FEM43-03

FEMISE RESEARCH PAPERS

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February 2019

Ce rapport a été réalisé avec le soutien financier de l'Union Européenne dans le contexte du projet UE-FEMISE sur: "Support to economic research, studies and dialogue of the Euro-Mediterranean Partnership". Le contenu du rapport relève de la seule responsabilité des auteurs et ne peut en aucun cas être considéré comme reflétant l'opinion de l'Union Européenne.

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1. Introduction

International trade increasingly involves the exchange of services and goods that are used in production process to generate intermediate inputs and final products to be shipped all over the world. According to the OECD, about 60% of international trade is related to intermediate inputs. This radically affects the traditional analysis of international trade as exports embed imported intermediate inputs and the direct importing country can differ from the country where the product is absorbed by final demand.

One of the major reasons for the rising share of trade in intermediate inputs is that companies increasingly organise their sourcing strategies on a global basis thus leading to emergence of Global Value Chains (GVCs). The concept of Global Value Chain appeared for the first time in the discussions of the Global Value Chains Initiative (2000-2005) supported by the Rockefeller Foundation and it was formalised by Gereffi et al. in 2005. According to Gereffi et al. (2005, p. 79), GVCs research and policy "examine the different ways in which global production and distribution systems are integrated, and the possibilities for firms in developing countries to enhance their position in global markets". In other words, GVCs try to account for globalisation and fragmentation of production in the sense employed by Dicken (2003, p. 12), that is, by taking into consideration not only the geography spread of activities across national boundaries but also their integration and coordination.

Put it simply, GVCs label all production processes that involve international trade in intermediate inputs (Wang et al., 2017). Two main statistical sources can be used to analyse GVCs: firms´ business records and input-output tables. Although firms´ business records can provide interesting insights on the structure of GVCs they have a limited use from a macroeconomic perspective. In his overview of the analytical framework for GVCs, Ianomata (2017) traces back the origin of the analysis of GVCs using input-output tables to the pioneering work by Hummels et al. (2001) that introduced the concept of vertical specialisation. Vertical specialisation focuses on "a deeper dimension to international integration involving the connection of production processes in a vertical trading chain that stretches across many countries" (Hummels et al., 2001, p. 92-93) and can be described as the import content of exports. As Bohn et al. (2018) note, there are two main approaches to measure the relationship between value

added flows and trade flows: the demand-side absorption approach, introduced by Johnson and Noguera (2012), and the supply-based approach developed by Koopman et al. (2014). Johnson and Noguera (2012) estimate "trade in value added", that is, they describe the destination where the value added produced in each country is absorbed. Koopman et al. (2014) go a step further by combining the literature on trade in value added and on vertical specialisation and estimate "value added in trade", that is, they decompose gross exports into three parts: domestic value added, foreign value added and double counting items (that appear when intermediate inputs cross national borders several times). This decomposition is the basis for the construction of indicators on the participation in GVCs, like vertical specialisation (Hummels et al., 2001), international fragmentation of production (Cappariello and Felettigh, 2015) and GVC-related trade (Koopman et al., 2014; Borin and Mancini, 2017).

Empirical evidence on the participation of Mediterranean countries in GVCs using input-output analysis is very scarce. Few exceptions are the works of Foster-McGregor et al. (2015), Bass (2016) and Del Prete et al. (2017, 2018).

The analyses conducted by Foster-McGregor et al. (2015) and Del Prete et al. (2018) drawing on the UNCTAD-Eora GVC database show that, within the North Africa region, Morocco and Tunisia show a more downstream position in GVCs and a higher potential for participation in high value added production stages. At industry level four industries stand out in Morocco: the aerospace industry, the textile and clothing industry, the automotive industry and the phosphate industry. Big international companies are behind the growth of these industries like Airbus in the case of the aerospace industry, Zara or Armani in the textile and clothing industry or Renault-Nissan in the automotive industry. Concerning the impact of GVCs on productivity, the analysis conducted by Del Prete et al. (2017) for Morocco shows that more productive firms tend to become involved in GVCs and that there is a positive impact of the participation in GVCs on firms´ performance, and, as result, on the country competitiveness. In the case of Tunisia three industries stand out: textile and footwear, food, beverages and tobacco industry and electrical and optical equipment (Bass, 2016). In addition, since the 2000s some service industries are gaining importance like call centers or business services.

Various theoretical works provide support for the positive impact that the use of better business services as intermediates inputs can have on the production processes of rest of industries and, in general, on growth and competitiveness (Ethier 1982; Grossman and Helpman 1991; Markusen 1989). Ethier (1982) states that, in general, a country tends to import those products which make most intensive use of its relatively scarce factors although a higher variety of intermediate inputs thanks to trade can result into higher productivity of user industries. In the case of developing countries, as many business services are knowledge intensive their production is relatively scarce in their first stages of development and international trade can serve as a vehicle to transfer science and technology. In this sense Grossman and Helpman (1991) note that innovation resulting from technological and knowledge flows from abroad are related to the extent of international trade. Starting from the model proposed by Ethier (1982), Markusen (1989) concludes that free trade in business services is superior to free trade in goods as domestic and foreign specialised business services intermediate inputs complement in final production.

The reasons for the increasing importance of business services in exports are varied. Following Baldwin et al. (2015) four main explanatory factors can be highlighted. First, the reclassification of outsourcing: when a manufacturing company outsources business services the work moves from the manufacturing sector to the service sector. Second, the increasing number of services embedded in goods: as goods become more technology intensive they involve more business services like design. Third, the rising participation of business services in the production processes. The growth of domestic and foreign outsourcing implies not only more transportation services but also more business services. Finally, there is a simple accounting reason: cheaper fabrication reduces the share of value added coming from manufacturing. Overall, more developed countries tend to show a higher content of services in their exports (Francois et al. 2015). In many cases raising exports in developing countries rely on the production of manufacturing products involving increasing levels of knowledge and sophistication so the use of business services becomes an essential element for improving trade in goods (Golub et al., 2007; Tajoli and Felice, 2018). Heuser and Mattoo (2017) highlight that the very existence of GVCs is due to improvements in services like transport and communications, but also in business services like computer and related activities, and that when GVCs include services, and in particular business services in favorable price-

quality bundles and diverse varieties, firms perform better and increases in productivity and shifts in the pattern of comparative advantages can be achieved. Concerning the impact on comparative advantage, the recent work by Liu et al. (2018) shows that the development of business services enhances the revealed comparative advantage of manufacturing sectors that use this type of services and that the handicap of an underdeveloped business services sector can partially be overcome by relying on imported business services intermediate inputs.

In this report we will argue that for a better understanding of how business services can contribute to competitiveness and growth in Morocco and Tunisia decomposing trade flows in terms of value added can be a useful first step. We start from the OECD-WTO Trade in Value Added database (OECD, 2016) to decompose exports in value added in business services from Morocco and Tunisia to the EU28 and to the rest of the world. This decomposition is used to compute several indicators of participation in the GVCs. Two business services industries are examined: computer and related activities and R&D and other business activities.

1. Methodology and data.

To measure value added flows the starting point is an Inter-Country Input-Output (ICIO) table with *n* countries (indexed by *s* or *r*) and *k* industries (indexed by *i* or *j*) as shown in Figure 1.

The information of an ICIO table can be organised into matrices and vectors as follows: a *nkxnk* matrix of intermediate deliveries D, a *nkxn* matrix Y of final demand, *nk*-elements value added vector va and *nk*-elements output vector x. The 2016 edition of the OECD-WTO Trade in Value Added database covers 63 economies and 34 industrial sectors (16 manufacturing sectors and 14 services sectors) over the period 1995-2011. The ICIO tables from which the database is derived are based on national and international statistics compiled according to the 1993 System of National Accounts (SNA 1993).

If we take country *s* and country *r*, each element d_{ij}^{sr} of the *k k* matrix D^{sr} shows the intermediate deliveries from industry *i* in country *s* to industry *j* in country *r*. Each element y_i^{sr} of the *kx1* vector y^s shows the final deliveries from industry *i* in country *s*

for final demand in country *r*. Each element va_j^s of the *1xk* vector va^s shows the value added generated in industry *j* in country *s*. Each element x_j^s of the *1xk* vector x^s shows the output of industry *j* in country *s*.

Figure 1. Structure of an Inter-Country Input-Output (ICIO) table.

			Intermediate deliveries							Final demand			Output
			Country 1			…	Country n			Country 1		Country n	
			Industry 1	…	Industry k	…	Industry 1	…	Industry k				
Intermediate inputs	Country 1	Industry 1	d_{11}^{11}	…	d_{1k}^{11}	…	d_{11}^{1n}	…	d_{1k}^{1n}	y_1^{11}	…	y_1^{1n}	x_1^1
		…	…	…	…	…	…	…	…	…	…	…	…
		Industry k	d_{k1}^{11}	…	d_{kk}^{11}	…	d_{k1}^{1n}	…	d_{kk}^{1n}	y_k^{11}	…	y_k^{1n}	x_k^1
	…	…	…	…	…	d_{ij}^{sr}	…	…	…	…	y_i^{sr}	…	x_i^s
	Country n	Industry 1	d_{11}^{n1}	…	d_{1k}^{n1}	…	d_{11}^{nn}	…	d_{1k}^{nn}	y_1^{n1}	…	y_1^{nn}	x_1^n
		…	…	…	…	…	…	…	…	…	…	…	…
		Industry k	d_{k1}^{n1}	…	d_{kk}^{n1}	…	d_{k1}^{nn}	…	d_{kk}^{nn}	y_k^{n1}	…	y_k^{nn}	x_k^n
Value added			va_1^1	…	va_k^1	va_j^s	va_1^n	…	va_k^n				
Output			x_1^1	…	x_k^1	x_j^s	x_1^n	…	x_k^n				

By introducing a summation vector u_n consisting of ones, we can obtain total output in country *s* as follows:

$$x^s = \sum_{r=1}^{n} D^{sr} u_n + \sum_{r=1}^{n} y^{sr} \qquad (1)$$

We can compute an input coefficient matrix A^{sr} by dividing the intermediate deliveries matrix D^{sr} by the diagonalised output vector $\hat{x}^r$ as follows:

$$A^{sr} = D^{sr}(\hat{x}^r)^{-1} \qquad (2)$$

Each element a_{ij}^{sr} of matrix A^{sr} shows the intermediate deliveries from industry *i* in country *s* necessary to produce one unit of output in industry *j* in country *r*.

If we introduce the input coefficient matrix into the first equation, total output in country *s* can be obtained as follows:

$$x^s = \sum_{r=1}^{n} A^{sr} x^r + \sum_{r=1}^{n} y^{sr} \quad (3)$$

And re-arranging:

$$x^s = \sum_{t=1}^{n} B^{st} y^{tr} \quad (4)$$

Where $\mathrm{B} \equiv (\mathrm{I} - \mathrm{A})^{-1}$ is the Leontief inverse matrix. Matrix B^{st} shows the amount of output in producing country *s* required for a one-unit increase in final demand in destination country *r*.

In a global setting, using block matrix notation, this relationship can be described for *n* countries and *k* industries as follows:

$$\begin{bmatrix} X^1 \\ \vdots \\ X^s \\ \vdots \\ X^n \end{bmatrix} = \begin{bmatrix} I - A^{11} & \cdots & -A^{1s} & \cdots & -A^{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ -A^{s1} & \cdots & I - A^{ss} & \cdots & -A^{sn} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ -A^{n1} & \cdots & -A^{ns} & \cdots & I - A^{nn} \end{bmatrix}^{-1} \begin{bmatrix} \sum_{r=1}^{n} Y^{1r} \\ \vdots \\ \sum_{r=1}^{n} Y^{sr} \\ \vdots \\ \sum_{r=1}^{n} Y^{nr} \end{bmatrix} =$$

$$\begin{bmatrix} B^{11} & \cdots & B^{1s} & \cdots & B^{1n} \\ \vdots & \ddots & \cdots & \ddots & \vdots \\ B^{s1} & \cdots & B^{ss} & \cdots & B^{sn} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ B^{n1} & \cdots & B^{ns} & \cdots & B^{nn} \end{bmatrix} \begin{bmatrix} \sum_{r=1}^{n} Y^{1r} \\ \vdots \\ \sum_{r=1}^{n} Y^{sr} \\ \vdots \\ \sum_{r=1}^{n} Y^{nr} \end{bmatrix} \quad (5)$$

In order to obtain value added in exports, we need to compute value added coefficients vectors v^s in the same way as we compute the input coefficients matrices:

$$(v^s)' = (va^s)'(\hat{x})^{-1} \quad (6)$$

Each element v_j^s of vector v^s shows the value added per unit of output in industry *j* of country *s*.

Following Johnson and Noguera (2012), the exports of value added from country *s* to country *r* (VAX^{sr}) can be obtained by pre-multiplying equation (4) by the value added coefficients vector $(v^s)'$ as follows:

$$VAX^{sr} = \sum_{t=1}^{n} (v^s)' B^{st} y^{tr} \quad \text{for } s \neq r \tag{7}$$

Each element of vector VAX^{sr} shows the value added exports from country *s* to country *r*, that is, the value added generated in country *s* that is finally absorbed by the final users in country *r*. The ratio of value added exports to gross exports can be used as an indicator of the value added content of trade.

According to Bohn et al. (2018), it is possible to compute two additional indicators to answer two complementary questions: where does the value added of each country go? And where does the consumed value added of each country come from?

To answer the two questions, it is necessary to create an *nxn* matrix with VAX^{sr} including the diagonal elements $s = r$.

As the sum by rows of VAX^{sr} equals the gross domestic product of each country (GDP), for country *s* VAX^{ss} shows the value added for its own final users and $\sum_{s \neq r} VAX^{sr}$ shows the value added exported to final users abroad. Thus, the first indicator (XVA^{sr}) tries to answer the first question on the destination of the value added by normalising the rows of matrix VAX^{sr} as follows:

$$XVA^{sr} = \frac{VAX^{sr}}{GDP^s} \tag{8}$$

It shows the share of the GDP of country *s* exported to country *r* and embodied in its final demand.

In the same way, as the sum by columns of VAX^{sr} equals the final demand of each country, to answer the second question on the origin of the consumed value added, for

country *s* VAX^{ss} shows the value added generated by its own producers and and $\sum_{s \neq r} VAX^{sr}$ shows the value added imported. The second indicator (MVA^{sr}), normalises the columns of matrix VAX^{sr} as follows:

$$MVA^{sr} = \frac{VAX^{sr}}{Y^r} \quad (9)$$

It shows the share of the final demand of country *r* that is imported and generated by country *s*, that is, the value added imports from *s* as a share of total final demands in country *r*.

As was mentioned in the introduction, Koopman et al. (2014) go a step further by combining the literature on trade in value added (Johnson and Noguera, 2012) and on vertical specialisation (Hummels et al., 2001) and estimate "value added in trade", that is, they decompose gross exports into three elements: domestic value added exports plus domestic value added in intermediate inputs exports that finally return home and foreign value added. Each of these three components is further disaggregated into three sub-components. Thus, the first component, value added exports, is composed of domestic value added incorporated in final products exports, domestic value added in intermediate inputs exports absorbed by direct importers and domestic value added in intermediate inputs re-exported to third countries. The second component comprises the domestic value added in intermediate inputs exports that finally return home. The way of returning home can be via imports of final products, via imports of intermediate inputs or via double counted intermediate inputs exports produced at the home. Finally, the foreign value added is disaggregated (as the first component) into foreign value added incorporated in final products exports, in intermediate inputs exports and in double-counted intermediate inputs exports produced abroad.

In order to obtain the decomposition introduced by Koopman et al. (2014), we start from a value added coefficient vector v^s. It can be obtained as one minus the sum of the input coefficients from all countries (including those intermediate inputs domestically produced):

$$v^s = u_n(I - \sum_{r=1}^{n} A^{rs}) \quad (10)$$

where u_n is a summation vector consisting of ones. Each element v_j^s shows the ratio of direct domestic value added in industry *j* of country *s*.

Using block matrix notation, we can define an *nxnk* direct domestic value added matrix V for all countries as follows:

$$V = \begin{bmatrix} v^1 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & v^s & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & v^n \end{bmatrix} \quad (11)$$

The total value added shares matrix is obtained by multiplying the V matrix by the Leontief inverse matrix. In addition, as the domestic value added shares of all countries in final demand have to sum one, the following property holds:

$$\sum_{r=1}^{n} v^s B^{sr} = u_n \quad (12)$$

Koopman et al. (2014) start from the following equivalence to derive their results:

$$B(I - A) = (I - A)B = I \quad (13)$$

Thus, the block-diagonal elements B^{ss} can be expressed as:

$$B^{ss} = \sum_{t \neq s}^{n} B^{st} A^{ts} (I - A^{ss})^{-1} + (I - A^{ss})^{-1} = (I - A^{ss})^{-1} + (I - A^{ss})^{-1} \sum_{t \neq s}^{n} A^{st} B^{ts} \quad (14)$$

While the off-diagonal elements B^{rs} can be expressed as:

$$B^{rs} = \sum_{t \neq s}^{n} B^{rt} A^{ts} (I - A^{ss})^{-1} = (I - A^{rr})^{-1} \sum_{t \neq r}^{n} A^{rt} B^{ts} \quad (15)$$

Let e^{sr} be a vector of gross bilateral exports from *s* to *r*

$$e^{sr} = A^{sr}x^r + y^{sr} \text{ for } s \neq r \quad (16)$$

Country *s* gross exports to the world are equal to:

$$e^{s*} = \sum_{r\neq s}^{n} e^{sr} = \sum_{r\neq s}^{n}(A^{sr}x^r + y^{sr}) \text{ for } s \neq r \quad (17)$$

Using the equivalences described above, Koopman et al. (2014) decompose total exports of country *s* ($u_n e^{s*}$) as follows:

$$u_n e^{s*} = \left(v^s \sum_{r\neq s}^{n} B^{ss}y^{sr} + v^s \sum_{r\neq s}^{n} B^{sr}y^{rr} + v^s \sum_{r\neq s}^{n}\sum_{t\neq s,r}^{n} B^{sr}y^{rt}\right) + (v^s \sum_{r\neq s}^{n} B^{sr}y^{rs} + v^s \sum_{r\neq s}^{n} B^{sr}A^{rs}(I - A^{ss})^{-1}y^{ss}) + (v^s \sum_{r\neq s}^{n} B^{sr}A^{rs}(I - A^{ss})^{-1}e^{s*}) + (\sum_{t\neq s}^{n}\sum_{r\neq s}^{n} v^t B^{ts}y^{sr} + \sum_{t\neq s}^{n}\sum_{r\neq s}^{n} v^t B^{ts}A^{sr}(I - A^{rr})^{-1}y^{rr}) + (\sum_{t\neq s}^{n}\sum_{r\neq s}^{n} v^t B^{ts}A^{sr}(I - A^{rr})^{-1}e^{r*}) \quad (18)$$

The three elements in the first parenthesis shows value added exports, which are composed of: domestic value added in direct final products exports ($v^s \sum_{r\neq s}^{n} B^{ss}y^{sr}$), domestic value added in intermediate inputs exports absorbed by direct importers ($v^s \sum_{r\neq s}^{n} B^{sr}y^{rr}$) and domestic value added in intermediate inputs re-exported to third countries ($v^s \sum_{r\neq s}^{n}\sum_{t\neq s,r}^{n} B^{sr}y^{rt}$). The second parenthesis captures the domestic value added in intermediate exports re-imported as final goods ($v^s \sum_{r\neq s}^{n} B^{sr}y^{rs}$) and the domestic value added in intermediate inputs reimported as intermediate goods and finally absorbed at home ($v^s \sum_{r\neq s}^{n} B^{sr}A^{rs}(I - A^{ss})^{-1}y^{ss}$). If we add the first and second parenthesis we obtain the gross domestic product in exports. The third parenthesis captures the double-counted intermediate inputs exports produced at home ($v^s \sum_{r\neq s}^{n} B^{sr}A^{rs}(I - A^{ss})^{-1}e^{s*}$). The fourth parenthesis shows the foreign value added in final products exports ($\sum_{t\neq s}^{n}\sum_{r\neq s}^{n} v^t B^{ts}y^{sr}$) and in intermediate inputs exports ($\sum_{t\neq s}^{n}\sum_{r\neq s}^{n} v^t B^{ts}A^{sr}(I - A^{rr})^{-1}y^{rr}$). Finally the fifth parenthesis shows the double-counted intermediate inputs exports originally produced abroad ($\sum_{t\neq s}^{n}\sum_{r\neq s}^{n} v^t B^{ts}A^{sr}(I - A^{rr})^{-1}e^{r*}$).

The methodology developed by Koopman et al. (2014) is a key step into the analysis of global value chains. However, they estimate the components of gross exports at the

aggregate level. To go deeper into the analysis of global value chains, it is necessary to conduct this decomposition at industry level and bilateral level (Borin and Mancini, 2017; Nagengast and Stehrer, 2016; Wang et al., 2018). Borin and Mancini (2017) start from the fact that intermediate inputs from *r* can undergo one or more processing phases to produce final products for domestic consumption or products for re-exports that can be final products or intermediate inputs. Thus, they decompose gross bilateral exports by identifying the country of origin of value added, the direct importers, the eventual second destination of re-export, the country of completion of final products and the ultimate destination market. In addition, in line with Nagengast and Stehrer (2016), they distinguish whether value added flows anchor to the country of final absorption (sink-based approach) or the country of production (source-based approach). They employ a modified version of the Leontief inverse matrix that is obtained by setting to 0 the coefficients that show the requirements of inputs from country *r* in the A matrix (excepting only the domestic input requirements matrixA_{rr}). Their source-based decomposition of bilateral exports from country *s* to country *r* can be arranged into brackets to show the correspondence with the decomposition of Koopman et al. (2014), shown in equation (18).

The first bracket shows the domestic value added in direct final products exports absorbed by bilateral importers, the domestic value added in intermediate inputs exports absorbed by bilateral importers as domestic final products after additional processing stages and the domestic value added in intermediate inputs exports absorbed by third countries as domestic final goods after additional processing stages.

The second bracket shows the domestic value added in intermediate inputs exports distinguishing whether they are absorbed by direct importers as local final products, by direct importers as local final products after further processing stages or by third countries as local final products.

The third bracket captures the domestic value added in intermediate inputs exports absorbed by third countries as final products from direct bilateral importers, the domestic value added in intermediate inputs exports absorbed by third countries as final products from direct bilateral importers only after further processing stages, the domestic value added in intermediate inputs exports absorbed by direct importers as final products from third countries and the domestic value added in intermediate inputs exports absorbed by third countries as final products from other third countries.

The fourth bracket shows the domestic value added in intermediate inputs exports absorbed at home as final products of the bilateral importers, the domestic value added in intermediate inputs exports absorbed at home as final products of the bilateral importers after further processing stages and the domestic value added in intermediate inputs exports absorbed at home as final products of a third country.

The fifth bracket shows the domestic value added in intermediate inputs exports absorbed at home as domestic final products.

The sixth bracket captures the double-counted intermediate inputs exports originally produced at home. The seventh bracket shows the foreign value added in exports of final products and of intermediate inputs absorbed by the importing country *r*. Finally, the eighth bracket captures the foreign value added in exports of intermediate inputs re-exported by country r and the double-counted intermediate inputs exports originally produced abroad.

$$
\begin{aligned}
& u_n e^{sr} = \left[v^s (I - A^{ss})^{-1} y^{sr} + v^s (I - A^{ss})^{-1} A^{sr} (I - A^{rr})^{-1} \left(\sum_{j \neq r}^{n} A^{rj} B^{js} y^{sr} + \right.\right. \\
& \left.\left. \sum_{j \neq r}^{n} A^{rj} \sum_{k \neq s,r}^{n} B^{js} y^{sk}\right)\right] + \left[v^s (I - A^{ss})^{-1} A^{sr} (I - A^{rr})^{-1} \left(y^{rr} + \sum_{j \neq r}^{n} A^{rj} B^{jr} y^{rr} + \right.\right. \\
& \left.\left. \sum_{j \neq r}^{n} A^{rj} \sum_{k \neq s,r}^{n} B^{jk} y^{kk}\right)\right] + \\
& \left[v^s (I - A^{ss})^{-1} A^{sr} (I - A^{rr})^{-1} \left(\sum_{j \neq r,s}^{n} y^{rj} + \sum_{j \neq r}^{n} A^{rj} \sum_{l \neq s,r}^{n} B^{jr} y^{rl}\right) + \right. \\
& \left. \sum_{j \neq r}^{n} A^{rj} \sum_{k \neq s,r}^{n} B^{jk} y^{kr} + \sum_{j \neq r}^{n} A^{rj} \sum_{k \neq s,r,l}^{n} \sum_{l \neq s,r}^{n} B^{jk} y^{kl}\right] + \left[v^s (I - A^{ss})^{-1} A^{sr} (I - \right. \\
& \left. A^{rr})^{-1} \left(y^{rs} + \sum_{j \neq r}^{n} A^{rj} B^{jr} y^{rs} + \sum_{j \neq r}^{n} A^{rj} \sum_{k \neq s,r}^{n} B^{jk} y^{ks}\right)\right] + \left[v^s (I - A^{ss})^{-1} A^{sr} (I - \right. \\
& \left. A^{rr})^{-1} \sum_{j \neq r}^{n} A^{rj} B^{js} y^{ss}\right] + \left[v^s (I - A^{ss})^{-1} \sum_{t \neq s}^{n} A^{st} B^{ts} e^{sr}\right] + \\
& \left[\sum_{t \neq s}^{n} v^t (I - A^{tt})^{-1} A^{ts} (I - A^{ss})^{-1} (y^{sr} + A^{sr} (I - A^{rr})^{-1} y^{rr})\right] + \left[\sum_{t \neq s}^{n} v^t (I - \right. \\
& \left. A^{tt})^{-1} A^{ts} (I - A^{ss})^{-1} A^{sr} (I - A^{rr})^{-1} \sum_{j \neq r}^{n} y^{rj} + \sum_{t \neq s}^{n} v^t (I - A^{tt})^{-1} A^{ts} (I - \right. \\
& \left. A^{ss})^{-1} A^{sr} (I - A^{rr})^{-1} \sum_{j \neq r}^{n} A^{rj} \sum_{k}^{n} \sum_{l}^{n} B^{jk} y^{kl} + \right. \\
& \left. \sum_{t \neq s}^{n} v^t (I - A^{tt})^{-1} \left(\sum_{j \neq t,s}^{n} A^{tj} B^{js} e^{sr} + A^{ts} (I - A^{ss}) \sum_{t \neq s}^{n} A^{st} B^{ts} e^{sr}\right)\right]
\end{aligned}
\tag{19}
$$

This decomposition can be used to obtain three basic indicators:

- Value added exports: it is obtained as the sum of the first three brackets, that is, the domestic value added in direct final exports, the domestic value added in

intermediate inputs exports absorbed by direct importers and the domestic value added re-exported to third countries.

- Domestic value added content in exports: it is obtained as the sum of value added exports plus the fourth, fifth and sixth brackets, that is, the domestic value added in intermediate inputs that returns via final exports, the domestic value added in intermediate inputs that returns via intermediate imports and the double counted intermediate exports produced at home.
- Foreign value added content of gross exports: it is obtained as the sum of the three latter brackets, that is, the foreign value added in final exports, the foreign value added in intermediate inputs exports and the double counted intermediate inputs exports produced abroad.

In the particular case of business services, in order to measure the weight of GVCs in their trade several indicators can be used. One of the most commonly used is the vertical specialisation indicator introduced by Hummels et al. (2001) which is computed as the foreign value added content in total gross exports. Another option is to measure the international fragmentation of production (Cappariello, and Felettigh, 2015) which adds to the foreign value added content the domestic value added content in intermediate exports that finally return home and the domestic value added content in intermediate inputs re-exported to third countries.

One of the main advantages of the methodology proposed by Borin and Mancini (2017, p. 17) is that it allows to identify the domestic value added directly absorbed by the bilateral partner (first terms in the first and in the second bracket) from the domestic value added absorbed by the bilateral partner only after further processing stages abroad or at home (second terms in the first and in the second bracket and third term in the third bracket). In fact, the summation over the importing countries *r* produces the corresponding components of Koopman et al. (2014). This equivalence does not hold for the foreign value added because Koopman et al. (2014) define foreign value added at the world level and not at the country level. In their source-based decomposition Borin and Mancini (2017) classify value added as foreign the first time that an item is re-exported to a foreign country. This definition corresponds to the measure proposed by Johnson (2017). Starting from their decomposition of gross exports, Borin and Mancini (2017) propose a refined version of the GVC-related trade indicator developed by Koopman et al. (2014). This indicator is computed by excluding from gross exports

the fraction of domestic value added that never leaves the first importing country, that is, the first components of first and second bracket.

2. Results and discussion.

Before entering into the analysis of trade in value added and participation in GVCs, we look at the evolution of the gross trade in business services in Morocco and Tunisia. Figures 2 and 3 report the evolution of total gross exports and total gross imports of computer and related activities and R&D and other business activities in Morocco and Tunisia over the period 2000-2011 distinguishing between those business services used as final products (final services) and those business services used as intermediate inputs (intermediate services).

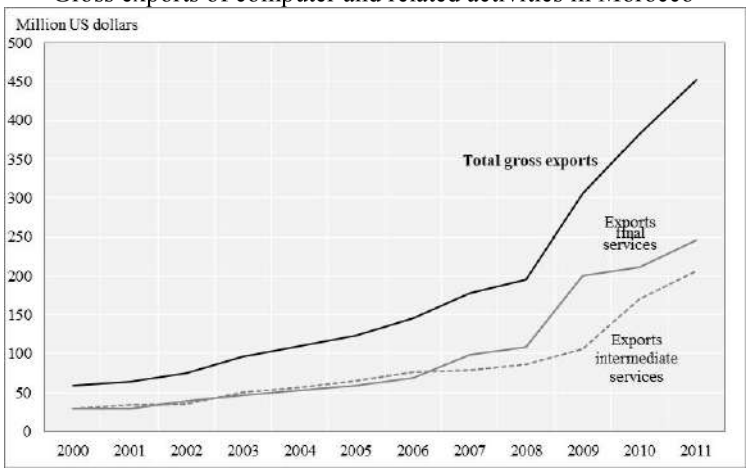
As can be seen, over the period 2000-2011, trade in business services grew at a very fast pace both in Morocco and Tunisia. On average, gross exports of computer and related activities grew at an annual average rate of 21% in Morocco and of 9% in Tunisia. The annual average growth rate of gross exports in R&D and other business activities was double in Morocco (26%) than in Tunisia (13%).

Concerning imports, we find two completely opposed situations: while in Morocco imports grew at a lower annual rate than exports (19% computer and related activities and 21% R&D and other business activities), in Tunisia the pace of grow of imports was superior to the pace of growth of exports (21% in computer and related activities and 15% in R&D and other business activities). The impact of the two downturns experienced over the period analysed: the dot-com bust in 2000-2001 and the global financial crisis in 2008-2009 can be observed in the Figures.

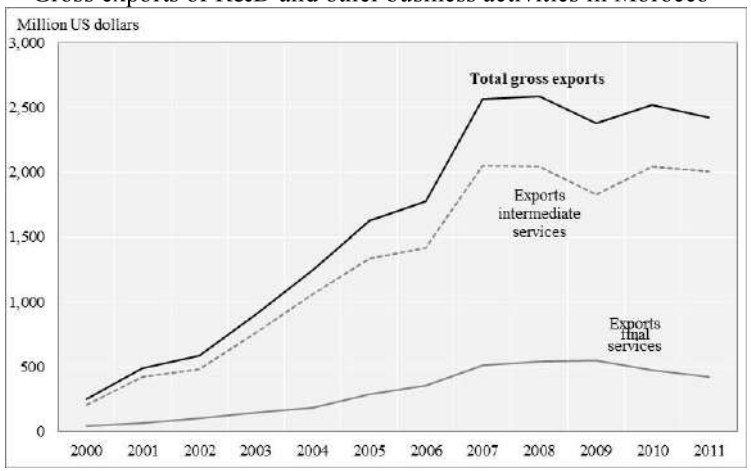
If we distinguish between final business services and business services used as intermediate inputs, we can note how the behaviour of trade in business services intermediates has been much more dynamic that that of final business services. This confirms the hypothesis that GVCs were the most important factor explaining growth in trade during the period 2000-2008, and that the global financial crisis caused three main changes: the rise of protectionism, the substitution of domestically produced intermediate inputs for imported intermediate inputs and the technology and innovation reshoring (Degain et al., 2017).

Figure 2. Evolution of gross exports of business services in Morocco and Tunisia, 2000-2011.

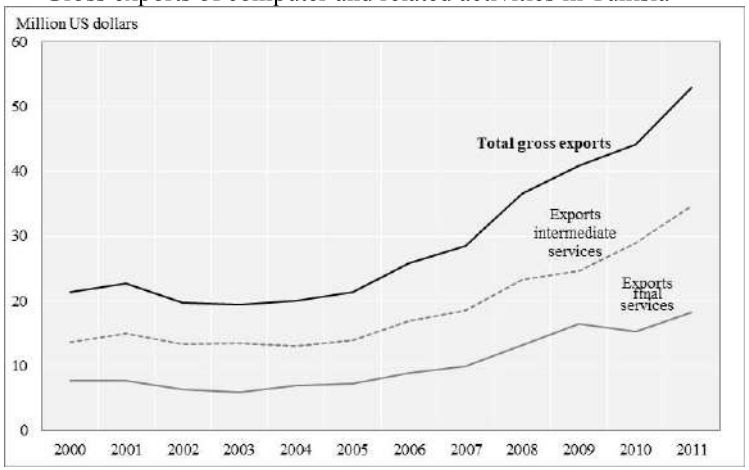
Gross exports of computer and related activities in Morocco



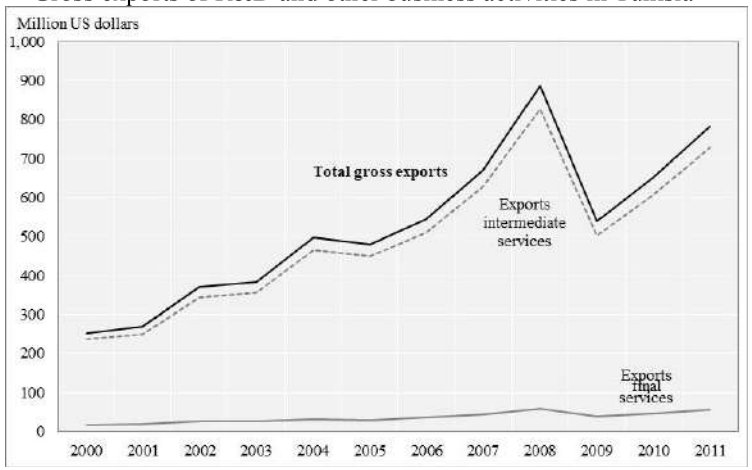
Gross exports of R&D and other business activities in Morocco



Gross exports of computer and related activities in Tunisia



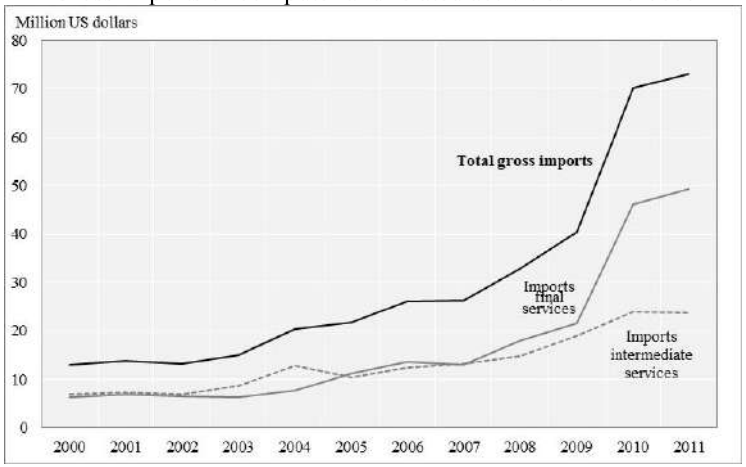
Gross exports of R&D and other business activities in Tunisia



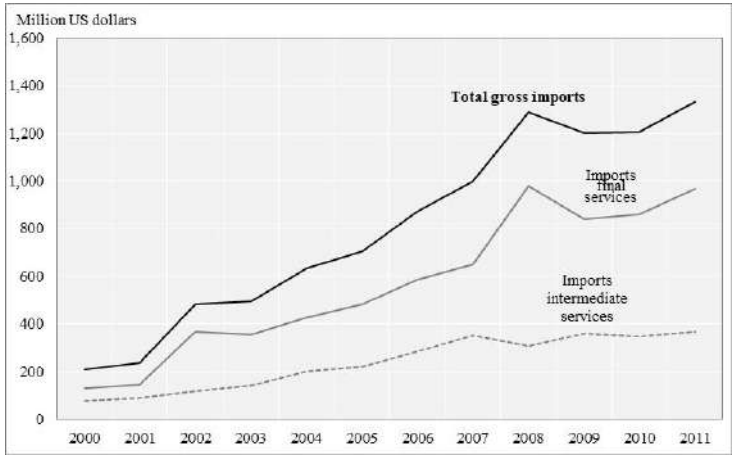
Source: TiVA Database.

Figure 3. Evolution of gross imports of business services in Morocco and Tunisia, 2000-2011.

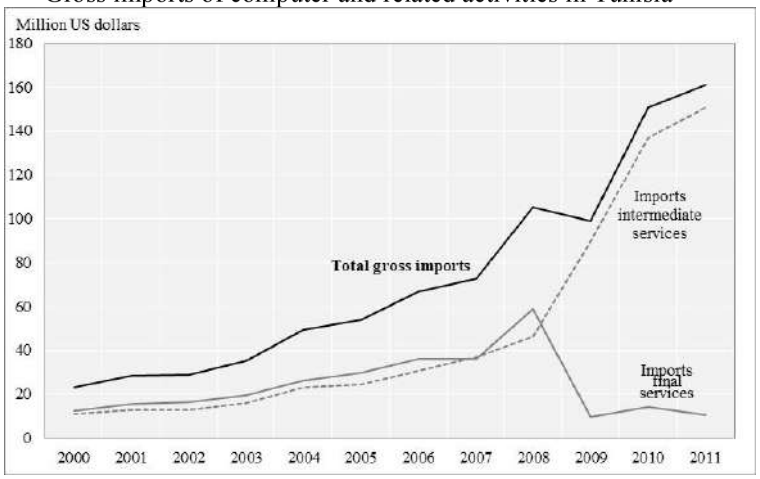
Gross imports of computer and related activities in Morocco



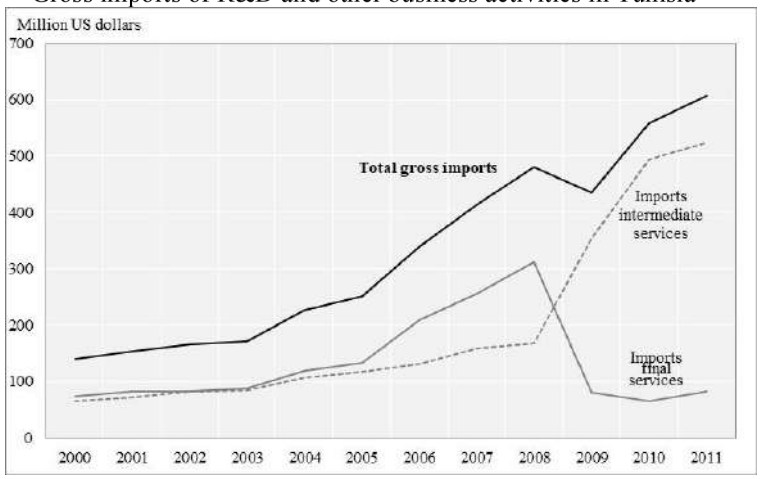
Gross imports of R&D and other business activities in Morocco



Gross imports of computer and related activities in Tunisia

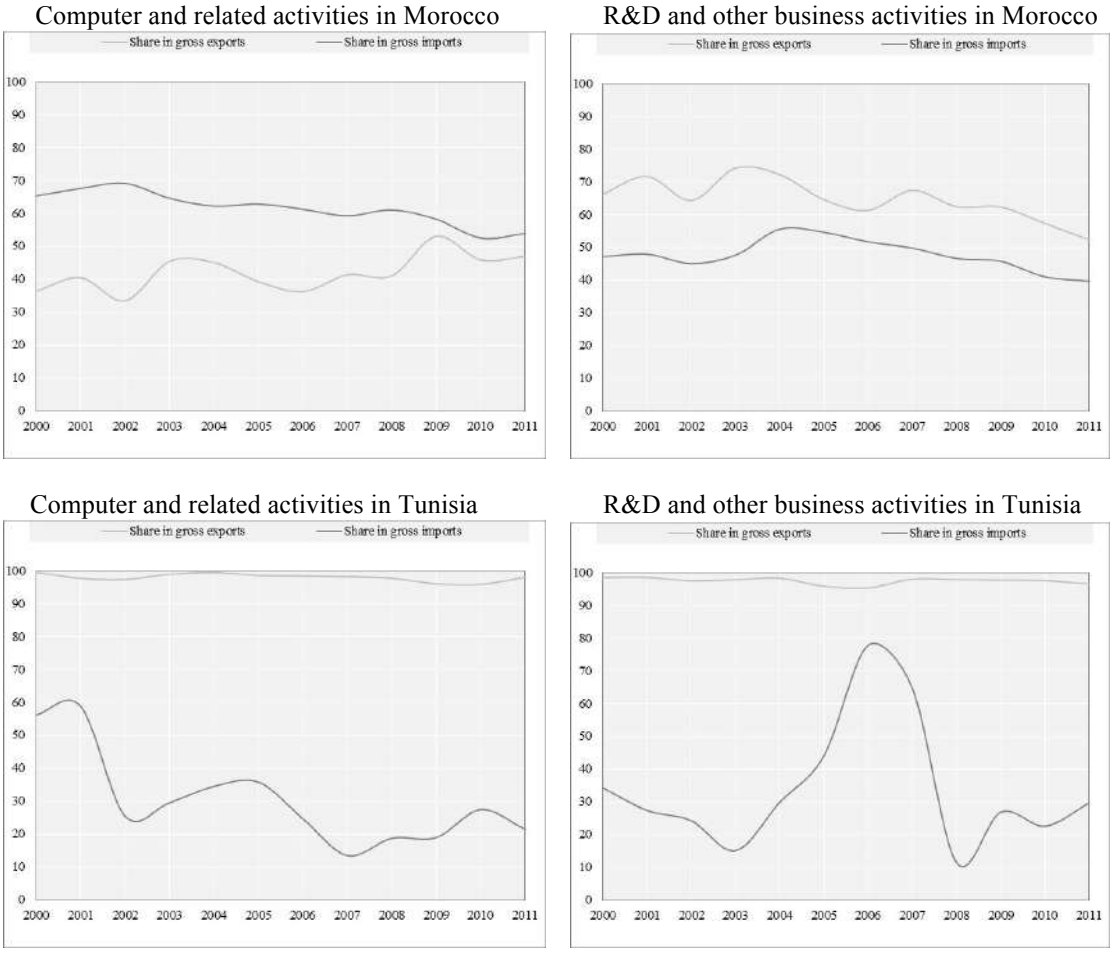


Gross imports of R&D and other business activities in Tunisia



Source: TiVA Database.

Figure 4. Evolution of the share of the EU28 in trade in business services in Morocco and Tunisia, 2000-2011.



Source: Own elaboration from TiVA database.

What is the role played by the EU28? In order to assess the importance as client and provider of the EU28, Figure 4 shows the share of the EU28 in total gross exports and total gross imports of business services in Morocco and Tunisia.

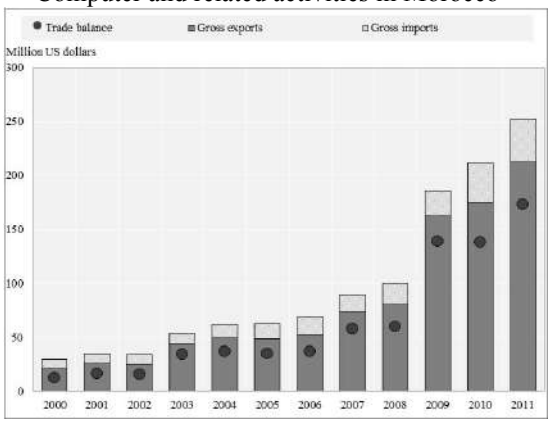
Starting with the importance of the EU28 as a client, we have to note that there are important differences between Morocco and Tunisia. The greatest participations of the EU28 in trade are found in Tunisia where, on average, 98% and 97% of gross exports of computer and related activities and R&D and other business activities were directed to the EU28. The shares in Morocco were much more modest: on average, 43% of gross exports of computer and related activities and 65% of gross exports of R&D and other business activities were directed to the EU28.

Concerning the provider role of the EU28, the highest shares are found in Morocco. On average, 62% of gross imports of computer and related activities and 48% of gross imports of R&D and other business activities came from the EU28. In the case of Tunisia the average participation of the EU28 is total gross imports is considerably lower: 30% of gross imports of computer and related activities and 34% of gross imports of R&D and other business activities came from the EU28. In terms of evolution we have to highlight a certain "convergence" between the client and provider role of the EU28 for Morocco, while in the case of Tunisia the deep differences between the client and the provider roles of the EU28 maintains in the case of R&D and other business activities and increases substantially in the case of computer and related activities.

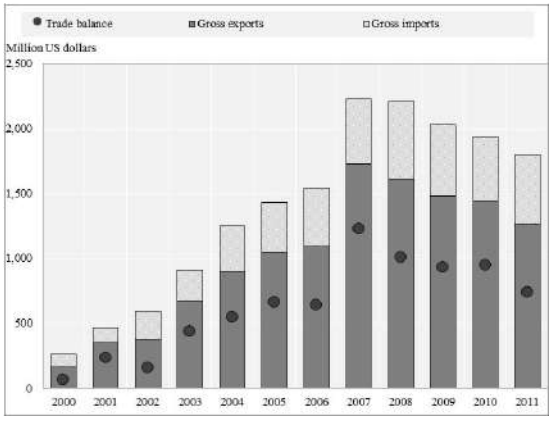
To go deeper into the evolution of gross trade in business services between Morocco and Tunisia and the EU28, Figure 5 shows the evolution of the trade flows and the trade balances in computer and related activities and R&D and other business activities.
Overall we have to highlight the positive trade balance in business services in the two countries examined as a result of the comparatively higher amount of gross exports than of gross imports. In Tunisia, given the strong concentration of trade in business services with the EU28 shown in Figure 3, the evolution in terms of annual average growth rates was exactly the same than that described in Figures 1 and 2 with the sole exception of the comparatively faster increase in gross imports in R&D and other business activities from the EU28: the annual average growth rate of imports in this type of services from the EU28 was 36%, more than doubling the annual average growth rate registered at the world level. In Morocco we find just the opposite trend: the annual average growth rates of imports from the EU28 were lower than the averages at the world level (16% in the case of imports of computer and related activities and 19% in the case of imports of R&D and other business activities). This differential behaviour between exports and imports reflects, especially in the industry of computer and related activities, in a comparatively higher trade surplus in Morocco. Differences are also found in previous analyses on the international competitiveness of (Al-Majali and Adayleh, 2018).

Figure 5. Evolution of gross trade balances in business services with the EU28 in Morocco and Tunisia, 2000-2011.

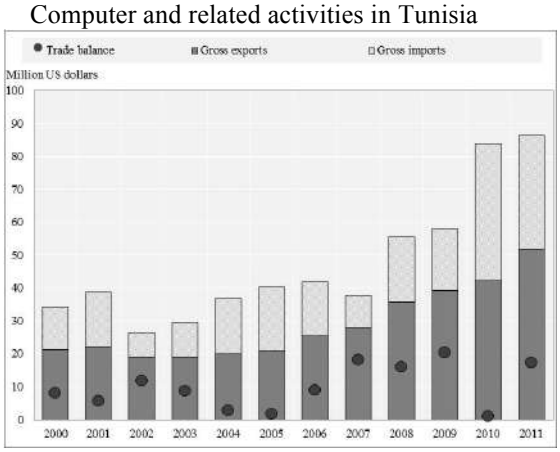
Computer and related activities in Morocco



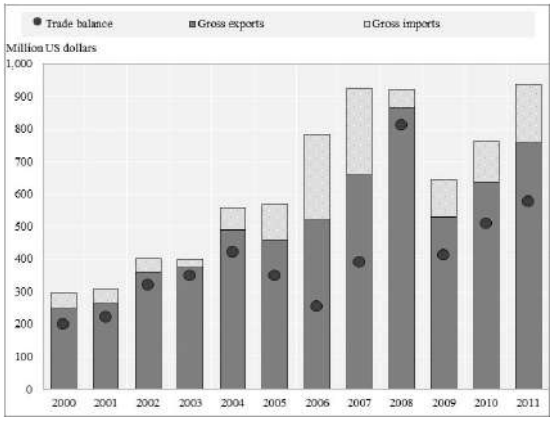
R&D and other business activities in Morocco



Computer and related activities in Tunisia



R&D and other business activities in Tunisia



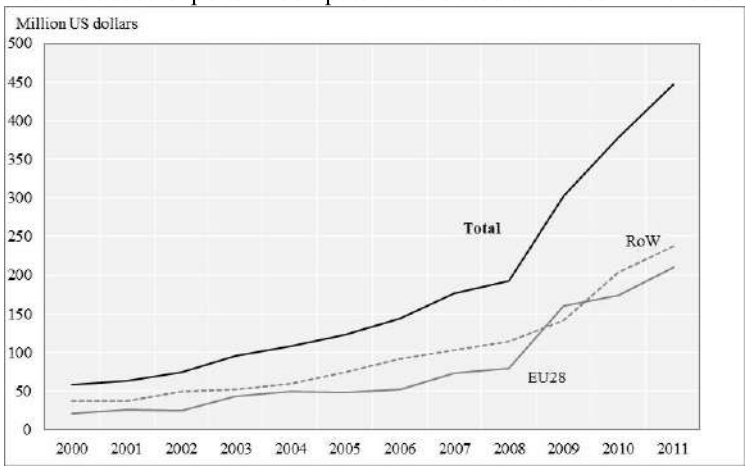
Source: Own elaboration from TiVA database.

As shown in the methodology section, gross exports can be decomposed into domestic and foreign value added. Once examined the recent evolution of gross trade in business services, we focus on value added flows. Thus, we compute the three basic indicators on trade in value added, that is, value added exports, domestic content of exports and foreign content of gross exports from Morocco and Tunisia to the EU28. First, we compare the evolution of value added exports in business services from Morocco and Tunisia to the EU28 and to the rest of the world (Figure 6).

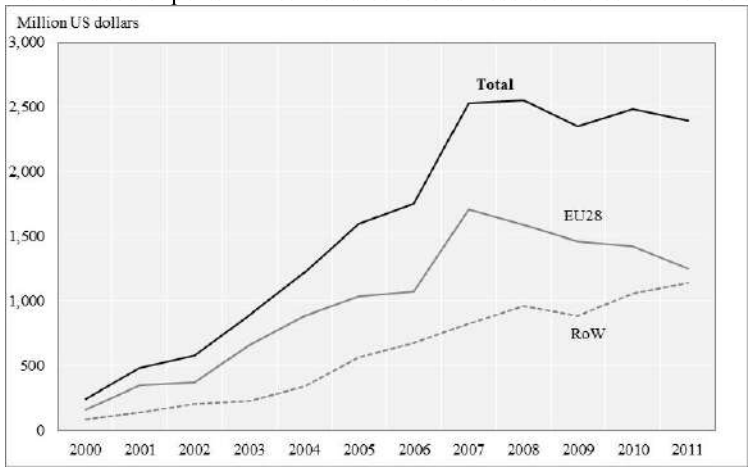
In Morocco value added exports were very similar to total gross exports (on average, they accounted for 99% of total gross exports in computer and related activities and in R&D and other business activities) while in Tunisia value added exports represented, on average, 90% of gross exports in computer and related activities and 83% of gross exports in R&D and other business activities.

Figure 6. Evolution of value added exports in business services from Morocco and Tunisia, 2000-2011.

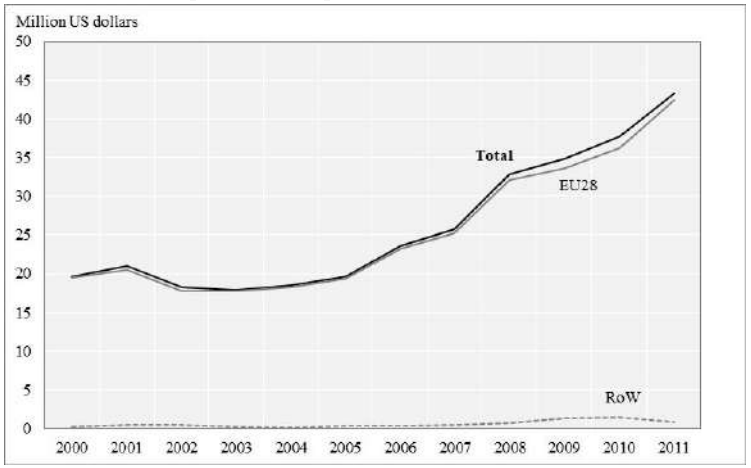
Valued added exports in computer and related activities in Morocco



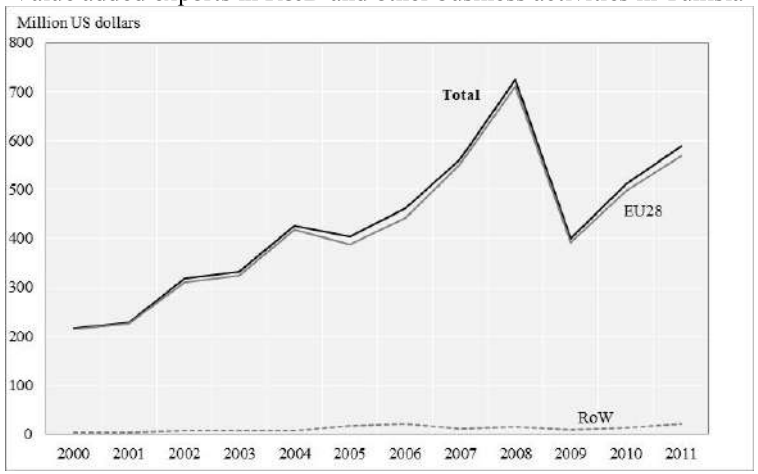
Value added exports in R&D and other business activities in Morocco



Valued added exports in computer and related activities in Tunisia



Value added exports in R&D and other business activities in Tunisia



Source: Own elaboration from TiVA Database.

Although, as was pointed out before, the importance of the EU28 as a client is much higher in Tunisia than in Morocco, we have to note that the paces of growth of value added exports directed to the EU28 and directed to the rest of the world were different. Thus, in Morocco value added exports in computer and related activities directed to the EU28 grew at higher pace (27%) than those directed to the rest of the world (19%). The opposite happened in the case of value added exports in R&D and other business activities: the annual average growth rate for those value added exports directed to the EU28 was 26% compared to 29% for value added exports to the rest of the world.
In contrast, in Tunisia the annual average growth rates of value added exports to the EU28 were substantially lower (8% in computer and related activities and 12% in R&D and other business activities) than the annual average growth rates of value added exports to the rest of the world (36% in computer and related activities and 32% in R&D and other business activities).

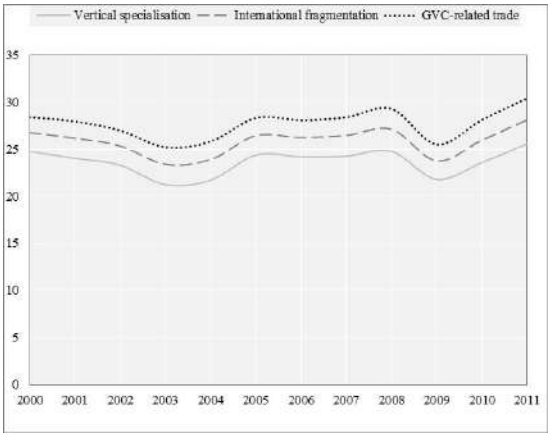
After examining the evolution of value added exports we turn to the analysis of the three indicators on the participation in GVCs described in the methodology section: vertical specialisation, international fragmentation of production and GVCs-related trade.

Figure 7 provides a general overview of the evolution of the participation of Morocco and Tunisia in GVCs. The three indices on vertical specialisation, international fragmentation of production and GVCs-related trade computed for total trade are shown. Overall, participation in GVCs can be expected to be higher in countries with more open and liberal trade regimes. However, countries that specialise in service activities will tend to show a comparatively higher domestic value-added content in their exports.
In line with the trends described above, we have to note that the participation of Tunisia in GVCs is higher than the participation of Morocco. Starting with vertical specialisation, on average the import content of exports in Tunisia was 29% compared to 24% in Morocco. In spite of the fact that vertical specialisation was similar in Morocco and in Tunisia in the beginning of the period (25% and 24%, respectively), there was a much higher growth in the foreign value added content of Tunisian gross exports over the period 2000-2011 (a 2.8% annual average growth rate in Tunisia compared to a 0.5% annual average growth in Morocco) which translates into a higher

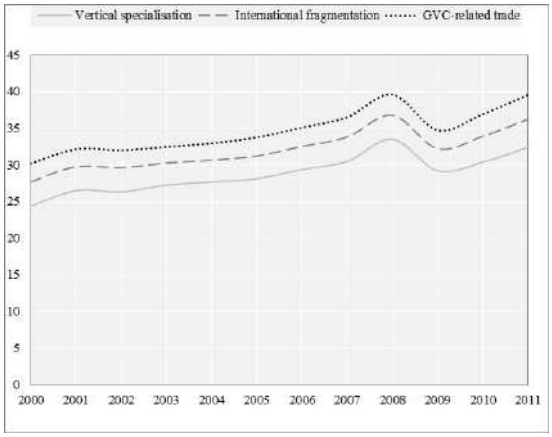
participation of Tunisia in GVCs. We have to highlight to ascending trend in the participation in GVCs experienced after the global final financial in 2008-2009 in both countries.

Figure 7. Participation of Morocco and Tunisia in GVCs, 2000-2011.

Morocco



Tunisia



Source: Own elaboration from TiVA Database.

Focusing on business services, Table 1 shows the evolution of the three indicators of the participation business services in GVCs in Morocco and Tunisia. Overall, participation in GVCs has increased at a faster pace in business services, and in particular in R&D and other business activities, than in total trade although strong differences are observed between Morocco and Tunisia.

Concerning the import content of exports or vertical specialisation, this remained almost unchanged in Morocco: on average, over the period 2000-2011 the import content of exports in computer and related activities was 1.17% and the import content of exports in R&D and other business activities was 1.23%. In contrast, vertical specialisation considerably increased in Tunisia: the import content of Tunisian exports in computer and related activities rose from 7.5% to 10% and the import content of Tunisian exports in R&D and other business activities grew from 14% to 25% in 2011. While the vertical specialisation index was almost identical for exports directed to the EU28 and for exports directed to the rest of the world, differences appear when we take into consideration the domestic value added in intermediate exports, especially in the case of R&D and other business activities.

Table 1. Participation of computer and related activities in GVCs in Morocco and Tunisia, 2000-2011.

Computer and related activities												
	Morocco						Tunisia					
	EU28			RoW			EU28			RoW		
	VS	IF	GVC	VS	IF	GVC	VS	IF	GVC	VS	IF	GVC
2000	0.99	3.63	5.84	0.99	3.17	5.14	7.52	12.14	16.03	7.52	8.41	9.03
2001	0.96	4.16	7.00	0.96	2.74	4.54	7.47	12.20	16.25	7.47	9.44	11.19
2002	0.99	3.62	5.74	0.99	2.62	4.31	7.01	11.81	15.87	7.01	8.40	9.52
2003	1.51	4.38	6.94	1.51	3.29	5.15	7.57	12.06	16.05	7.57	9.11	10.47
2004	1.32	3.19	5.00	1.32	3.18	5.31	7.63	11.85	15.80	7.63	8.66	9.58
2005	1.37	3.66	5.87	1.37	3.51	6.05	7.69	12.05	16.14	7.69	8.66	9.56
2006	1.31	4.35	7.03	1.31	3.17	5.38	8.58	13.26	17.53	8.58	9.71	10.81
2007	1.13	4.16	6.70	1.13	2.77	4.66	9.69	14.58	18.77	9.69	10.51	11.24
2008	1.10	3.55	5.54	1.10	2.60	4.36	10.22	15.02	19.29	10.22	11.30	12.40
2009	1.08	2.58	3.89	1.08	2.36	3.91	14.67	19.00	22.92	14.67	16.12	17.60
2010	1.10	3.94	6.64	1.10	2.51	4.28	14.53	19.71	24.29	14.53	17.56	22.62
2011	1.13	3.61	5.96	1.13	2.57	4.24	18.21	23.39	28.25	18.21	19.10	20.07

Source: Own elaboration from TiVA database.

Table 2. Participation of R&D and other business activities in GVCs in Morocco and Tunisia, 2000-2011.

R&D and other business activities												
	Morocco						Tunisia					
	EU28			RoW			EU28			RoW		
	VS	IF	GVC	VS	IF	GVC	VS	IF	GVC	VS	IF	GVC
2000	0.98	10.47	19.56	0.98	4.33	7.71	13.93	23.04	31.61	13.93	15.57	16.93
2001	0.95	12.69	23.95	0.95	4.08	7.57	14.42	22.29	29.18	14.42	16.43	18.61
2002	0.99	10.61	19.24	0.99	3.78	6.76	14.03	21.48	27.80	14.03	16.70	20.92
2003	1.59	11.05	20.04	1.59	4.63	8.00	13.05	19.81	25.82	13.05	15.84	20.36
2004	1.39	9.56	17.61	1.39	4.66	8.66	14.46	22.02	29.21	14.46	17.05	20.62
2005	1.45	9.11	16.79	1.45	4.99	9.91	15.67	23.52	31.24	15.67	20.58	30.84
2006	1.42	8.27	14.77	1.42	4.68	8.99	15.09	21.99	28.38	15.09	19.95	29.44
2007	1.20	8.56	15.17	1.20	4.32	8.04	16.36	23.41	29.50	16.36	18.16	19.80
2008	1.19	8.63	15.35	1.19	4.58	9.02	18.08	24.97	30.96	18.08	20.01	21.95
2009	1.15	7.30	13.06	1.15	4.05	7.77	25.87	31.80	37.15	25.87	27.04	28.16
2010	1.18	8.28	15.06	1.18	3.84	7.37	21.65	28.68	35.05	21.65	22.89	24.18
2011	1.23	9.04	16.59	1.23	3.85	7.38	24.68	31.75	38.08	24.68	25.83	27.06

Source: Own elaboration from TiVA database.

Thus, on average, international fragmentation in exports in computer and related activities directed to the EU28 was 3.7% in Morocco and 14.8% in Tunisia. For those exports in computer and related activities directed to the rest of the world the average international fragmentation was 2.9% in Morocco and 11.4% in Tunisia. Differences were higher in the case of R&D and other business activities. The average international fragmentation of exports in these services directed to the EU28 was 9.5% in Morocco and 24.6% in Tunisia while the figures for the exports in R&D and other business activities directed to the rest of the world were 4.3% in Morocco and 19.7% in Tunisia. This fact provides some insights about the high importance of trade in business services used as intermediate inputs by European partners.

Finally, if we look at the more general indicator of GVC-related trade, we can observe how the patterns described above also hold. Thus, the importance of GVC-related trade is stronger when exports are directed to the EU28 than when exports are direct to other countries. By industries, the participation in GVCs in substantially higher for R&D and other business activities than for computer and related activities. By countries, the participation in GVCs is much higher for Tunisia than for Morocco. These differences are explained by the diverse trends experienced by the GVC-related trade indicator. On average, GCV-related trade in computer and related activities directed to the EU28 grew at an annual average rate of 3.7% in Morocco and of 5.5% in Tunisia. In the case of GVC-related trade in computer and related activities directed to the rest of the world, the annual average growth rates were -1.17% in Morocco and 8.8% in Tunisia.
Concerning the GVC-related trade in R&D and other business activities, annual growth rates were more modest: -0.7% in Morocco and 2.1% in Tunisia for exports directed to the EU28, and 0.2% in Morocco and 6.4% in Tunisia for those exports directed to the rest of the world.

3. Conclusions and policy recommendations.

The traditional vision on international trade has focused on final products that are produced in a specific country and exported to consumers all over the world. However, international trade increasingly involves GVCs “where services, raw materials, parts and components are exchanged across countries before being incorporated in final products that are shipped to consumers all over the world. Exports from one country to another are now reflecting complex interactions among a variety of domestic and

foreign suppliers and create income for firms and workers in widely separated locations" (OECD, 2015a, p.1).

As Heuser and Mattoo (2017) highlight, the starting point for analysing the importance of business services in GVCs is the decomposition of exports in value added. In this report we have decomposed exports in business services from Morocco and Tunisia over the period 2000-2011, distinguishing between those exports directed to the EU28 and those exports directed to the rest of the world. In line with the findings of previous studies (OECD, WTO and World Bank Group, 2014) we found that both in gross terms, and particularly in value added terms, exports in business services grew at a faster pace than total exports. The importance of the EU28 as a client differs between Morocco and Tunisia ranging from 43% of value added exports in computer and related activities in Morocco to 98% of value added exports in Tunisia. These differences reflect a higher trade dependency from the EU28 of Tunisia.

The decomposition of gross exports into value added exports, domestic value added content and foreign value added content has allowed to examine the evolution of the participation of business services in GVCs, and more concretely in European GVCs.
The results obtained have confirmed the rising importance of Moroccan and Tunisian business services in GVCs, and especially in European GVCs. However, they have also shown that the participation in GVCs varies significantly between the two countries: the participation of Morocco is much more modest than the participation of Tunisia. In terms of industries, differences were also noticeable with a considerably higher integration in GVCs of R&D and other business activities than that of computer and related activities. This can be explained, at least partially, by the fact that the Moroccan State still holds significant shares in companies in key sectors like telecommunications and by the existence of importance restrictions in most business services, which are largely reserved for Moroccans. For instance, professions like architecture and engineering require authorisations to practice by the Directorate of Regulated Associations and Professions of the General Secretariat of the Government, and after the granting of the authorisation foreigners have to obtain a residence permit for between one and ten years. In the case of accounting and auditing, the government reserves the right to impose a Moroccan nationality requirement for access to its market (WTO 2016a). Despite Tunisia holds provisions that restrict foreign competition in

business services, it is also a country with a good human capital endowment. A high number of foreign business services firms, most of them subcontractors of European firms, set up in Tunisia over the last years. These firms take advantage of the existence of a high qualified and bilingual labour force and are mainly aimed at exporting business services (WTO, 2016b).

The development of GVCs has important implications for trade policy (Miroudot et al., 2013) and, at the same time, services are key to competitiveness: on average, the value created services as intermediate inputs represent over a third of total value added in manufacturing exports (OECD, 2018). In the case of business services their rising participation in GVCs can have a direct impact on comparative advantages (Miroudot and Cadestin, 2017). In this sense, the recent analysis conducted by Liu et al. (2018) shows the existence of a bypass effect of imported business services intermediate inputs. Thus, it can be affirmed that those countries with less developed business services should liberalise business services instead of protecting inefficient domestic business services sectors that can damage the competitiveness of their manufacturing sectors. In other words, trade negotiations should simultaneously treat trade in goods and trade in services jointly.

The Euro-Mediterranean Association Agreements with Morocco and Tunisia essentially contain basic provisions such as the confirmation of the GATS principles (Van der Loo, 2016). The decision made by the European Council in December 2011 of negotiating of "Deep and Comprehensive Free Trade Areas" (DCFTAs) can imply a significant shift and a challenge as, according to the World Bank Services Trade Restrictions Index, business services are among the most protected industries (Borchert et al., 2014). But not only trade barriers can block the development of GVCs in business services. Regulatory divergences across countries can also inhibit it so liberalisation commitments could extend beyond the context of trade agreements to be secured in other fora for regulatory cooperation (Heuser and Mattoo, 2017). To date, Morocco has conducted numerous reforms in its trade regime. It is one of the countries that have concluded a high number of trade agreements over the last years (a total of ten over the last decade) and has actively participated in the WTO work. It has also devoted strong efforts to develop transport and telecommunication infrastructures. However, concerning trade in business services, as mentioned before, restrictions on foreign

presence in business services still persist, some of them completely obsolete (for instance, engineering services are regulated by the Dahir of 11 June 1949).

In the case of Tunisia, changes in trade policy over the last decade have been scarce and, despite the fact that a new law on competition was introduced in 2015 and a new Investment Incentives Code entered in force in 2017, there exist restrictions and exclusions that should be revised. In relation to business services, they are protected from foreign competition by means of provisions, authorisations or specifications. As a result, exporting activity is much more attractive for offshore and "wholly exporting" firms (WTO, 2016b).

The combination of adequate trade liberalisation and investment policy reforms and the promotion of business linkages between foreign and domestic firms could help local companies move up to GVCs thanks of the transfer of knowledge, skills and technology, following the example of countries like Costa Rica or Malaysia (OECD, 2015b).

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