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# Factor Accumulation and the Determinants of TFP in the GCC

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# Factor Accumulation and the Determinants of TFP in the GCC

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## Abstract

GDP growth in the GCC has been considerably higher than in advanced economies or other oil exporters since 1986. The paper shows that the GCC countries have swiftly accumulated large stocks of physical capital but the population increase and the shift away from oil meant that capital intensity actually decreased or remained roughly constant. On the other hand, the efforts that have been made to improve human capital would have had positive effects on growth, though educational attainment remains below what is achieved by countries with similar levels of income. A growth accounting exercise suggests as a result that the development of Bahrain and Saudi Arabia was hampered by declining TFP, while TFP growth in Qatar and the U.A.E. would have been low. One potential explanation is that the kind of capital that has been accumulated in the region (aircraft, computer equipment, electrical equipment) is not fully productive because the labor force is not educated enough. The paper also discusses the lessons from the empirical growth literature for the GCC. The poor quality of institutions and the large size of government consumption, both of which are possible symptoms of a resource curse, could explain the disappointing TFP growth.

JEL: O43; O53

Keywords: Gulf Cooperation Council; Growth Accounting; Middle East and North Africa; Resource Curse

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## 1. Introduction

The member countries of the GCC have changed considerably over the last thirty years. The fast development of the region has spurred the creation of new cities, the development of infrastructure and the expansion of new industries that have attracted capital and a new labor force from around the world. The growth of these economies has been considerably higher than that of advanced economies or other oil exporters as the size of the GCC economies more than doubled since 1986 (see the second column in Table 1). However, economic development was accompanied by very large inflows of foreign workers and the population increased by more than 80 percent in the GCC (with the exception of Kuwait). As a result, real Gross Domestic Product (GDP) per worker, a measure used to assess the improvements in worker productivity, declined in Bahrain, Kuwait and the U.A.E., and improved at very low rates Saudi Arabia, Oman and Qatar (third column of Table 1).

The disappointing growth in GDP per worker has been a worry mostly in Bahrain, Oman and Saudi Arabia where a large portion of the national population has relatively low incomes and where job prospects, especially for the growing young population, are scarce. Poor economic performance and youth unemployment have been one of the triggers of the political transitions taking place in the broader region. In the GCC countries, economic problems have not been as acute but the region is lagging in several development areas. The Human Development Index (HDI) compiled by the United Nations (UN), which takes into account the quality of education and life expectancy consistently ranks GCC countries at levels below what would be predicted by their GDP per capita.

Governments in the GCC have had an explicit objective of diversification away from oil, with policies of high investment financed by oil revenues and undertaken with the help of migrant workers. Understanding the factors of growth, the role of investment, the role of skills and the labor force, and refining our measure of success on this enterprise has therefore a value even for the smaller and richer countries of the Gulf.

The modern analysis of long-term growth and productivity started with Solow (1957). His growth accounting model assumes that production (output), usually measured by real GDP, is obtained by combining two inputs: capital, and some measure of labor (e.g. the hours of work in a year, or the number of workers). Solow (1957) showed however that for the United States, the two factors of production did not explain well output, and he interpreted the remaining unexplained part as technical change or Total Factor Productivity (TFP), a measure of efficiency in the use of factors of production. The literature on TFP flourished as economists debated on the sources of growth in East Asia (factor accumulation versus a growth miracle), but surveys showed that results on TFP were fairly sensitive to assumptions (Felipe, 1997). Nonetheless, a growth accounting exercise remains a useful start to interpret data of factors accumulation and to discuss the sources of growth.

The aim of this paper is to go beyond the raw numbers presented in Table 1 to explain the drivers of GDP growth and of productivity growth. It shows that the GCC countries have swiftly accumulated large stocks of physical capital but the population increase and the shift away from oil meant that capital intensity actually decreased or remained roughly constant. On the other hand, the efforts that have been made to improve human capital have had positive effects on growth, though educational attainment remains below what is achieved by countries with similar levels of income.

Finally, the growth accounting exercise suggests that the development of Bahrain and Saudi Arabia is hampered by declining TFP. In addition, although Qatar and the U.A.E. have grown fast in the last 20 years, their TFP growth has been low. One potential explanation is that the kind of capital that has been accumulated in the region (aircraft, computer equipment, electrical equipment) is not fully productive because the labor force is not educated enough. The paper also finds that the poor quality of institutions and the large size of government consumption, both of which are possible symptoms of a resource curse, could explain the disappointing TFP growth.

Table 1. Annual growth rate of real GDP, population and real GDP per worker, between 1990 and 2009

| Country | Source | GDP, in US dollar, 2005 | Annual growth rate, real GDP 1990-2009 | Annual growth rate, GDP per worker |
|---|---|---|---|---|
| **BHR** | IMF | 13.5 | 5.3 | -1.3 |
| | PWT | 20.5 | 5.7 | -0.9 |
| | IMF (non-oil GDP) | 10.1 | 5.9 | -0.7 |
| | PWT/IMF (non-oil GDP) | 17.1 | 6.2 | -0.4 |
| **KWT** | IMF | 80.8 | 4.4 | -3.0 |
| | PWT | 111.0 | 4.4 | -3.0 |
| | IMF (non-oil GDP) | 35.6 | 7.1 | -0.3 |
| | PWT/IMF (non-oil GDP) | 65.8 | 4.6 | -2.8 |
| **OMN** | IMF | 30.9 | 4.5 | 0.5 |
| | PWT | 49.6 | 4.9 | 0.8 |
| | IMF (non-oil GDP) | 14.0 | 6.3 | 2.3 |
| | PWT/IMF (non-oil GDP) | 32.7 | 7.0 | 3.0 |
| **QAT** | IMF | 44.5 | 9.6 | 1.0 |
| | PWT | 68.7 | 9.6 | 1.1 |
| | IMF (non-oil GDP) | 18.6 | 9.7 | 1.2 |
| | PWT/IMF (non-oil GDP) | 42.7 | 9.5 | 1.0 |
| **SAU** | IMF | 315.8 | 2.9 | -0.1 |
| | PWT | 465.0 | 3.6 | 0.6 |
| | IMF (non-oil GDP) | 150.7 | 3.5 | 0.5 |
| | PWT/IMF (non-oil GDP) | 299.9 | 4.3 | 1.3 |
| **UAE** | IMF | 180.6 | 5.4 | -3.4 |
| | PWT | 195.0 | 6.6 | -2.2 |
| | IMF (non-oil GDP) | 118.7 | 8.5 | -0.2 |
| | PWT/IMF (non-oil GDP) | 133.1 | 10.2 | 1.4 |
| **Oil exporters (median)** | PWT | | 3.7 | 3.7 |
| **Other developing c. (median)** | PWT | | 3.8 | 3.8 |
| **OECD (median)** | PWT | | 2.8 | 2.8 |

Source: Penn World Tables 7, IMF, and author's calculations

Note: the oil exporters (excluding the GCC) used in the paper are Algeria, Angola, Azerbaijan, Brunei, Chad, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Kazakhstan, Libya, Nigeria, Rep. of Congo, Russia, Sudan, Timor-Leste, Trinidad & Tobago, Turkmenistan, Venezuela, Yemen.

The paper first describes the economic data in the region. In section 3, it discusses the process of diversification and shows how factors of production were accumulated. The accounting exercise is applied in section 4. Section 5 concludes on the vast cross-country literature that has attempted to explain growth by a variety of institutions and applies the econometric estimates typically found in the literature to throw light on the determinants of TFP.

## 2. Economic Data

The most commonly used dataset to assess long-term growth in the literature is the Penn Word Tables (PWT, Heston, Summers and Aten, 2011) because this dataset corrects for the differences in purchasing power that the dollar has in different countries. However, other data sources exist that provide statistics for GDP, population, investment, etc. In particular, the World Bank, the United Nations, and the IMF provide statistics that are comparable across counties, while national statistical agencies supply some detailed data. This section describes the basic series needed for assessing the determinants of long-term growth and explains which source was chosen based on an assessment of data quality.

The region hosted 40 million people in 2009, a number that tripled in 30 years, with a similar growth pattern across country (see Table 2). Revisions on population data are frequent in countries that attract a large population of migrant workers, and the data from the Penn World Tables and the United Nations report lower population estimates. An increasingly large fraction of this population is of foreign origin. Population growth was matched by a strong increase in total employment, from around 7 million workers in the GCC in 1990 to 16 million workers in 2009.

To assess the evolution of real income and of productivity, one can use different series, for instance the series of real GDP from the IMF and from the Penn World Tables. Data quality is variable. For instance, for many years, real GDP was not compiled in the region, except in Saudi Arabia. To obtain a measure of real GDP, statisticians must remove the effect of inflation on the nominal value of economic activity ('nominal GDP')[2], using information on prices that are specific for each industry. As these statistics were not available in the Gulf countries, economists estimated these prices using other prices – for instance consumer price

[2] Nominal GDP can itself be compiled in different ways. From the production side, nominal GDP is the sum of the value of output of all sectors (typically calculated by surveying companies sales and inventories), subtracting the cost of intermediate inputs (GDP is a measure of value added). From the expenditure side, nominal GDP is the sum of consumption, private sector investment, public expenditure, and exports minus imports. However, the production method is more reliable in the region as surveys on spending are incomplete.

indices or price indices for imported products. The Purchasing Power Parity (PPP) index of the Penn World Tables also correct for the purchasing power of dollars in different countries. Table 1 shows different measures of GDP that take into account inflation (all converted in 2005 US dollars). The first measure is real GDP from the IMF, which in most cases yields the smallest estimate of growth. The second measure is GDP growth in US$ PPP from the PWT, which tends to be high because inflation in the costs of production in the GCC is lower than in the U.S.

Although real GDP is a commonly used measure of economic activity, its meaning in the region, as well as for other major oil producers, is questionable. In countries without a significant natural resources sector, real GDP is a useful measure of the amount of production in the economy, which affects crucially many markets and sectors of the economy. Higher volumes of output create jobs, yield taxes to the government, attract investors, etc.

But in countries where oil production is very large, real GDP (which includes the volume of production in the oil sector) is not a good measure of economic activity, especially when the focus is on the private sector. On one hand, the effect of oil prices is taken away and therefore increases in oil prices – which improve profitability in the energy sector, yield revenues to the government, and boost asset prices – have no effect on the measure of real GDP. On the other hand, increases in the number of barrels of oil extracted (even if sold at half the price) do improve real GDP, although they do not translate into more jobs or higher private sector profits.

This line of reasoning suggests two measures of economic activity for the region, and the validity of each of them will depend on the intended use of the indicator. One measure is GDP in constant U.S. dollars (i.e. after taking into account the loss of purchasing power of the U.S. dollar). This measure will be of interest when assessing the development of wealth and income in the region, or when reporting indicators of assets (or liabilities) in proportion of GDP. A second measure is a measure of real economic activity excluding production of oil and gas, what is called loosely non-oil real GDP (and more specifically, real value added in

the *non-hydrocarbon* sector). This measure will be used when discussing growth, either in the context of short-term fluctuations or in the study of long-term development and diversification.

Series for non-oil real GDP are provided by the IMF since 1980[3] and the UN since 1970,[4] but the noise in the data is heightened by the focus on a smaller subset of the economy and the need to estimate a price index for the non-oil economy. As a result, the series coming from the two data source are not consistent, especially for Saudi Arabia and the U.A.E., signaling an issue with the estimation procedures for prices and therefore for data quality. The collection of statistics in the U.A.E. is also complicated by the federal structure of the country and the lack of homogeneity between statistics provided by the different statistical agencies. I also constructed a new series for non-oil GDP using the Penn World Tables value of total GDP, and subtracting from it the IMF series for oil GDP, after deflating it using oil prices. This latter series may provide a better source for cross-country comparison because it is based on the PWT prices.

Employment dynamics was a source of economic growth but the standards of living in the GCC also increased, with annual income per capita exceeding 20,000 dollars in all GCC countries in 2009. Qatar, the U.A.E. and Kuwait are among the ten richest nations in the world. Bahrain, Saudi Arabia and Oman are not as rich, but living standards there are equivalent to those of Portugal and the Slovak Republic, and the region stands out among its poor Middle-Eastern neighbors (see Figure 1). Income is however not evenly distributed. Data on income inequality is sparse in the region, but income inequality should be higher than that of Algeria, Egypt, Israel or other developing economies (where Gini coefficients are around 40 percent; see Gader Ali, 2003).

[3] Non-oil GDP series from the IMF World Economic Outlook and Regional Economic Outlook for the Middle East and Central Asia start in 1990. Data pre-1990 was obtained from older individual IMF country reports.

[4] The UN reports data on valued added at constant prices, excluding the mining and the utilities sectors. The utilities and non-oil mining sectors in the GCC are quite small though, so this measure is a good proxy of nonoil growth. The IMF series were extended manually using IMF Article IV staff reports for the years 1980-1990.

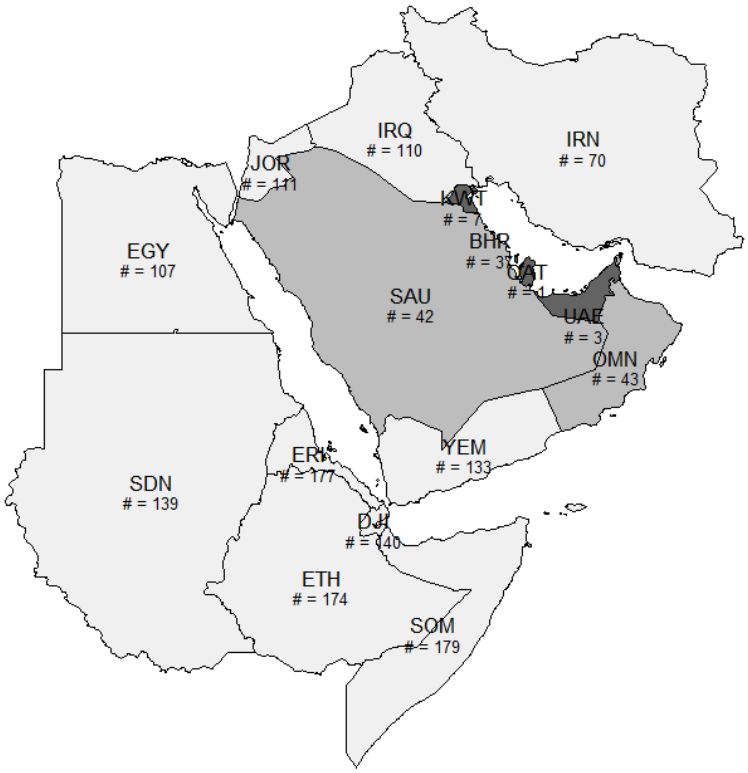
Table 2. Employment and population in the GCC, in million

| Country | Bahrain | Kuwait | Oman | Qatar | Saudi Arabia | U.A.E. | **GCC** |
|---|---|---|---|---|---|---|---|
| **Employment** | | | | | | | |
| IMF (1990) | 0.12 | 0.53 | 0.52 | 0.25 1/ | 4.65 | 0.72 | **6.8** |
| IMF (2009) | 0.41 | 2.06 | 1.11 | 1.18 2/ | 8.15 | 3.54 | **16.4** |
| | | | | | | | |
| **Population** | | | | | | | |
| IMF (1980) | 0.35 | 1.37 | 1.20 | 0.22 | 9.32 | 1.01 | **13.5** |
| IMF (1990) | 0.48 | 2.13 | 1.63 | 0.42 | 15.19 | 1.84 | **21.7** |
| IMF (2000) | 0.67 | 2.22 | 2.40 | 0.62 | 20.47 | 3.00 | **29.4** |
| IMF (2009) | 1.04 | 3.54 | 2.88 | 1.64 | 25.52 | 4.91 | **39.5** |
| **Other sources:** | | | | | | | |
| World Bank (2009) | 0.79 | 2.79 | 2.85 | 1.41 | 25.39 | 4.60 | **37.8** |
| United Nations (2009) | 0.72 | 1.58 | 1.58 | 1.20 | 14.90 | 4.82 | **24.8** |
| PWT (2009) | 1.14 | 2.49 | 2.91 | 0.83 | 25.33 | 4.80 | **37.5** |

1/ source is World Bank, extrapolated from 1991 data

2/ source is World Bank

Figure 1. World rankings of income per capita (2009)



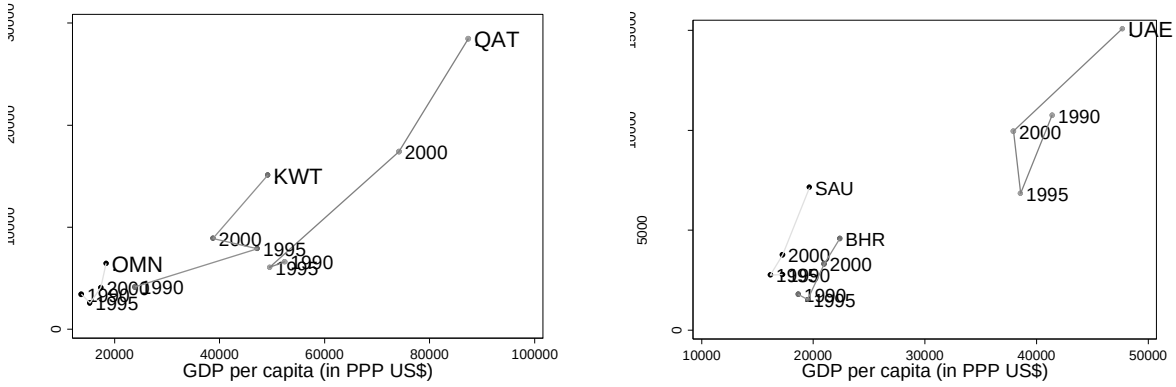

Source: Heston, Summers and Aten (2011). Map source is ThematicMapping.org

Note: Income per capita is US$ PPP 81000 in Qatar (using IMF statistics for population), US$ PPP 52932 in the U.A.E., US$ 32826 in Kuwait (using IMF statistics for population), US$ PPP 23539 in Bahrain, US$ PPP 21579 in Saudi Arabia, and US$ PPP 20505 in Oman.

The fortune of the region depends on its energy exports. Indeed, average income has followed closely the evolution of hydrocarbon revenues (Figure 2). As oil prices fell to record lows after the first Gulf War, income declined to a bottom in 1995. Since then, oil revenues have soared thanks to the tripling in oil prices and the growth of hydrocarbon production. Production increased by more than 50 percent in Kuwait the U.A.E., and by more than 100 percent in Oman and Qatar. Production was stable in Saudi Arabia and started declining in Bahrain (the country's reserves were drained), but this did not prevent income per capita from more than doubling in the last 15 years.

The hydrocarbon exports have supported the countries' ambitious development agendas. Governments financed infrastructure, developed cities, improved educational attainment, and managed to build a more diversified and modern economy. The strategy has been relatively successful and although the GCC countries rankings in the UN HDI are still lagging their ranking in income per capita, Qatar, Bahrain, Saudi Arabia and the U.A.E. are now among the 20 to 30 percent most advanced countries according to the Human Development Index, a significant improvement since 1980.

Figure 2. Oil production and per capita income in the region (1990-2005)




Source: U.S. Energy Information Agency, IMF and author's calculations

## 3. Diversification and the drivers of long-term growth

### A. Diversification

With the exception of Saudi Arabia, the GCC region's non-hydrocarbon growth performance has been above that of other oil producers or of advanced economies for the period 1980-2009. Growth in Kuwait, Qatar and the U.A.E. was in fact at par with that of India and China. The sectors that contributed most to non-hydrocarbon growth (and that therefore increased their share in real GDP) were the manufacturing sector in Bahrain, Oman, Saudi Arabia and the U.A.E. (driven by petrochemicals), the construction sector in Qatar, and the transportation sector in Kuwait, Oman and Qatar. The financial sector (classified under the headline "Others") also grew strongly (see Table 3).

The push for diversification was successful in the U.A.E. where the share of oil to GDP decreased by more than 20 percent (although the decline would be less strong when looking at GDP in current prices). The share of hydrocarbon production in GDP also decreased in Bahrain and Oman but this is explained as much by the limitations of oil resources than by growth in the non-hydrocarbon sector. In Qatar, gas production increased dramatically, driving the reduction in the share of the non-hydrocarbon sector in the economy. On average, the diversification efforts have paid off as non-oil growth reached high levels and was relatively symmetric across sectors.

Diversification can also be assessed by looking at the structure of exports. Hydrocarbon exports still overwhelm non-hydrocarbon exports but the push for diversification has also generated additional export revenues. Exports of energy-intensive manufactures have increased and exports of services have boomed.

Table 3. Real value added by sectors, in percent of non-mining value added

| | Bahrain | | Kuwait | | Oman | | Qatar | | Saudi Arabia | | U.A.E. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 80-99 | 99-09 | 80-99 | 99-09 | 80-99 | 99-09 | 80-99 | 99-09 | 80-99 | 99-09 | 80-99 | 99-09 |
| Agriculture | 1 | 1 | 0 | 1 | 4 | 3 | 1 | 0 | 6 | 7 | 2 | 3 |
| Manufacturing | 9 | 14 | 16 | 14 | 6 | 14 | 23 | 17 | 12 | 17 | 13 | 18 |
| Construction | 8 | 5 | 6 | 4 | 12 | 8 | 6 | 16 | 12 | 9 | 14 | 12 |
| Transport | 6 | 7 | 6 | 10 | 5 | 9 | 3 | 9 | 5 | 6 | 9 | 9 |
| Trade | 14 | 14 | 17 | 10 | 16 | 17 | 11 | 11 | 9 | 10 | 22 | 19 |
| Others | 62 | 59 | 55 | 61 | 56 | 48 | 56 | 47 | 56 | 50 | 40 | 39 |
| Memorandum: oil GDP/total GDP | 32 | 27 | 48 | 52 | 61 | 53 | 48 | 58 | 49 | 49 | 58 | 38 |

Source: UN and author's calculations

## B. The stock of capital

What are the main drivers of growth? The economics literature has emphasized the role of investment and of the stock of capital because capital is used in the production process.

Over the period 1980-2009, investment has not been significantly higher in oil exporters or in the GCC than in other countries. Countries invest typically around 22 percent of their production and the GCC is no exception. However, the ratio that matters to assess the extent of capital formation in the economy is investment in proportion to non-oil GDP, and this has been very high for oil exporting countries.[5] Investment to non-oil GDP was around 33 percent over the period 1980-2000 in the GCC, and the ratio increased to 40-50 percent after 2000!

Given a series for investment, it is possible to compute the capital stock K, using the perpetual inventory method:[6]

[5] One would normally want to remove the component of investment that is used in the oil sector, but this data is not available for a cross section of countries. We therefore abstract from the difference between non-oil investment and total investment. For Saudi Arabia, oil investment represents around 10 percent of total investment only.

[6] An initial level of capital for 1960 and an assumption for $\delta$ are needed to compute the series. We use the steady-state relationship between capital and investment $K_0 = I_0/(g+\delta)$, where g is the average growth rate in the data and $I_0$ is investment in year 1960 (we use year 1965 for the GCC). For the non-GCC countries, if investment data in 1960 is not available, it is extrapolated from investment to GDP ratios using a linear time trend. Caselli (2005) argued the initial level of capital stock and that the specific value for $\delta$ did not affect

(continued)

$$K_t = (1-\delta)K_{t-1} + I_t$$

where $\delta$ is the physical rate of depreciation of capital, assumed to be 6 percent.

Data for investment and in particular for investment in real terms (i.e. deflating for the change in the price of investment) is of poor quality. Because national sources do not publish a deflator for investment, except in Saudi Arabia, two methods are possible. The first one is to use the deflator used in Saudi Arabia and apply it to the IMF series for investment in current prices (see Table 4, columns (a), (b) and (c)). This method corrects for inflation in the GCC and therefore corrects for differences in the price of investment across time. The second method uses the series provided by the Penn World Tables that also take into account the differences in costs of production across countries. As a result, investment in PWT is constantly higher than in the IMF database because production costs are low in the GCC. However, the PWT series only start in 1986 in the GCC and this is too late to compute a stock of capital in 1990. We therefore need to extrapolate the PWT investment series back to 1965 using the IMF series. The results for the capital stock are presented in columns (d) and (e) in Table 4.

The second method probably provides a better picture of the cross-sectional differences in investment, in particular when one wants to compare capital intensity with other developing or advanced economies. Column (e) in Table 2.4 shows that capital intensity remains high in the GCC, at par or slightly superior to capital intensity in advanced countries. However, the first method provides a better proxy of the evolution across time of capital, because the capital stock in 1990 was constructed using actual IMF series starting from 1965 (as opposed to extrapolated PWT series). This is why we will use the statistics in columns (a), (b) and (c) of Table 4 for the growth accounting exercise (i.e. to decompose growth through time), although we will also use the statistics from column (d) and (e) in an attempt to compare productivity across countries.

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dramatically the performance of the model in explaining the dispersion of income per capita. However, this does not imply that the assumptions are innocuous for the diagnostics of growth for individual countries.

Between 1990 and 2009, the capita stock would have increased by around 200 percent in Bahrain, Kuwait, Saudi Arabia and the UAE. Growth in the stock of capital would have reached 30 percent in Oman and 600 percent in Qatar. Although the GCC countries have invested massively in the last 20 years, the stock of capital per worker has been declining in Bahrain, Kuwait and the U.A.E. because the population increase has outpaced the rate of investment. These countries also had sizeable stocks of capital in 1990 because the oil sector was already developed, and since 1990, diversification strategies have led to the development of less capital-intensive sectors attracting a large migrant population, in particular in real estate and services. In Qatar, gas production was not developed yet in 1990 and this sector has required massive investments, yielding higher stocks of capital per capita. In Saudi Arabia and in Oman, where population growth was slower and where the energy sectors have been mature for many years, the dynamics of capital intensity has been more moderate.

Table 4. Investment and growth in the stock of capital

| | Capital stock, cummulative growth rate, in percent | Capital stock per worker | Capital stock per worker | Capital stock per worker | Capital stock per worker |
|---|---|---|---|---|---|
| | 1990-2009 | in 2005 US$, 1990 | in 2005 US$, 2009 | in 2005 PPP US$, 1990 (PWT) | in 2005 PPP US$, 2009 (PWT) |
| | (a) | (b) | (c) | (d) | (e) |
| Bahrain | 188 | 161,891 | 90,226 | 354,729 | 231,668 |
| Kuwait | 182 | 147,102 | 69,136 | 309,260 | 160,663 |
| Oman | 324 | 51,927 | 79,058 | 104,010 | 177,864 |
| Qatar | 621 | 96,131 | 126,516 | 132,199 | 207,856 |
| Saudi Arabia | 182 | 80,409 | 83,340 | 151,694 | 220,616 |
| U.A.E. | 220 | 270,614 | 121,156 | 314,910 | 187,937 |
| Other oil producers (median) | | | | 57,457 | 45,024 |
| Other developing c. (median) | | | | 19,786 | 22,990 |
| OECD (median) | | | | 120,110 | 172,024 |

Source: IMF, PWT and author's calculations. See text for details.

## C. Human capital

A second factor that can explain growth is the level of qualification of the labor force ('human capital'). Based on the empirical literature on the returns to education, in particular Psacharopoulos (1994), Hall and Jones (1999) have suggested modeling human capital as $h = e^{\varphi(s)}$ , where $s$ is the average years of schooling of population aged 15 and over, and $\varphi$ is a piecewise linear function capturing the findings that returns to education are decreasing. In

Sub-Saharan Africa this return is about 13 percent, but returns to education decrease with higher levels of education, to about 10 percent on average in the world, and to about 7 percent in OECD countries. This functional form has become standard in the growth accounting literature and the value *s* is obtained from Barro and Lee (2010).

Between 1990 and 2010, all GCC countries pushed forward plans to increase schooling. The increase in the average number of years of schooling of the population was impressive in Bahrain (from 6.5 to 9.5 years), in Saudi Arabia (from 5.9 to 8.5 years), and in the U.A.E. (from 6.1 to 9.2 years). In Kuwait (from 5.9 to 6.3 years) and in Qatar (from 5.6 to 7.5 years), the increase was more moderate.[7] The estimated growth in the stock of human capital may however be overstated because the quality of education in the region has been disappointing, as noted for instance by the PISA study.

## 4. A growth accounting exercise

A formal growth accounting exercise, as applied by Artadi and Sala-i-Martina (2002) is the step usually taken to investigate in more depth the role of the different factors of production. We follow Caselli (2005)'s description of the model as

$$Y = AK^{\alpha}(Lh)^{1-\alpha} \qquad (1)$$

where $Y$ is output (GDP or non-oil real GDP), $K$ is the stock of capital in the economy, $L$ is the number of workers and $h$ is the measure of human capital. Because there are no available series on investment in the oil sector versus investment in the non-oil sector, we are not able to subtract the capital stock in the oil sector when trying to explain GDP in the non-oil sector using capital in the non-oil sector. Similarly, we do not distinguish between employment in

[7] The data for Oman was not available. The World Development Indicators from the World Bank provide numbers for the literacy rate in all the countries in the GCC, and a regression showed that the sensitivity of educational attainment to the literacy rate is 0.12 in the GCC. This coefficient was used to estimate educational attainment in Oman of 5.4 years in 1995, 6 years in 2000, 6.5 years in 2005 and 7.2 years in 2010.

the whole economy and employment in the non-oil sector because employment in the oil sector is very small.

The parameter $\alpha$ is an important parameter capturing the elasticity of growth to the stock of capital. Under the additional assumption that factors are paid their marginal product, the wage rate is $w = \partial Y/\partial L = (1-\alpha)Y/L$ and therefore α can be estimated from the share of factor payments in GDP, i.e. $\alpha = 1- (wL)/Y$. Barro and Sala-i-Martin (2004, Chapter 10) report $\alpha$ estimated from the national accounts data on factor payments for several OECD and developing countries. Their $\alpha$ ranges from 0.26 (Taiwan) to 0.69 (Mexico), but its value is thought to be around 0.3 to 0.5 for most countries. $\alpha$ can also be estimated by regressing GDP on the factors of production (i.e. estimating equation 1), but such estimations are fraught with difficulties. Simple regressions are incorrect and overestimate $\alpha$ because of the common issue of reverse causality: higher GDP (which results in higher profits) finances investment and therefore a higher capital stock. Disentangling the effect of capital stock on GDP from the reverse effect is difficult. Senhadji (2000) attempted such an estimation using long-term cointegration relationships and a correction for endogenenity with the Fully-Modified estimator of Phillips and Hansen (1990). His results do not point to a specific range for oil exporters. Senhadji (2000) found that $\alpha$ was as high as 0.7 in Algeria, 0.89 in Norway, and 0.64 in Venezuela, but estimates for Ecuador, Iran and Nigeria were all below 0.4.When no specific estimate for $\alpha$ is available, the literature has tended to use $\alpha = 1/3$, which is what we apply for our growth accounting exercise.

Dividing equation (1) by the number of workers $L$, we define $y=Y/L$ and $k= K/L$, which leads to

$$y = A\, k^{\alpha}\, h^{1-\alpha}, \text{ or } y = A\, y_{KH} \quad \text{where } y_{KH} = k^{\alpha}\, h^{1-\alpha}$$

What does the model say about total factor productivity (TFP)? Our results are presented in Figure 3, where TFP in 2008 in oil exporting countries is shown as a ratio to TFP in the U.S. The left hand side chart shows TFP computed using GDP/non-oil GDP and the stock of capital deduced from the IMF series, whereas the right hand side chart shows TFP computed

using the PWT series. The model suggests that TFP is higher in the GCC than in most other oil exporters. In addition, TFP is higher in the smaller countries of the region. In fact, Qatar and the U.A.E. have productivities roughly at par with that of the U.S., even when TFP is calculated on non-oil GDP and when the relatively large estimate of the stock of capital from PWT is used. TFP for Saudi Arabia, Oman and Bahrain is found to be lower, around 50-60 percent of that of the U.S when computed on non-oil GDP.

The model also allows us to decompose the contributions to growth coming from capital, human capital, and TFP (the unknown factor). The contribution from the stock of capital can be computed using the two different series described earlier, but the choice of the series is innocuous because both series show similar changes in the stock of capital per worker between 1990 and 2009 (although the levels are different). We choose the series computed using IMF data and the Saudi Arabia deflator for investment.

Table 5 and Figure 4 show that the efforts made to improve skills were important drivers of GDP per worker (worker productivity) in all countries but in Kuwait. However, in Bahrain, Kuwait and to some extent the U.A.E., the decrease in capital intensity has been strong enough to drive a decline in worker productivity. Overall, capital and skills cannot explain the long-term performance of the GCC. In particular, the model suggests a decline in TFP in Bahrain and in Saudi Arabia even when looking at non-oil GDP.

Positive TFP growth is important because it indicates that factors of production are used efficiently. Indeed, most growth successes in the past 20 years can be attributed to positive developments in TFP (see the factors of growth for Albania, China and the other non-oil exporting emerging countries shown in Figure 4 that are shown as examples of growth success stories). Even slowly growing advanced economies such as the UK have benefitted from positive TFP. In line with the findings of a resource course in earlier periods (Sachs and Warner, 1995, 2001), many other oil producers (Algeria, Gabon, Libya, Sudan, Venezuela) suffered also from negative TFP in the period 1990-2008, despite high oil prices in the years 2002-2008. The objective of the remainder of the paper is to investigate what could have driven TFP down in the GCC region.

Figure 3. Total factor productivity relative to the US (total GDP and non-oil GDP) (logarithmic scale, 2008)

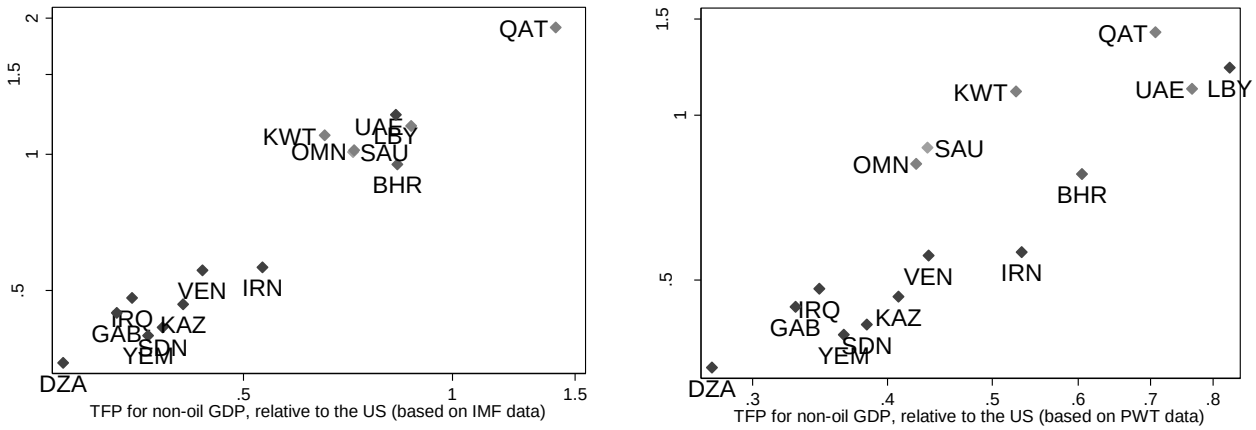
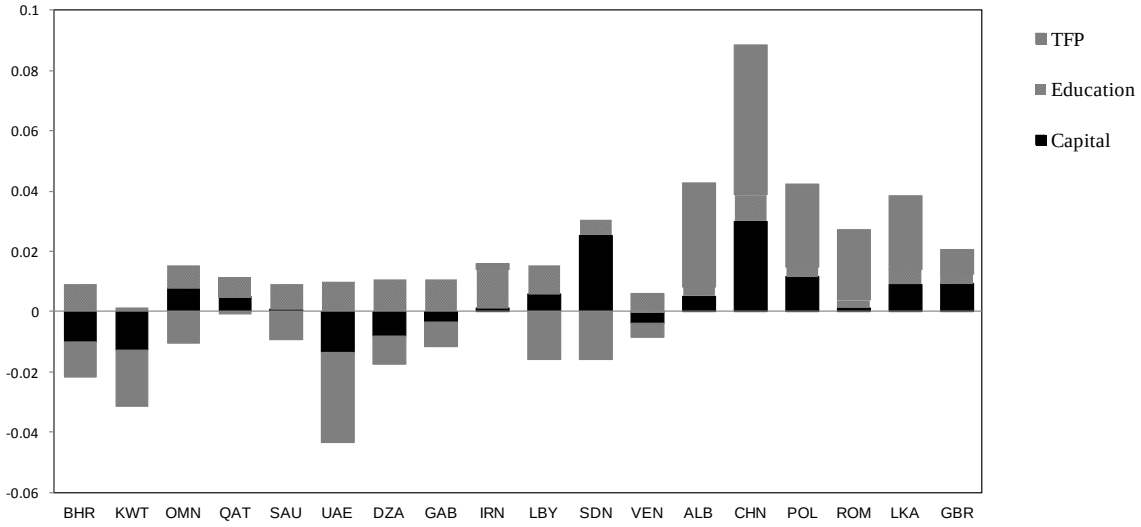



Table 5. Growth accounting of GDP per capita, (contributions, in percentage points, 1990-2009)

| | Model with Total GDP | | | | Model with non-oil GDP | |
|---|---|---|---|---|---|---|
| | Δy (total GDP, IMF) | αΔk | (1-α)Δh | ΔTFP (total GDP) | Δy (non-oil GDP, IMF) | ΔTFP (non-oil GDP) |
| Bahrain | -1.3 | -1.0 | 0.9 | -1.2 | -0.7 | -0.6 |
| Kuwait | -3.0 | -1.3 | 0.1 | -1.9 | -0.3 | 0.9 |
| Oman | 0.5 | 0.7 | 0.8 | -1.0 | 2.3 | 0.8 |
| Qatar | 1.0 | 0.5 | 0.7 | -0.1 | 1.2 | 0.1 |
| Saudi Arabia | -0.1 | 0.1 | 0.8 | -1.0 | 0.5 | -0.4 |
| U.A.E. | -3.4 | -1.4 | 1.0 | -3.0 | -0.2 | 0.2 |

Figure 4. Contributions to the annual percentage change in GDP per worker – 1990-2009




Source: author' calculations; model using total GDP for the GCC

Note: DZA stands for Algeria; GAB for Gabon; IRN for Iran; LBY for Libya; SDN for Sudan; VEN for Venezuela, ALB for Albania; CHN for China; POL for Poland; ROM for Romania; LKA for Sri Lanka and GBR for Great Britain.

## 5. Total Factor Productivity and country characteristics

In the absence of a 'standard model' of economic growth, the unexplained component of production, Total Factor Productivity, has been linked to various factors in the economic literature, either explicitly in analyses of TFP, or indirectly in broader analyses of growth. There are a number of country characteristics that could matter, and formal arguments have been made to explain why the type of capital, geography, history, but also macroeconomic policy, trade openness, political and legal institutions, etc., might be important for the growth process.

A. Type of capital

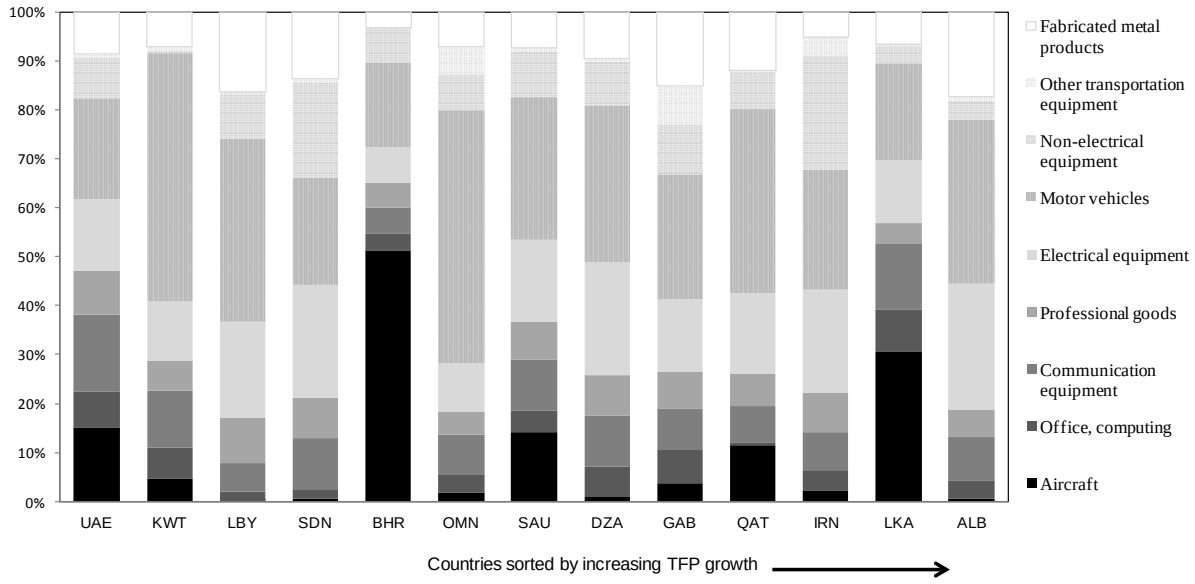
Caselli and Wilson (2004) have argued that not all investments are alike and that heterogeneity in the technology content of different capital goods can explain part of the

unexplained factor of growth. In other words, countries that use more productive capital (for instance computers if the labor force is skilled) will produce more for a given value of the stock of capital. To investigate the type of capital used in the GCC countries, we use Feenstra (2000) data on capital goods imports, which proxy for capital stocks. The use of this proxy is justified because for most countries (including for the GCC), capital goods cannot be produced domestically and are imported. The distribution of capital imports by type of capital is shown in Figure 5. The data shows that the GCC countries have invested large amounts in high-tech equipments, especially aircraft (Bahrain, Saudi Arabia, Qatar and the U.A.E.), communication equipment (Kuwait, the U.A.E., Saudi Arabia). In contrast, Oman has invested in relatively low-tech capital (motor vehicles).

In Figure 5, countries were sorted by their TFP growth between 1991 and 2008 and capital goods were sorted by their R&D content, as estimated by Caselli and Wilson (2004). This ordering shows that there is no clear pattern between the share of high-tech capital and the TFP growth. As a result, it is problematic to interpret, for instance, the disappointing growth performance of Oman in light of the lower technological content of its capital. Indeed, it is not so much the R&D content of capital that matters as it is its complementarily with country characteristics, such as human capital or remoteness. In particular, Caselli and Wilson (2004) documented that for the *average country*, aircraft, computing, communication and electrical equipment are relatively inefficient given the average country's low level of human capital. As capital imports in the GCC are relatively high-tech whereas skill levels are average, one argument could therefore be that the capital stock accumulated by the GCC is not well exploited by the labor force, yielding the decreasing TFP estimates.

Caselli and Wilson (2004) also showed that computers, motor vehicles and communication equipment are relatively efficient for countries remote from the world's largest economies. Several countries in the GCC have developed successfully their trade and transportation sector, basing this success on the geographical location between Asia and Europe.

Figure 5. Imports of capital, by type (darker color for increasingly R&D-intensive capital)




Source: Feenstra (2000) and author's calculations following classification in Caselli and Wilson (2004)

B. Institutions and the empirical growth literature

Barro (1991) estimated a reduced-form econometric model where income per capita is regressed on a vector of candidate variables that could explain growth. The results, however, were found by subsequent research to be sensitive to the inclusion of different variables. Although specifying the correct model remains elusive, the body of empirical work is now large enough that a survey of the literature should be able to identify the factors that have been found to be statistically and economically significant. This section discusses different surveys (or meta-analyses) that have been written in the recent years and uses coefficient estimates that reflect our view of the literature to assess the drivers of TFP growth in the GCC. The exercise is similar to that of Hakura (2004) who explains the low performance of the GCC (and of the rest of MENA) by using an econometric model of long-term growth, but instead of relying on a small set of regressions, we prefer to base our results on the existing literature with the objective of relying on robust relationships between growth and its determinants.

We start from the results of Sala-i-Martin et al. (2004) as a benchmark measurement of the relevance of each of the six factors. Sala-i-Martin et al. use the 67 candidate regressors chosen by Sala-i-Martin (1997) to estimate all possible combinations of a growth regression with seven explanatory variables and they use Bayesian updating methods to compute the posterior probability that the coefficient of a particular variable is non-zero. Based on this methodology, they rank regressors by their potential significance, and we focus on those factors with high significance that have been most studied by economists and political scientists:[8] initial income per capita, size of the government, macroeconomic stability, terms of trade, participation in international trade, democracy and institutional quality. Although the interpretation of some of these variables remains open to debate,[9] there is a growing consensus that the above categories, in one form or another, are all important determinants of economic growth.

***Initial income per capita and convergence***

The negative relation between initial income per capita and economic growth is among the most robust in the empirical literature. The relation – known as beta-convergence after the customary Greek letter used as a regression coefficient – is grounded in the neoclassical growth theory of Solow (1956) and Swan (1956). The model yields predictions for the path of output but it is important to note that convergence depends on the rates of population growth, capital depreciation and technological progress, as well as the elasticities of output to

[8] Since we focus on TFP, we do not discuss the role of physical capital or of education. These have been covered in section 4 using estimates in line with the growth accounting literature. Among the 25 most significant variables in Sala-i-Martin et al. (2004), we do not discuss the variables that are geographic, religious or ethnic dummies (East Asian dummy, African dummy, Latin American dummy, fraction of tropical area, Spanish colony, Fraction Confucian, Fraction Muslim, Fraction Buddhist) as they are not fundamentally informative about the growth process (they merely capture omitted variables). We do not discuss either initial life expectancy because it is highly correlated with initial income per capita.

[9] For example, institutional quality might be measured as the strength of property rights, the presence of democratic institutions, or the level of bureaucracy.

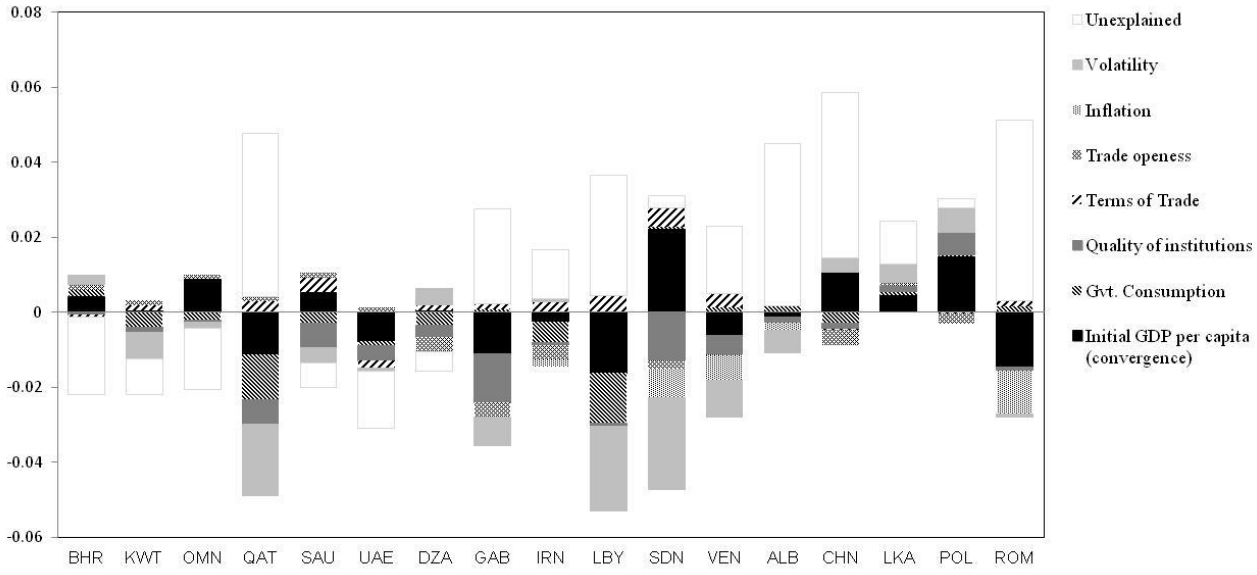
the various factors of production. The Solow-Swan model is said indeed to predict *conditional* convergence. Mankiw, Romer and Weil (1992) estimated a regression on OECD countries that yielded a speed of convergence of two percent. Abreu, de Groot and Florax (2005) conducted a meta-analysis of beta-convergence and examined the results of 619 different growth regressions from 48 different published papers. They found that taking stock of country differences matters for the estimated rate of convergence, which is exactly what the Solow growth model predicts. Overall, it is difficult to attribute a large fraction of growth to convergence for very heterogeneous economies. We therefore apply the commonly-estimated 2 percent convergence rate only within the GCC. We apply a similar rate of convergence within non-GCC oil exporters, within non-OECD countries and within OECD countries. Figure 6 shows our decomposition of TFP by factors. Qatar and the U.A.E. were the richest countries in the GCC and therefore conditional convergence would have slowed down their growth. On the contrary, poor countries like Sudan or China would have benefitted from conditional convergence.

***Size of the government***

The size of the public sector is potentially an important factor in growth performance, and Barro (1991) had already noted that the coefficient on government consumption was negative in growth regressions. Sachs and Warner (1995) also argued that one of the possible reasons why resource-endowed countries have tended to grow slower than resource-poor countries has to do with outsized governments. Artadi and Sala-i-Martin (2002) applied this argument to MENA and claimed that the large income that these governments receive – and subsequently spend – from oil revenues creates rent-seeking behavior. Rather than concentrate their efforts in productive activities, the incentives are for agents to concentrate on securing as big a share as possible from the oil revenues. For the GCC, the government is clearly a driving force in the economy, in particular for factor accumulation: investment, immigration and educational improvements are to a large extent financed by the government. The argument is however that from the supply side, TFP (in the long run) is hurt by rent-seeking activities, and *unproductive* government consumption is a good proxy for this effect.

Standard regression estimates did not support fully the findings of Barro (1991) (Levine and Renelt, 1992; Nijkamp and Poot, 2003) but the formal Bayesian approach of Sala-i-Martin et al. (2004) found nonetheless that the effect of government share of consumption is significant and economically important: a ten percentage points increase in the share of government consumption over GDP would reduce annual growth by 0.4 percent. We apply this coefficient in our estimates, using the ratio of government consumption to non-oil GDP for oil producers, and find that for Qatar, Libya, and to some extent Kuwait, government consumption was large enough that it may have been a drag on TFP (Figure 6). The impact is relatively small for the other GCC countries.

Figure 6. Contributions to TFP (1991-2009), in difference from median non-oil exporting country




source: Sala-i-Martin et al. (2004) database, IMF, and author's calculations. Data for inflation and terms of trade was not available for Iraq. Data for trade openness was not available for Albania, Kazakhstan and Libya.
Note: the median non-OECD country in the sample has a TFP over the period 1990-2008 very close to 0.

***Inflation and macroeconomic stability***

High inflation, volatile export revenues or variable economic growth add to the risks faced by agents and thereby worsen the prospects of economic activities that pay off in the future. These uncertain environments are therefore detrimental to investment, to skills learning, and in general to the development of businesses. Empirical studies have indeed found a significant statistical relationship between inflation and growth, even after controlling for fiscal performance, wars, droughts, population growth, openness, human and physical capital and after allowing for simultaneity bias. Based on a cross-country regression of 101 countries over 1960–89, Fischer (1993) found that high inflation reduces the output growth by reducing investment and productivity growth. Using annual data for 87 countries over 1970–90, Sarel (1996) found evidence of a structural break at an 8 percent inflation rate. Inflation and growth are positively correlated below 8 percent but negatively correlated above that, suggesting that ignoring this nonlinearity would significantly underestimate the impact of inflation on growth. Ghosh and Philips (1998) confirmed the presence of nonlinearities and found that increasing inflation from the optimal level (2-3 percent) to 5 percent reduces annual growth by 0.3 percent. Khan and Senhadji (2001) and Espinoza, Leon and Prasad (2012) reexamined this result and found that for developing countries and for oil producers, inflation becomes costly only when it exceeds 10 percent. We choose the nonlinear specification adopted by both these papers in our application. For the GCC, inflation was lower than 10 percent during the period under study, and therefore it is unlikely poor macroeconomic management be a cause of low TFP in the region, contrary to the experience of Sudan and Venezuela (Figure 6).

***Volatility and growth***

Output variability and exports or terms of trade volatility are the other commonly used measures of macroeconomic stability, and since Ramey and Ramey (1995) the literature has confirmed the negative relationship between growth and volatility. Hnatkovska and Loayza (2005) estimated that a one point increase in the volatility of GDP per capita decreases annual growth by around 0.3. Hnatkovska and Loayza (2005) also found that the negative

link is stronger for poor countries, for countries with underdeveloped institutions, for countries with intermediate levels of financial development, and for countries that do not implement countercyclical fiscal policies. Similarly, Kose et al. (2005) suggested that the relationship between growth and output volatility is positive at high levels of income but negative at low levels of income, and depends on trade and financial liberalization. Loayza et al. (2007) provide a survey of some recent findings. Van der Ploeg and Poelhekke (2009) also found that a one point increase in volatility reduces growth by around 0.3 percentage points. They re-interpreted these findings for resource-rich countries, and argued that volatility is indeed the key channel for the resource curse, dwarfing the Dutch disease effect that had been at the center of the literature. We apply a coefficient of 0.3 in our analysis and find that macroeconomic volatility could be a significant drag on growth for all other oil producers. The standard deviation of growth per capita in Kuwait,[10] Qatar and Saudi Arabia exceeded 5 percent since 1992.

***Openness to trade***

Barro (1991) argued that price distortions significantly affected growth, and a growing literature confirmed that trade openness is positive for growth (Sachs and Warner, 1995; Edwards, 1998), despite some critics (Rodriguez and Rodrik, 2001). The recent literature has suggested that the effect of trade openness on growth is positive albeit small (for instance Lee, Ricci, and Rigobon, 2004; Billmeier and Nannicini, 2009). Mookerjee (2005)'s meta-analysis harvested the results of 95 regressions from 76 different papers on trade and growth and confirmed the near unanimous consensus among economists that exports orientation is positive for growth.[11] However, Makdisi et al. (2005) suggest that the link between trade and

[10] We compute the volatility after the first Gulf War for this exercise.

[11] There are typically two ways to measure an economy's 'openness,' or its disposition to trade: one is a measure of net exports (or exports plus imports) as a share of GDP, the other one is number of years an economy is deemed to be open, using Sachs and Warner (1995) binary measure of openness. An economy is considered closed – for which it receives a zero – if it satisfies at least one of the following five criteria: nontariff barriers covering 40 percent or more of trade, average tariff rates of 40 percent or more, a black market exchange rate that is depreciated by over 20 percent relative to the official rate, a socialist economic system, or a state monopoly over major exports. If an economy does not exhibit any of the above traits it is

(continued)

growth is weaker in MENA than it is on average. They use the same measure of openness as Sala-i-Martin et al. (2004) in their full regression, and then include an interaction term with a MENA dummy. They find the interaction term to be both significant and negative. Given the positive link between trade and growth, conditional on being a MENA country the marginal effect of openness is only one fourth of what it would be otherwise. However, it is not clear this result applies to the GCC, which had a very different tariff regime than the rest of MENA in most of the period covered. We therefore follow Sala-i-Martin et al. (2004) who find that for every four more years a country remained open in the period 1950-1994, GDP growth was higher by 0.12 percent per year. The average growth of terms of trade has also been clearly associated with growth. Mendoza (1997) found that an increase of 1 percentage point in the terms of trade increases consumption growth by 0.05 percent, a result we take into account in our calculations. Terms of trade have been moving favorably for oil producers in the last 20 years, but the results shown in Figure 6 suggest that the effect was not strong enough to improve TFP in any GCC country.

***Institutions***

As standard growth models failed at explaining the differences in growth across countries, the literature investigated whether non-economic factors, in particular institutions, could explain growth performance. Institutional quality is notoriously difficult to measure. Different freedom indices – political freedom, economic freedom, democracy – tend to be highly correlated to each other, and insignificantly correlated to growth. Sala-i-Martin et al. (2004), for example, find that an index of political rights is not significantly correlated to growth. In a meta-analysis of the growth-democracy nexus, Doucouliagos and Ulubasoglu (2008) find that three quarters of the 470 regressions they examine do not have a positive, robust correlation between democracy and economic growth. In fact, their meta-analysis does not find any direct effects from democracy to growth.

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considered open and receives a score of one. Sala-i-Martin et al. (2004) noted that the numbers of years the economy is open is statistically more robust.

Even though political regime variables were not found to correlate with growth, narrower measures of institutional quality were found to consistently correlate with growth. Economists and political scientists have accumulated theoretical arguments and empirical results showing that bureaucracy, corruption, or the strength of property rights matter for the growth process. However, it is important to use institutional measures parsimoniously in order to avoid multicollinearity problems. Acemoglu and Johnson (2005), for example, found that a variable capturing 'contracting institutions' is significant only when the variable for 'property rights institutions' is not included. Once both institutional measures are included as regressors, 'contracting institutions' loses explanatory power. If the initial institutional measure is chosen appropriately, the marginal information provided by additional institutional regressors is unlikely to be significant. This is why we focused on a single variable measuring the quality of institutions, and opted for the measure of corruption of the International Country Risk Guide (ICRG), which is available for a wide range of countries. The claim is not that corruption is the only relevant feature for growth, but rather that high levels of corruption are surely symptomatic of institutional breakdown. Indeed, in the ICRG database, the correlation between the corruption and bureaucracy indices is 80 percent, and the correlation between corruption and the ICRG's composite rating is 75 percent.[12]

Ugur and Nandini (2011) conducted a meta-analysis from 72 different studies on corruption and economic growth. They found that corruption retards growth both directly as well as through a decline in human capital and a worsening of public finance. More importantly, they also found that corruption has a stronger negative effect in middle and high-income countries than it does in low-income ones. Using the full sample of countries, they find that a one-point drop in the corruption index corresponds to an increase in the annual growth rate of 0.86 percent.[13] We keep this coefficient for our estimates. In several countries in the GCC, (Qatar, Saudi Arabia and the U.A.E.), the ICRG graded corruption to be worse than in the

[12] We prefer the corruption index to the composite rating because the former is the one surveyed by the meta-analysis of Ugur and Nandini (2011). We use this meta-analysis to calibrate the impact of corruption on growth.

[13] This coefficient is practically unchanged when removing the effect via human capital and physical capital accumulation, which are already taken into account in the growth accounting exercise.

median country in our sample. As a result, the analysis suggests that poor institutions in these countries could have accounted for around -0.1 to -0.6 percentage point, per year, to the disappointing TFP of the period 1990-2008.

We conclude by summarizing our findings presented in Figure 4 and in Figure 6. Total factor productivity growth has been disappointing in the GCC in the last 20 years, as it has in many other oil exporters – although with positive growth numbers in GDP it is difficult to point at a resource curse. The emerging consensus in the growth literature is that high initial income per capita, oversized governments, instable macroeconomic environments, restrictions to trade, declining terms of trade and poor institutions can explain declining TFP.

The GCC has had stable inflation and benefitted from terms of trade and trade policies in the region that were favorable to exports. However, relatively poor institutions (especially in Saudi Arabia and the U.A.E.) oversized governments (in Kuwait and the U.A.E.), and volatile growth in the region would have contributed negatively to TFP. Although we attempted to take into account the major lessons learnt from the growth literature, a significant part of declining TFP remains unexplained, especially in Bahrain, Oman and the U.A.E. In Qatar, on the contrary, TFP was stable despite several factors that could have harmed growth.

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