology for estimating TFP followed the neoclassical growth accounting framework and used the Solow residuals from a production function regression as the measure of TFP. Olley and Pakes (1996) demonstrated that this methodology does not account for the possible endogeneity of inputs and suggested a method to correct for the associated biases. Their approach is designed to deal with both problems of simultaneity between the choice of inputs and the firm's productivity and the selectivity bias due to entry and exit in an unbalanced panel. A plant's private knowledge of its productivity affects its behavior on using inputs (simultaneously hiring or firing labor, investing in new capital or not, etc.).

We first assume that a firm-specific production function can be described by a Cobb-Douglas form as:

$$y_{it}=A_{it}^{\gamma}K_{it}^{\alpha}L_{it}^{\beta} \quad (1)$$

Where *y* indicates the output, *K* and *L* are capital and labor inputs, respectively. α and β are parameters to be estimated, representing factor share coefficients. The subscripts *i* and *t* make reference to the *ith* firm and the *tth* time period. A allows for total factor productivity.

Specifying the production function in log linear form, the following equation may be written:

$$\ln y_{it} = cte + \alpha \ln K_{it} + \beta \ln L_{it} + w_{it} + v_{it} \quad (2)$$

w_{it} captures the productivity **s**hock and v_{it} captures all other shocks.

To deal with the problem of simultaneity between the choice of inputs and the firm's productivity, Olley and Pakes (1996) offer an approach which consists in using investments as a proxy for productivity shocks. The selection bias due to entry and exit is also controlled for in the estimation of the production function.

Table 9. Parameter estimates of the production functions in manufacturing sectors

Dependent Variable: Log(y) **Sample Period: 1997-2002**

Olley Pakes (1996) method				**Fixed effects model**		
Sector	**ln L**	**ln K**	**Observations**	**ln L**	**ln K**	**Observations**
IAA	.5025 *** (.0786)	.2331 *** (.0591)	736	.1387 *** (.0484)	.1257 *** (.0267)	933
IMCCV	.6845 *** (.1107)	.2840 *** (.0812)	490	.4308 *** (.1143)	.1629 *** (.0431)	574
IME	.6528 *** (.0404)	.2593 *** (.0728)	1107	.3476 *** .(0512)	.0840 *** (.0234)	1296
ICH	.5271 *** (.0813)	.2235 *** (.0461)	633	.2209 *** (.0605)	.1120 *** (.0311)	719
ITHC	.7112 *** (.0276)	.2026 *** (.0290)	2996	.2711 *** (.0269)	.1118 *** (.0122)	3507
IMD	.8192 *** (.0502)	.1949 *** (.0674)	743	.5228 *** (.0778)	.0895 *** (.0281)	900
TOTAL	.6357 *** (.0165)	.2090 *** (.0154)	6735	.2818 *** (.0197)	.1119 *** (.0090)	7902

Source: Author's estimations

Note: Standard error in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%. All computations are done using STATA.

Table 9 presents the estimated coefficients of the labor and capital elasticities in the production function of different sectors. From this table, we can see that the results from the fixed effects method and from the Olley Pakes method are significantly different. The elasticities estimated by Olley and Pakes method are more accurate and are in conformity with many other results on Tunisian

manufacturing (Goaied and Mouelhi 2003, Mouelhi 2007). Therefore, accounting for endogeneity of inputs and for selectivity bias seems to be important for the accurate estimation of firms' TFP.

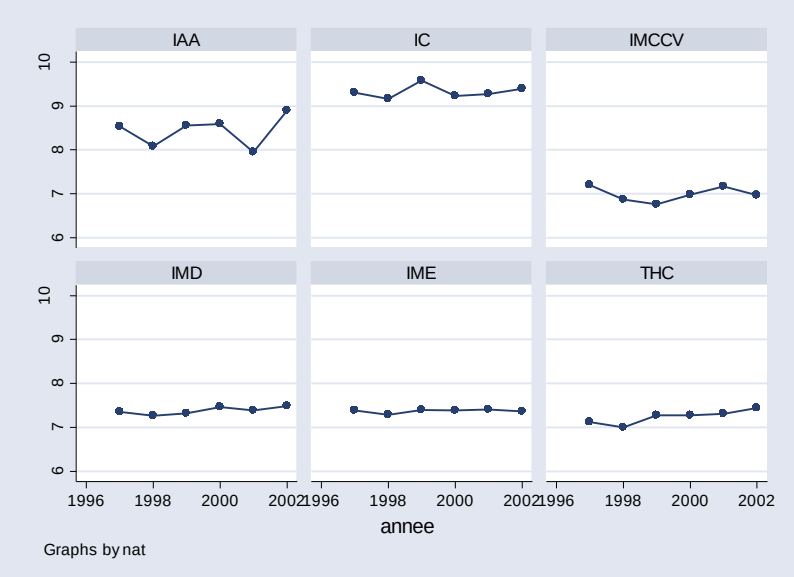
The elasticities of output with respect to labor are higher than the elasticities of output with respect to capital, reflecting the high labor use in Tunisian manufacturing.

Once the input elasticities were consistently estimated, the plant level TFP was deduced using the following equation:

$$TFP_{it} = \frac{y_{it}}{L_{it}^{\beta} K_{it}^{\alpha}} \tag{3}$$

Aggregate industry productivity is calculated annually as the share weighted average of the plant level productivity, using plant level output share as weights.

Figure 10. Evolution of weighted average productivity by industry



Source: Author's calculations

Figure 10 shows the TFP evolution over the period 1997-2002 by industry. On average, the weighted TFP has been higher in the chemical and IAA sectors than in the other manufacturing sectors. TFP in the IMCCV sector on average is significantly lower than in the other sectors. It also appears from this graph that the TFP, on average, stagnated until 2000. It increased gradually toward the end of the sample period in the IAA, ICH and ITHC sectors. Productivity growth over the studied period was limited. The productivity stabilization probably reflects the cost of the reorganization and restructuring process.

Differences in TFP are observed across sectors. ICH and IAA are the sectors with the highest TFP and the productivity-disadvantage of IMCCV is obvious. This would lead to a reallocation of output from less efficient to more efficient sectors and to productivity gains.

Productivity decomposition: Structural change

To check the importance of productivity gains stemming from the reallocation of resources from less to more productive firms we follow Olley and Pakes (1996) and decompose the industry productivity measure. In a given year, the aggregate industry productivity measure (P_t) is a sum of the unweighted average of firms' productivity and a weighted average of firms' individual productivities TFP_{it} with an individual firms' weight *pmit* corresponding to its output share in total industry, in a particular year.

$$P_t = \overline{TFP}_{it} + \sum_i \Delta pm_{it} \Delta TFP_{it} \quad = \quad \text{within effect} \quad + \text{between effect} \qquad (4)$$

$\overline{TFP}_{it}$ is the unweighted average of firm-level productivity

pm_{it} is the share of firm i in the given sector at time t

TFP_{it} is the total factor productivity measure of an individual firm i at time t

Δ refers here to the deviations from the means,

With: $\Delta pm_{it} = pm_{it} - \overline{pm}_t$ and $\Delta TFP_{it} = TFP_{it} - \overline{TFP}_t$

And , $\overline{TFP}_t$ and $\overline{pm}_t$ represent unweighted mean productivity and the mean output share, respectively.

The change in weighted productivity P_t depends both on the change of any given firm's productivity (within effect) and on changes in aggregate productivity arising from firms' entry and exit flows (a reallocation of factors towards more productive firms). This is the "between" or "turnover effect", a sample covariance between productivity and output share. This represents the contribution, of the reallocation of market share and resources across plants with different productivity levels to the aggregate weighted productivity. Thus, if there is a reallocation of resources within industries from less to more productive plants, the latter measure should be positive and increasing over time.

Table 10. Productivity decomposition by industry and by year

		1997	**1998**	**1999**	**2000**	**2001**	**2002**
IAA	Within	7.4	7.4	7.5	7.5	7.6	7.7

	Between	1.1	0.7	1.1	1.1	0.4	1.2
	Total	8.5	8.1	8.6	8.6	7.9	8.9
IMCCV	Within	6.1	6.0	5.8	5.9	6.1	6.0
	Between	1.1	0.9	1.0	1.1	1.1	0.9
	Total	7.2	6.9	6.8	7.0	7.2	7.0
IME	Within	6.8	6.6	6.8	6.8	6.8	6.8
	Between	0.6	0.6	0.6	0.6	0.6	0.6
	Total	7.4	7.3	7.4	7.4	7.4	7.4
ICH	Within	7.5	7.6	7.8	7.7	7.7	7.9
	Between	1.8	1.6	1.8	1.5	1.6	1.5
	Total	9.3	9.2	9.6	9.2	9.3	9.4
ITHC	Within	6.8	6.7	6.8	6.7	6.8	6.9
	Between	0.4	0.3	0.5	0.6	0.5	0.5
	Total	7.1	7.0	7.3	7.3	7.3	7.4
IMD	Within	6.7	6.7	6.7	6.7	6.8	7.0
	Between	0.6	0.6	0.6	0.8	0.6	0.5
	Total	7.4	7.3	7.3	7.5	7.4	7.5
All	Within	6.9	6.8	6.9	6.8	6.9	7.0
	Between	1.0	0.9	1.2	1.0	0.9	1.0
	Total	7.9	7.7	8.1	7.9	7.8	8.0

Source: Author's calculations

Table 10 presents the within and the between components of productivity and their evolution over the period 1997-2002, by industry. It shows that the within effect is significantly higher than the between effect in all sectors. The within component, such as internal restructuring and organizational change, was the most important source of productivity in Tunisian firms. The unweighted productivity increased between 1997 and 2002 in the IAA (4.2%), ICH (1%), ITHC (4.7%) and IMD (1.76%) and it decreased in IMCCV (-3.3%) and in IME (-0.27%). Between 1997 and 2002 Tunisian manufacturing experienced a productivity growth of almost 1.5 percent, roughly all of which was accounted for by the within component. These were due to some increases in the unweighted productivity (within). However, the reallocation component has stagnated and, in some cases, declined (only ITHC shows an increase in the structural change component between 1997 and 2002). The restructuring process was not important and not sufficient to lead to a more significant increase in the overall productivity.

The results also suggest that the weighted average productivity (the between component) has not changed significantly over the studied period. The reallocation of output from less productive firms to more productive firms was not very important.

We used labor productivity instead of total factor productivity to test the robustness of our results. The results from the decomposition of labor productivity were very similar to those obtained with TFP. Structural change has not been very important and has not varied significantly over the period and it has declined in four sectors. The increase in the overall productivity is due to the within component.

In sum, while heterogeneity in productivity is a common finding in sectoral data and in firm-level micro data, these differences were not exploited in a way that contributes to aggregate productivity growth. Obstacles to free entry and exit, among other factors, hinder the reallocation process and are likely to slow productivity growth.

V. Policy analysis

The low level of structural change in Tunisia may be due to obstacles to growth in the size of firms throughout the whole economy and barriers to entry in some specific sectors, but also to labor market inefficiencies and bad governance.

Political economy issues

A recent firm survey (IEQ 2008 cited by World Bank 2010) points out the problems of anti-competitive behavior from firms that do not pay taxes or social security (their owners being protected by the Government or operating in the informal sector). Given the non-independence of the judiciary system, protection of property rights is not guaranteed. Thus, it is rational that some firm owners prefer keeping their businesses small to avoid having to lose their control to the ruling families. Most big businesses in Tunisia ended up being controlled directly or indirectly by these families (Rijkers, Freund and Nucifora, 2014). Moreover, corruption, arbitrariness and discretion in the links with the public administration create a climate of uncertainty that does not favor investment.

There are also obstacles to free entry in some regulated sectors such as transport and telecom or financial services (World Bank 2007). These barriers impede firms and slow down job creation in these sectors and also have a negative impact on the rest of the economy as they induce higher production costs. For example the monopoly of *Tunisie Telecom* on landlines had a negative impact on internet providers' development and consequently on backbone services development in Tunisia.

The lack of access to credit and its high cost also seem to be severe constraints on investment (IEQ 2010, cited by World Bank 2010). Informal firms almost do not have access to it, but formal firms also suffer from favoritism, or the lack of, in access to credit. Due to the high rate of non-performing loans in Tunisia, the Central Bank has imposed high provisions on Tunisian banks which increased the credit rationing on Tunisian firms financing.

Inefficient capital and labor markets

Various imperfections in the factors markets entail costs and inhibit mobility in the Tunisian economy.

Where the capital market is concerned we have already pointed out the difficulty of access to credit. However, there is also a problem of irreversibility of investment due to the small size of the second-hand market in capital goods. Less efficient firms may not exit if they are cross subsidiaries to affiliates in other sectors. Firms that invest heavily in capital equipment may face significant costs if they wish to leave the market and are therefore forced to stay on even if productivity is low. Bankruptcy rules are also not well developed.

As for the Tunisian labor market, it is characterized by difficult and costly hiring/firing procedures for permanent workers which impedes their mobility from one activity to another rapidly. Moreover, the share of temporary contracts has recently increased dramatically. This gives way to a very inefficient and dual labor market; there is a highly protected segment, yet there is an increasing number of unprotected workers, and a high and increasing unemployment rate. The education and training systems seem to be non-reactive and inefficient in breeding specific skills needed for the new high productivity activities (World Bank 2008).

The firms upgrading program

The "*Programme de mise à niveau"* (PMN) was intended to help Tunisian firms compete with European firms after the implementation of the Free Trade Agreement with the EU in 1996. To our knowledge there is no independent evaluation of this program, based on a thorough selection of a control group to avoid selection (or auto-selection) biases when assessing the impact of the program. The sectoral distribution of the program intervention is dominated by three sectors: textiles and clothing (THC), the food industry and mechanical and electrical industry. THC alone represented 48% of the accepted applications in 2008 and 27% of the volume of investments (IEQ 2010). This high level of support granted to a sector suffering from increased competition at the global level may contribute to explain the low level of structural change in the country. Services have been excluded from this program which is limited to manufacturing industries.

The positive impact of the PMN seems to be the increase of immaterial investment (mainly in technology) and the development of the export potential [60% of treated firms in the sample which have never exported before exported in 2002 (Bougault and Filipiak 2005)]. However, the authors emphasize the risk of grants hunting by some firms given that these grants are not linked to productivity improvements but to investment realizations.

Sophistication and export composition

The analysis of the technological sophistication of Tunisian exports can help to understand the evolution of productivity and the specialization process. Tunisia tends to specialize in products and industries that exhibit less linkages, spillovers and potential for productivity. According to Diop and Ghali (2012), the share of high-tech products is low in Tunisia in comparison to other emerging countries. However the share of medium-tech products is higher than some of them (such as India or Indonesia). The sophistication of exports seemed to increase steadily since 2004.

Using the methodology developed by Hausmann et al. (2007), Hausmann and Bustos (2012) find Tunisia on the regression line when they analyze the relationship between the export basket sophistication (EXPY) and income per capita. Meanwhile high-growth countries have EXPY levels much higher than the regression predictions.

The authors also compute the Economic Complexity Index (ECI), following the methodology developed by Hidalgo and Hausmann (2009), who show that the distance between the country and the regression line (EPI and income per capita) is a strong predictor of growth due to higher production capabilities than their current income per capita. Hausmann and Bustos (2012) find that Tunisia is below the trend line, which means higher growth potential in the future.

However, the increase in the technological content of exports has an impact on the whole economy if there are strong links between exporting firms and the rest of the economy. In Tunisia, the offshore sector is largely disconnected from the onshore sector which seems to face higher constraints and has lower productivity (World Bank 2007). Exporting companies remain apart from the rest of the economy because they are not allowed to sell locally and are not motivated to buy their inputs on the domestic market (free tariffs on their imports). This enclave economy prevents any spillover effects to the rest of the economy (Ben Romdhane 2007).

VI. Conclusion

The aim of this paper is to analyze the evolution of productivity and the contribution of structural change to productivity growth in Tunisia since the mid-eighties. The analysis is conducted on sectoral and firm data.

Although lower than the levels observed in Asia, productivity growth in Tunisia has been relatively high in the last twenty-five years (1983-2008) if compared to the main regions in the world (Africa, LAC, etc.). If we subdivide this period in two (before and after 1995) we notice that productivity growth has more than doubled in the latter period. This means that the reforms implemented have had a positive effect on productivity. However, these effects were concentrated on the within sector component of productivity. Structural change was very low before 1995 and nil since, while we would have expected trade liberalization and labor market reforms to enhance the inter-sectoral movement of resources. This observation based on sectoral data analysis is confirmed by the regressions of structural change on policy reform variables and by the analysis based on firm data from the manufacturing sector.

Regulatory, unofficial barriers to entry in some sectors and bad governance seem to be the main reasons behind the low structural change in Tunisia. The inefficiency of capital and labor markets also contributes to slowing the inter-sectoral reallocation of resources. The dominance of a traditional specialization pattern and the absence of incentives to diversify to higher productivity activities also explain the small magnitude of factor reallocation. Finally, the firms' upgrading program was only targeted at the sectors endangered by the free trade agreement with Europe and the dismantling of the Multifiber Agreement, and thus the program ignored some dynamic service sectors which could have absorbed more skilled labor and contributed more to total productivity growth.

To enhance productivity increasing structural change, the Government could remove barriers to entry to some sectors, mainly in backbone services where a high potential exists for skilled jobs creation. Industrial policies targeted on the most promising sectors, including greater financial access for the most innovative entrepreneurs could help accomplishing this objective. Finally, a reform of labor market institutions should take simultaneously into account the need for smoother labor reallocations from low productivity sectors to high productivity ones and a better protection of workers through unemployment insurance schemes and more training opportunities.

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