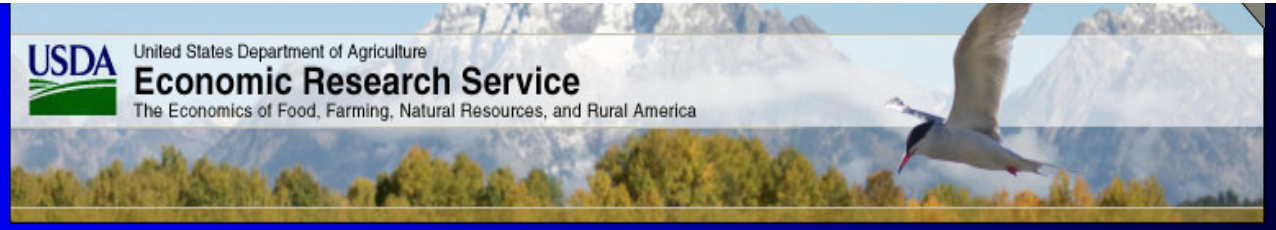

CAUSES AND CONSEQUENCES OF GLOBAL AGRICULTURE PRODUCTIVITY GROWTH CONFERENCE

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Measuring Productivity Growth in Tunisian Agriculture

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Outline

- Agricultural Sector in National Economy: An Overview
- Rational of the study
- Objectives of the research
- Methodological framework
- Results and discussion
- Concluding remarks
- Policy implications

Agricultural Sector in National Economy: An Overview

The agricultural sector occupies an important place in the Tunisian economy in terms of employment creation, income generation, balance of payment regulation, through exports, and for its major role in ensuring country's food security :

- Agriculture contributes to 12%, on average, in GDP;
- The agricultural investments represent 10% of total investments;
- Private operators contribute to up 57% in the investment sector;
- Agriculture investments represent 21% of agricultural GDP;
- Food exports contribute up to 11% in exports of goods and account for 26% of agricultural GDP;
- The sector employs 16% of the total active force;
- About 75% of farms were smaller than 10 hectares.

Rational of the Study

- The agricultural sector in Tunisia has undergone substantial structural changes and a new development paradigm calling for a change from state-led to private-led growth made its way in the country.
- Input subsidization schemes that provide little incentives for resource conservation, price support programs that distort market allocation of resources and heavy border protection making food more expensive for consumers were being increasingly recognized as inefficient ways to achieve food security and rural development objectives.
- An important milestone within this time period is the Agricultural Sector Adjustment Program (ASAP) initiated by the government in 1986. The essence of this program is to:
  - (i) Remove the major sources of price distortions that adversely affect efficiency and productivity;
  - (ii) Transfer marketing functions that are under state control to the private sector;
  - (iii) Improve the public sector management, which entails increasing privatisation.

Rational of the Study (continued…)

Why measuring agricultural productivity growth is important for Tunisia?

- **First**, it is particularly important because agriculture productivity growth is an essential source of overall growth in Tunisian economy.
- **Second**, improving agricultural productivity is the first logical step in a process to provide a sustainable development and consequently ensuring food security.
- **Last**, while major revisions in past policy pricing have taken place namely, a gradual disengagement from price fixing and removal of input subsidies, it is a little surprising that empirical evidence on aggregate production structure and productivity growth in the Tunisian agricultural sector is lacking.

Objectives of the Research

- **First**: To investigate the production structure in Tunisian agriculture for the period 1961-2007.
- **Second**: To identify the sources of Tunisian agricultural output growth.
- **Third**: To analyze the impact of Agricultural Sector Adjustment Program on Tunisian Agricultural Total Factor Productivity (TFP) growth.

Theoretical Framework and Model Specification

To study productivity in Tunisian agriculture, we adopt a production function approach:

$$
\begin{aligned}
\text{Ln } Y = {} & \alpha_0 + \alpha_X \text{Ln } X + \alpha_K \text{Ln} K + \alpha_L \text{Ln} L + \alpha_{La} \text{Ln} La + \alpha_{Li} \text{Ln} Li + \alpha_T T \\
& + 1/2\,\beta_{XX} \text{Ln} X^2 + \beta_{XK} \text{Ln} X \text{Ln} K + \beta_{XL} \text{Ln} X \text{Ln} L + \beta_{X La} \text{Ln} X \text{Ln} La + \beta_{X Li} \text{Ln} X \text{Ln} Li + \beta_{XT} \text{Ln} X \text{Ln} T \\
& + 1/2\,\beta_{KK} \text{Ln} K^2 + \beta_{KL} \text{Ln} K \text{Ln} L + \beta_{KLa} \text{Ln} K \text{Ln} La + \beta_{KLi} \text{Ln} K \text{Ln} Li + \beta_{KT} \text{Ln} K \text{Ln} T \\
& + 1/2\,\beta_{LL} \text{Ln} L^2 + \beta_{LLa} \text{Ln} L \text{Ln} La + \beta_{LLi} \text{Ln} L \text{Ln} Li + \beta_{LT} \text{Ln} L \text{Ln} T \\
& + 1/2\,\beta_{LaLa} \text{Ln} La^2 + \beta_{LaLi} \text{Ln} La \text{Ln} Li + \beta_{LaT} \text{Ln} La \text{Ln} T \\
& + 1/2\,\beta_{LiLi} \text{Ln} Li^2 + \beta_{LiT} \text{Ln} Li \text{Ln} T + 1/2\,\beta_{TT} \text{Ln} T^2
\end{aligned}
\qquad (1)
$$

- Where: *Y* is the output; *X* denotes intermediate inputs; *K* the capital; *L* the labour; *La* the land; *Li* the livestock; *T* represents the time trend proxy and *Ln* is the natural logarithm.

- The function is symmetric such that:

$$\beta_{ij} = \beta_{ji}$$

Theoretical Framework and Model Specification (continued…)

We also assume that production is characterised by constant returns to scale.

- Under this condition, the value share for each input in the value of output is equal to the elasticity of output with respect to that input such as:

$$
\begin{aligned}
S_X &= \alpha_X + \beta_{XX} LnX + \beta_{XK} LnK + \beta_{XL} LnL + \beta_{XLa} LnLa + \beta_{XLi} LnLi + \beta_{XT} T \\
S_K &= \alpha_K + \beta_{XK} LnX + \beta_{KK} LnK + \beta_{KL} LnL + \beta_{XLa} LnLa + \beta_{KLi} LnLi + \beta_{KT} T \\
S_L &= \alpha_L + \beta_{XL} LnX + \beta_{KL} LnK + \beta_{LL} LnL + \beta_{LLa} LnLa + \beta_{LLi} LnLi + \beta_{LT} T \\
S_{La} &= \alpha_{La} + \beta_{XLa} LnX + \beta_{KLa} LnK + \beta_{LLa} LnL + \beta_{LaLa} LnLa + \beta_{LaLi} LnLi + \beta_{LaT} T \\
S_{Li} &= \alpha_{Li} + \beta_{XLi} LnX + \beta_{KLi} LnK + \beta_{LLi} LnL + \beta_{LaLi} LnLa + \beta_{LiLi} LnLi + \beta_{LiT} T \quad (2)
\end{aligned}
$$

- And the value shares sum up to unity:

$$
\begin{aligned}
&\alpha_X + \alpha_K + \alpha_L + \alpha_{La} + \alpha_{Li} = 1 \\
&\beta_{XX} + \beta_{XK} + \beta_{XL} + \beta_{XLa} + \beta_{XLi} = 0; \ \beta_{XK} + \beta_{KK} + \beta_{KL} + \beta_{KLa} + \beta_{KLi} = 0 \\
&\beta_{XL} + \beta_{KL} + \beta_{LL} + \beta_{LLa} + \beta_{LLi} = 0; \beta_{XLa} + \beta_{KLa} + \beta_{LLa} + \beta_{LaLa} + \beta_{LaLi} = 0 \\
&\beta_{XLi} + \beta_{KLi} + \beta_{LLi} + \beta_{LaLa} + \beta_{LiLi} = 0; \beta_{XT} + \beta_{KT} + \beta_{LT} + \beta_{LaT} + \beta_{LiT} = 0
\end{aligned}
$$

Data Sources

- Annual data from 1961 to 2007 of the Tunisian agriculture sector are used.
- In particular, data on output, intermediate inputs, capital, labour, land and livestock.
- These data are constructed from several sources:
  - Agriculture output and livestock (investment in livestock sector is used as a proxy for animal stock) are taken from the Yearly statistics data of Ministry of Agricultural, Hydraulic Resources and Fisheries.
  - Current and real values of labour and intermediate inputs were collected from the *Tunisian Statistical Institute (TSI)*.
  - Capital stock variable constructed using the Perpetual Inventory Method (PIM), is collected from the *Quantitative Economic Institute (QEI)* publications.
  - Finally, data on land (total agricultural area) are drawn from the AGROSTAT system of FAO statistics division (online database).

Estimation Procedure

- (1) And (2) are solved using Zellner's iterative seemingly unrelated regression procedure.

- The livestock equation (S_{Li}) is dropped from the estimation to solve the singularity problem.

- The resulting Durbin–Watson statistics suggested that auto-correlation was not a problem.

- The price elasticities are defined as $\varepsilon_{ij}=S_j\sigma_{ij}$, where S_j is the estimated value-share of the jth input and σ_{ij} is the partial Allen elasticity of substitution. Allen elasticity is defined as:

$$\sigma_{ij} = \sum_{h=1}^{n} F_h X_h \left|\overline{F_{ij}}\right| / X_i X_j |F| \qquad (4)$$

Where /F/ is the determinant of the bordered Hessian, and /Fij/ is the cofactor of F_{ij} in /F/.

- The last step consists in measuring the Total Factor Productivity (TFP) growth by a Törnqvist index:

$$TFP_{t,t+1} = \log Y_{t+1} - \log Y_t - \sum_{i=1}^{n} \frac{1}{2}[S_{i,t+1} + S_t][\log X_{i,t+1} - \log X_{i,t}] \qquad (5)$$

Where S_i denotes the respective input's value-shares.

Results & Discussion

Parameters Estimation

- Estimated coefficients are expected.

- Both productivity growth and the acceleration of productivity growth were non-neutral.

- β_{iT} parameters indicate the biases of productivity growth; Tunisian agricultural productivity growth was capital, land and livestock saving and intermediate-input and labour using.

Results & Discussion

Price Elasticities

- The mean own price elasticity for capital and labor are the highest.
- All own price-elasticities are positive for the period 2001-2007. This is due to an increase of prices on the international market.
- Cross price-elasticities suggest that a percentage change in the price of intermediate input would have a large positive effect on demand for capital while only a modest positive effect on the rest of inputs.
- The low own price-elasticities for both land and intermediate inputs suggest low substitution possibilities for both these inputs.
- High elasticity for intermediate input in 1990-2007 period might be surprising in a sense since one would normally expect that intermediate inputs (such as fertilizers, seeds, etc.) are essential in agriculture and not easily substituted.

Results & Discussion

Total Factor Productivity & Output Growth

- The output growth in Tunisian agriculture was volatile over the whole period of empirical analysis (1961-2007).
- Agriculture output growth was high in 1961-1970, 1971-1980 and the 2001-2007 periods but decreased during the 1981-1990 and 1991-2000 periods.
- On average, output growth increased by less than 1.6% per year.
- Over the whole period, livestock, capital and intermediate inputs were the most important contributors to output growth and land was found to be the least significant in this growth.
- Total Factor Productivity growth has two principal periods of evolution and one important decreasing period. Its contribution to output growth decreased from 4.35% in 1981-1990 to 0.31% in 1991-2000. In contrast, this contribution increased in 1981-1990 to close the 4.35%. In the last period, namely 2001-2007, TFP increased.
- On average, productivity growth increased by less than 2.3% per year.

Results & Discussion

Impact of Agricultural Sector Adjustment Program on Output Growth (-) & TFP (+)

- Period I (1961-1985): Before the Agricultural Sector Adjustment Program
  - Output growth increased by less than 1.7% per year;
  - TFP increased, in average, by 1.97% per year;
  - Livestock, capital and labor are the most contributors to output growth.
- Period II (1987-2007): After the Agricultural Sector Adjustment Program
  - On average, TFP increased by less than 2.63% per year.
  - Output growth increased by 1.5% per year, in average;
  - Intermediate input and livestock are the most contributors to output growth.
- The Agricultural Sector Adjustment Program affect:
  - Positively the TFP (1.97% against 2.63%/year).
  - Negatively the output growth (1.7% against 1.5%/year).

Concluding Remarks

- Average output growth measure suggests that agriculture production could increase by about 1.6%. In addition, productivity growth increased by less than 2.3%.

- This result implies that improvement of productivity growth and technical efficiency of inputs should be the first logical step for increasing agricultural production.

- Further, considering that international competition is increasing and environment regulations are being tightened, the potential for increasing production by using more traditional inputs is limited.

- The contribution of land is expected to decrease in the future for the parceling of land due to the heritage tradition. Thus, the decisions makers need to set up land programs in order to ovoid this parcelling and to tray together the smallest farmers in a cooperative system.

Concluding Remarks

- The quantity increase of labour will have only limited effect on agricultural production. Thus, the improvement of labour quality is the unique feather for considerable agricultural production growth. This highlights the need for government policies, through extension activities, to set up training programs on conducting agricultural activities.

- Increased capital input might have some significant effect on production if and only if it increases land productivity (machinery and irrigation). This highlights the need for government policies to encouraging inversion in this fact by facility credit access at lowest interest rates.

- An increase on Livestock input might have the most important effect on output growth. Thus, encouraging investment in this sector is necessary for agricultural sector output increase.

Policies Implications

Empirical results from this research:

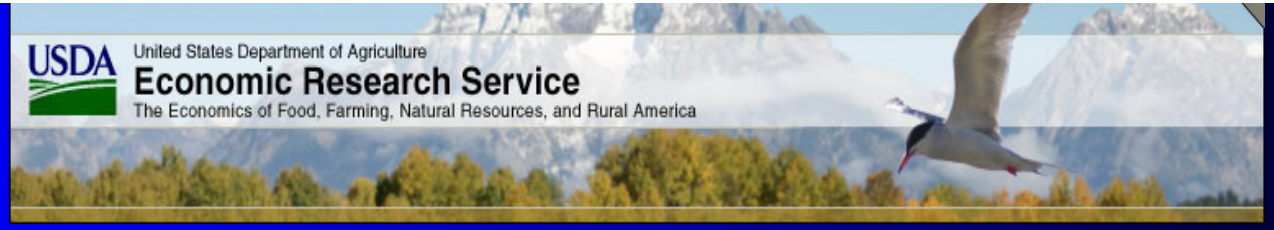
- **Suggests** that findings can be considered as a basic support to decisions makers in order to design optimal policies enhancing agricultural productivity growth in Tunisia.

- **Implies** a potential indicator such as higher levels of agricultural productivity can reduce food prices and therefore increase consumer's welfare. In addition, in the context of an open economy for Tunisia, productivity growth can also improve the agriculture competitive position .

- **Stimulate** the necessity to decompose output growth in TFP, technological change and efficiency effects in order to explain the true determinants of productivity growth.

- **Could be** the background of a new research that covering, examining changes and comparing agricultural productivity in MENA region .

Farm Foundation



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