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ARE JORDAN AND TUNISIA'S EXPORTS BECOMING MORE TECHNOLOGICALLY SOPHISTICATED? ANALYSIS USING HIGHLY DISAGGREGATED EXPORT DATABASES

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Abstract

There is a growing consensus that "what countries export matters for growth" (Haussman and al. (2007) and Krishna and Maloney (2011). Thus, the evolution of countries' export baskets can provide useful clues as to how the underpinnings of long-term growth are changing overtime. Using two highly disaggregated export time series (products captured at the 11-digit level), this paper examines how Jordan and Tunisia's production and export structures have changed over the last decade, in terms of technological content. We find that Jordan and Tunisia have experienced contrasting dynamics over the last decade. Thanks to its large exports of pharmaceutical products, Jordan enjoys a much higher share of high tech products in its export basket (11.5 percent versus 5.4 percent respectively) but this share has been declining overtime due to the rapid rise of low-tech exports, in particular textiles products. In contrast, from a very low basis, Tunisia has been slowly but steadily climbing the technological ladder, thanks to a rise in medium-high tech products (electronics and mechanical components) and a corresponding decline in the preeminence of exports of textile products. Given both countries' strong human capital base, further increase in medium-tech exports is likely to boost growth and reduce the unemployment of highly educated individuals. Analysis of the factors behind the few success stories in both countries underscores the importance of overcoming institutional weaknesses and establishing transparent and rules-based Government-business relationships as a pre-requisite for successful global integration in developing countries.

JEL Classification: F14, O30, O55

Keywords: Growth, Trade, Technological Content, OECD Technological Classification, Jordan, Tunisia.

ملخص

هناك إجماع متزايد على "أن ما تصدره الدول هام بالنسبة للنمو" هاوزمان (2007) وكريشنا ومالوني (2011). وهكذا، تطور سلال الصادرات للبلدان يمكن أن توفر أدلة مفيدة حول كيفية تحول أسس النمو على المدى الطويل. باستخدام اثنين من بيانات التصدير المتتابعة المفصلة (منتجات مسجلة على مستوى 11 رقم)، فإن هذه الورقة تبحث في كيفية تغير هياكل الإنتاج والصادرات فى الأردن وتونس على مدى العقد الماضي، من حيث المحتوى التكنولوجي، ونحن نجد أن الأردن وتونس شهدت ديناميات متناقضة على مدى العقد الماضي. بفضل صادراتها الكبيرة من المنتجات الصيدلانية، وتتمتع الأردن بحصة أكبر بكثير من منتجات التكنولوجيا العالية في سلة صادراتها (11.5 في المئة مقابل 5.4 في المئة على التوالي)، ولكن هذه النسبة كانت فى انخفاض مستمر بسبب الارتفاع السريع لصادرات التكنولوجيا المنخفضة ، وخاصة في منتجات المنسوجات ، وفي المقابل، ومن أساس منخفض جدا، بدأت تونس بشكل مطرد في السلم التكنولوجي، وذلك بفضل ارتفاع متوسط المنتجات عالية التكنولوجيا (هندسة الالكترونيات والمكونات الميكانيكية) وانخفاض مماثل في تفوق الصادرات من المنتجات النسيجية. ونظرا لأن البلدين لديهما قاعدة قوية من رأس المال البشري، فانه من المرجح أن زيادة الصادرات متوسطة التكنولوجيا يعزز من النمو والحد من بطالة الأفراد المتعلمين تعليما عاليا. تحليل العوامل الكامنة وراء قصص النجاح القليلة في كلا البلدين تؤكد على أهمية التغلب على نقاط الضعف المؤسسية ووضع قواعد شفافة والاستناد إلى علاقات الحكومة وقطاع الأعمال كشرط مسبق لنجاح التكامل العالمي في البلدان النامية.

1. Introduction

The last decade has witnessed two interesting features in international trade. First, "higher-tech" products have become the fastest growing segment of international trade. Second, participation of developing countries in the rise of global high tech exports has increased significantly thanks to greater trade openness, greater ability to master and use technologies and a rise in foreign direct investments (WTO, 2009). This process is likely to continue. Thanks to the important investments in science and technology in developed countries, greater movements of capital and talents globally and the globalization of production processes, developing countries have greater prospects and opportunities to capture knowledge spillovers and specialize in niches within high-tech sectors. The potential is particularly strong for developing countries that are open to trade and foreign direct investments and have a good human capital base (Keller 2004, Klenow and Rodriguez-Clare 2005 and Howitt 2000).

But why should developing countries aim at improving the technological intensity of products exported? In other words, what are the benefits associated with exporting more sophisticated goods? A short answer is that there is evidence that "what you export matters for growth". Haussman, Hwang and Rodrik (2007) show, for instance, that the extent of the overlap of a country's export basket with those goods that are exported by richer countries is a significant predictor of the country's growth rate. In earlier papers, Fagerberg (1988) and Dalum, Laursen and Verspagen (1999) stress that exporting products with higher income elasticity – typically the case of technology-intensive products, provides better growth prospects. In the same vein, Lall (2000) argues that low technology products tend to grow the slowest and technology-intensive products the fastest. Finally, to the extent that technology-intensive sectors are more productive, a movement of resources into these sectors enhances productivity, growth and competitiveness.

Because countries' export "basket" likely provides a clue for growth, many studies attempt to gauge countries' growth prospects by examining the technological intensity of what they export. However capturing the technology-content of exports is fraught with technical problems and the significance of empirical results is often unclear. Indeed, there is no uniform definition of high-tech; the degree of data aggregation is different across studies; and participating in global high tech supply chains is compatible with a large spectrum of production technologies. For instance, Mayer, Butkevicius and Kadri (2002) suggest that the expansion of high-tech exports from developing countries largely reflects their increased participation in labor-intensive segments of high-tech electronics in the context of international production sharing. Mani (2000) notes that a significant part of the high-tech industry outbreak in developing countries might be "something of a statistical illusion", as they specialize in labor-intensive processes within high-tech-intensive industries. Most studies in the empirical literature fail to adequately capture the true technological content of industries and the corresponding changes in countries' production and export structures. Yet, if what countries export matter for growth, adequately capturing this would be crucial in examining how the underpinnings of long-term growth are changing overtime.

The objective of this paper is to pinpoint the changes in Jordan and Tunisia's production and export structures over the last decade or so, using a methodology that avoid the usual pitfalls found in the empirical literature. To that effect, we use two highly disaggregated panel export database (products captured at the 11-digit level) and a "product-based" methodology that allows a mapping of products classified by technological content and their sector of origin. This approach circumvents the major flaw of "sector-based" methodologies. Indeed, while the same sector can be technology-intensive in one country and not in another one, a technology-intensive product has similar characteristics in all countries. The database used

runs from 2003 to 2010 for Jordan and from 1995 to 2009 for Tunisia, providing a pseudo-panel structure.

The choice of Jordan and Tunisia is, by no means, fortuitous. First, these countries are among the most globally integrated economies in a region known for its weak links to the global economy. In 2010, FDI stood at 11 percent of GDP in Jordan and 4 percent of GDP in Tunisia while exports/ GDP stood at 49 percent in both countries; Second, Jordan and Tunisia have a strong human capital base: the secondary school enrollment rate is 88 percent in Jordan and 83 percent in Tunisia; both countries enjoy a substantial high-skill diaspora (500,000 and 55,000 educated Jordanian and Tunisian abroad, respectively) and an IT-savvy young generation attuned to innovation; Third, both countries struggle with a very high level of unemployment for the educated/ skilled individuals: the unemployment rate for university graduates is around 20 percent in Jordan and 30 percent in Tunisia, against a national average of 14 percent in both countries.

In both countries, moving up the value chain and the technological ladder is likely to help enlarge the scope for employing available skilled labor. At the same time, this very movement is likely to boost productivity and growth. It is estimated that a growth rate above 6 percent is necessary for reducing unemployment in both countries. To reach this objective, the countries count on pursuing structural reforms to enhance competitiveness and on encouraging the emergence of new sources of growth through diversification of products and markets. Product diversification entails, according to Jordanian and Tunisian strategists, a necessary movement up the value chain and the technological ladder, in many existing economic activities.

The rest of the paper comprises 5 sections. The next section reviews briefly the evolution of the structure of global trade in general and in the global light manufacturing market in particular over the last few decades. These changes highlight why moving up the value chain and technological ladder is important for countries like Jordan and Tunisia, like many other middle-income countries. Section 3 discusses the different methodologies proposed to capture the technological intensity of industries and exports, their shortcomings and evolution overtime. Section 4 describes the methodology used in this paper. Section 5 presents the results. Finally, section 6 discusses the policy implications of our findings and, beyond that, some of the key industrial policy issues faced by Jordan and Tunisia.

2. Major Changes in the Structure of Global Trade and in Light Manufacturing

2.1 Changes in the structure of global trade

The WTO's recent statistics on global trade reveal that China has now overtaken Germany as the world largest exporter of merchandise with about 10 percent of global exports. Over the period 2000-2008, the average annual growth in global merchandise exports (in value) is 12 percent, the same rate at which EU exports grew and almost twice as high as for US (7 percent). Remarkably, during this period, the average export growth of Africa stood at 18 percent, at par with oil-rich countries in MENA and greater than in Asia (13 percent). China has been of course an outlier, with an outstanding average annual export growth of 24 percent! Tunisia managed to secure an average growth of 10 percent per annum but as seen below, the low value- added of the export basket significantly reduces the direct growth impact of such exports.

According to WTO statistics (2009), manufacturing products accounted for 66.5 percent of world export of goods, followed by oil and extractives industries (22.5 percent). Agricultural products represented 8.5 percent of global trade. Within the manufacturing group, chemical products (10.9 percent), office and telecommunication equipments (9.9 percent) and automobile industry products (7.8 percent), considered as high-tech products, dominate. In

terms of regional specialization, while the EU and North America still dominate products categories deemed of high value-added content, China and India are catching up fast. For instance, in chemical products, China has more than doubled its market share in the world chemical market between 2000 and 2008 (from 2.1 to 4.7 percent) while India has nearly doubled its own (0.7 to 1.2 percent). This contrast with the sharp decline in US global market share which stood at 13.4 percent in 2008 against 17.6 percent in 2000. Within chemical, US market share of pharmaceutical products declined from 12.1 percent to 9 percent.

This global dynamics (rise of China and India and reduction of market share of traditional market leaders) is even more accentuated in office and telecommunication equipments. Here, the global share of the EU27 and the US dropped from 29.2 to 26 percent and 21.5 to 13.3 percent respectively between 2000 and 2008. In contrast, the share of "developing" Asia rose from 47.3 to 58.3 percent, driven by China whose market share exploded from 4.5 percent to a quarter of the world market share. Interestingly, China multiplied by 4 its market share in telecom equipments (from 6.8 to 27.1 percent), by 6 its share of the integrated circuits and micro-electronic assembling global market (from 1.7 to 10.5 percent) and by 6.5 its share of information technology equipments (from 5 to 32.2 percent).

2.2 Global light manufacturing markets entry and exit dynamics and challenge

As seen above, over the last 30 years, trends in global manufacturing markets have been strongly affected by the growth dynamics of key Asian economies. As the four Asian tigers (Korea, Taiwan, Hong Kong and Singapore) exited the markets of light manufacturing to a large extent and upgraded, China has entered, forcefully. There is today evidence that China's manufacturing efficiency and scale has pushed down the prices of many manufacturing products, relative to many other goods and services in the global economy. World Bank data and projections show a clearly declining trend of the relative price of manufacturing goods in global markets (Figure 1).

The overall decline in global manufacturing prices has profound implications for developing economies' export and growth strategies. For labor-abundant developing countries scrambling to "break" into global manufacturing, labor cost can be so low that the returns to investment in labor-intensive manufacturing still exceed the cost of capital. In these circumstances, the labor-intensive route to export and GDP growth is still possible even if the extent to which it can be effective depends on the pace at which China upgrades and moves away from these industries (Cline's adding up hypothesis).[1]

But depressed manufacturing prices pose important challenges for low and middle-income countries that have already broken into global manufacturing for some time. Although there are a number of niches where prices are increasing and where these countries' firm can still strive, their survival in the low-end segments of manufacturing markets (e.g., in garments, toys, shoes and other light manufacturing markets) which successful low-income countries are entering have become difficult. Middle-income countries that have broken into light manufacturing decades ago have now no choice but to upgrade and exit the low value-added segments of export industries, as the four Asian tigers did and as China is expected to do in the coming years. This is because no country can remain competitive in labor-intensive industries indefinitely. This is all the more so for countries with limited labor and natural resources (Chile, Tunisia, Jordan, Mauritius, etc.) where surplus labor is quickly absorbed and wages tend to rise with the development of a middle-income class.

[1] William Cline has recently revisited the conclusions of his initial paper and subsequent book in the light of 25 more years of evidence. "Exports of Manufactures and Economic Growth: The Fallacy of Composition Revisited." Paper prepared for the World Bank. 2006.

3. Review of Methodologies Used to Capture the Technological Content of Industries and Products

The concept of high-tech does not lend itself to easy quantification. R&D content is a generally accepted yardstick and a product that incorporates directly or indirectly a high level of R&D can be considered as high-tech. However, in addition to R&D expenses, many other indicators are used in the empirical literature: share of technical and scientific staff in total personal used in production, share of specialized personal on total, correlation between patent and market share, unit values, clients' opinion and a priori judgments of experts. For instance, the OECD (OECD, 2005) proposes to consider the following factors in defining high-tech products, industry or activity : (i) research undertaken that leads to the new product or new process ; (ii) the strategic importance of the product, industry or activity for a government ; (iii) the links and delays between basic research, industrial application, commercialization and obsolescence due to concurrent products and processes ; (iv) risks and (v) international collaboration in R&D, production and commercialization. The only quantifiable element among this list of factors is however R&D.

Not surprisingly, different organizations and countries end up classifying "high-tech products" differently thereby making international comparison complicated. Nevertheless, the lists of products/industries considered as high-tech by the USA and the OECD countries are considered authoritative in the empirical research and are widely used. The US has had a long experience in classifying its industries by technology content. The first official lists of high-tech industries date back to 1971. Based on the work by Boretsky (1971), the US Commerce Department developed a list called DOC1, based on two criteria: R&D expenditures and share of scientific and engineers in total employment. Using the standard industrial classification (SIC), industries in which R&D accounts for at least 10 percent of gross value-added and in which the share of personal with scientific and engineering education represent 10 percent or higher are defined as "high-tech".

The DOC1 list was further improved in 1977, following the empirical work of Kelly (Kelly, 1976, 1977). The new list, called DOC2, captures the technological content at the product level and defines as "high-tech" products for which the R&D expense in percentage of sales is above a certain threshold. To enable an analysis of the technological content of traded goods, a correspondence table was introduced to map out SITC trade data with SIC industries. In 1982, the US Commerce Department introduced further improvements (Davis, 1982, 1988) by considering not only R&D in percent of sales, but also the R&D undertaken at the intermediate and final producer levels as well. This led to yet another list called DOC3.

In parallel to the work by the US Commerce Department, the National Science Foundation has invested time and resources in developing indicators used in its "Science Indicators Series". These indicators were then used to provide an "NSF" list of high-tech industries. The specific indicators used for this list were the number of scientific and engineers in total employment and R&D expenditures as a percentage of total sales. Goods produced in industries that invest at least 3.5 percent of their sales in R&D and in which scientific and engineers represent at least 2.5 percent of the personal are considered high-tech. This definition uses industrial data and is based on the SIC. This list was further refined recently using disaggregated trade data (NSF, 2008).

Following unsatisfactory attempts at using US definitions, the OECD started developing its own classification of industries. The first classification was published in 1985 (OECD1 list) and was based on the share of R&D on the production of each industry. Three product categories were established, according on R&D intensity (over 4 percent, between 1 and 4 percent and lower than 1 percent). This list was replaced by a refined one in 1989 (OECD2) which made adjustments and introduced the concept of high, medium and low technologies

based on R&D intensity. The graduation of industries along the technological ladder was further refined in 1997, when the distinction was introduced between "medium-high" and "medium-low" technology (Hatzichronoglou, 1997). Twenty two manufacturing sectors in 10 OECD countries were ranked using such criteria in the period 1973-1992.[2] OECD started using SIC3 in 2001 leading to an upgrade of industries such as "manufacturing of medical, precision, optics instruments" from medium-high to high technology. The OECD now updates direct and indirect R&D intensities regularly and adjusts the list consistently (OECD, 2007). The OECD list is today the most popular one used by practitioners, researchers and international organizations, including the World Bank.[3]

4. Methodology Used in this Paper

We use two highly disaggregated panel export databases (products captured at the 11-digit level) and the OECD's industry classification to map out exported products with their sector of origin. The export database runs from 1995 to 2009 for Tunisia, and from 2003 to 2010 for Jordan. Comparison between the two countries is thus possible in the overlapping period of the entire database, 2003-2009. Both databases include products classified according to the Harmonized System of Classification Rev3 at 11-digit disaggregation. Three steps are involved in using this product level export database to determine the technological-intensity of industries and its drivers.

First, we harmonize the two datasets with the OECD classification, using an HSC (Rev.3) conversion key to reclassify the two countries' data according to ISIC (Rev.3), and then group the products according to their industry of origin clustered by technology intensity. The OECD ISIC (Rev.3) data features four levels of technology intensity: high-tech, medium-high tech, medium-low tech and low tech products. Once the conversion to ISIC is completed, the share of each industry in total exports and their evolution can be calculated and the evolution of the technological content of exports determined.

The second step involves determining the products (captured first at 4-digit level and then at 11-digit) that drive the observed evolutions. To that effect, a few selection criteria have to be put in place. First, the average share of the exported product (at 4-digit) during the period which the data is available (2003-2010 for Jordan and 1995-2009 for Tunisia) should be at least 5 percent. Obviously, products that have smaller weight cannot drive growth in their category. Second, the product must have been exported during the 3 latest years covered, i.e., 2008, 2009 and 2010 for Jordan and 2007, 2008 and 2009 for Tunisia. Finally, the selected "products category" (4-digit) are then disaggregated to the 11-digit and the same two criteria applied: the average share of 11-digit products within the 4-digit sub-group is calculated; products that represent more than 5 percent of their sub-group selected; and among the latter, products not exported during the latest 3 years dropped.

A concrete example is warranted. For instance, for "Aircraft", the product category 8411 (turbo reactors, turbo propellers, and other gas turbines) was exported by Tunisia during 2007-2009. This category represents on average 11.16 percent of AIRCRAFT exports during 1995-2009. Thus the product category 8411 is selected for analysis at the 11-digit level. The data shows that within this category 8411, the product 84112100009 (turbo propellers of power not exceeding 1.100 kW) and the product 84119110005 (parts of turbo reactors or turbo propellers) accounted for 6.7 percent and 37.7 percent of exports respectively over

[2] A consistent product-based list was also derived from this latest bit of improvement with the view of analyzing international trade based on SITC3.

[3] The World Bank made some attempts at establishing a list that would be relevant for a wide-range of developing countries in the late 1990s but use of highly aggregated data (4-digit) and the heterogeneity of inter-sectoral relationships within developing countries led to important misclassifications and inconsistent ranking (see World Bank (1999) for the results obtained and Mani (2000) for a critical analysis of the results).

1995-2009. These two products are thus selected while the 11-digit positions of 8411 that do not meet our two criteria are dropped.

5. Results

5.1 Structure and dynamics of exports by technological content, Jordan versus Tunisia

Figure 2 shows the "current" composition (average shares) of exports by technology content (high, medium-high, medium-low and low-tech), for the period 2007-2010 for Jordan and 2007-2009 for Tunisia.[4] Clearly, the share of high tech products in total exports is low in both countries, but Jordan exports more than twice as much high tech as Tunisia (11.5 percent versus 5.4 percent respectively). Total exports remain largely dominated by low-tech products, which represent 35.5 percent of total exports in Jordan and 37.9 percent in Tunisia. As shown below, this reflects the large share of textiles and textile products in the export basket. For both countries however, the share of medium high-tech exports is quite large, standing at 28.4 percent.

Interestingly, the current export structure of Jordan and Tunisia reflects a contrasting evolution over the last decade or so, with Tunisia slowly but steadily moving up the technological ladder from a very low basis while Jordan saw a steep rise in low-tech exports overtime. In Tunisia, since 2004, excluding the global crisis year 2009, the share of medium and high tech exports has increased steadily while exports of low-tech products have declined significantly as a percentage of total exports -from 56.7 percent in 1995 to 38.3 percent in 2009 (Table 1). This decline gave way to a slow rise in the export of products classified as medium-low tech (from 6.1 to 11.2 percent of total exports), medium-high (17.4 to 30 percent) and high-tech (1.8 to 6.5 percent). In Jordan, the share of low and medium-low tech exports increased dramatically since 2003, overshadowing the relative resistance of high and medium-tech in the entire period. The share of low-tech exports almost doubled between 2003 and 2006 when it reached its peak (43 percent) while medium-low tech export share increased steadily from 5 to 17 percent between 2003 and 2010.

Drilling down, it appears that the contracting evolution of Jordan and Tunisia's export structure is the result of the dynamics of a few products. For example, the rise of low-tech exports in Jordan and the decline of that category in Tunisia are driven by textiles and textile products, which dominate low-tech exports in both countries. In Tunisia, the share of textiles and textiles products in total exports dropped by almost half, from 44 to 24 percent (Table 3) whereas Jordan saw a steady increase in the share of this product category, from 10 to 18 percent between 2003 and 2010 (Table 4).

In Tunisia, textiles and textile products became the largest export sector following the creation of an "offshore" investment regime in 1971 and the subsequent participation to EU textile production networks. Tunisia's offshore regime features generous investment incentives granted to exporters—duty-free tariffs on imported raw materials and equipments, freedom of investment, tax holiday, etc. It has triggered tremendous growth FDI from EU companies and in exports of textile products. The share of textiles and clothing in exports rose from 18 percent in 1980 to 44 percent in 1995, before dropping gradually to 33 percent in 2006 and 24 percent in 2009. The rise and relative decline of textiles and clothing illustrates two successive structural transformations in Tunisia's manufacturing sector since the 1970s: (i) a period of rapid diversification away from fuel exports which dropped from 52 percent in 1980 to 13 percent in 2006 and; (ii) a gradual diversification away from low value added textiles and clothing towards light mechanical and electrical manufacturing which now dominates exports.

[4] The total of these shares does not add up to 100 percent because products not processed or of natural resource type could not be classified by technology and are dropped. These represent on average 15 percent of total exports.

The second structural transformation warrants some elaboration since it is one of the main drivers of the rise in medium tech exports observed over the last decade or so. Indeed, in the mid-1990s, Tunisia abandoned its ambition to build "made in Tunisia" cars and focused on automobile parts and components, in which the country has developed real expertise over the years. The "local content" partnerships built with EU automakers rapidly led to increased participation to EU automobile production networks (France, Italy and Germany mainly) and a double digit growth in exports of engineering and electrical machineries since 1997. As of 2010, this category has overtaken textiles and clothing as Tunisia's largest export sector, accounting for 30 percent of total exports (against 9 percent in 1995). Products in this broad category also classified as "machinery and transport" include: electrical wiring systems, electrical motors and generators, wheels and rubber tires, plastic auto components as well as various mechanical auto parts.

The rise of textiles and clothing in Jordan was also driven by incentives granted to exporters and greater market access. The Qualifying Industrial Zone agreement signed with the US gave Jordanian exports quota-free and duty-free access to the U.S. market under advantageous rules of origin. Thanks to these incentives, investments in the sector skyrocketed and Jordan's apparel and textile exports rose dramatically from US$50 million per year before 1999 to US$1 billion in 2010. As everywhere around the world, the textile and clothing industry is a significant and cost-effective source of low-skill employment, as it is labor-intensive and does not require heavy investment in assets. In contrast with Tunisia however, most of the 60,000 workers in this sector in Jordan are foreigners.[5] Although the sector's competitiveness has diminished following the abolition of quotas on China and other large exporters within the framework of the Multi-Fiber Agreement, it remains an important sector for the economy. A key objective for both Tunisia and Jordan is to move up the value chain in textiles and exit gradually the lower end of this sector where competition with lower cost producers is stiff (see section 6).

Tables 5 to 8 show the products behind the changes in the shares of medium-low, medium-high tech industries in Tunisia and Jordan. In both countries, exports of basic metals and fabricated metal products, rubber and plastics products drove the increased share in the medium-low tech category (Tables 5 and 6). For Tunisia, exports of coke and refined petroleum products also contributed to the rise of medium-low tech industries. For medium-high tech industries, as discussed above, a key feature is the formidable rise in export of electrical machineries in Tunisia, which saw a near four-fold increase in share, from 3.7 percent in 1995 to 14.6 percent in 2009. To a smaller extent, the increase in export of motor vehicles and machineries and equipments also contributed to the increased share of medium-high tech industries in total exports (Table 7). In Jordan, medium-high exports have declined over time as a result of a decline in chemical product exports, in particular manufacture of fertilizers and nitrogen compounds (potassium-based products) which represent almost half of this category. The sharp increase in exports of electrical machineries (mainly air conditioning) in recent years was overshadowed by the decline in chemical product exports (Table 8).

Regarding high tech exports, the data reveals an important contrast between Jordan and Tunisia: the former relies on one strong high tech sector that alone explains Jordan's larger share of high tech products in total exports. The latter has a large number of small (underdeveloped) sectors that contribute modestly to high tech exports.

In Jordan, high tech exports are driven almost exclusively (98.6 percent) by pharmaceutical products. Jordan's pharmaceutical sector features high value-addition for the economy, with strong links to local input markets (packaging, material capsules, technology, research, etc.)

[5] In Tunisia, the sector employs about 240,000 workers, all Tunisians.

and an ability to add real or perceived value to the products through branding. High quality products are exported to more than 60 markets worldwide, which attests to their competitiveness, particularly with regard to brand generic drugs (Jordan Vision 2020). The development of the sector was fuelled by specific strategies implemented by individual companies, which include: (i) US Food and Drug Administration's certification; (ii) research on product manufacture for drugs which are nearing their patent expiration exploiting loopholes in the Free Trade Agreements signed with the US and the EU signed in the early 2000s. These agreements provide Jordanian pharmaceutical companies with first mover advantage in marketing generic drugs compared to international (European and American) pharmaceutical companies;[6] (iii) signature of the intellectual property right (IPR) and WTO agreements which increased the confidence of multinational drug companies in Jordan and resulted in the establishment of several strategic alliances and licensing agreements with leading international drug companies.

In contrast with Jordan where high tech exports are concentrated, in Tunisia, a large number of products contribute modestly to the rise in high tech exports: electronics, in particular radio, TV and telecom equipments (2.5 percent of total exports), office accounting and computing machineries (1.9 percent) and medical, precision and optical equipments (1.7 percent) are all contributors to the slow rise in high tech exports. There is no apparent pro-active strategy behind the evolution of these sectors. Their emergence relates to the exploitation of existing advantages: availability of skilled and semi-skilled labor, proximity to the EU and the "natural" development of productive capabilities and inflows of FDI.

5.2 Benchmarking Jordan and Tunisia against OECD and emerging economies

One advantage of the methodology used in this paper is that it allows benchmarking Jordan and Tunisia against OECD and some emerging economies, for which the OECD has undertaken a classification in 2005. Table 11 shows that Tunisia has a long way to go in catching up with OECD countries. Indeed, in 2005, high-tech industries accounted for 22 percent of total exports in OECD against only 3 percent in Tunisia. The gap is much lower for medium-high industries however (39 versus 22 percent). Furthermore, Tunisia lags behind emerging economies like Turkey, South Africa, Brazil, China, India and Indonesia when it comes to high-tech exports. However, the share of medium-high tech export in total is higher in Tunisia than it is in India and Indonesia.

In contrast, Jordan fares quite well compared to many countries. With 12.7 percent of its total exports high tech (again thanks to its large pharmaceutical sector) in the mid-2000s, Jordan ranks better than most emerging economies except China. At 26.7 percent, the share of medium-tech exports was also sizeable on a comparative basis. However, as seen above, Jordan's export structure has become more concentrated on low-tech products in the second half of the 2000s with the rise of textiles and textile products. While data for the emerging and OECD countries is not available for the year 2009, the table clearly shows that the gap in high tech export performance between Jordan and Tunisia has narrowed quite significantly in the second half of the 2000s.

The above results depart from those find in the empirical literature using more "aggregated" methodologies. For instance, using Lall (2000) classification (resource-based, low-tech, medium-tech and high-tech products) at 4-digit level (SITC), Ferragina and Pastore (2007) found that 16 and 14.4 percent of Tunisia and Jordan's exports respectively were hich-tech in 2004. Using the same methodology (albeit at the 3-digit level) however, Abmoullah and

[6] European Union legislation prohibits European companies from undertaking generic product preparation (R&D) prior to patent expiry. Jordanian companies are unaffected by this legislation and have exploited this loophole to develop first mover advantage in the generic market for drugs which have recently come off patent. The US has removed such a loophole. The EU may close this loophole in its FTA with Jordan as well.

Laabas (2010) found different results. Specifically, high tech exports stood at 8 and 5 percent for Jordan and Tunisia respectively. These inconsistent results reflect the intrinsic flexibility of Lall's methodology. In the words of Lall (2000), « judgment is inevitably involved in assigning products to categories. The classification is based on available indicators of technological activity in manufacturing and on the author's knowledge of industrial technology. It conforms to most analysts' conception of the technological ranking of manufactured products." It is noteworthy that Lall's approach has been used by many other authors, including by Gallagher and Porzecanski (2008) and Haddad (1998).

6. Policy Discussion

Four observations come out of the analysis above. First, success stories in embracing globalization and moving up the technological ladder exist in MENA, as Jordan's pharmaceutical industry or Tunisia's emerging electronics sector illustrate. Second, "smart" industrial policy seems to play a role in some cases, such as Tunisia's decision to abandon making cars and focusing on parts and components in partnership with European automakers in the mid-1990s. At the same time, success stories identified in both countries are all associated with the establishment of an "enclave" where transparent "rules of the game" are credibly enforced with the help of an external policy anchor either through international agreements. This is illustrated by Jordan's free trade agreement with the US and signature of and compliance with WTO's Intellectual Property Rights which underpinned the rise of its pharmaceutical industry and Tunisia's "offshore" regime which, combined with the local content partnership with European automakers, is behind the rise in exports of automobile parts and components. Finally, when predictable rules of the game exist and are credibly enforced, success stories feature an absence of government intrusive "intervention" in all cases. It is noteworthy that the "external anchor policy device" is an important tactic for addressing institutional weaknesses around the world as discussed by Noland and Polack (2007).

These observations point to the importance of trade tools and a predictable business environment as important ingredients for industrial success in Jordan and Tunisia. In particular, the institutional framework for business conduct seems to be a key determinant of private investment, whether from foreign or domestic entrepreneurs. This is consistent with the main finding of the World Bank regional study "from privileges to competition" published in 2010. The main policy implication from the findings of the paper (as for the Bank report) is that Jordan and Tunisia need first and foremost a reform of the way the state interacts and interface with the private sector. This institutional reform is also a pre-requisite for any effective industrial policy support that these countries may envisage going forward. The current Arab Spring context provides for a unique opportunity to undertake this reform and send the signal the change is real. Indeed, countries at the frontier of innovation typically enjoy a stable, trust-based societal environment. The institutional reform entails deep political and public administration reform to upgrade public services standards in Jordan and Tunisia.

Given the patterns of changes in export structures analyzed above however, simply improving the rules of the game seems not enough to accelerate structural change. In the case of Jordan, a key question is whether the country should base its movement up the technological ladder solely on one sector: pharmaceutical. Therefore the question arises as to how Jordan can replicate the success in this sector elsewhere, given its capabilities and endowment[7]. Another question is whether it is sensible for Jordan to spend much public resources to support the textiles and clothing sector, when the latter employs predominantly

[7] Jordan is a services-dominated economy and its current strategy may be sensible. However, to the extent that sectors such as consumer appliances (in particular Air Conditioning) have shown real strengths in recent years, it may be worth keeping in mind.

foreign labor, displays poor working standards, uses scarce water and energy and is subject to eroding preference in the US market.[8] While the response to these questions is beyond the scope of this paper, they are worth considering as Jordan devises a new industrial strategy.

For Tunisia, a key industrial strategy question is whether the country should keep counting on a large number of sectors/ products to accelerate its movement up the technological ladder or whether a focus on a few strong sectors where the country has demonstrated real capacity in recent years is more warranted. Another question is whether Tunisia can boost growth in its emerging high-tech sectors (electronics, office accounting and computing machineries and medical, precision and optical equipments) without deliberately creating new advantages (specialized skills, specific technological capabilities and specific inputs such as new legislation, accreditation or industry-specific infrastructures) and/or attracting specific international firms/champions. In any case, the existence of market failures with access to credit, skilled labor and specific knowledge provide a rationale for specific policy interventions. However, greater accountability of policymakers and control of corruption (institutional reform) will be necessary to avoid the usual pitfalls associated with government intervention.

Finally, improving the environment for firm innovation may facilitate the movement up the technological ladder in both Jordan and Tunisia. As found by Rischard and al (2010) and World Bank (2010), innovation policy in both countries (i) is too narrowly cast, addressing mostly technological innovation and largely missing out on today's important non-technological sources of innovation; (ii) suffers from an institutional spaghetti bowl problem with too many organizations with confusing/overlapping mandates and (iii) not aligned to the country's industrial strategy and resource endowment. Resources to support innovation are spread across too thin and key priority areas lack adequate resources to undertake their duties. Addressing these shortcomings can be crucial in supporting structural changes in Jordan and Tunisia.

[8] With the removal of the Multi-Fiber Agreement, the US textile market has become more open to China and other large suppliers.

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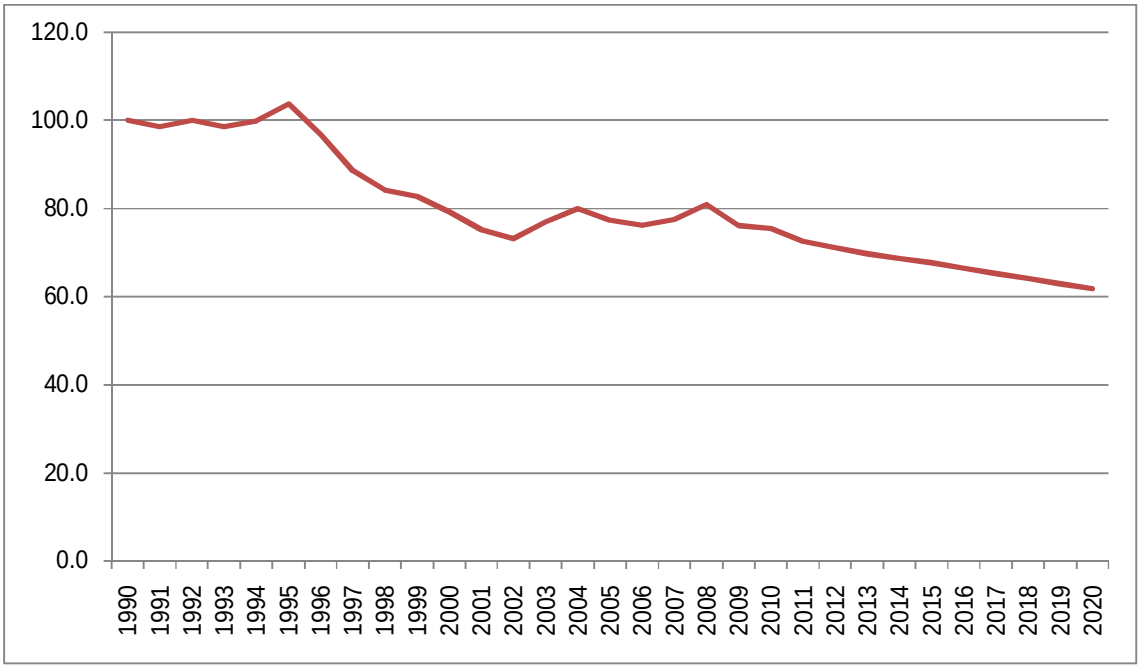
Figure 1: Global Manufacturing Unit Value Relative to US GDP Deflator*



Note: * Global manufacturing unit value index (base 100=1990) divided by US GDP deflator index base 100=1990;
Source: World Bank Global Prospects Group

Figure 2: Average shares of exports by technology content. Jordan: 2007-2010; Tunisia: 2007-2009

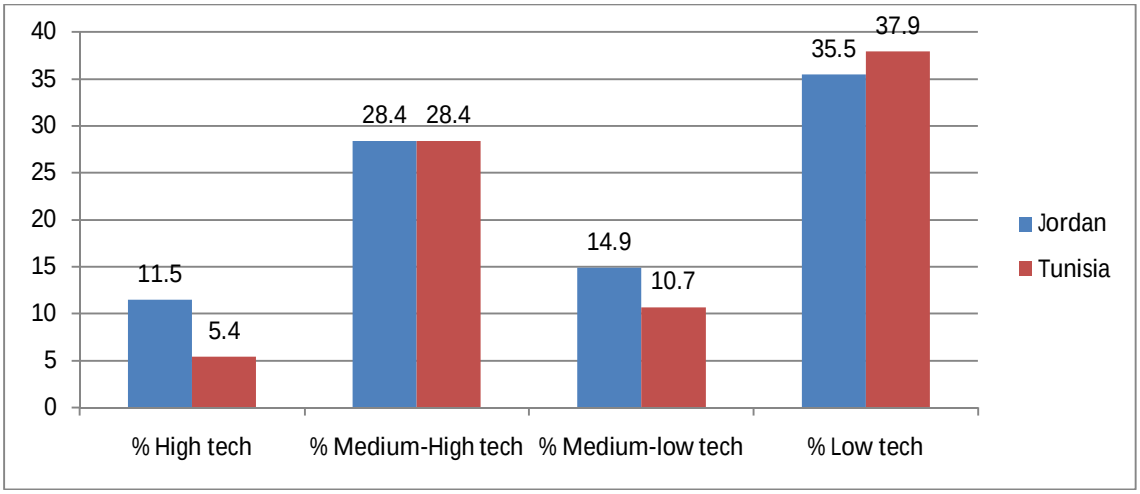


Table 1: Share of Manufacturing Industries by Technology Levels in the Tunisian Total Export (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total High Tech	1.8	1.8	2.1	2.7	1.8	2.0	1.9	2.2	2.6	2.7	3.1	2.9	4.5	5.4	6.5
Total Medium High Tech	17.4	18.4	18.2	20.1	19.4	18.6	20.2	20.5	20.3	21.2	22.4	21.7	24.0	31.3	29.9
Total Medium Low Tech	6.1	4.2	4.1	4.1	4.0	3.8	3.8	5.5	7.3	6.9	8.0	10.2	10.0	11.0	11.2
Total Low Tech	56.7	55.5	57.7	57.5	57.8	53.1	53.7	54.0	53.6	53.2	47.6	45.3	40.9	34.7	38.3

Source: Authors' calculations.

Table 2: Share of Manufacturing Industries by Technology Levels in the Jordanian Total Export (%)

	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2003-2010
Total High Tech	15.1	13.8	12.7	10.1	13.4	10.7	10.3	11.9	12.2
Total Medium High Tech	37.5	29.3	26.7	25.3	26.3	33.3	29.3	24.9	29.1
Total Medium Low Tech	5.6	4.7	6.7	10.1	11.7	13.2	17.2	17.6	10.9
Total Low Tech	23.0	33.7	37.6	43.1	37.2	34.8	34.2	35.8	34.9

Source: Authors' calculations.

Table 3: Share of Low-Tech Industries in the Tunisian Total Export (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Manufacturing, n.e.c.; Recycling	0.5	0.6	0.7	0.7	0.8	0.9	0.9	0.9	0.8	0.8	0.8	1.4	1.2	1.0	1.4
Wood, pulp, paper, paper products, printing and publishing	0.8	0.8	0.9	0.8	1.0	1.1	1.1	1.3	1.6	1.7	1.4	1.3	1.3	1.2	1.6
Food products, beverages and tobacco	7.1	5.0	9.3	7.6	9.6	7.1	5.5	4.7	5.1	9.1	8.1	9.9	7.3	6.8	6.9
Leather and Footwear	4.4	4.6	4.9	4.9	5.2	5.2	5.7	5.9	6.0	5.2	5.1	4.7	4.5	3.8	4.2
Textiles, textile products	43.8	44.5	42.0	43.5	41.4	38.9	40.5	41.2	40.1	36.5	32.2	28.1	26.5	21.8	24.2
Total Low Tech	56.7	55.5	57.7	57.5	57.8	53.1	53.7	54.0	53.6	53.2	47.6	45.3	40.9	34.7	38.3

Source: Authors' calculations

Table 4: Share of Low-Tech Industries in the Jordanian Total Export (%)

	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2003-2010
Manufacturing, n.e.c.; Recycling	5.0	6.9	8.8	7.2	5.2	3.0	3.3	3.4	5.3
Wood, pulp, paper, paper products, printing and publishing	2.0	1.4	2.9	2.6	3.5	6.5	5.8	7.1	4.0
Food products, beverages and tobacco	5.5	5.5	7.0	5.8	5.5	5.6	6.8	7.2	6.1
Leather and Footwear	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Textiles, textile products	10.4	19.7	18.8	27.5	23.0	19.7	18.3	18.0	19.4
Total Low Tech	23.0	33.7	37.6	43.1	37.2	34.8	34.2	35.8	34.9

Source: Authors' calculations

Table 5: Share of Medium Low-Tech Industries in the Tunisian Total Export (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Building and repairing of ships and boats	0.08	0.01	0.16	0.02	0.06	0.04	0.04	0.04	0.06	0.13	0.11	0.24	0.30	0.25	0.19
Rubber and plastics products	1.07	1.14	0.74	0.78	0.90	1.20	1.22	1.68	1.52	1.74	1.77	1.86	1.89	1.74	2.17
Coke, refined petroleum products and nuclear fuel	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.96	2.64	1.82	2.53	2.93	2.63	3.69	3.00
Other non-metallic mineral products	2.03	1.40	1.52	1.46	1.20	1.27	1.22	1.30	1.31	1.30	1.44	1.58	1.53	1.47	1.61
Basic metals and fabricated metal products	2.92	1.64	1.65	1.80	1.83	1.32	1.32	1.51	1.80	1.95	2.19	3.61	3.68	3.87	4.20
Total Medium Low Tech	6.1	4.2	4.1	4.1	4.0	3.8	3.8	5.5	7.3	6.9	8.0	10.2	10.0	11.0	11.2

Source: Authors' calculations

Table 6: Share of Medium Low-Tech Industries in the Jordanian Total Export (%)

	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2003-2010
Building and repairing of ships and boats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubber and plastics products	1.3	1.3	1.6	1.3	1.4	1.3	2.6	4.6	1.9
Coke, refined petroleum products and nuclear fuel	0.0	0.0	0.0	1.9	1.1	1.6	0.3	1.1	0.8
Other non-metallic mineral products	2.1	0.7	0.5	0.3	0.6	1.0	0.7	1.6	0.9
Basic metals and fabricated metal products	2.2	2.7	4.5	6.7	8.7	9.3	13.7	10.3	7.3
Total Medium Low Tech	5.6	4.7	6.7	10.1	11.7	13.2	17.2	17.6	10.9

Source: Authors' calculations

Table 7: Share of Medium High Tech Industries in the Tunisian Total Export (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Electrical machinery and apparatus, n.e.c.	3.72	3.80	3.83	5.50	5.80	5.99	7.20	7.16	8.10	9.05	9.21	8.69	10.65	12.32	14.66
Motor vehicles, trailers and semi-trailers	0.77	0.62	0.68	0.66	0.76	0.95	1.41	2.04	1.98	2.11	2.38	2.58	2.40	1.94	2.63
Chemicals excluding pharmaceuticals	11.50	12.57	12.25	12.27	11.49	10.22	9.70	9.24	8.41	8.59	8.95	8.54	8.66	14.60	9.72
Railroad equipment and transport equipment, n.e.c.	0.04	0.06	0.04	0.21	0.08	0.10	0.10	0.15	0.18	0.17	0.19	0.21	0.31	0.29	0.29
Machinery and equipment, n.e.c.	1.36	1.38	1.42	1.45	1.30	1.38	1.84	1.94	1.63	1.31	1.64	1.63	2.01	2.16	2.60
Total Medium High Tech	17.4	18.4	18.2	20.1	19.4	18.6	20.2	20.5	20.3	21.2	22.4	21.7	24.0	31.3	29.9

Source: Authors' calculations

Table 8: Share of Medium High Tech Industries in the Jordanian Total Export (%)

	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2003-2010
Electrical machinery and apparatus, n.e.c.	1.0	1.1	0.8	1.1	0.8	1.0	6.6	2.5	1.9
Motor vehicles, trailers and semi-trailers	1.4	1.6	1.2	1.0	0.5	0.5	0.2	0.5	0.9
Chemicals excluding pharmaceuticals	33.2	25.6	21.1	20.1	20.1	28.8	20.3	19.8	23.6
Railroad equipment and transport equipment, n.e.c.	0.02	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Machinery and equipment, n.e.c.	1.9	1.04	3.5	3.2	5.0	2.9	2.3	2.2	2.8
Total Medium High Tech	37.5	29.3	26.7	25.3	26.3	33.3	29.3	24.9	29.1

Source: Authors' calculations

Table 9: Share of High Tech Industries in the Tunisian Total Export (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Aircraft and spacecraft	0.02	0.01	0.02	0.01	0.10	0.08	0.13	0.18	0.04	0.04	0.04	0.03	0.06	0.04	0.06
Pharmaceuticals	0.23	0.12	0.26	0.29	0.09	0.08	0.11	0.10	0.10	0.17	0.13	0.12	0.14	0.13	0.21
Office, accounting and computing machinery	0.03	0.02	0.01	0.00	0.02	0.04	0.03	0.09	0.13	0.37	0.34	0.50	0.73	0.81	1.98
Radio, TV and communications equipment	0.96	1.07	1.38	1.91	1.03	1.12	0.98	1.08	1.10	1.04	1.15	1.14	2.26	3.04	2.56
Medical, precision and optical instruments	0.57	0.57	0.41	0.49	0.51	0.68	0.63	0.78	1.18	1.10	1.48	1.06	1.31	1.38	1.71
Total High Tech	1.8	1.8	2.1	2.7	1.8	2.0	1.9	2.2	2.6	2.7	3.1	2.9	4.5	5.4	6.5

Source: Authors' calculations

Table 10: Share of High Tech Industries in the Jordanian Total Export (%)

	2003	2004	2005	2006	2007	2008	2009	2010	Mean 2003-2010
Aircraft and spacecraft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pharmaceuticals	15.0	13.7	12.7	10.0	13.0	10.4	10.2	11.6	12.1
Office, accounting and computing machinery	0.0	0.0	0.0	0.0	0.01	0.04	0.02	0.06	0.02
Radio, TV and communications equipment	0.0	0.0	0.01	0.05	0.4	0.3	0.11	0.14	0.12
Medical, precision and optical instruments	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.02	0.02
Total High Tech	15.1	13.8	12.7	10.1	13.4	10.7	10.3	11.9	12.2

Source: Authors' calculations

Table 11: Share of Manufacturing Industries by Technology Levels in the Total Exports: Benchmarking, 2005

	High tech manufacturing industries	Medium high tech manufacturing industries	Medium low tech manufacturing industries	Low tech manufacturing industries
France	22.4	39.8	15.6	18.5
OECD	22.6	38.8	16.2	15.6
EU19	20.6	39.6	17.3	18.3
China	34.7	19.9	13.8	29.3
Spain	10.5	42.0	20.8	20.1
Italy	10.8	39.0	21.5	26.9
Portugal	11.6	29.3	20.0	36.3
Brazil	7.5	24.9	17.9	29.1
Turkey	5.6	26.5	25.6	36.3
South Africa	3.8	25.6	36.6	13.3
Greece	11.5	14.9	30.4	31.2
India	4.9	17.5	25.4	42.6
Indonesia	10.0	12.2	12.6	30.9
JORDAN	**12.7**	**26.7**	**6.7**	**37.6**
TUNISIA	**3.1**	**22.4**	**8.0**	**47.6**
JORDAN (2009)	**10.3**	**29.3**	**17.2**	**34.2**
TUNISIA (2009)	**6.5**	**29.9**	**11.2**	**38.3**

Source: Authors' calculations and OECD: Science. Technology and Industry Scoreboard. 2007