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Analysing Growth and Productivity in Syria by Growth Accounting

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Abstract

This study investigates the performances of growth and productivity in Syria for the period 1985-2008 by means of growth accountings for the total economy and three major sectors, agriculture, industry, and services. Based on these analyses, guidelines for policies are suggested aiming at the targets for growth and employment as projected in the 11th Five-Year Plan of the economy for the period 2011-2015. The relative importance of the growth of physical capital and labour, of human capital and total factor productivity (TFP) is assessed. The study shows that much higher investments in physical and human capital per year are necessary than accomplished in the recent past in all sectors to achieve the projected growth targets of the Plan. Particularly in the industry sector negative TFP growth hampers growth of output and productivity in the global economy. Growth and reform policy should be focused in the planning period particularly on this sector in order to meet the requirements with respect to the growth and employment targets for the total economy in the Plan.

Keywords: economic growth, productivity, growth accounting, investment, TFP

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Preface

In 2004 the Syrian government launched a comprehensive reform of its economic policy with the objective of transforming the national economy from a planned into a social market economy. By this reform the growing pressure of problems should be tackled resulting on the one hand from the high population growth rate and on the other hand from the slow momentum and low international competitiveness of Syria's economy. Furthermore, dwindling oil reserves had led to a drastic decline in revenues from oil exports. In April 2006, then, the 10th Five-Year Plan (FYP) 2006-2010 in the form of a reform program was issued.

The German "Gesellschaft für Technische Zusammenarbeit", GTZ (now Gesellschaft für Internationale Zusammenarbeit, GIZ) has been supporting the economic reform process in Syria right from its inception by the project "Support for Economic Reform in Syria". The project's tasks were to give support to the Syrian government in the analyses of the current macroeconomic situation, forecast the prospective development of Syria over the five-year planning period, analyse the impacts of planned policies and economic policy reforms, and to advise the government on how economic policy could be planned to achieve the policy targets of the Plan.

Within the framework of the GIZ-project this study investigates the medium- to long-run patterns of economic growth for Syria by means of "growth accounting" with data for the period 1985 to 2008. Growth accounting provides a method for the empirical analysis of economic growth of output and (labour) productivity by decomposing their growth rates into separate major sources as there are physical and human capital and their efficient use in production (Total Factor Productivity). On base of this investigation the contributions of the various sources to growth and productivity are analyzed, the growth prospects as projected in the next (11th) FYP 2011-2015 assessed, and conclusions drawn for economic (reform) policies with respect to the projected targets for growth and employment in the Plan.

A preliminary version of the study was provided by the end of 2010 and the final report submitted just before unrests broke out in Syria in mid-March. In the wake of the uprising the economic reform process has stalled, its main architect, the Deputy Prime Minister for economic affairs, Abdullah al-Dardari, was dismissed, and the German GIZ collaborators in the project left the country. While it is still too early to predict the outcome of the current political situation at the moment there is little to suggest that growth will be able to remain within its medium-term average around 8(!) per cent as projected in the 11th FYP. To put it less euphemistically, if the protest movement cannot be stopped soon, a growth disaster similar to that Syria experienced in the 1980s in the wake of falling oil-prices and war will be the most likely outcome in the planning period.

In contrast to these rather gloomy prospects the study paints a brighter picture of Syria's economic growth and development for the coming 5 years. It is assumed that the reform process of the 2000s is continued and the unrests, which were unforeseeable at the time the study was drafted, do not occur. But even in this favourable scenario great efforts are necessary to reach the 8-percent growth rates over the planning period, which is mainly required to struggle the high un- respectively underemployment in particular of the young labour force aged 25 years old and under. Thus, under consideration of the current events in the country, the (rhetorical) question suggests itself: quo vadis poor Syria?

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Executive Summary

Achieving faster long-run growth is of particular pressing importance to Syrian policy makers. To create enough jobs annually to match the people entering the labour market every year, to reduce unemployment, to struggle poverty respectively to improve standard of living, to meet the rising investment needs for public infrastructure due to the high population growth, etc., Syria plans to boost real GDP growth to 8 percent by 2015.

By definition, output is labour productivity (output per worker) multiplied by employment. Therefore, to achieve the 8 percent growth target and, once attained, to keep it at this level it is essential to direct economic activities to improve (labour) productivity and to generate the jobs (employment) for the growing labour force. “A Growth Diagnostics Report” of the World Bank in cooperation with CEM estimates that annual growth rates of 8 percent requires 175000 jobs per year during the next 10 years, which corresponds to an employment growth of 3.4 percent. Thus, to boost GDP growth to 8 percent, labour productivity must grow by 4.6 percent annually, a three times higher rate than accomplished on average per year in the 2000s (1.6 percent per year). This raises the fundamental question: is the GDP growth target of 8 percent not a pipe dream, and attainable at all?

Basically, yearly GDP growth rates of 6-8 percent are even over the *long-run* not impossible. Starting in the 1960’s and for over 30 years, growth rates of this order of magnitude were achieved by a group of four rapidly growing countries (Singapore, Taiwan, Hong Kong, and South Korea), called the New Industrialized Countries (NIC) or East Asian “tigers”. And more recently, since the 1990s, new “growth miracles” have emerged with China, India, Malaysia, Thailand, which are growing with even higher rates than the NICs. Thus, in principle, the 8 percent growth projection seems not to be an unrealistic goal for Syria. But it raises the obvious question of how Syria can do as good as or even better than most East Asian tigers so as to emerge as the new “Economic Tiger of the Middle East”?

Improving the growth performance of output and productivity of Syria motivates, therefore, the overall objective of this study. Understanding the causes and sources of economic growth and determining what government policies can promote or retard economic growth is central to this goal. To this end, the study investigates the patterns of economic growth for Syria based, firstly, on *aggregate* growth accounting. The growth accounting framework provides a method for analysing economic growth of output and (labour) productivity by decomposing their rates into separate major sources, namely, contributions from physical capital and labour accumulation respectively increases in capital per worker (capital intensity), improvements in educational attainments (human capital per worker), and in efficiency of resources use (Total Factor Productivity). The objective is to assess the contributions of the sources to growth and productivity and to draw conclusions for policy aimed at a better economic growth performance.

However, such an analysis of the growth performance on the *macroeconomic* level may masks large and important differences in the growth patterns of output and productivity among *economic sectors*. For the economy as a whole negative and positive output and productivity growth among economic sectors may cancel out at the macroeconomic level. Thus it may turn out that a growth policy at the macro-level does not appear to be necessary while, nevertheless, a structural policy at the sectoral level can be essential. Therefore, secondly, separate accounts for three major economic sectors are performed in this study: Agriculture, Industry, and Services. These investigations may help to throw further light on the growth process and the factors that drive it and provide the basis for structural (sectoral) policies to promote growth in the total economy.

Over the total period of observation underlying this study from 1986-2008 Syria reports strong average output growth of 4.1 percent per year but only a meagre 0.1 percent increase in output per worker (see for the figures the tables in the Annex, particularly Table 1 in the following). However, for the more recent years since 2000, as Syria intensified structural reforms, output per worker increased by 1.6 percent per year, a significant improvement relative to the 1990s and late 1980s, for which little gains

or even negative growth in productivity are registered. Capital per worker (capital intensity) growth contributed the first time positively to labour productivity growth in the 2000s. This positive contribution to growth can be traced back to two effects: on the one side physical capital increased by 5 percent yearly. These are growth rates Syria never experienced before. On the other side employment growth slumped from much higher rates than 4 percent in the years prior to 2000 to averaged 3 percent per year in the 2000s. Both effects together let capital intensity grow by roughly 2 percent annually so that capital *deepening* occurred for the first time in the 2000s. Nevertheless, capital per worker's contribution to productivity growth has been modest at best (1.1 percent per year) before the background of the required 4.6 percent, despite intensifying reforms in the 2000s, and particularly in comparison with that of fast growing countries in East Asia.

The accumulation rate of physical capital, typically approximated by the investment share in GDP, the *investment rate*, averaged out a yearly 22 percent over the 2000s in Syria. However, such investment rates, which are quite "normal" in high-developed Western countries, are too low in Syria for two reasons. Firstly, they lead to capital accumulation too low to equip the exceptionally high growing working-age population with enough capital to absorb all new job seekers entering the Syrian labour market each year. In the 2000s employment grew about 3 percent per year but the working-age persons by 4 percent. Thus a yearly widening lack of jobs arose. Secondly, enduring labour productivity growth of 4.6 percent requires investment rates on a higher scale. If again the rapidly growing East-Asian countries are any guide, it appears that overall (public and private) investment rates of 30 percent or above are needed to achieve the required gains in labour productivity. China, for example, registered over a period of 26 years, from 1978-2004, investment rates of around 35 percent. This led to capital deepening, which accounted for 3.2 percent per year of output and productivity growth, about 3 times the amount estimated by the growth accounts for Syria in the 2000s.

Therefore, policy should aim at investment rates of 30 percent and higher. According to the growth accounts performed for Syria such rates will provide the still fast growing working-age population with sufficient jobs and physical capital to give the economy for just an extended time impetus towards the desired 8 percent growth path.

Besides this obvious under-capitalization, Syria reports in comparison to East Asian countries also a rising gap in human capital per worker. Education contributed to growth in those countries about 5 times more each year than in Syria over the total period 1986-2008 (0.5 percent versus 0.1 percent). In the 1990s human capital's contribution to growth was even zero, but then, in the 2000s, it increased to 0.2 percent yearly, at least. These differences are the result of the different investments in human capital, measured by average years of schooling, which are per worker much higher in the Asian countries than in Syria. Thus, half a percentage point growth per year could be gained by drawing level with those countries in the improvement of educational attainments. Therefore, acceleration of the pace of improvements in educational attainment should obtain priority of Syrian's economic policy for the next 10 years.

As for TFP growth, the estimated rate of 0.4 percent averaged over the entire period 1986-2008 appears to be rather low. However, leaving out the growth disaster of the 1980s to separate out the effects of the oil price slump, and averaging over the 17 years from 1991-2008 only, TFP growth is calculated as 0.9 percent. This figure might still deem to be too low, but it is in full line with the rate obtained for the NICs over a period of 23 years from 1980-2003. This is a remarkable result given that negative TFP growth was most prevalent in Middle East and North African countries still until the 1990s. Because high frequency phenomena such as business cycles and other exogenous chocks are likely cancelling out each other over the 17 years, this TFP growth rate can be considered as primarily driven by innovation, knowledge, technology, and institutional reforms, factors that raise the economy's efficiency in the longer run. Therefore, the growth rate which is suggestive of "technical progress" is about 1 percent for Syria presently.

Besides for the global economy, growth accounts have been performed for three main economic sectors: Agriculture, Industry, and Services. The empirical results revealed indeed that the

macroeconomic growth accounting discussed so far masks large and important differences in the growth patterns between the three sectoral aggregates.

With respect to the *agricultural sector* productivity growth in the second half of the 1980s is highly negative (-5.5 percent per year), in the 1990s still negative but more moderate rates are registered on average (-0.4 yearly), but then for the 2000s labour productivity soars to whopping 8.3 percent compound annual growth rates. In the latter period capital deepening alone accounts a fully half, 4.3 percentage points, to the increases in output per worker, an amount never before observed in Syria's economy. Nearly another half, 3.8 percentage points, comes from TFP growth, the highest rate measured in all growth accountings performed in this study for the 2000s. A remainder of 0.2 percent is due to education. However, despite the exceptionally high productivity growth, averaged output grew in the 2000s only 4.1 percent per year because of the tremendous dismantling of employment by 4.2 percent each year in agriculture.

This result has affected decisively the growth performance of the economy on the national level in the 2000s. First, capital deepening which accounted remarkably for the soaring labour productivity growth did not occur because of an exceptionally high capital accumulation but was due to *declining* employment. And because shed agricultural labour could not fully be drawn into the industry and services sectors, total employment growth in the economy decelerated, increasing in turn unemployment in the economy. Second, without the extremely high capital deepening process in agriculture the strong although less spectacular 1.1 percent contribution of capital per worker to labour productivity growth had not been observed at the macro-level. Third, it can be ascribed to the exceptionally high gains in Total Factor Productivity in the 2000s, presumably due to investments into the modernisation of the agricultural production technology and more efficient use of labour that a positive though very moderate TFP growth was also obtained for the entire economy. In short: the agricultural sector was in the 2000s not only the major contributor to the increases of productivity at the national level and to positive TFP growth but also to the decrease of annual national employment growth of 1 percentage point below that of the work force.

In contrast to the agricultural sector output and productivity growth deteriorated in the *industry sector*, in the 2000s even dramatically. Output growth slumped by 5.6 percentage points, from 7.7 percent in the 1990s to 2.1 percent in the 2000s, and because yearly employment growth has jumped after 1990 to an average of 4.5 percent per year, productivity declined each year in the 2000s by 2.5 percent. Despite an acceleration of capital accumulation (jump of physical capital growth from 1.4 percent in the 1990s to 4.4 percent in the 2000s) capital *per worker* did nearly not change in the 2000s because labour (employment) increased by 4.6 percent per year at the same time. Therefore, capital deepening and a notable contribution of physical capital per worker to labour productivity growth could not be observed. As a result, negative productivity growth was dominated by changes in TFP, which declined by about the same amount (-2.5 percent) per year.

This dramatic decline of TFP in the 2000s is the most striking pattern in the industrial sector's growth accounting. Presumably, this is partly a reflection of the reduction of over-utilization of the production factors prevailing mainly in the late 1980s and still in the 1990s and of the decline in oil production in Syria since the 2000s. Hardly is it suggestive of technological change, unless one thought that much of the recent development in the industrial sector is technological regress, which is improbable. But for all that, the collapse of TFP growth in the 2000s is disappointing in the light of the on-going reform process, which is focused on the industrial sector. Particularly in the 2000s, when such reforms were implemented with increased intensity, improvements in the efficiency of production and, therefore, positive effects on TFP growth were expected. However, it might still be too early for these effects to be detected in the data used for the empirical growth accounting in this study.

After less favourable growth performances in the late 1980s and the 1990s the growth account paints in the 2000s a brighter picture of the *services sector's* growth pattern. Output grows at a very high rate of 6.8 percent annually, 2.7 percent higher than agriculture's and 4.7 percent higher than industry's output in the same period. As a result, and taking into consideration that services is the largest sector

producing about 45 percent of total output, it accounts for more than half of the economy's national growth.

In contrast to output growth, labour productivity growth in services is relative weak (1.0 percent) in the 2000s. This follows mainly from the fact that, as in industry alike, capital deepening did not occur, even though the sector reports the highest compound physical capital growth rate over the whole period. But because it has employed at least part of the large pool of shed workers from agriculture, additionally to a high share of yearly accruing working-age persons (more than 4 percent), capital intensity has not changed noteworthy and, consequently, capital per worker's contribution to productivity growth is insignificant. As human capital per worker's contribution to output per worker growth is also negligible, TFP growth accounts for fully 90 percent of output per worker growth in services in the 2000s. One can presume that reforms have led to this pleasant result by reversing the negative TFP growth rates observed in the pre-periods. But before any definite conclusions in this respect can be drawn more and in-depth analyses are needed.

Summarizing and concluding, the growth accounts performed in this study provide some confirming evidence of the role of various contributors to growth in Syria. They can be used as guidelines for a growth policy aiming to increase output growth from a level of 4.5 percent, accomplished in the 2000s on average per year, to 8 percent as planned for the next 10 years. The study shows, that this global target can basically be achieved, but to this end much higher investments in physical and human capital are necessary per year than accomplished in the recent past. Investments in physical capital of 30 percent of GDP and higher are indispensable. Besides, much higher investments in human capital per worker (improvements in educational attainments) are necessary to boost its contribution to growth to a level as accomplished by the fast growing East Asian countries (5 times higher). Luckily, a yearly 1 percent TFP growth coming like manna out of the blue sky can be booked on this back-of-the-envelope calculation for the coming 10 years.

A sectoral (structural) growth policy can contribute significantly to the macroeconomic 8 percent growth goal. In the industry sector the declining respectively stagnant rate of growth of capital per worker and negative growth rates are both responsible for high negative productivity growth in the 2000s, despite relative high capital accumulation. This reflects the rapid growth of the work force in this sector. This trend, which is likely to continue in Syria, is particularly problematic. Higher amounts of new investments are necessary to equip the accruing work force with sufficient capital, particular in the industry sector. Higher investments and thus higher capital-embodied technical change, which is not explicitly allowed for in the growth accounting approach will eliminate at the same time negative TFP growth and stimulate additionally output and productivity growth.

A similar rationale applies to the services sector. A higher equipment of labour with new capital to the tune of the national average in the 2000s (1.1 percent) would lift alone output growth to the 8 percent benchmark. To this adds an additional growth due to an increase of labour efficiency via TFP.

The growth pattern of the agricultural sector in the 2000s is, because of high depletion of labour, most problematic. High TFP growth and increases in the capital intensity lead to strong substitution of labour by capital and raise productivity to an extremely high growth rate. More control of this process by policy is advisable because under- respectively unemployed workers are drawn out of agriculture into industry and services, which have to carry a heavy load with this dislocated labour. Such a policy would reduce capital per worker's contribution to productivity growth in agriculture but must not be detrimental to output growth, if appropriately designed.

1. Introduction

Achieving faster long-run growth is of particular pressing importance to Syrian policy makers. To create enough jobs annually to match the people entering the labour market every year (more than 3 percent of the labour force), to reduce unemployment (from a high of 10-12 percent presently to 4 percent), to struggle poverty (according to UNDP 30 percent of the Syrian population lives in poverty and 11.4 percent below the subsistence level) respectively to improve standard of living, to meet the rising investment needs for public infrastructure due to the high population growth, etc., Syria plans to boost real GDP growth to 8 percent by 2015 (ZAWYA, Feb 08, 2010 and Al-Ba'th, Syria, August 25 and 26, 2009).

To achieve this growth rate and, once attained, to keep it at the high 8 percent level it is essential to direct economic activities to improve (labour) productivity and to generate the jobs (employment) for the growing labour force. By definition, output is labour productivity (output per worker) multiplied by employment. The latter grew in Syria with a high rate of about 2.9 percent per year over the period 2001-2008 while labour productivity increased by 1.6 percent. This adds up to the average GDP growth rate of 4.5 percent actually observed per year in the 2000s. "A Growth Diagnostics Report" of the World Bank in cooperation with CEM estimates that annual growth rates of 8 percent requires 175000 jobs per year during the next 10 years, which corresponds to an employment growth of 3.4 percent. Thus, to boost GDP growth to 8 percent, labour productivity must grow by yearly 4.6 percent, a three times higher rate than accomplished in the 2000s. This raises the question, is the GDP growth target of 8 percent not a pipe dream and attainable at all?

Basically, yearly GDP growth rates of 6-8 percent are even over the *long-run* not impossible. Starting in the 1960's and for over 30 years, growth rates of this order of magnitude were achieved by a group of four rapidly growing countries (Singapore, Taiwan, Hong Kong, and South Korea), called the New Industrialized Countries (NIC) or East Asian "tigers". And more recently, since the 1990s, new "growth miracles" have emerged with China, India, Malaysia, Thailand, which are growing with even higher rates than the NICs.[2] Thus, in principle, the 8 percent growth projection seems not to be an unrealistic goal for Syria. Nevertheless, the fundamental question persists: given the projected employment growth of 3.4 percent, how to generate *productivity growth* of 4.6 percent yearly needed to hit the 8 percent output growth target?

Most nations, and Syria as well, do not only care about *absolute* economic growth, but also about *standard of living* or *prosperity* respectively *poverty*, roughly gauged by real GDP *per person* rather than output itself, and about *relative* growth, that is, a country's economic

[2] Some of the "tigers" had their heydays prior to the financial crisis of 1997-98. Though the Asian economies recovered quickly the growth rates from before the crisis were no more attained.

growth performance *relative* to that of other countries. Even though Syria has been rather successful in increasing economic output at an average growth rate of 4.1 percent annually from 1986-2008 (the total period of observation in this study), its growth performance in GDP per head of population was with 1.4 percent yearly weak compared to rapidly growing East Asian countries. As a result, Syria did not catch up in living standard to the high levels enjoyed by people in Western industrial countries, nor did it keep pace with the NICs and the other tiger countries like India and China, which report growth rates for GDP per person of 2.5 percent and much higher.[3]

If Syria had experienced already in the past 10 years an annual output growth as planned for the future, output per capita would have grown by 5.2 percent per year, the country had outperformed all tiger countries in this period except for China, and its standard of living had been in 2010 by a tremendous factor of 1.7 higher than in 2000. Regarding the 8 percent growth target this raises the obvious question of how Syria can do even better than the most East Asian tigers and emerge as the first "Economic Tiger of the Middle East"?

Improving the growth performance of output and productivity of Syria and the living standard of its citizens motivates, therefore, the overall objective of this study. Understanding the causes and sources of economic growth and determining what government policies can promote or retard economic growth is central to this goal. To this end, the study investigates the patterns of economic growth for Syria by constructing, firstly, *aggregate* "growth accounts". The growth accounting framework provides a method for analysing economic growth by decomposing its rate into separate major sources, namely, contributions from physical capital and labour accumulation, educational attainment, and improvements in efficiency of resources use (total factor productivity). The objective is to assess the contributions of the sources to growth and to draw conclusions for policy aimed at a better economic growth performance and an improvement in productivity.

However, this analysis of growth performance on the *macroeconomic* level may masks large and important differences in the growth patterns of output and productivity among *economic sectors*. For the economy as a whole negative and positive output and productivity growth among economic sectors can cancel out at the macroeconomic level. Thus it may turn out that a growth policy at the macro-level does not appear to be necessary while, nevertheless, a structural policy at the sectoral level can be essential. Therefore, in addition to the aggregate growth accounting, secondly, separate accounts for three major economic sectors are performed in this study: agriculture, industry, and services. These investigations for sectors may help to throw further light on the growth process and the factors that drive it and provide the basis for structural (sectoral) policies to promote growth in the total economy.

Thus, this study comprises three remaining sections. The second section presents the theoretical background of the growth accounting framework as a method of analysing the

[3] See figures in Table 1 in Bosworth, Collins (2008).

contribution of the sources to economic growth and productivity. The third section is devoted to the empirical analysis and comprises a description of the data used and the results obtained of growth accountings for the aggregate economy of Syria and three major sectors. Section four presents conclusions.

2. Theoretical background and methodology

Growth accounting is a method used to analyse how economic growth depends on the growth in factor inputs and the improvements in the *overall efficiency* with which the factor inputs are combined or the level of *technology*, also called *Total Factor Productivity*. This method allows assessing the relative importance of the measurable factors of production for output growth and to derive measures for the empirically not observable growth of Total Factor Productivity. In this way the analysis provides the base for the planning of a policy targeted to enhance output, productivity, and technology.

Besides some general background characteristics, a host of specific factors determines a country's levels and rates of growth of output. Among those, major contributions to growth are expected from four groups of factors: (1) the quantity of physical capital, (2) the quantity of labour, (3) the equipment of labour with human capital, that is the knowledge and skills that workers acquire through education and on-the-job training, and finally (4) Total Factor Productivity.

For quantitative growth accounting a Cobb-Douglas production function with constant returns to scale is assumed, where output Y is produced according to

$$Y = (H)^{\alpha} K^{(1-\alpha)} TFP \quad (1)$$

H denotes human capital, K the stock of physical capital and TFP is Total Factor Productivity. The parameters α and (1-α) are the partial elasticity of output with respect to H respectively K and measure the relative importance of human and physical capital in producing a unit of output.

The inclusion of human capital into the production function to reflect changes in the quality of labour has become standard in growth theory. Human capital is defined as:

$$H = e^{\lambda S} L, \quad (2)$$

where L is the number of workers (employment), which is adjusted for improvements in educational attainment assuming that each year of schooling (education), S, raises average workers efficiency (productivity) by a constant proportional rate, λ, the rate of return to an additional year of schooling. In other words: the term $e^{\lambda S}$ in (2) is an index for human capital per worker, H/L=h, and shows the factor by which efficiency of uneducated labour gets multiplied due to S years of schooling. Thus H can also be considered as a skill-adjusted

measure of labour input or as educated workers that are like extra quantities of uneducated workers.[4]

By setting H=hL, the production function (1) can be rewritten as,

(3) $$Y = (hL)^{\alpha} K^{1-\alpha} TFP.$$

For growth accounting analyses the production function (3), which is a relation between the *level* of output Y and the *levels* of the inputs h, L, K, and TFP is expressed in *growth rate* form:[5]

(4) $$g_Y = \alpha(g_h+g_L) + (1-\alpha)g_K + g_{TFP},$$

where g denotes the growth rate of the subscript variables of the production function. This form indicates that output growth, g_Y, equals the growth rates of human capital subdivided into education per worker, g_h, and total number of workers, g_L, and physical capital, g_K, weighted by their output elasticities, α respectively (1-α), plus the growth rate of Total Factor Productivity, g_{TFP}. To put it differently, output growth is accounted for by the contribution from increases in education per worker, αg_h, the growth of workers, αg_L, and physical capital, $(1-\alpha)\, g_K$, and from improvements in Total Factor Productivity, g_{TFP}. While the production factors h, L, and K contribute a less than proportional amount to output growth (because α is less than 1 and due to diminishing returns to scale) the elasticity of output with respect to TFP equals 1, which means, that any TFP growth generates a proportional increase in production.

An alternative way of writing the growth accounting framework is to express the production function in per worker terms by dividing both sides in (3) through labour, L. The growth rate form of this formulation is obtained by subtracting off in the growth accounting equation (4) the growth rate of labour, g_L, from both sides:

(5) $$g_Y - g_L = \alpha g_h + (1-\alpha)(g_K - g_L) + g_{TFP}$$

This expression decomposes the growth of labour productivity (the growth rate of output minus the growth rate of labour) into three terms: the first term, αg_h, is again the contribution of human capital per worker (contribution of education) to increased labour productivity, the

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[4] For example: Assuming a seven percent rate of return to education (λ=0.07) workers with no schooling (S=0) are efficient or represent a productivity of $e^{0.07*0}$=1. Then, according to (2) human capital H equals L. One year of schooling raises the level of human capital to $H=e^{0.07*1}L$=1.07L. Two years of schooling increases the level of human capital to $H=e^{0.07*2}L$=1.15L, etc. Thus each additional year of schooling raises workers' efficiency by the constant proportional rate λ=0.07 and human capital is growing at this rate.

[5] Technically equation (4) is obtained by taking the natural logarithm and total differentiation of equation (3). Note that the differential of the log of a variable is approximately equal to its growth rate.

second term, $(1-\alpha)(g_K-g_L)$, gives the contribution of physical capital per worker, *capital deepening*, and the third term that of Total Factor Productivity, g_{TFP}, to growth of labour productivity. This form of the growth accounting is more useful if one is focused on the growth of standard of living, typically measured by GDP per head of population, which is, at least in the longer term, closely related to output per worker respectively labour productivity.[6] Moreover, for international comparisons and sectoral analyses the appropriate form of growth accounting is where output and physical capital are measured in per worker terms.

TFP growth is in growth accounting perceived as that portion of output growth, which is left unaccounted for by growth in the production factor inputs. To put it differently, the growth rate of TFP is the difference between the growth rate of output and the weighted average of the rate of change of human and physical capital. By slightly rearranging equation (4) an expression for g_{TFP} is obtained as:

(6) $$g_{TFP} = g_Y - [(\alpha g_h + \alpha g_L) + (1-\alpha)g_K]$$

According to this equation, the unobservable growth rate of TFP, g_{TFP}, is a "residual", which can be computed from the other variables on the right-hand side of (6) (output and inputs of human and physical capital), which are observable as well as an estimate for the partial output elasticity of labour, α.

TFP is supposed to represent "technology" and estimates of growth in TFP is sometimes set equal to "technological progress". However, calculated as a residual once the weighted contributions of changes in human and physical capital inputs have been accounted for, TFP growth includes much more than what is suggested by technological progress. It is not just new knowledge about production methods, new ways of constructing building, newly-invented machines, and new sources of power, for which TFP growth is used as a measure of technological progress. But other non-technology factors will also be picked up by the residual. Such factors include changes in infrastructure, work organisation, the degree of monopoly in the economy, trade openness, changes in government policies and institutions (policy reforms), property rights and economic regime, and in the sectoral economic structure. Factors like political turmoil, financial economic and oil price crises, business cycles, cultural attitudes toward entrepreneurship and work, external shocks, and even weather shocks can also affect measured TFP growth. And because it captures anything that affects the relationship between measured inputs and output, TFP growth estimates are also affected by the assumptions and errors concerning the measurement of the parameters (partial output elasticities) as well as of the variables of the production function (output and factor inputs). Thus, TFP growth includes much more than what is suggested by the word "technological progress". Therefore, because it reflects the impacts of all sources of growth other than the contributions of the inputs human and physical capital, TFP and its growth are

[6] In the short term this relationship might be weak but over longer periods of time of 20 years and more, on which growth accounting should in fact be focused, the correlation between the growth in labour productivity and the growth of real per capita output is robust and very high.

best interpreted more generally as a measure of gains (and losses) in the efficiency with which these factor inputs are used.

3. Empirical analyses

3.1 The data

Using the theoretical framework described in the preceding section, a set of growth accounts is performed, for the total economy and, a novelty for Syria, for three major economic sectors: agriculture, industry, and services.[7] Basically, growth accounting is a method for analysing *long-term* growth and, as a result, requires time series data for many years. To make sure that short-term phenomena like, for example, business cycles are not affecting the outcomes, the data set should cover at least ten years, and more likely 20 years. For this investigation time series data for 24 years (1985-2008) could be collected. This data set spans a long enough period, that it can be used to address the interesting long-term growth performance of Syria.

Because much of the controversy over the relative contribution to output growth from increases in factor inputs versus TFP growth results from differences in the measurement of output and the factor inputs, the construction of the data basis for the growth accounting model described in the preceding section will be discussed briefly. Time series data is required for the three major economic sectors on output, Y, human and physical capital, H and K, and labour and investment, L and I, the latters in order to construct the human and physical capital stocks.

Output

The Central Bureau of Statistics (CBS) provides GDP data for several main economic sectors and for a long time period beginning in 1963. In most empirical growth accounts GDP is used as the representative variable for output. However, in case of Syria GDP is not an appropriate variable to measure output of the industry sector. This is due to high subsidization of production prices in this sector which implicates low or even negative GDP values in all years of the observation period. Therefore, in this study output is measured by "Value Added" in constant 2000 SP prices, which is readily available for Syria and the three major sectors from the World Bank data set.

Human capital

For the purpose of this investigation an indicator for human capital was developed according to the methodology described in the preceding section. The functional form of human capital

[7] The sectoral grouping follows that traditionally used by UN, World Bank, and other international organisations. "Agriculture" includes forestry and fishing, "Industry" comprises manufacturing, mining, construction, and electricity, water, and "Services" cover the remainder of the economy.

augmented labour has been assumed in equation (2) as $H=e^{\lambda S}L$. Thus to construct H, data for average years of schooling, S, Labour, L, and an estimate for λ, the rate of return for schooling, are required. A time series for S was calculated using estimates for the educational attainment for the Syrian population aged 15 and above from Barro and Lee.[8] Since it is not possible to distinguish differential levels of education across sectors for the Syrian economy, a common index to all three sectors is applied.

Labour input is based on employment data for the total economy taken from the World Bank data set. These figures were allocated among the sectors: agriculture, industry, and services by means of employment shares on total employment for these sectors, which are also obtainable from the World Bank data set. Total employment and shares are available back to 1985 only, for which reason this study has to be restricted to the time period 1985-2008

As for λ a huge number of empirical studies for countries around the world has established that each year of schooling tends to raise a worker's efficiency between 5 to 12 percent, on average.[9] In constructing the index as in equation (2), a 7 percent rate of return for each year of schooling is assumed.[10] This assumption is consistent with estimates for several other (developing) countries (Bosworth, Collins, Virmani, 2006), and also used in the growth accounting analyses conducted for China and India (Bosworth, Collins, 2008), which will be compared with that obtained for Syria in a later section.

Physical Capital

There is no official time series on the physical capital stock for Syria, neither for the total economy much less for any of the economic sectors. Therefore, own estimates for the value of the capital stocks for each of the three selected sectors were generated by the perpetual inventory method. For this purpose in the first step initial values of the capital stocks for 1963 were estimated for each sector by the formula:

(7) $$K(1963) = I(1963)/(\delta+g).$$

I is investments measured by gross fixed capital formation in constant 2000 SP prices, which is available for the sectors from the national account statistics of Syria as time series extending back to 1963. δ represent the sectoral physical capital depreciation rates calculated by multiplying the national depreciation rate, estimated by Zaman (2006) as 6.4 percent, with the sectoral depreciation to value-added ratios from national accounts. As results 3.5 percent for agriculture, 10.7 for industry, and 4.7 for services were obtained. g is

[8] The Barro, Lee (2010) paper and the accompanying "New Data Set of Educational Attainment in the World, 1950-2010" are available at www.barrolee.com.

[9] The numbers vary depending on the quality of schooling, the type of education, etc. See for empirical studies Bosworth, Collins, and Virmani, 2007.

[10] Thus, for Syria in 2010 with an average level of educational attainment around 5 years, effective labour (human capital) corresponds to $e^{0.07*5}$=1.4 times the number of employed workers.

calculated as the average geometric growth rates of investments over the years 1963 to 1973: 15.5 percent for agriculture, 3.2 percent for industry, and 4.7 percent for services.

In a second step, physical capital stocks for the subsequent years until 2008 were calculated according to the equation:

$$K(t) = (1-\delta)K(t-1) + I(t), \quad (8)$$

Output elasticity of labour

The value for the output elasticity of labour, α, plays a key role in determining the contributions of human and physical capital and TFP to growth. In empirical growth accountings for national economies it is often approximated by the labour share in aggregate output, and calibrated from national accounts data in the range between 0.6 and 0.7 as suggested by the national income accounts data of industrial countries.[11] However, such estimates are problematic for Syria because of two reasons: First, the assumption implied with these estimates that employees are paid according to their marginal productivity is not very realistic for Syria (and for most developing countries). Second, because of the high share of self-employed persons in total employment in Syria (and other developing countries), national account statistics do not comprise all labour income. Self-employed persons earn income from both capital and their own labour. This makes it difficult to obtain meaningful results for the labour share in national output and thus reliable estimates for the output elasticity of labour, α.[12]

Notwithstanding these caveats, there are two studies for Syria, which provide estimates of α based on national account data: Nasser estimates α with data from 1992-2002 by the average share of labour in total income as 0.48, Zaman (2006) calculates an estimate by dividing the "productive" labour income through total national income minus state salaries and obtains a value of 0.44.

To escape the shortcomings of the usual calibration methods α can be derived, instead, from econometrically estimated production functions. Thus, a recent study for 10 MENA (Middle East and North Africa) countries revealed by estimation of Cobb-Douglas production functions a labour share of 0.45 on average.[13] In another study of Senhadji (1999) an equal value of 0.45 was found by the same methodology for countries in the Middle East (Syria

[11] The labour income share can be calculated, for example, from national accounts statistic as the compensation of employees over GDP at factor cost. Hall and Jones (1999) assume a value of α=2/3 for all 127 countries in their data set used for growth accounts, several of them counted as developing countries. Similarly, Bosworth and Collins (2003) set α equal to 0.65 for the entire sample of 84 countries, among them 22 industrial countries and the remainder developing countries. Syria is not included in either of the two growth accounting investigations.

[12] Even if this reasoning is not valid for Syria the described method cannot be applied to the major sectors of the study, because the requisite data does not exist.

[13] See Abu-Quarn, A. S. and S. Abu-Bader (2005). The 10 MENA countries comprise: Algeria, Egypt, Iran, Israel, Jordan, Morocco, Sudan, Syria, Tunisia, and Turkey.

excluded). But also for industrial countries and countries of the "whole" world (66 countries) Senhadji obtained elasticities in the order of 0.46 and 0.45, respectively.

Common to all of these estimates is that they are significantly lower than the values in the typical range of 0.6 to 0.7 used in several growth accounting exercises in the literature. Given the values of α from the production function estimations and the above discussed reasons against its calibration from national accounts data for, in particular, developing countries, an output elasticity of labour of 0.44 is used in this study as national benchmark based on which values for the three selected sectors are estimated. For this to achieve it is assumed that the output elasticity of labour is proportionate to labour productivity. The sectoral shares in national labour productivity are then used to apportion the aggregate output elasticity of labour to the three selected sectors. The results are: 0.47 for agriculture, 0.41 for industry, and 0.46 for services.

3.2 Empirical results

The empirical results of the growth accounts are shown in Table 1 below for the total economy of Syria and disaggregated by three major sectors. The table reports the results for the entire time period 1986-2008 and three sub-periods 1986-1990, 1991-2000, and 2001-2008 separately. Results are presented in the following for the total economy and then for three major sectors: Agriculture, the "primary sector", which also includes forestry and fishing, Industry, the "secondary sector", which is composed of manufacturing, construction, and utilities, and Services or "tertiary sector", which covers the remainder of the economy.

3.2.1 Macroeconomic analysis

Consider first the results for the total economy and the entire time period 1986-2008 at the bottom of the table. As shown in the first column of Table 1 Syria's annual output growth averaged notably 4.1 percent during the entire period. This growth is attributable in nearly equal amounts to increases in physical capital (1.9 percent) and labour (1.8), a meagre 0.1 percent to human capital per worker (education), and 0.4 percent to gains in Total Factor Productivity. Thus, most of the output growth during the entire period is associated with increases in factor inputs of physical capital and labour, both together contributing to output growth a share of 88 percent, a small part is associated with TFP growth (a share of 9.5 percent), and a marginal amount is attributed to education (a share of 2.5 percent).

As noted earlier, growth accounting is not only focused on *output* growth but also, and primarily, on growth of *output per worker* (labour productivity) because this is closely related to output (income) per capita, which in turn is regarded as an indicator of living standards.[14]

[14] See also footnote 5.

As shown in the second column of Table 1, Syria experienced a very high employment growth of 4 percent per year over the full period.[15] However, due to output growth to the tune of employment growth, labour productivity growth remained anaemic, increasing by an average of only 0.1 percent per year (column 3 in the table).

Thus, to achieve notable increases in output per worker and living standards in Syria, given its high labour force and population growth, much higher contributions of their determinants, physical and human capital per worker and TFP growth, are required than those attained during 1986-2008. Columns 6-8 in Table 1 show the sources of the disappointing growth performance in output per worker over the whole period: improvements in the quality of labour measured by education contributed along with TFP growth a small positive amount of 0.5 percent. But this was nearly thwarted by the *negative* contribution of capital per worker growth of -0.4 percent, which was due to the low accumulation of capital relatively to employment over the entire period.

The rate of physical capital accumulation, typically approximated by the investment share in GDP, the *investment rate*, averaged out a yearly 21 percent over the full period. However, for Syria such an investment rate is too low to equip the exceptionally high growing working age population with enough capital to bring about capital *deepening*. To achieve capital deepening, the physical capital stock must grow *more* than employment. In contrast, over the entire time period capital grew in each year 0.7 percentage points *less* than labour. This issue can be put another way: in the face of a growing labour force a fraction out of GDP must each year go only to keep the average amount of capital per worker in the economy constant. However, investment *per worker* was too low to equip the large amount of additional entrants to the labour market each year with enough capital in order to maintain the average capital intensity, let alone to increase it.

Therefore, strong, enduring labour productivity growth requires higher rates of investment than Syria attained in the past. If the fast-growing Asian countries are any guide, it appears that overall (public and private) investment rates of 25 percent or above are needed to achieve notable gains in labour productivity. The NICs, for example, experienced over a period of 23 years, from 1980-2003, investment rates between 25 and 30 percent. In this period increases in capital per worker contributed 2.2 percent per year to an output per worker growth of 3.7 percent.[16] Because the labour force grows in Syria much higher than in most Asian countries even higher investment rates are necessary to achieve such a result.

[15] In the longer-term and at the level of the total economy employment growth is largely determined from the supply side by increases in the "labour force", which comprises everyone of working-age who is a participating worker, that is people actively employed or looking for work (but who are not employed). In fact, over the period 1986-2008, the labour force grew at a (slightly) higher rate on average than employment so that unemployment respectively "underemployment" must have increased over the observation period.

[16] See Bosworth, Collins (2008), Table 1 for this result. Another example is China, which realised over 26 years (from 1978-2004) even higher investment rates of around 35 percent. This led to capital per worker growth, which contributed 3.2 percent per year to an output per worker growth of 7.3 percent (see ibid. Table 1).

The data in the table paint rather different pictures for the three separate time periods. The figures show that the relative low TFP growth observed for the entire period is solely due to its deterioration in the second half of the 1980s (-1.5 percent per year).[17] Because capital per worker contributed also negatively (-2.1 percent per year), labour productivity growth experienced a sharp fall of 3.3 percent annually, which was slowed down only slightly by the small positive contribution of educational attainment (0.3 percent). As a result, in 1990 output per worker was 20 percent lower than in 1985.

Output growth itself was mainly driven by labour (2.1 percent contribution), which grew during this sub-period with 4.7 percent per annum. Together with smaller contributions from physical capital and education, the negative TFP growth effect could be overcompensated, so that output grew with a humble positive 1.5 percent rate annually during the late 1980s. However, as for the negative TFP contribution to growth in this period half there are some doubts, if this was due to a genuine shift of technical progress based on deterioration in the technology of production in Syria. It might more likely be the outcome of a less efficient usage of the existing capital stock and the labour force triggered by a downturn of the economy Syria experienced in those years due to disruptions caused by wars, political unrests in the region, and deteriorating oil prices in the 1980s. This suggestion will find some empirical evidence in the results gained from the growth accounting for economic sectors discussed below.

Between the second half of the 1980s and the 1990s output growth accelerated overwhelmingly by 3.7 percentage points (from 1.5 percent to 5.2 percent). Then, it settled in the 2000s at a slightly lower rate of 4.5 percent. Even on a per labour basis economic growth experienced in the 1990s an astonishing revival. Labour productivity growth accelerated between the late 1980s and 1990s even more than output growth by 3.9 percentage points, from -3.3 percent to 0.6 percent per annum. And although output growth declined between the second and third sub-period, the slowdown in the employment growth in the 2000s meant that labour productivity growth accelerated again after 2000 by a full 1 percentage point. Nevertheless, with 1.6 percent per year labour productivity growth remained relatively weak.[18]

The remaining columns 4-8 in Table 1 show how the production inputs and TFP contributed to output and labour productivity growth over time. Columns 4 and 5 show that capital's contribution to output growth increased while that of labour declined between the sub-periods. However, the contributions to output growth from both factor inputs together increased continuously from 2.7 percent before1991, over 3.8 percent in the 1990s to 4.1

[17] Other studies found also negative or rather low TFP growth rates for Syria respectively for countries of the Arab world in the 1980s (and 1990s). See ESCWA (2007), and there Table 5 for an overview. Bosworth, Collins (2003), Senhadji (1999), Dasgupta, Keller, and Srinivasan (2002) report also very low or negative TFP growth for the Middle East and MENA countries in the 1980s and 1990s.

[18] If employment had grown with the labour force rate of 3.9 percent in the 2000s, no acceleration of labour productivity growth would have been observed at all. This indicates a strong increase in the under-utilisation of the working age population of 1 percent per annum in the 2000s.

percent after 2000. But it was not until the 2000s that a process of *capital deepening* gained momentum and capital per worker contributed the first time positively with 1.1 percent per year to output per worker growth. But because this capital deepening was partly due to a decline of employment growth rather than an increase in capital growth alone, output grew by about 0.7 percentage points less in the 2000s than it would have grown if employment had increased as in the 1990s.[19]

Improvements in the quality of workers measured by education play nearly no role in the acceleration of economic growth between the late 1980s and 1990s[20] while TFP growth increased considerably by 2.9 percentage points from -1.5 to 1.4 percent. However, this leap in TFP growth was unsustainable because it was not due to a genuine shift of technical progress based on improvements in technology. Rather it was presumably the outcome of a more efficient usage of the existing capital stock and the labour force triggered by the upsurge most economies in the Middle East experienced in the 1990s after the growth disaster in the 1980s when oil prices collapsed, and due to transitory demand-side effects. Syria, in particular, benefited in this period additionally from both, increased oil production and agricultural performance, as well as a windfall gain during the Gulf war, which allowed it to undertake key growth-enhancing infrastructure investments, such as the purchase of power stations and a telephone network. After these output effects had faded away, TFP growth fell back in the 2000s and contributed a modest 0.3 percent to the performance of output growth.[21]

This TFP growth in the 2000s might be considered as rather low given the economic policy reforms beginning with the 10th Five-Year Plan. One of the premises of such reforms is that it would be expected to foster the overall efficiency of the economy, TFP, and thus output and productivity growth. However, although nobody doubts that there are impacts of economic policy reforms on growth, it is uncertain if they are affecting TFP growth at the macroeconomic level significantly.[22] With respect to Syria, in particular, it is argued that the actual implementation of the various components of the "declared" reform programmes and projects is proceeding very slowly or even stagnating.[23] Besides, some of the reform elements do not affect TFP at all but rather the amounts of physical and human capital inputs. Hence, TFP might grow slower in dependence of reforms than expected.

[19] The subsequent growth accounts for sectors will show that this decline in total employment growth was evoked by labour shedding in the agricultural sector.

[20] The main reason for the meagre contribution of human capital per worker to growth is because years of schooling per worker increased only marginally over the entire observation period. For the 1990s no increase at all is reported for Syria in the Barro, Lee (2010) dataset on average per year, so a contribution of education to growth could not be identified in this period.

[21] If human capital per worker is excluded from the growth accounting framework a TFP growth value of 0.5 percent is obtained for the 2000s as well as for the entire 1986-2008 time period (sum of numbers in columns 7 and 8). A simple unweighted average of TFP growth across studies for Syria listed in Table 5 of ESCWA (2007) yields 0.08 percent. (all studies exclude years after 2000). Nasser obtained with a different approach and data for 1965-2004 a rate of 0.44 percent TFP growth for Syria.

[22] In literature there are only a few investigations concerning the relationship between TFP and reforms; see for example Dasgupta, Keller, and Srinivasan (2001). The results are very ambiguous.

[23] Chahoud (2010) is elaborating throughout her study on this view of economic reforms in Syria.

In addition, high TFP growth is not a necessary condition for the achievement of excellent growth performance of output and productivity. Thus, the fast growth of both output and productivity some East Asian economies experienced has been mainly based on significant capital deepening and rapid increases in educational attainment rather than exceptional high TFP growth. In the NICs, for example, physical and human capital per worker contributed 2 respectively 2.5 times more to labour productivity growth over the period 1980-2003 than in Syria during its "heydays" in the 2000s.[24]

From these comparisons following preliminary conclusion for policy can be drawn: if Syria is out to enhance its growth in output and productivity and to catch-up in income per capita it should first and foremost try to draw level with rapidly growing Asian countries in physical and human capital per worker growth instead of hoping on high TFP gains coming like manna out of the blue sky.

3.2.2 Analyses for economic sectors

The results for economic sectors, depicted in Table 1, reveal that a macroeconomic growth accounting, as performed so far, inevitably masks large and important differences in the growth patterns among sectors. For the economy as a whole negative and positive output and productivity growth among economic sectors can cancel out at the macroeconomic level. Thus it may turn out that a growth policy at the macro-level does not appear to be necessary while, nevertheless, such a policy can be essential at the sectoral level.

Agriculture

Syria's economy is heavily dependent on agriculture. Over the whole period 1985-2008 the sector produced 24 percent of total output and employed 25 percent of the work force on average per year. But its share in total employment declined in the 2000s continuously from a high of 33 percent in 2000 to a low 19 percent in 2008 whereas the output share remained rather constant at the 24 percent level.

The growth account for the agricultural sector is shown in the upper panel of Table 1. Leaving aside the growth disaster period of the 1980s, output has grown in agriculture at a very rapid pace, 6.0 percent per year in the 1990s and a lower but still impressive 4.1 percent in the 2000s. For the entire period 1985-2008 an average of 4.1 percent per year was achieved.

The growth patterns changed strikingly between the 1990s and the 2000s. While in the 1990s output and employment grew both with high rates of 6 respectively 6.4 percent, in the

[24] Compare for this the results in Table 1 of this study with those in Table 1 in Bosworth, Collins (2008). Comparability is by far guaranteed because both studies are based on similar methodologies. China, however, stands also out for the sheer magnitude of its gains in TFP growth.

2000s output growth occurred at a still very strong 4.1 percent but against the backdrop of declining employment in the sector. During the 1990s output growth is completely driven by physical capital and labour (education and TFP show both no contribution to growth), in the 2000s it is concentrated in improvements of TFP and the contributions of factor inputs cancel each other out. While in the 1990s output *per worker* growth hardly exists, in the 2000s it is a whopping 8.3 percent per year. Capital deepening contributes a fully half (4.3 percentage points) to the increases in output per worker in the 2000s and nearly another half (3.8 percentage points) comes from TFP growth (and a negligible 0.2 percent from education).

This striking change of the growth pattern in the 2000s deserves some more discussion because it seems to have affected decisively the growth performance of the aggregate economy. First, capital deepening, which accounted remarkably for the soaring output per worker growth, did not occur because of an exceptional high capital accumulation (which in fact decelerated slightly across the 1990 period) but was rather due to declining employment. And because shed agricultural labour could not fully be drawn into the industry and services sectors, aggregate employment growth decelerated (which in turn increased unemployment in the economy). Second, without the extremely high capital deepening process in agriculture the strong although less spectacular 1.1 percent contribution of capital per worker to labour productivity growth had not been observed at the macro-level. Third, it can be ascribed to the exceptionally high gains in Total Factor Productivity in the 2000s, presumably due to investments into the modernisation of the agricultural production technology and more efficient use of labour that a positive though very moderate TFP growth was also obtained for the entire economy. In a nutshell: the agricultural sector was in the 2000s the major contributor not only to the national productivity and TFP growth but also to the decrease in employment growth below that of the labour force.

Industry

The industrial sector produced 32 percent of total output (value added) on average per year over the period 1985-2008 (31 percent in 2008) and employed 29 percent (30 percent in 2008) of all employees.

To begin, a comparison of the figures in the second panel of Table 1 with those for the total economy at the bottom of the table shows that the growth disaster in MENA countries in the 1980s, the “lost decade of growth”, hit Syria’s industrial sector most and differently than forecasted for the aggregate economy. Since international oil prices collapsed, it is argued, there was a significant effort on the part of oil-producers to prop up oil prices by *reducing* production.[25] However, the empirical data in the table do not support this view: in contrast to the total economy, industrial output grew a whopping 9.1 percent per year, the highest figure for output growth in Table 1. And because employment increased only sluggishly output per worker growth was also extremely high (8.4 percent).

[25] See Dasgupta, Keller, Srivinasan (2002, 19).

On the factor input side, investments in industry collapsed totally so that physical capital experienced a dramatic decline in accumulation in the 1980s. [26] As a result, the sector contributed along with labour negatively to output growth, despite the slight increase in labour input. Since capital per worker contributed also negatively to output per worker growth all increases in output and improvements in labour productivity have to be traced back to the "residual". This is a whopping 9.2 percent TFP growth rate, the only positive value for the 1980s and the highest rate at all registered for TFP growth in the table. Of course this high measure cannot be equated with technological progress or alike but it rather reflects the degree to which over-utilisation of the factor inputs prevailed in this period.

In the following two periods, output and productivity growth deteriorated, in the 2000s even dramatically. In contrast, in the agricultural and services sector as well as in the total economy they ameliorated. Output growth slumped by 5.6 percentage points, from 7.7 percent in the 1990s to 2.1 percent in the 2000s, and because yearly employment growth has jumped after 1990 to an average of 4.5 percent per year, output per worker declined each year by 2.5 percent.

According to the growth accounting equation for the 2000s a yearly output growth of 4.6 percent can be calculated, which is implied by the growth of physical capital (2.6 percent) and labour (1.9 percent). However, *actual* output grew only by 2.1 percent, i.e. 2.5 percent less than the implied growth. This difference is reflected in a negative TFP growth by about the same amount[27]. As for the yearly output per worker growth a similar reasoning applies. Despite high capital accumulation capital per worker did nearly not change in the 2000s. Therefore, a notable contribution of physical capital per worker to labour productivity growth could not be observed.[28] As a result, negative output per worker growth was dominated by changes in TFP, which declined by about the same amount per year.

This dramatic decline of TFP in the 2000s is the most striking pattern in the industrial sector's growth accounting. Presumably, this is partly a reflection of the reduction of over-utilization of the production factors prevailing mainly in the late 1980s and still in the 1990s and of the decline in oil production in Syria since the 2000s. Hardly is it suggestive of technological change, unless one thought that much of the recent development in the industrial sector is technological regress, which is improbable. But for all that, the collapse of TFP growth in the 2000s is disappointing in the light of the on-going reform process, which is focused on the industrial sector. Particularly in the 2000s, when such reforms were implemented with increased intensity, improvements in the efficiency of production and, therefore, positive effects on TFP growth were expected. However, it might still be too early for these effects to be detected in the data used for the empirical growth accounting in this study.

[26] Gross investment was too low to make up for depreciation in this period. The increase in employment was too low to offset the negative effect of capital on output growth.
[27] The minor contribution of education to growth is ignored in this calculation.
[28] Actually, this contribution is slightly negative.

Services

Services is the largest sector of Syria's economy, producing 44 percent of total value added over the period 1985-2008 on average (46 percent in 2008) and employing 46 percent of all employees (52 percent in 2008).

The third panel summarizes the growth performances of the sector. The results for the second half of the 1980s show that the period of growth disaster hit services most: it reports negative annual output growth rates, which along with high employment growth of 6.6 percent per year (roughly comparable to that for the agricultural sector in this period) led to the sharpest slump in labour productivity growth. These yearly losses in output per worker are attributed for a smaller part to negative contributions of capital per worker and for the most part to the huge negative TFP growth, averaging nearly 6 percent annually. Of course, as in case of agriculture, this negative TFP growth should not be misunderstood as technological regress but rather interpreted as a growing inefficiency of production due to the under-utilization of factor inputs in the 1980s.

In the following decade and in the 2000s the sector witnessed a remarkable rebound of output growth, which accelerated from -1.7 percent in the 1980s over 2.8 in the 1990s to 6.8 percent in the 2000s, thus by 8.5 percentage points. This growth was so strong that increases in output per worker accelerated even more, by 9.3 percentage points, reversing the minus 8.3 percent in the period 1986-1990 to a plus of 1.0 percent in the 2000s. Albeit not high, the growth on a per-worker base is particularly impressive because it occurred against the background of a similar high employment growth as reported for the late 1980s.

The sector achieved its gains in growth mainly through both substantial increases in capital accumulation and TFP growth. The contribution of physical capital to output growth accelerated by 2.3 percent and that of TFP switched from a negative 5.8 percent in the 1980s to a positive 0.9 percent in the 2000s, a swing or turnaround of nearly 7 percentage points. The acceleration of output per worker growth has come to 72 percent alone from this dramatic turnaround in TFP growth and the remainder from the increase in the contribution of capital per worker growth, which was a huge negative 2.8 percent per year in the late 1980s and diminished to a small negative 0.1 percent in the 2000s.

Thus, for the more recent period the data in the table paint a brighter picture of the growth pattern for the services sector than in the two previous periods. Output grows in the 2000s very high at a steady 6.8 percent annually, 2.7 percent higher than agriculture's and 4.7 percent higher than industry's output. As a result, the services sector accounts for most of the growth in the economy's total output. Capital and labour contribute roughly equal amounts, both factors together 85 percent to output growth. Compared to output growth improvement in labour productivity is weak, but for the first time a positive number (1.0

percent) at least. Because capital per worker has not changed noteworthy and human capital per worker's contribution is negligible TFP growth accounts for fully 90 percent of output per worker growth in the 2000s. One can presume that reforms have led to this pleasant result by reversing the negative TFP growth rates observed in the pre-periods. But before any definite conclusions in this respect can be drawn more and in-depth analyses are needed, which would go beyond the purpose of this investigation.

4. Summary and conclusions

Summarizing and concluding, the growth accounts performed in this study provide some confirming evidence of the role of various contributors to growth in Syria. They can be used as guidelines for a growth policy aiming to increase growth from a level of 4.5 percent, accomplished in the 2000s on average per year, to 8 percent as planned for the next 10 years. The study shows, that this global target can basically be achieved, but to this end much higher investments in physical and human capital are necessary per year than accomplished in the recent past. Investments in physical capital of 30 percent of GDP and higher are indispensable. According to the growth accounts performed for Syria such rates provide the still fast growing working-age population with sufficient jobs and physical capital to give the economy for just an extended time impetus towards the desired 8 percent growth path. Besides, much higher investments in human capital per worker (improvements in educational attainments) are necessary to boost its contribution to growth to a level as accomplished by the fast growing East Asian countries (5 times higher). Luckily, a yearly 1 percent TFP growth coming like manna out of the blue sky can be booked on this back-of-the-envelope calculation for the coming 10 years.

A sectoral (structural) growth policy can contribute significantly to the macroeconomic 8 percent growth goal. In the industry sector the declining respectively stagnant rate of growth of capital per worker and negative growth rates are both responsible for high negative productivity growth in the 2000s, despite relative high capital accumulation. This reflects the rapid growth of the work force in this sector. This trend, which is likely to continue in Syria, is particularly problematic. Higher amounts of new investments are necessary to equip the accruing work force with sufficient capital particular in the industry sector. Higher investments and thus higher capital-embodied technical change, which is not explicitly allowed for in the growth accounting approach will eliminate at the same time negative TFP growth and stimulate additionally output and productivity growth.

A similar rationale applies to the services sector. A higher equipment of labour with new capital to the tune of the national average in the 2000s (1.1 percent) would lift alone output growth to the 8 percent benchmark. To this adds an additional growth due to an increase of labour efficiency via TFP.

The growth pattern of the agricultural sector in the 2000s is, because of high depletion of labour, most problematic. High TFP growth and increases in the capital intensity lead to strong substitution of labour by capital and raise productivity to an extremely high growth rate. More control of this process by policy is advisable because under- respectively unemployed workers are drawn out of agriculture into industry and services, which have to carry a heavy load with this dislocation of labour. Such a policy would reduce capital per worker's contribution to productivity growth in agriculture but must not be detrimental to output growth, if appropriately designed.

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Table 1: Sources of Growth in Syria, 1986 - 2008

- Annual percentage rate of change -

			Contribution of					
	Output	Employment	Output/ Worker	Capital	Labour	Capital/ Worker	Education	Total Factor Productivity
	1	2	3	4	5	6	7	8
Agriculture								
1986 - 1990	0,5	6,0	-5,5	3,9	2,8	0,8	0,3	-6,6
1991 - 2000	6,0	6,4	-0,4	2,9	3,0	-0,4	0,0	0,0
2001 - 2008	4,1	-4,2	8,3	2,1	-2,0	4,3	0,2	3,8
1986 - 2008	4,1	2,6	1,5	2,9	1,2	1,5	0,1	-0,1
Industry								
1986 - 1990	9,1	0,7	8,4	-0,7	0,3	-1,2	0,3	9,2
1991 - 2000	7,7	4,5	3,2	0,8	1,9	-1,8	0,0	5,0
2001 - 2008	2,1	4,6	-2,5	2,6	1,9	-0,1	0,2	-2,5
1986 - 2008	6,0	3,7	2,3	1,1	1,5	-1,1	0,1	3,3
Services								
1986 - 1990	-1,7	6,6	-8,3	0,8	3,0	-2,8	0,3	-5,8
1991 - 2000	2,8	3,3	-0,5	2,0	1,5	0,2	0,0	-0,7
2001 - 2008	6,8	5,8	1,0	3,1	2,7	-0,1	0,2	0,9
1986 - 2008	3,2	4,9	-1,7	2,1	2,2	-0,5	0,1	-1,2
Total Economy								
1986 - 1990	1,5	4,7	-3,3	0,6	2,1	-2,1	0,3	-1,5
1991 - 2000	5,2	4,5	0,6	1,8	2,0	-0,8	0,0	1,4
2001 - 2008	4,5	2,9	1,6	2,8	1,3	1,1	0,2	0,3
1986 - 2008	4,1	4,0	0,1	1,9	1,8	-0,4	0,1	0,4

Sources: Author's estimates as described in text.

Methodology: The growth accounting approach is based on a Cobb-Douglas production function with constant returns to scale, in which output (Y) is a function of human capital (H), physical capital (K), and total factor productivity (TFP). Human capital is defined as H=hL, where h is human capital per worker, designated as education in the following, and L denotes the number of workers. Then, the production function can be written as: $Y= (hL)^{\alpha} K^{(1-\alpha)} TFP$. α is a measure of the output elasticity of labour and assumed equal 0.47 for Agriculture, 0.41 for Industry, and 0.46 for the Service Sectors. The results are reported in the table in two forms. One form decomposes the growth of output (g_Y) into the contributions of growth in education (g_h), total number of workers (g_L), capital (g_K), and the contribution of improvements in Total Factor Productivity (g_{TFP}): $g_Y = \alpha(g_h+g_L) + (1-\alpha)g_K + g_{TFP}$, where g designates the growth rate of the subscript variable. In the table the figures in columns "Capital", "Labour", "Education", and "Total Factor Productivity" represent the contributions of growth in these variables to output growth shown in column "Output". The other form decomposes the growth of labour productivity into the contributions of growth in capital per worker, education, and in TFP: $g_Y-g_L = \alpha g_h + (1-\alpha)(g_K - g_L) + g_{TFP}$. The figures in columns "Capital per Worker", "Education", and "Total Factor Productivity" represent the contributions of growth in these variables to productivity growth shown in column "Output per Worker".

Table 2: Data Total Economy

Year	GDP 2000 pr, Mill SP	Employment in 1000	Labour Force in 1000	Investment 2000 pr, Mill SP	Physical Capital 2000 pr, Mill SP	Human Capital in 1ooo
1985	520209,8	2365,7	2571	169375,6	1261984,5	3165,4
1986	494481,8	2478,3	2694	149861,2	1320153,4	3339,4
1987	503914,2	2595,2	2821	101196,4	1326541,2	3521,7
1988	570764,9	2718,0	2954	97562,9	1329289,9	3714,5
1989	519634,6	2849,0	3097	88910,0	1323719,3	3921,0
1990	559338,7	2995,9	3256	99515,4	1330395,2	4152,3
1991	589508,9	3181,0	3428	103129,1	1341418,6	4402,0
1992	658001,1	3339,9	3613	137376,9	1387118,5	4614,5
1993	688386,2	3523,4	3816	138966,3	1432744,8	4860,3
1994	726120,8	3704,8	4021	168069,1	1505278,0	5102,4
1995	766307,6	3917,5	4243	167904,7	1572781,1	5386,7
1996	821238,5	3766,5	4373	167389,4	1635602,9	5185,3
1997	832198,8	3547,2	4505	158764,0	1685882,4	4889,3
1998	893860,0	3898,0	4641	163962,7	1738271,0	5379,2
1999	870292,0	4293,2	4792	159816,7	1783507,0	5931,5
2000	938458,0	4712,7	4932	156093,0	1822642,2	6518,8
2001	966433,0	4669,2	5077	170189,0	1874328,7	6475,4
2002	998396,0	5002,7	5247	197330,0	1949918,4	6955,8
2003	999005,0	4843,3	5424	231944,0	2056581,3	6751,5
2004	1094398,0	5090,7	5691	255768,0	2180640,4	7114,6
2005	1155016,0	5339,7	5986	288195,0	2329605,5	7481,9
2006	1234080,0	5558,6	6229	308670,0	2489599,2	7838,8
2007	1320898,6	5750,3	6487	283098,0	2613485,1	8161,5
2008	1350471,8	5965,6	6733	266486,0	2712533,3	8521,7

Sources: World Bank data set and Centre of Statiscal Office Syria. Physical and Human Capital author's calculation as described in text.

Table 3: Data Agriculture

Year	Value added 2000 pr, Mill SP	Employment in 1000	Investment 2000 pr, Mill SP	Physical Capital 2000 pr, Mill SP	Human Capital in 1ooo
1985	119993,1	608,0	22115,2	134988,0	813,5
1986	127737,0	641,9	20828,6	151032,5	864,9
1987	109933,5	677,3	11357,5	157037,3	919,2
1988	145196,9	714,8	14071,0	165542,7	976,9
1989	101694,9	755,0	19783,1	179458,8	1039,1
1990	122934,0	820,9	22712,8	195811,5	1137,7
1991	131249,8	897,1	22013,6	210885,3	1241,4
1992	154765,2	992,0	24385,1	227796,5	1370,5
1993	154528,8	1095,8	22425,0	242148,1	1511,5
1994	163972,5	866,9	23077,9	256644,1	1194,0
1995	170687,7	1113,7	25131,5	272679,9	1531,4
1996	195608,6	870,1	24922,1	287938,0	1197,8
1997	189954,5	631,4	24986,9	302720,2	870,3
1998	232289,3	888,8	24295,9	316287,4	1226,5
1999	197229,0	1195,9	22204,4	327282,3	1652,3
2000	222886,0	1552,0	24431,0	340114,1	2146,8
2001	246104,0	1430,2	18866,0	346926,2	1983,4
2002	265338,0	1562,4	32279,0	366909,8	2172,4
2003	251568,0	1309,0	30173,0	384079,2	1824,7
2004	247305,0	952,0	37218,0	407685,1	1330,4
2005	273024,0	1074,4	40571,0	433807,4	1505,4
2006	301080,0	1089,5	34634,0	453066,9	1536,4
2007	291569,6	1098,3	26260,0	463269,8	1558,9
2008	309063,8	1109,6	21879,0	468730,1	1585,0

Sources: World Bank data set and Centre of Statiscal Office Syria. Physical and Human Capital author's calculation as described in text.

Table 4: Data Industry

Year	Value added 2000 pr, Mill SP	Employment in 1000	Investment 2000 pr, Mill SP	Physical Capital 2000 pr, Mill SP	Human Capital in 1ooo
1985	104853,3	757,0	76448,3	567263,0	1012,9
1986	93109,5	763,3	70133,6	576770,8	1028,5
1987	97576,8	770,8	57884,5	573013,4	1045,9
1988	123591,5	763,8	55151,0	566924,0	1043,8
1989	144373,3	777,8	40243,3	546577,7	1070,4
1990	165166,6	784,9	44078,2	532240,8	1087,9
1991	177602,9	795,3	43984,5	519342,5	1100,5
1992	195310,2	861,7	50699,1	514537,3	1190,5
1993	217499,5	937,2	58639,4	518185,9	1292,8
1994	227601,8	1159,6	82531,3	545336,5	1597,1
1995	259735,2	1196,0	77993,6	565047,6	1644,6
1996	309498,0	1201,5	79459,5	584118,1	1654,1
1997	351123,1	1177,7	77431,1	599122,0	1623,2
1998	362441,4	1200,6	75760,6	610851,9	1656,8
1999	349543,0	1217,4	71620,0	617187,6	1682,0
2000	356084,0	1231,2	63539,0	614765,1	1703,1
2001	356682,0	1224,6	80544,0	629606,6	1698,2
2002	347309,0	1387,1	70986,0	633303,9	1928,7
2003	354526,0	1241,1	94673,0	660293,0	1730,1
2004	384247,0	1674,8	103406,0	693130,7	2340,7
2005	388604,0	1480,6	120013,0	739065,9	2074,6
2006	399890,0	1573,1	133145,0	793223,8	2218,4
2007	430554,8	1673,3	126934,0	835382,6	2375,0
2008	420780,6	1777,8	126634,0	872735,7	2539,5

Sources: World Bank data set and Centre of Statiscal Office Syria. Physical and Human Capital author's calculation as described in text.

Table 5: Data Services

Year	Value added 2000 pr, Mill SP	Employment in 1000	Investment 2000 pr, Mill SP	Physical Capital 2000 pr, Mill SP	Human Capital in 1ooo
1985	295363,4	1000,7	70812,0	559733,4	1339,0
1986	273635,3	1073,1	58899,0	592350,1	1446,0
1987	296404,0	1147,1	31954,4	596490,6	1556,6
1988	301976,6	1239,4	28340,9	596823,1	1693,8
1989	273566,5	1316,2	28883,6	597682,8	1811,5
1990	271238,1	1390,1	32724,4	602342,9	1926,7
1991	280656,2	1488,7	37131,0	611190,7	2060,1
1992	307925,8	1486,3	62292,6	644784,8	2053,5
1993	316357,9	1490,4	57902,0	672410,7	2055,9
1994	334546,5	1678,3	62459,9	703297,4	2311,4
1995	335884,7	1607,8	64779,6	735053,6	2210,8
1996	316131,9	1694,9	63007,8	763546,8	2333,4
1997	291121,2	1738,2	56346,0	784040,2	2395,7
1998	299129,3	1808,7	63906,2	811131,7	2495,9
1999	323520,0	1879,9	65992,3	839037,1	2597,3
2000	359488,0	1929,4	68123,0	867762,9	2668,9
2001	363647,0	2014,4	70779,0	897795,9	2793,7
2002	385749,0	2053,2	94065,0	949704,7	2854,7
2003	392911,0	2293,2	107098,0	1012209,1	3196,7
2004	462846,0	2463,9	115144,0	1079824,6	3443,5
2005	493388,0	2784,8	127611,0	1156732,2	3902,0
2006	533110,0	2896,0	140891,0	1243308,5	4084,0
2007	598774,2	2978,7	129904,0	1314832,7	4227,7
2008	620627,4	3078,3	117973,0	1371067,4	4397,2

Sources: World Bank data set and Centre of Statiscal Office Syria. Physical and Human Capital author's calculation as described in text.