

Euro–Med trade integration in agriculture and food

Social accounting matrix analyses

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Abstract: *This paper explores social accounting matrices (SAMs) using three country case studies (Egypt, Morocco and Tunisia). For each, the agri-food sector, trade negotiations with the European Union and associated challenges are first presented. The key sectors are then identified and analysed using the SimSip SAM tool (Parra and Wodon, 2009). Using sensitivity analysis, the implications of free trade for key sectors were analysed. By evaluating backward and forward linkages in the economy of each country, the most important sectors likely to take a lead role and become essential drivers of growth were identified. Due to strong backward relations and high labour intensity, some agricultural sectors have the potential to generate significant income, thus supporting economic growth.*

Keywords: *trade integration; multisectoral models; impact analysis; North Africa area*

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Agri-food sector in the Euro–Med area

The agricultural sector is a vital and integral component of economies in Egypt, Morocco and Tunisia. Egypt's contribution to gross domestic product (GDP) was 14% in 2012, compared with 38% and 48% for the industrial and service sectors respectively. The agricultural sector employs a larger portion of the workforce than any other sector in the economy, with more than 5.5 million workers (27% of the workforce in 2010). About 40% of the Egyptian population depends on the agri-food sector as its main source of income. Agricultural production is highly concentrated along the Nile River and in the Nile Delta, although about 97% of the area of Egypt is still unculti-

vated due to the extremely limited rainfall. Although the arable land per person is quite small (0.04 ha), this is offset to some extent by multiple cropping with two growing seasons (winter and summer) and intensive production making up a total cropped area of about 6.3 million ha. Smallholder-based mixed farming is the dominant production system (80% of farms cultivate less than 1 ha). The main agricultural products are wheat, cotton, rice, maize, fruit and vegetables, poultry, cattle, water buffalo, sheep and goats. The major agricultural exports from Egypt comprise cotton, rice, onion, fruits and vegetables. Overall, Egypt is a net importer of agri-food products, and the self-sufficiency ratio for various agri-food products has declined considerably since the 1960s. However, about

60% of national food demand is met by domestic production. Egypt suffers from severe food shortages, particularly in basic food commodities including wheat, maize, edible oil and sugar. The rising dependence on imported food is a major concern among policy makers, and has resulted in various attempts to restrict food imports and stimulate domestic production.

In Morocco, the agricultural contribution to GDP ranges from 12% to 17% and accounts for almost 40% of employment. The total agricultural area is about 9 million ha, about 85% of which is cultivated as rainfed production. Irrigated agriculture accounts for about 1.4 million ha, and on average contributes 45% of the value added in the agricultural sector. In 2010, the agri-food sector was ranked second in terms of its contribution to industrial GDP, reinforcing the country's strong agricultural dependence. Indeed, the share of the agri-food sector in the total value added varies between 30% and 35%. The agri-food sector focuses mainly on the domestic market. About 80% of Moroccan food production is sold into domestic markets; the remainder is exported. Food products supplied to the domestic market are import substitutes such as wheat, oilseeds, sugar and milk, while fish products, canned vegetables and fruit are produced specifically for export.

A similar situation exists in Tunisia, with all development plans since independence supporting agricultural development. However, unlike in the other countries, the agricultural sector has until recently faced many constraints regarding productivity and profitability. In 2011, agriculture contributed about 12% to GDP in Tunisia (agriculture's share in GDP declined from 16.9% in the 1970s to 12% in the 2000s) and employed about 16–20% of the overall workforce. Agriculture represented 10% of all investments in the economy. Over half of investment (57%) in agriculture was private. Hence, the share of public investment remains important and it concerns mainly forestry, hydraulic works, water conservation and, to a lesser extent, research and agricultural public services.

Trade liberalization and challenges

Egypt

Egypt has an Association Agreement with the EU, which was signed in June 2001 and enforced in June 2004. The EU-Egypt Association Agreement follows the model of the Euro-Mediterranean Partnership Agreements between the EU and southern Mediterranean countries. In particular, it involves a free trade agreement for industrial products and preferential access for agri-food trade; it also covers services (to a limited extent). An agreement between Egypt and the EU on further liberalization of bilateral trade in agricultural, processed agricultural products and fish/fishery products was signed in October 2009, and following approval by the Egyptian parliament, was enforced in June 2010. The agreement includes the dismantling of tariffs on the above-mentioned products, and leaves only a very limited number of sensitive products subject to protection. Agricultural products, however, remain a very sensitive area of cooperation between the EU and Egypt (European Parliament, 2012). Both agree-

ments proved to be effective in terms of intensifying trade relationships. Indeed, under the Association Agreement, trade doubled (from €11.5 billion in 2004 to €23.3 billion in 2011), and under the Agricultural Agreement, the value of agricultural products imported by the EU from Egypt rose from €527 million in 2009 to €604 million in 2011.

Regarding the free movement of goods and technical regulations, Egypt continues its preparations for the negotiation of an Agreement on Conformity Assessment and Acceptance of Industrial Products (ACAA). On accreditation, the Egyptian Accreditation Council (EGAC) signed a cooperation contract with the European Cooperation for Accreditation (EA). Egypt is a full member of the International Accreditation Forum (IAF) and the International Laboratory Accreditation Cooperation (ILAC). It will endorse peer assessments to obtain Multilateral Recognition Arrangements (MRAs) with the EA. In November 2011, EGAC became an associate EA member. Market surveillance remains a key concern. Egypt is being encouraged to finalize the alignment of its legislation, the adoption of related EU standards and its affiliation with the European Committee for Electrotechnical Standardization (CENELEC).

Regarding sanitary and phytosanitary (SPS) issues, the draft unified food law and the establishment of a single food safety authority are still to be finalized. The EU and Egypt addressed several trade problems and, as a result, Egyptian potato imports into the EU can now follow simplified procedures. After a severe outbreak of a food-borne illness in the EU (linked to *Escherichia coli*) in July 2011, the European Commission temporarily banned imports of certain seeds and beans from Egypt. In August 2011, the Food and Veterinary Office (FVO) of the European Commission assessed the production of seeds that could be consumed as sprouts. Subsequently, Egypt committed to address the FVO observations.

In order to reinforce democracy and economic reforms in the countries affected by the Arab Awakening, the EU adopted negotiating directives at the end of 2011 for new Deep and Comprehensive Free Trade Agreements (DCFTAs) with Egypt, Tunisia, Morocco and Jordan. These second-generation agreements aim not only to remove tariffs, but also to protect investments and intellectual property and to standardize rules of origin and competition policies (European Parliament, 2012). There are some agricultural policy issues that may determine the impact of DCFTAs on the agri-food sector. Over the past 20 years there has been a substantial decline in public sector support for agriculture, and many producers have lost access to key inputs and services. While public sector provision of these services was not very efficient, it often provided the sole linkages to markets for poor rural producers. Today, such links are tenuous and complicated by much greater integration of the global economy. Smallholder producers, normally with little surplus, now have to compete in markets that are much more demanding in terms of quality and food safety, and more concentrated and integrated than in the past. Agricultural subsidies from the Organisation for Economic Cooperation and Development (OECD) countries further distort many of these markets. Economic integration is accompanied by other challenges that further weaken the socioeconomic position of the rural poor. Externally,

Egypt has made substantial progress in reducing tariffs, even though the dispersion in tariffs remains high and Egypt's use of non-tariff measures (NTMs) is still persistent, with 49% of its tariff lines in the World Customs Organization's Harmonized System (HS)-6 level having technical (one or several) regulations. Finally, Egypt's exports are still relatively concentrated compared to those of other countries.

Morocco

The Morocco-EU Association Agreement has been in force since March 2000 under the framework of the Euro-Mediterranean Partnership launched in November 1995. In 2008, Morocco and the European Commission decided to strengthen their relationship under the 'advanced status' requested by Morocco within the European Neighbourhood Policy (ENP). In December 2009, the European Commission and the Kingdom of Morocco concluded negotiations to update the Agricultural Protocol, which was enforced in March 2012. The comparison between the new and the latest protocols allows distinguishing the new concessions benefiting Morocco according to three different lists for the complete elimination of tariff rate quotas (TRQs): that is, full duty-free access to the EU market. The TRQ elimination applies to a list of products including early potatoes, onions, celery and cherries. For other products, there are new concessions, which imply that TRQs are still in force but are enlarged with increasing tariff reduction. This is the case, for example, with strawberries and garlic. For other products, such as oranges, tomatoes and cucumbers, larger trade volumes are registered under the current preferential EU Entry Price system.

Regarding Moroccan imports from the EU, the new protocol distinguishes four groups of measures. The first is on immediate free access to the Moroccan market for products such as seeds, oilseeds and pork. The second is for products under quota or with no quota binding, whereas a 20% tariff reduction per year (over five years) will be implemented (for example, on butter, maize, cheese and edible oil). The third group applies a 10% yearly tariff reduction for products such as skimmed milk powder, soybean meal and dried prunes. The last group encompasses the so-called 'negative list' of products with binding quotas (cereals, olive oil, processed tomatoes, red meat, poultry and apples).

Tunisia

Important reforms have been undertaken in the agricultural sector since the 1990s, aiming to remove border protection, reduce subsidies to inputs and allow market forces to determine the value of goods. These reforms, however, are still incomplete and the government plays a major role in markets. Economic and non-economic reasons are advanced by the Tunisian authorities in order to justify their intervention in agriculture. The first is the role of agriculture in economic development, while the second reflects strategic objectives, such as increasing food security and agricultural income support.

The process of trade liberalization of the agricultural sector with the EU was established within the framework of the Euro-Mediterranean Association Agreements (Barcelona Process) signed in 1995 and enforced in 1998 (becoming the Union for the Mediterranean in 2008).

Tunisia was the first Mediterranean country to sign an Association Agreement with the EU in July 1995. Tunisia finalized the dismantling of tariffs for industrial products in 2008, thus making it the first Mediterranean country to enter into a free trade area with the EU. Since January 2001, trade in agricultural and food products has been governed by the 2000 Agreement, which followed the Association Agreement of 1995 and established reciprocal tariff concessions granted by both parties. The process of trade liberalization between Tunisia and the EU was enhanced by the opening of new trade negotiations in order to establish DCFTAs and Tunisia obtaining 'Statut Avancé' in November 2012. Negotiations are currently under way between Tunisia and the EU to expand trade liberalization between the two partners. These negotiations will probably lead to greater liberalization of trade than what was agreed on between the EU and its trading partners Morocco and South Africa.

Observation of the progress of agreements between Tunisia and the EU has shown that the tariff preferences granted by the EU to Tunisian agricultural products were poorly exploited. This situation is a result of a number of constraints, some of which are structural, including (i) the relative weakness of local supply, (ii) the irregularity of supply, and (iii) the lack of competitiveness of exports. It was also due to the erosion of tariff preferences resulting from granting similar tariff conditions to competing countries.

Structural analysis of Euro-Med economies using SAMs

Egypt

The national social accounting matrix (SAM) of Egypt used in this study was constructed by the National Institute of Planning attached to the Ministry of Planning for 2000/2001 and updated by Abouleinein *et al* (2009) for 2009/2010. A SAM is a comprehensive, economy-wide data framework, typically representing the economy of a nation. The structure of this SAM may be briefly explained, as follows. Six major accounts are provided: production factors, economic agents, industries, composite products, capital and taxes. It incorporates two production factors (labour and capital) and 15 economic agents, including households (rural and urban), companies (private and public), government and the rest of the world. The SAM includes 21 sectors structured as two agricultural types (crop and animal production), 12 industries (oil extracts, food industries, tobacco, spinning and weaving, clothing (including leather), chemical industries, petroleum products, non-metal industries, industries of basic metals, metal industries, engineering industries and other industries) and finally seven service sectors (construction and electricity, transportation, communication and transport, hotels and restaurants (tourism), trade and finance, and social services). The capital account shows the investment demand by sector. Finally, the tax account reports on direct taxes, tariffs on imports, other indirect taxes and subsidies.

Backward and forward linkages. A sector is considered as key in the economy when its backward and forward

linkages are greater than 1 (Cardenete *et al*, 2012). This means that the sector generates more income than the average sector in the economy and thus responds more to shocks than the average sector. The backward linkage (BL) of a sector quantifies the change in the economy-wide income, relative to the average change in the economy, caused by a unitary injection in the final demand of the sector. In other words, the BL represents a diffusion effect since it quantifies the changes in the economy-wide activity generated by increasing the final demand of the respective sector by US\$1. Table 1 summarizes the list of sectors according to their BL and FL. This shows there are five sectors that are above the average, and top of these are food industries, which have the greatest forward and backward linkage effect. Looking at the FL, the value of 2.3 is high. The food sector is thus a key sector in Egypt. Other sectors among the top five are trade and services, social services, agri-vegetal and oil and extracts, which all have comparatively high FL values. These results indicate a high absorption effect: that is, these sectors are affected by the rest of the sectors of the economy to a larger extent than the average response.

The position of crop production and related food industries highlights the importance of the agriculture sector in terms of absorption effect and income diffusion in the Egyptian economy. It should be noted that animal production has a forward linkage of 0.6, which is significantly less than 1.0. The small FL value indicates the animal sector's lack of absorption capacity. This could be explained by the fact that animal production is dominated by traditional activities and can be considered as a subsistence sector. Most inputs used in this sector, such as green fodder, feed grains and labour, are provided by the agricultural sector itself, while inputs such as animal feed concentrates, veterinary services as well as extension services are used to a much smaller extent and provided by other sectors. However, the higher income diffusion capacity of the livestock sector (BL 1.1) could be explained by the fact that it constitutes the main source of income for about four million farm households, as well as by its importance as the major source of raw milk and meat used in food industries.

Strong backward linkages (values greater than 1) are evident for 13 sectors, with petroleum products (BL 1.9) and food industries (BL 1.3) ranked highest. In contrast, eight sectors have moderate BL values, with engineering industries scoring the lowest (BL 0.8). The leading role and strong backward linkages for food industries and primary agricultural sectors (agri-vegetal and agri-animal) should enable these sectors to become essential drivers of economic growth in Egypt.

Five sectors fulfil the criteria to be defined as key sectors (Table 1), with four observations regarding their status. First, vegetables and other plant crops as primary agricultural production constitute a key sector. Second, food industries are ranked top and represent a very important sector for primary production. Food industries combine a wide range of products including: processing and preserving of meat/meat products, processing and preserving of fish/fish products, processing and preserving of fruit and vegetables, oil and edible oils, milk processing, grain milling and flour production, livestock fodder, bakery products, sugar production and refining,

Table 1. Sectors classified according to BL and FL, Egypt, 2010.

	Backward linkages	Forward linkages
Key sectors		
Food industries	1.296	2.282
Oil & extracts	1.152	1.302
Agri-veg	1.133	1.336
Trade & finance	1.100	1.952
Social services	1.082	1.877
Sectors with strong backward linkages		
Petroleum products	1.932	0.706
Basic metals	1.196	0.259
Transportation	1.108	0.645
Communication	1.101	0.278
Chemical industries	1.095	0.531
Electricity	1.093	0.249
Agri-animal	1.071	0.625
Hotels & restaurants	1.055	0.359
Weak sectors		
Metal industry	0.974	0.031
Spinning & weaving	0.971	0.311
Tobacco	0.964	0.250
Non-metal industry	0.957	0.242
Other industries	0.948	0.470
Construction	0.933	0.187
Cloth	0.893	0.577
Engineering industry	0.840	0.195

chocolates and candies, other food processing industries, alcoholic beverages, beer beverages, non-alcoholic beverages and mineral water. In Egypt, the food processing sector employs more than 750,000, and represents around 35% of labour employed in the industrial sector (CAPMAS, 2003) and 16% of the total labour force in Egypt. In addition to direct employment, there is indirect employment related to processed food, which is estimated to employ 2.25 million workers. This means that employment effects associated with the food sector are potentially considerable. Third, among the remaining key sectors are two service sectors: trade and finance and social services, as well as oil and extracts. Fourth, petroleum products, transportation and animal production score comparatively highly, but are not identified as key sectors. Of the 21 sectors in the SAM of Egypt, eight have weak backward and forward linkages.

Morocco

The Moroccan SAM is that of the Global Trade Analysis Project (GTAP) database for 2004. It has 57 activities (among which are 21 agri-foods), 57 commodities, two categories of labour, one capital account, two accounts of land (land and natural resources), two categories of households, 18 accounts for government, one capital account and one account for the rest of the world.

Backward and forward linkages. Here we adopt the definition of key sectors given by Cardenete *et al* (2012) to identify the important sectors in the Moroccan economy. A slight modification is, however, used regarding the levels of linkages to identify the number of key sectors, since Cardenete *et al* (2012) relaxed the key sector criteria by considering both linkages greater than 0.9 rather than 1.

Table 2. Sectors classified according to BL and FL, Morocco, 2004.

	Backward linkages	Forward linkages
Key sectors		
Public administration, defence, health and education	1.306	4.534
Trade	1.261	1.919
Food products nec	1.188	1.477
Transport nec	1.102	1.321
Sectors with strong backward linkages		
Wool, silkworm cocoons	1.450	0.854
Paper products, publishing	1.085	0.962
Vegetables, fruit, nuts	1.155	0.859
Leather products	1.107	0.899
Wearing apparel	1.081	0.904
Business services nec	1.083	0.877
Sugar cane, sugar beet	1.200	0.240
Plant-based fibres	1.165	0.281
Cattle, sheep, goats, horses	1.181	0.413
Animal products nec	1.162	0.450
Raw milk	1.208	0.350
Forestry	1.010	0.171
Minerals nec	1.065	0.582
Meat: cattle, sheep, goats, horses	1.163	0.599
Meat products nec	1.232	0.332
Dairy products	1.019	0.424
Processed rice	1.002	0.155
Sugar	1.151	0.626
Beverages and tobacco products	1.226	0.457
Mineral products nec	1.091	0.548
Manufactures nec	1.111	0.452
Water	1.096	0.162
Construction	1.245	0.289
Sea transport	1.080	0.226
Communication	1.209	0.328
Financial services nec	1.296	0.405
Insurance	1.151	0.225
Recreation and other services	1.215	0.381
Dwellings	1.035	0.656
Sectors with strong forward linkages		
Oil	0.140	1.154
Textiles	0.714	1.289
Petroleum, coal products	0.353	1.806
Electricity	0.808	1.069
Weak sectors		
Oilseeds	0.733	0.305
Crops nec	0.761	0.263
Coal	0.141	0.270
Gas	0.174	0.190
Vegetable oils and fats	0.624	0.345
Wood products	0.778	0.455
Ferrous metals	0.653	0.723
Metals nec	0.771	0.348
Motor vehicles and parts	0.439	0.557
Transport equipment nec	0.664	0.425
Machinery and equipment nec	0.664	0.648
Gas manufacture, distribution	0.419	0.146

Given the small number of eligible key sectors in Morocco, a relaxed approach using the 0.85 threshold is applied. We define the thresholds for evaluating the effect of backward linkages (BL) or forward linkages (FL) as 0.85 (rather than 1.0). Thus we consider a sector to be key when it has values higher than 0.85 for both linkages.

Using the SimSip SAM tool, we present the results of sector classification according to the economic importance of each sector to the Moroccan economy (Table 2). The

results show that the sectors with a strong BL are wool/silkworm cocoons, public administration/defence/health/education, communication, trade, financial services, meat products, beverages and tobacco products, sugar cane and sugar beet, construction and recreation and other services. For each of these sectors, an increase of the final demand in all other sectors of the economy by US\$1 generates an increase in their production by more than US\$1.2. It should be noted that the sector of wool/silkworm cocoons is of limited importance in Morocco, and therefore, the results do not accurately represent Morocco's situation. Sectors with strong FL are public administration/defence/health/education, trade, chemicals, rubber and plastic products, food products, transport, wheat and textiles. For each sector, changes in the final demand of commodities produced by these sectors by US\$1 result in an increase in their income by more than US\$1.2.

We can distinguish four key sectors (Table 2). Among these, wheat, vegetables, fruit, nuts and food products tend to generate higher incomes than the average. The importance of the wheat sector is obvious in relation to the country's food security and the spillover effects that grain activity generates throughout the economy. Similarly, fresh or processed fruit and vegetables play a very important role in terms of export and rural employment, especially for women. The BL sectors are the most numerous, which is a good indicator related to the diffusion effect that could generate a change in the final demand of these sectors across the economy. Indeed, among 57 activities of the Moroccan SAM, 29 sectors are BL, among which 14 are agri-food. The most important agri-food BL sectors are sugar plants and sugar, milk and dairy products, live animals and meat, and beverages and tobacco. Less important are cereals other than wheat (including rice) and fish.

In contrast, only four activities are FL: namely oil, textiles, petroleum, coal products and electricity. Thus, no agri-food sector is absolutely FL, which means that no agri-food sector displays an absorption effect without combination with significant diffusion effect. The remaining sectors are considered as weak sectors with scores below 1.0 for both BL and FL. Oilseeds, vegetable oils and fats and crops not elsewhere classified (nec) belong to this group. This result is expected, given the small size of the vegetable oils sector in the economy, with a self-sufficiency rate not exceeding 20%.

Tunisia

The 2005 SAM for Tunisia used here was based on a new 2005 supply-use table (SUT) developed by Drine *et al* (2011). The SAM has 43 activities and 44 commodities. Agriculture is divided into crop agriculture (five subsectors: grains or cereals, olives and other pulses, fruits and tree-crops, vegetables, other crops), livestock and fisheries. Most of the sectors identified in the SAM are in industry, which is separated into mining (two subsectors), manufacturing (20), utilities (2) and construction. Finally, the SAM also contains information on 11 service sectors, including private services (eight subsectors) and public or government services (three).

Backward and forward linkages. As shown in Table 3, using the SimSip SAM tool and following the definition of

Table 3. Sectors classified according to BL and FL, Tunisia, 2005.

	Backward linkages	Forward linkages
Key sectors		
Real estate	1.508	2.178
Trade and repair services	1.381	2.630
Transport	1.380	2.213
Hotels and catering	1.310	1.910
Post and telecommunications	1.264	1.004
Prepared foodstuffs	1.161	2.900
Sectors with strong backward linkages		
Financial and insurance services	1.522	0.880
Fishery products and aquaculture	1.393	0.177
Refined petroleum	1.297	0.524
Public administration	1.269	0.677
Business services	1.252	0.451
Oil mining	1.235	0.716
Other services	1.229	0.158
Other mining	1.206	0.241
Construction	1.193	0.710
Water supply	1.184	0.110
Health	1.149	0.370
Non-metallic minerals	1.134	0.418
Livestock	1.111	0.783
Electricity, gas and heat	1.091	0.473
Vegetables (including melons & tomatoes)	1.086	0.644
Education	1.081	0.347
Fruits and tree crops	1.077	0.394
Wood products	1.069	0.224
Olives and other pulses	1.061	0.346
Grains or cereals	1.052	0.336
Other crops (including roots & peppers)	1.040	0.114
Weak sectors		
Furniture and other manufacturing	0.979	0.325
Rubber and plastic	0.962	0.222
Clothing and furs	0.928	0.805
Leather, travel goods, footwear	0.921	0.233
Electrical machinery and apparatus	0.910	0.437
Textile products	0.907	0.577
Manufactured tobacco	0.900	0.099
Printing and publishing	0.857	0.072
Paper and paperboard	0.794	0.166
Scientific equipment	0.790	0.123
Fabricated metal products	0.776	0.324
Automotive products	0.772	0.322
Machinery and equipment	0.704	0.106
Metal products	0.697	0.167
Other transport equipment	0.684	0.021

backward and forward linkages in Tunisian's economy in 2005, the classification shows that the sectors with a strong BL are: real estate, fishery products and aquaculture, trade and repair services, transport, hotels and catering, refined, financial and insurance services, public administration, petroleum, post and telecommunications, business services, oil mining, other services, other mining, construction, water supply, prepared foodstuffs, health, non-metallic minerals, livestock, electricity, gas and heat, vegetables (including melons and tomatoes), education, fruits and tree crops, wood products, olives and other pulses, and grains or cereals and other crops (including roots and peppers). For each of these, an increase of US\$1.0 in the final demand generates an increase in activity of other sectors of > US\$1.0. It should be noted that all agricultural sectors (fruit and tree crops,

vegetable and livestock have the greatest capacity to diffuse income within the Tunisian economy) and all service sectors have significant BL. The BL sectors are the most numerous, which is a good indicator related to the diffusion effect that could generate a change in the final demand of these sectors across the economy. Indeed, among 43 activities of Tunisia's SAM, 27 sectors are BL, among which seven are agro-food, 11 are services and only nine are industries.

Sectors with strong FL or absorption effect ($FL > 1.0$) include prepared foodstuffs, trade and repair services, transport, real estate, hotels and catering, chemicals, post and telecommunications. These enjoy the greatest capacity to diffuse income within the Tunisian economy. In contrast to BL, only six sectors have a strong FL. There is no agro-food sector that has important FL for the Tunisian economy. Thus, in Tunisia, the agro-food sector does not display an absorption effect without a combination with significant diffusion effect. It should be noted that all service sectors have a significant FL. Only one industry sector and no agricultural sectors have a significant FL. Relative to the other agricultural sectors, livestock has the highest FL for the agricultural sector and represents a very important sector for agro-food.

In accordance with the definition of a key sector (both FL and BL >1.0), only five out of 43 sectors can be categorized as key (Table 3). These are real estate, trade and repair services, transport, hotels and catering, post and telecommunications and prepared foodstuffs. Except for prepared foodstuffs, which is an industrial sector, all these are service sectors; no agricultural sector can thus be considered as key. The remaining sectors considered as weak, with scores below 1 for both BL and FL, are shown in Table 3. Table 3 also shows that all key sectors, except for prepared foodstuffs (an industrial sector), belong to the service sectors. However, no agricultural sector can be categorized as key. To improve growth in Tunisia, productivity must be increased in a sustainable way and the key sectors must be developed. Public investments should target these sectors and those with strong BL, given the fact that they have significant diffusion capacities. This requires, among other measures, an increase in research and development (R&D) activities linked to these sectors.

Implications of free trade for key sectors

Egypt

Following Ben Abdallah *et al* (2013), we used the MAGNET results on production changes and introduced respective shocks to Egypt's SAM using the SimSip SAM tool. The focus was on a trade liberalization scenario. As highlighted in Kavallari *et al* (2013), the MAGNET results suggest that under S1 (tariff liberalization), crop and livestock production in Egypt decreases by 1.5% and 0.6% respectively. Under S2 (combined tariff and non-tariff measure (NTM) liberalization), crop and livestock production in Egypt increases by 3.6% and 4% respectively. These changes are used as production shocks with the SimSip SAM tool. The results are shown in Tables 4 and 5. As shown in Tables 4 and 5, production, GDP and employment are affected, with the magnitude of the effects being different according to sector. At the national level,

Table 4. Effects of trade liberalization on Egyptian crop and livestock production, 2020 – Scenario 1.

Sector	Impact of -1.5% and -0.6% changes in crop and livestock production respectively under S ₁				
	Total impact on production/income		Total impact in terms of GDP		Change in labour after shock(worker)
	(US\$ million)	Percentage change after shock (%)	(US\$ million)	Percentage change after shock (%)	
Agri-vegetal	-444	-1.8	-401	-1.8	-81,888
Agri-animal	-103	-0.9	-56	-0.9	-11,487
Oil & extracts	-55	-0.2	-52	-0.2	-214
Food industries	-132	-0.3	-36	-0.3	-1,410
Tobacco	-14	-0.3	-9	-0.3	-307
Spinning & weaving	-15	-0.2	-5	-0.2	-1,810
Cloth	-33	-0.3	-6	-0.3	-686
Chemical industry	-34	-0.3	-10	-0.3	-138
Petroleum products	-35	-0.2	-30	-0.2	-102
Non-metals industry	-1	-0.0	-1	-0.0	-113
Basic metals	-7	-0.1	-2	-0.1	-112
Metals industry	-1	-0.2	-1	-0.2	-164
Engineering industry	-9	-0.2	-3	-0.2	-495
Other industries	-23	-0.2	-6	-0.2	-659
Construction	-1	-0.0	-0	-0.0	-84
Electricity	-13	-0.2	-5	-0.2	-492
Transportation	-32	-0.2	-27	-0.2	-1,364
Communication	-14	-0.2	-11	-0.2	-567
Hotels & restaurants	-23	-0.2	-14	-0.2	-348
Trade & finance	-104	-0.2	-77	-0.2	-4,728
Social services	-96	-0.2	-63	-0.2	-13,238
Total/average	-1,188	-0.33	-814	-0.38	-120,405

Table 5. Effects of trade liberalization on Egyptian crop and livestock production, 2020 – Scenario 2.

Sector	Impact of change of 3.6% and 4% in crop and livestock production respectively under S ₂				
	Total impact on production/income		Total impact in terms of GDP		Change in labour after shock(worker)
	(US\$ million)	Percentage change after shock (%)	(US\$ million)	Percentage change after shock (%)	
Agri-vegetal	1,147	4.7	1,034	4.7	211,291
Agri-animal	562	4.9	305	4.9	62,509
Oil & extracts	168	0.5	161	0.5	658
Food industries	405	0.9	112	0.9	4,323
Tobacco	43	0.8	26	0.8	934
Spinning & weaving	45	0.7	15	0.7	5,526
Cloth	100	0.9	18	0.9	2,083
Chemical industry	101	0.9	30	0.9	413
Petroleum products	108	0.7	93	0.7	314
Non-metals industry	3	0.1	2	0.1	345
Basic metals	21	0.2	6	0.2	354
Metals industry	4	0.5	2	0.5	514
Engineering industry	33	0.5	10	0.5	1,775
Other industries	72	0.6	18	0.6	2,047
Construction	3	0.0	1	0.0	266
Electricity	38	0.5	17	0.5	1,509
Transportation	103	0.6	86	0.6	4,354
Communication	43	0.6	35	0.6	1,786
Hotels & restaurants	76	0.6	46	0.6	1,149
Trade & finance	353	0.7	259	0.7	15,989
Social services	292	0.6	193	0.6	40,391
Total/average	3,719	1.0	2,467	1.1	358,529

production, GDP and employment decrease by 0.3%, 0.4% and 0.4% under a tariff elimination scenario (S1). In contrast, the NTM reduction scenario (S2) has positive impacts on the Egyptian economy as a result of the

positive change in agricultural production; the corresponding percentage changes are 1%, 1.1% and 1.6% for national production, GDP and employment respectively. Under S2, the total impact on production amounts to

US\$3.7 billion, about half of which is generated by the two primary agricultural sectors: namely the crop and live-stock sectors. The absolute change in labour after the shock amounts to 358,000 workers, whereby three-quarters of the change in workers takes place in the agriculture sector. These results confirm of the importance of the agricultural sector in terms of income and employment generation in Egypt's economy.

Morocco

To assess the effects of trade liberalization on key sectors, three scenarios were simulated to assess the objective of promoting the economic role of these sectors through an increase in income and exports: (i) Scenario 1: a uniform shock of 1% of aggregate GDP; (ii) Scenario 2: a 10% increase in exports from key agri-food sectors, and (iii) Scenario 3: a 10% increase in exports of agri-food BL. The results are summarized below.

In Scenario 1, we assessed the sectoral impact of a shock equivalent to 1% of aggregate GDP on growth (measured as aggregate GDP) in each of the productive sectors. Figure 1 shows that all sectors have an effect that varies between 0.43% for petroleum and coal products and 1.22% for sugar. The agri-food products display relatively good scores, with the highest GDP impact for sugar (1.22%) and the lowest for processed rice (0.68%). It is also interesting to note that within the agri-food sector, food processing displays a higher impact on aggregate GDP compared with primary products. Among the former, the most important sectors are vegetable oil and fats (1.19%), dairy products (1.04%), sugar (1.22%), food products nec (1.19%) and beverages and tobacco products (1.10%). Apart from vegetable oil and fats, which are classified as a weak sector according to the SAM analysis, other agri-food sectors are classified as either key sectors (food products nec) or sectors with BL (dairy

products, sugar, meat products nec and beverages and tobacco products). In terms of elasticity, the values range between almost 0 for sugar cane and sugar beet and 0.36 for administration (Figure 1). Among the agri-food sectors, the food products nec sector displays the highest elasticity with a value of 0.11, meaning that a 1% change in total supply of this sector would change aggregate GDP by 0.11%. For the rest of the agri-food sectors, the elasticity is below 0.05.

Scenario 2 assumed a 10% increase in exports from agri-food key sectors; the most important are vegetables, fruit, nuts and food products nec, which contribute most to exports (Table 6). The aggregate effect on the total production of all sectors reached about US\$767 million, or a 0.44% increase compared with the SAM data for 2004. The key agri-food sectors contribute around 11.6%, with wheat dominating the contribution, followed by food products nec, and vegetables, fruit and nuts. The contribution of the BL agri-food sectors is more significant, with an increase in production of slightly more than US\$117 million, which represents 15.3% of the aggregate volume. The sectors that contribute most are cereal grains nec, dairy products and sugar. For total GDP, an increase of almost US\$341million would be possible, corresponding to a variation of 0.48% compared with the same 2004 SAM data. The increase in GDP of agri-food key sectors could reach almost US\$59 million, or about 17.3% of the total impact in terms of GDP. Again, the contribution of wheat is the most important, followed by vegetables, fruit and nuts, and then food products nec. For the agri-food BL sectors, GDP would increase by almost US\$68 million, or about 20% of the total impact. As with the case of the production effects, cereal grains nec would be the sector benefiting the most, but in this case, it would be followed by meat, meat products nec and dairy products.

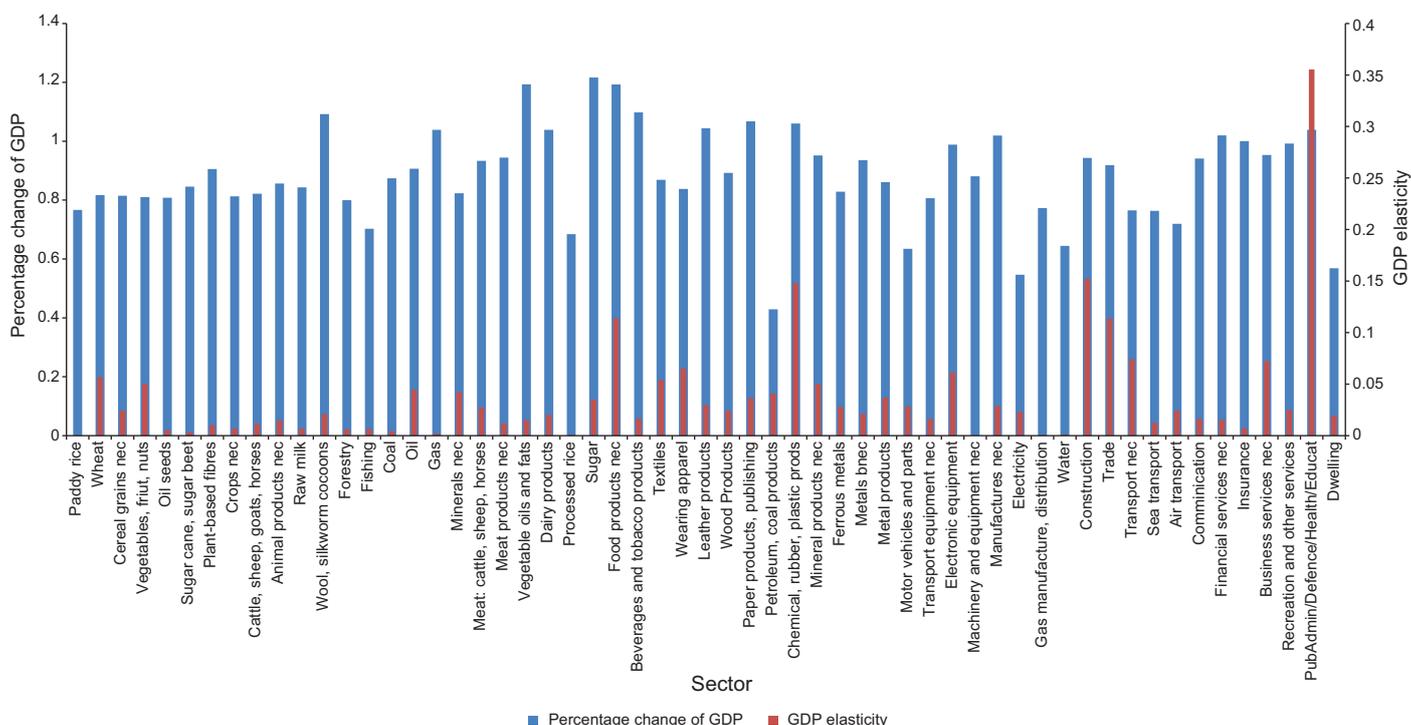


Figure 1. Sectoral growth impact and GDP elasticity, shock of 1% of aggregate GDP, Morocco.

Table 6. Effects of 10% increase of exports of agri-food key sectors (Scenario 2), Morocco.

Sector	Total impact on production/income	% change after shock	Total impact in terms of GDP	% change in GDP after shock
Wheat	54.14	1.46	38.20	1.46
Vegetables, fruit, nuts	27.21	0.60	19.26	0.60
Food products nec	7.63	0.30	1.38	0.30
<i>Aggregate</i>	<i>767.08</i>	<i>0.44</i>	<i>340.63</i>	<i>0.48</i>

Table 7. Effects of 10% increase of exports of agri-food backward linkages sectors (Scenario 3), Morocco.

Sector	Total impact on production/income	% change after shock	Total impact in terms of GDP	% change in GDP after shock
Wheat	5.28	0.14	3.73	0.14
Vegetables, fruit, nuts	2.88	0.06	2.04	0.06
Food products nec	1.32	0.05	0.24	0.05
<i>Aggregate</i>	<i>106.00</i>	<i>0.06</i>	<i>45.44</i>	<i>0.06</i>

Scenario 3 aimed to evaluate the diffusion effect that a 10% increase in exports of agri-food BL sectors could generate in the economy, especially on total revenue and aggregate GDP. Table 7 shows that the overall effects on both total production and GDP are much lower than in Scenario 2. Indeed, the aggregate output of all sectors increased by US\$106 million, an improvement of 0.06% compared with the 2004 SAM. The impact is very limited on agri-food key sectors, with an increase not exceeding US\$9.5 million in total.

Due to their higher number, the production of the BL agri-food sectors would increase by US\$17.3 million, a share estimated to be 16.3% of total production. Here, the sectors most affected would be raw milk, cereal grains nec and sugar. The total GDP increase would be US\$45.4 million, or only 0.06% compared with the same matrix. Improvement of the GDP of the three key agri-food sectors is very small, with a maximum of US\$6 million, while BL agri-food sectors display an impact of US\$10.4 million, or almost 23% of the aggregate GDP. Consequently, the economic interest of export promotion of agri-food key sectors seems to be largely justified in comparison with a policy that could target a wider range of agri-food sectors displaying BL. The wheat sector could benefit most from such a policy, given the importance of the transfer effect and the closed-loop effect, which respectively recorded a value of almost US\$30 million and US\$24.2 million as an income increase. As BL agri-food sectors, other cereals, raw milk, dairy products, meat and meat products would also benefit from the economic openness, given their highest records in terms of production and GDP among the whole set of BL agri-food sectors.

Tunisia

Following Ben Abdallah *et al* (2013), we used the MAGNET results to show that after trade liberalization, food production could increase by about 16.6% in 2020 under

Scenario 2. Hence, this is equivalent to an annual increase of Tunisia's food production by 2.1%. We implemented the same shock to all the agri-food sectors, given the mismatch between the sectors considered in the MAGNET model and the sectors considered in Tunisia's (2005) SAM. Therefore we performed a first simulation to study the sensitivity of the Tunisian economy to these shocks. It is important to note that the choice of the level of increase in GDP does not matter, since the model is linear; this means that, for example, the effects of a shock of 2% would simply be twice as large as those obtained for 1%.

Figure 2 summarizes the impacts on GDP. Fishery products constitute the agricultural sector with the highest impacts on aggregate GDP, with a 2.73% increase, followed by vegetables (2.62%), livestock (2.61%), fruits and tree crops (2.57%) and olives and other pulses (2.02%). The sectors with the lowest impacts are grains or cereals (1.70%) and other crops (including roots and peppers) (1.59%). In terms of elasticity, the situation is quite different. The sector with the highest elasticity is livestock (0.05), meaning that a 1% change in total livestock supply causes a change in aggregate GDP of 0.05. Vegetables have the second highest elasticity (0.03), followed by grains or cereals, olives and other pulses, fishery products and aquaculture and fruits and tree crops with the same elasticity (0.02). The sector with the lowest elasticity (0.01) is 'other crops'; it also has the lowest GDP impact.

Table 8 shows the estimated change in GDP and labour after a shock of 2.1% on aggregate GDP. The agricultural sector with the highest change in GDP is vegetables (8.8%), followed by grains or cereals (8.4%). Generally, to respond to these shocks, the agricultural sector would have to create almost 42,300 new jobs. The agricultural sector with the highest impact on labour is the livestock sector, with 11,583 jobs created, followed by the vegetables sector, with 9,841 jobs created in response to an increase in production of 2.1%. The agricultural sectors

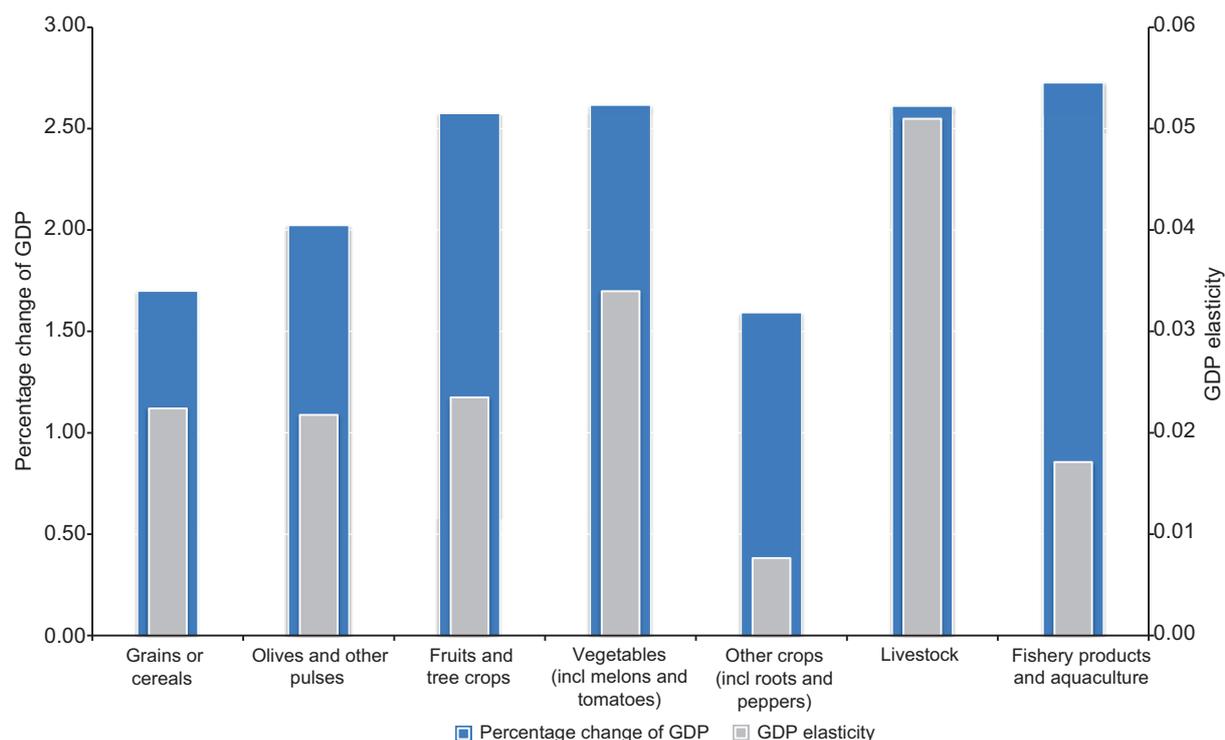


Figure 2. Sectoral growth impact and GDP elasticity, shock of 2.61% of aggregate GDP, Tunisia.

Table 8. Change in GDP and labour after an increase of 2.1% of aggregate GDP, Tunisia.

Sector	Size of the shock (million US\$)	Change in GDP (%)	Change in labour after shock		
			Skilled	Semi-skilled	Unskilled
Grains or cereals	13.7	8.4	317.9	59.0	4,911.3
Olives and other pulses	11.2	8.0	324.2	60.2	5,008.7
Fruits and tree crops	9.6	7.8	355.3	65.9	5,489.6
Vegetables (incl melons & tomatoes)	14.0	8.8	591.6	109.8	9,140.0
Other crops (incl roots & peppers)	4.9	7.5	101.7	18.9	1,570.6
Livestock	21.0	7.2	696.3	129.2	10,757.4
Fishery products and aquaculture	6.2	6.6	836.2	115.3	1,638.4

Table 9. Estimated change in income due to increase of 2.1% aggregate GDP, Tunisia.

Household	Total impact on production/ income (million US\$)	% change in income after shock
Senior professionals and bureaucrats	14.7	0.3
Junior professionals and bureaucrats	6.3	0.3
Other wage employees	6.6	0.3
Owners of non-farm enterprises	8.5	0.4
Self-employed in small enterprises	2.3	0.4
Workers in non-farm enterprises	13.9	0.4
Farmers with own farms	16.2	1.0
Other agricultural workers	1.0	0.4
Unemployed	0.6	0.3
Retired	5.7	0.2
Inactive	2.5	0.2
Remittance-dependent	1.5	0.2

that will generate more jobs, especially for skilled labour, are fishery products and aquaculture, with 836 jobs, followed by livestock and vegetables, with 696 and 592 jobs created respectively. These results are consistent with the labour multiplier analyses. With regard to the impacts of the increase in food production on households' incomes, Table 9 shows that trade liberalization will increase farmers with their own farms' income by 1%, and other income of agricultural workers by 0.4%. This implies that trade liberalization will respond to one of the claims of the Arab Spring: the enhancement of rural income.

Concluding remarks

This paper presents an analysis of deeper trade integration between the EU and Egypt, Morocco and Tunisia. Overall, the simulation results show that further trade

Table 10. Highest backward (BL) and forward (FL) linkages for agri-food sectors in North African countries.

Country	Agri-food sectors	BL	FL
Egypt(SAM 2010)	Food industries (processed food products)*	1.29	2.28
	Agricultural plant production: vegetables & fruits*	1.13	1.34
	Agricultural animal	1.07	0.63
Morocco (SAM 2004)	Wheat	0.87	1.37
	Vegetables, fruit, nuts	1.16	0.86
	Paddy rice	0.89	0.15
	Cereal grains nec	0.93	0.67
	Food products nec*	1.19	1.48
	Sugar cane, sugar beet	1.20	0.24
	Plant-based fibres	1.17	0.28
	Cattle, sheep, goats, horses	1.18	0.41
	Meat: cattle, sheep, goats, horses	1.16	0.59
	Meat products nec	1.23	0.33
	Dairy products	1.02	0.42
	Processed rice	1.00	0.16
	Tunisia (SAM 2005)	Grains or cereals	1.11
Olives and other pulses		1.11	0.49
Fruits and tree crops		1.13	0.57
Vegetables (including melons & tomatoes)		1.13	0.74
Other crops (including roots & peppers)		1.10	0.33
Livestock		1.12	0.88
Fishery products and aquaculture		1.09	0.37

Note: *Key sector measured by the largest score of BL and FL larger than 1. The agri-food product classification differs for the respective countries according to the detail provided in the SAM.

liberalization would lead to a general gain for the agri-food sector in each of the countries reviewed. With the SAM analysis, the key sectors in the respective countries are identified, showing that manufacturing, services and other sectors tend to be more important than the agri-food sector. A sector is considered key when the estimates of its backward (BL) and forward linkages (FL) are greater than 1. This means that the sector generates more income than the average sector in the economy, and thus responds to shocks more than the average sector. The BL of a sector refers to the change in economy-wide income, relative to the average change in the economy caused by a change in the respective sector. The FL of a sector refers to the change in income for the respective sector, relative to the average change in the economy caused by a change in all sectors. The FL represents how each sector is affected by changes in other sectors in the economy.

Key sectors can be considered as important for stimulating and triggering growth in terms of multiplier effects via BL and FL amongst sectors. Table 10 presents the highest BL and FL in Egypt, Morocco and Tunisia. The detail of the aggregation depends on the case studies. In Egypt, food industries (processed food), oil and fats as well as vegetables are identified as key sectors. These could play a leading role and become essential drivers of growth in Egypt. In Morocco, key agri-food sectors are sugar cane, vegetables, fruit, nuts, meat as well as food products nec, while edible oil crops and other plant products seem to be less important, given their relatively low BL. In Tunisia, all agricultural sectors have a significant BL. Fruits and tree crops, vegetables and livestock are the sectors with the greatest capacity to diffuse income within the Tunisian economy. In comparison with the other agricultural sectors, the livestock sector has the

highest FL: that is, livestock is affected to a larger extent by the other sectors of the economy. A comprehensive understanding of economic linkages is crucial in the design of public and private policies that foster growth and jobs.

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