Global Value Chain Participation and Real Effective Exchange Rates: Insights from Tunisia[1]

Insaf Guedidi
Université de Tunis, Ecole Supérieure des Sciences Economiques et Commerciales de Tunis (ESSECT), DEFI
World Trade Organization Chair, Tunis, Tunisia
Université Paris 1, Panthéon Sorbonne, Paris, France
Email: insaf.guedidi@gmail.com

Leila Baghdadi
Université de Tunis, Ecole Supérieure des Sciences Economiques et Commerciales de Tunis (ESSECT), DEFI
World Trade Organization Chair, Tunis, Tunisia
Email: leilabaghdadi@gmail.com

Abstract:

Exchange rate policies remain a major concern for countries engaging in Global Value Chains (GVCs). Traditionally, policy makers consider depreciating the exchange rate to increase exports. In GVCs, exports rely on imported intermediate inputs, and therefore, the trade effects of the exchange rate may be dampened. This paper analyzes the impact of the Real Effective Exchange Rate (REER) on international trade and, specifically, on GVC-related trade. In this study, we calculate REER based on the sectoral value-added terms to account for the rising importance of GVCs. Using value-added data from UNCTAD-Eora Global Value Chain (GVC) database for Tunisia over the 1990–2017 period, we conclude that REER effects on GVC-related trade differ from its impact on traditional trade. Results show that foreign value-added (FVA) share in gross exports dampens the response of REER to exports. The participation of Tunisia in backward linkages offsets the negative effect of REER appreciation on real gross exports by – 21 percent. Accounting for sectoral heterogeneity is important to determine competitiveness because

[1] We acknowledge the help provided by the research department of the Central Bank of Tunisia (CBT). We are grateful to M. Mourad Abdessalem, Dr. Rached Bouaziz, Dr. Nacef Abdennadher, M. Mehdi Bellalouna, and Mme. Malek Krimou. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Central Bank of Tunisia (CBT).

Tunisian sectors take part in GVCs at different levels. Thus, we find that depreciation in REER (DVX-based) rises indirect value-added exports in Tunisian Low-Tech manufacturing and service sectors. The analysis confirms that REER elasticity of foreign value-added in manufacturing sectors increased over time, although slightly, with a high significance level in recent years. Understanding the landscape of participation of Tunisian sectors in GVCs shall provide areas to policy-makers to set convenient policies to promote exports in the future.

Keywords: Global Value Chains, real effective exchange rate, value-added trade, sectoral analysis, competitiveness.

JEL codes : F14, F15, F30, F31, C20

1 Introduction

Eight countries engaged in international trade manipulated their currency to the aim of rising their exports between 2000 and 2017. In 2018, none of them do so. Through the prevalence of Global Value Chains (GVCs), depreciating exchange rates does not lead to the same export growth rate. Trading in parts and components increases the costs of manipulating exchange rates and reduces the gains from currency devaluation (Weldzius, 2021).

The global market is more interdependent regarding the production linkages. The rise of global value chains (GVCs) creates an economic connection between trade partners. Therefore, there is a propagation of the effect of economic level and policy conditions between countries engaged in fragmented production networks. Trade in intermediate inputs links the domestic activities of the importing country to other countries involved in the value chain. Through the prevalence of global production networks, decisions issued by governments and central banks have an impact not only on the national economic activities but also on the international ones. Thus, economic shocks are transmitted across borders just like products in GVCs.

In the past three decades, Tunisia had a good economic performance with a constant real exchange rate. Thus, Tunisian authorities maintained a static real exchange rate as a Tunisian foreign exchange policy. However, as the economy is becoming more open with more regional and global integration, the pursued foreign exchange policy is no longer valid and some

limitations are emerging. This leads to new dimensions in terms of the exchange rate regime from pegged to floating (Fanizza et al., 2002).

In this study, we investigate the impact of the Real Effective Exchange Rate (REER) on the participation of Tunisia in GVCs in terms of forward and backward linkages. The Real Effective Exchange Rate (REER) is one of the most popular measures of cost competitiveness in international trade. This research contributes to deciphering the extent to which depreciation of the Tunisian exchange rate could affect value-added exports of Tunisian sectors. Given the importance of monetary policy concerns, we aim to give policy implications. Findings will help to identify the effect of exchange rate on forward and backward participation of Tunisia in GVCs by sector. This would pave the way to determine the production tasks (design, manufacturing, assembly, logistics) that are more sensitive to changes in REER. We use a fixed-effects estimation to account for the responsiveness of gross exports and GVC-related trade to changes in the REER following Cheng et al. (2016) and Tan et al. (2019). This paper focuses on the methodology for computing REERs in value-added terms because the conventional way to calculate REER becomes questionable, especially when economies engage in GVCs.

The results show that REER effects on GVC-related trade differ from their impact on traditional trade. We find that FVA share in gross exports dampens the response of REER to exports. High integration level in GVCs can change the way we interpret REER response on gross exports and GVC-related trade. The findings show that REER elasticity of service and manufacturing indirect value-added exports and REER elasticity of foreign value-added in manufacturing sectors are growing over time.

The sectoral composition of gross exports alters the impact of REER. Exchange rate responses differ, as they are strong for LTS and weak for HTS and LTM. Interestingly, a depreciation in REER (DVX-based) rises indirect value-added exports amid the Tunisian Low-Tech manufacturing and service sectors. We capture the heterogeneous REER effects on different sectors in Tunisia FVA. REER depreciation leads to using more intermediate inputs in the Tunisian Low-Tech manufacturing and service sectors. The findings show that the backward participation of Tunisian manufacturing sectors in GVCs responds to changes in REER. Remarkably, backward participation of service sectors in GVCs is not responsive to changes in REER.

This paper contributes to the literature in many aspects. First, it uses value-added trade data from the recent UNCTAD-Eora Global Value Chain Database as an indicator for participation in forward and backward linkages in GVCs. Second, GVC trade data are further used to calculate REER measures based on value-added terms. Third, it is interesting to focus on a small economy like Tunisia to understand how participation in GVCs alters the response of REER to exports. Fourth, the paper analyzes the impact of sectoral REER on forward and backward participation of Tunisian sectors in GVCs and accounts for heterogeneity in periods.

Our findings have several important policy-relevant implications: Competitiveness is determined by the entire supply chain in GVCs. Small economies like Tunisia with low integration in GVCs compared to their partners in the supply chain and with high participation in GVCs are subject to have a negligible role in the value chain when the exchange rate changes. Here, REER fluctuations would have a modest effect on the competitiveness of the value chain. Therefore, a call for larger movements in REER is needed in small economies with higher integration in GVCs and a modest contribution to the entire value chain. Export-oriented companies and import-dependent would face tremendous expenses when engaging in GVCs. Those companies will not benefit from depreciating REER.

We organize the rest of the paper as follows. Section 2 reviews the most recent literature on exchange rates and GVCs. In Section 3, we outline the stylized facts about Tunisia. Section 4 presents the methodology and describes the data sources and variables. It includes the basic framework related to the construction of value-added REERs, and Section 5 presents the results. Section 6 concludes the paper.

2 GVC integration and Exchange Rates

International production networks have become more prominent in recent years through the prevalence of Global Value Chains (GVCs). The World Bank defines Global Value Chains (GVCs) as slicing up the production process across countries where firms execute a specific task. The product is produced internationally where parts and components are constructed in many countries forming a value chain. It is called “the new face of trade” (World Bank, 2019).

Bayoumi et al. (2013) show that, in the past, researchers measure competitiveness in terms of gross trade and goods. Through the prevalence of GVCs, trade in value-added increased drastically leading to what we call trade in tasks that alter the traditional definition of competitiveness. Exchange rate policy is important in determining a country competitiveness and attraction level of foreign investors (Patel et al., 2019).

A growing body of literature has investigated the impact of exchange rates on trade. Historically, a depreciation of exchange rates leads to an increase in exports and a decline in imports (Auboin and Ruta, 2013)[2]. However, fluctuations of the exchange rate may have a slight impact on GVC trade depending on whether the country is integrated into forward or backward linkages, on the length of the value chain, and the currency of the countries involved in the production network.

In recent years, there is a weak effect of exchange rate risk on exports in GVCs as export production relies on imports of foreign value-added. Trade flows under GVCs offset the negative effect of appreciation in exchange rates on exports. Tan et al., (2019) acknowledge that a high backward participation level in GVCs weakens the association between exchange rate appreciation or depreciation and gross exports in Asian countries. Thus, growth in exports is linked to growth in imports. The fact that depreciation leads to an increase in imported inputs for firms importing to exporting may explain this. Therefore, devaluating the local currency will not contribute to a growth in exports (Cheng et al., 2016; Tan et al., 2019; World Bank, 2019).
The real effective exchange rate (REER) is a suitable instrument that accounts for a country price competitiveness compared to its trading partners. Real effective exchange rates (REER) policy reforms help economies avoid exchange rate crises. Thus, the International Monetary Fund (IMF) calculates and displays REER data in its International Financial Statistics (IFS) publication. Similarly, the World Bank exhibits REER data in its World Development Indicators (WDI) database.

An increasing number of studies employ the real effective exchange rate (REER) to analyze its impact on trade and, specifically on GVC trade (Bayoumi et al., 2013; Bems and Johnson, 2012; Cheng et al., 2016). Cheng et al. (2016) mention that REER impact is muted once a country does not contribute well to the value chain. They compare the exchange rate elasticity of value-added

[2] Auboin and Ruta (2013) provide a good literature review of the relationship between exchange rates and international trade.

trade with the elasticity of gross trade. They find that a depreciation in the exchange rate affects foreign and domestic value-added. When the import content of GVC export gets large, elasticity size gets small. Moreover, Bayoumi et al. (2013) find that an increase in REER leads exports to become expensive and then imports turn to be cheaper. Thus, an increase in REER indicates a loss in trade competitiveness.

Some researchers argue that the conventional REER index is no longer a good measure of price competitiveness especially in the context of global production networks. Patel et al. (2019) indicate that traditional models, which account for REER calculations, do not correspond to the new changes in international trade under GVCs. Researchers propose new methods to calculate REER index which differ from the conventional ones used in the literature. Considering the example of Bayoumi et al., (2013) who argue that goods outsourcing calls for revising the traditional way of calculating REER. The formula needs to include value-added prices and an indication term which explains the loss/ gain in competitiveness due to participation in GVCs. They suggest a new index as the standard REER and they add a new term that accounts for Foreign Value Added (FVA). FVA eases the effect of the appreciation of the nominal exchange rate and the effect of the increase of prices in domestic production. Similarly, Bems and Johnson (2012) give new measures of REER to take into account global production networks in trade. They compute indices of REER based on value-added measures in a way to differentiate between the traditional measure of REER and the one value-added based. They find interesting differences between the conventional REER and the new derived REER that is based on value-added terms.

This paper relates to the literature in examining the impact of REER on the GVC-related trade of Tunisia in terms of forward participation and backward participation[3] in GVCs. Tunisia is a North African country that has witnessed various episodes of exchange rate and REER movements throughout history. In the past decades, the Central Bank of Tunisia (CBT) applied different reforms to the exchange rate system. In 1970, the CBT pegged the dinar to French Franc. Afterward, it started pegging the dinar to other currencies such as German Mark, U.S. Dollar, Italian Lira, Dutch Florin, Belgian Franc, and Spanish Peseta until 1994 with the aim of promoting export competitiveness and decreasing the volatility of the exchange rate. The dinar depreciated after those reforms by 40 percent (Chebbi and Olarreaga, 2019; Guizani, 2019). Between the years 1992 and 2000, Tunisia had targeted the real effective exchange rate (REER)

[3] Definitions of forward and backward participation in GVCs are further explored in the data section below.

to set a flexible exchange rate regime. The goal was to sustain its international competitiveness (Fanizza et al., 2002). With the emergence of GVC, REER declined by 7 percent between 2001 and 2007. Due to inflation, the CBT has settled a more stable REER since 2008 (Chebbi and Olarreaga, 2019).

Exchange rate policy is a key determinant of a country competitiveness and attraction of foreign direct investment. In this respect, it is crucial to study and analyze REER effects on the Tunisian participation in GVCs. Price competitiveness in global production networks is determined at the international level where sectoral dimension matters as each sector integrates GVCs at a different stage (Patel et al., 2019). In interconnected markets and high integration in GVCs, currency devaluation could result in fewer exports in specific sectors. Those sectors have both a high share of foreign value-added in exports and a high share of exports re-imported and consumed in a country with the same currency. Export volumes become more sensitive to foreign devaluations (World Bank, 2019).

The old method of calculating REER assumes that sectors behave the same way as if a country has a single sector. In addition, traded goods are final and do not include inputs. The conventional way incorporates imported inputs to a single sector. However, incorporating sectoral aspects in GVCs allows giving better measures of REER which take into consideration sectoral heterogeneity. Patel et al. (2019) state that the sectoral aspect is important when studying the competitiveness of a country. Thus, the new measures of REER are calculated at the sectoral level and account for participation in GVCs.

3 REER background

The old theoretical foundations demonstrate the existence of a common transmission mechanism of the relationship between trade and exchange rates that is based on the demand side (Dellas & Zilberfarb1993). For instance, the real effective exchange rates (REER) are computed based on the consumer demand model. However, the use of intermediate imports in domestic production and cross-border linkages is not taken into consideration, leading to a more complex expenditure mechanism.

GVCs impact several economic dimensions. Joining GVCs affects the way we analyze a country's export potential. In other words, the macroeconomic implications of GVCs shape the way economists conceive real effective exchange rates (REER). In traditional trade, the REER are usually measured in gross trade terms. The old measures assume that goods are wholly produced in the same country using domestic inputs. However, the use of foreign intermediate inputs in domestic production is not considered (Bang & Park 2018).

In addition, slicing up production processes implies that some countries appear to be big exporters of a specific commodity compared to other countries. In reality, their contribution in terms of value added is small (Siedschlag & Murphy 2015). Measuring REER that account for input linkages traces the demand spillovers resulting from a change in prices (domestic prices and the price elasticity of the demand for value-added). Thus, giving new measures of the REER in terms of value added becomes essential (Bayoumi et al. 2013, Bems & Johnson 2012).

Two things differentiate the new measure of value-added REER from the conventional one. First, calculations are based on value-added trade instead of gross trade. Second, the GDP as a real value-added measure is an indicator of prices instead of consumer prices (Bems & Johnson 2012). Considering that Bayoumi et al. (2013) do not incorporate value-added trade directly in REER calculations, we apply the measure proposed by Bems & Johnson (2012). As a first step, they compute the demand for value-added afer converting the demand for gross output. The second step replaces the use of gross output prices with value-added prices.

Currently, macroeconomic policies are more linked to demand for value-added than demand for total output. In this paper, we introduce a narrow framework that separates the use of foreign value-added inputs and the production of domestic value-added. Following Bems & Johnson (2017) and to account for the elasticity of exports to the real exchange rate when fragmentation of production is important, Bang & Park (2018) examine the case of total output demand and the case of intermediate input demand.

Y_i is the total demand of country i that encompasses domestic demand and foreign demand (exports) and it is expressed as follows:

$$Y_i = \nu_i \, (p_i \, D_i \, + \, R_i \, p_i^* \, X_i^*) \qquad (1)$$

D_i is the domestic demand and ν_i is the domestic value-added ratio. We deduct domestic value added from total demand. R is the nominal exchange rate and p and p∗ indicate domestic prices and prices in partner countries, respectively. X_i^* is export volumes. In addition, the real exchange rate is: $\widetilde{R_i} \; = \; R_i \, p_i^* \, / \, p_i$.

Equation 2 is derived from equation 1 and the expression of the real exchange rate. We get:

$$\partial \, \frac{Y_i}{\widetilde{R_i}} \, . \partial \, \frac{\widetilde{R_i}}{Y_i} \, = \, \frac{R_i X_i}{Y_i} \, \nu_i \qquad (2)$$

where $X_i \; = \; p_i^* \, X_i^*$. The share of exports in total output is equivalent to the elasticity of the output regarding the real exchange rate. A rise in $\widetilde{R_i} = R_i \, p_i^* \, / \, p_i$ is associated with an increase in the prices of foreign goods.

Assuming input linkages, intermediates of a country i are expressed as follows:

$$C_i \; = \; \nu_i \, (q_i \, I_i) + \, \nu_i^* \, (R_i \, q_i^* \, M_i^*) \qquad (3)$$

C_i is the intermediate inputs. We deduct the value added in producing country. I_i, and M_i^* are domestic and imported intermediate inputs, respectively. ν_i and ν_i^* are the value-added ratios of home and partner countries, respectively. q denotes the domestic input price. q∗ indicates the input price set in partner countries. Then, $\widetilde{R_i} = R_i \, q_i^* \, / q_i$. We derive Equation 4 from Equation 3:

$$\partial \frac{C_i}{\widetilde{R_i}} . \partial \frac{\widetilde{R_i}}{C_i} = \frac{R_i M_i}{C_i} \nu_i^* \quad (4)$$

Where $M_i = q_i^* M_i^*$. The share of imports of intermediates is equal to the elasticity of intermediate inputs with respect to the real exchange rate, as stated in equation 4. The size of the impact between the elasticities of the intermediate imports and the total output regarding the real exchange rate represents the net effect of the exchange rates on trade. A currency depreciation in the country i lead to a positive effect on the trade balance if the elasticity of the output with respect to the real exchange rate is higher than the elasticity of imported intermediate inputs regarding the real exchange rate.

Against this backdrop, the revised REER measure proposed by Bems & Johnson (2012) reflects cross border linkages across countries in the real exchange rate and it is as follows:

$$REER_i = \prod \left(\frac{q_i R_i}{q_k R_k}\right)^{W_{ik}} \quad (5)$$

With,

$$W_{ik} = \sum \left(\frac{p_i^y V_{ik}}{p_i^y V_i}\right) \left(\frac{p_j^y V_{jk}}{p_k F_k}\right) \quad (6)$$

Countries are i, j and k. q denotes prices and R denotes nominal exchange rates. P and p represent the price of final goods in home and partner countries. The amount of value added from i embodied in final goods absorbed in k is shown by the term V_{ik}. In this respect, $\frac{p_i^y V_{ik}}{p_i^y V_i}$ represents the share of the country i's exports to country k measured in value-added terms. Moreover, $\frac{p_j^y V_{jk}}{p_k F_k}$ represents the country j's value-added content in market k.

REER index is commonly used as an explanatory variable in trade (export and import) regressions. In this paper, we create two separate export and import value-added REER indexes. Changes in demand in the domestic market correspond to the import index and changes in demand in foreign markets are captured by the export index. Therefore, the weights are of foreign and domestic value-added sales. Moreover, price indexes are Gross Domestic Product (GDP) deflators.

4 Stylized Facts about Tunisia

In the Tunisian context, Ait Ali and Msadfa (2016) indicate that the government adopted a policy based on export promotion and import substitution. In 1972, the Tunisian government started attracting Foreign Direct Investment (FDI) by setting fiscal incentives. Among the manufacturing industries, the textile sectors have the lion's share. Offshoring firms benefit from trade facilitation services, duty-free imports of raw materials and equipment, and profits repatriation, etc. The purpose was to boost the Tunisian exports.

Analyzing inter-country linkages is important to understand how Tunisia participates in Global Value Chains (GVCs). The participation index that describes forward and backward linkages measures the level of integration in GVCs. Forward participation makes up domestic production exported to a country that will export again the value-added to a third party. However, backward participation is the share of foreign inputs. In this paper, DVX refers to indirect value-added and expresses forward participation in GVCs. FVA refers to foreign value-added and represents backward participation in GVCs. Figure 3 illustrates the decomposition of gross exports into their value-added terms. The domestic value-added (DVA) and the foreign value-added (FVA) are the two broad components that constitute gross exports. The breakdown of exports is according to Koopman et al. (2010)[4].

Figure 1 represents a breakdown of the Tunisian sectoral exports throughout 1990–2017. It shows 5 classifications of sectors: High-Tech Manufacturing sectors (HTM), Low-Tech Manufacturing

[4] More details about the decomposition of gross exports are mentioned in data section with an illustration in figure 3.

sectors (LTM), High-Tech service sectors (HTS), Low-Tech service sectors (LTS), and Primary sectors[5].

Decomposing the Tunisian gross exports, we notice that there is a sharp fall in value-added exports and gross exports in the year 2010. The world financial crisis during that period may explain this decline. After 2010, exports in all sectors grow again with a small decline starting from 2015.

Tunisia is best integrated into backward GVCs in manufacturing sectors with approximately equal contribution of FVA and DVA. We may say that manufacturing exports depend on imported intermediate inputs. As for manufacturing sectors, the share of FVA in gross exports has been rising from 226 to 1760 million US dollars for HTM sectors and from 222 to 1407 million US dollars for LTM sectors between 1990 and 2017.

The domestic value-added (DVA) in primary and service sectors considerably contributes to gross exports. However, the FVA share contribution in those sectors is very modest. Thus, Tunisia operates more at the beginning of the value chain (forward linkages) in service and primary sectors, maybe as providers of raw materials. Thus, the participation of Tunisia in the forward GVCs relies on intermediate goods and services which will be re-exported again by Tunisia's partners to a third party. Overall, Tunisia is more integrated into forward linkages in both service and primary sectors and backward GVCs in manufacturing sectors.

(Figure 1: Tunisia Global Value Chain (GVC) participation by sector, million US dollars)

The high participation rate of Tunisian sectors in GVCs calls for studying the impact of price competitiveness on GVC linkages. Tunisia Real Effective Exchange Rate (REER) is a measure of the value of the Tunisian dinar against a basket of foreign currencies of its partners. Contrary to the old conventional way of calculating REER which is derived from gross trade, we calculate REER measures based on value-added trade by sector. Weights are determined based on sectoral trade in value-added. The new REER (DVX based) and REER (FVA based)[6] allow quantifying changes in prices on domestic and foreign demand for value-added.

[5] The classification of Eora 25 sectors is included in the Appendix.

[6] More details about our methodology to calculate REER (DVX based) and REER (FVA based) are included in data section.

The data on value-added REER by sector in figure 2 demonstrates that the curves have the same trend with a slight difference in REER (DVX based) before 2007. Figure 2 shows that REER (DVX based) and REER (FVA based) have approximately the same trend as REER from IMF. However, the magnitude of the variations in IMF REER and value-added REER has consistently differed especially before 2010. The main possible drivers of REER differentials are the way trade weights are calculated, the type of price indexes, and the number of GVC country-partners. Both REER (DVX based) and REER (FVA based) have considerably increased until 2000. Then they have decreased following the slope of REER from IMF.

Using 2010 as the base year, REER (DVX based) and REER (FVA based) have depreciated since 2000. When REER is below 100, it means that imports become expensive and exports become competitive. The depreciation in REER indicates an improvement in competitiveness. However, Tunisia exports rely on imported intermediates, especially in the manufacturing sectors.

(Figure 2: Tunisia Real Effective Exchange Rate (REER))

5 Data and empirical methodology

The first part of this section discusses the data used in the empirical model then it shows the manner through which we calculated REER index in value-added terms in the second part. The third part introduces the empirical methodology.

5.1 Trade Data

In this paper, we use the UNCTAD-Eora Global Value Chain (GVC) database which contains the Tunisian gross exports sectoral data from 1990 to 2017 and key GVC indicators. Nominal exports and nominal GVC measures are in the current thousand US dollars. Figure 3 shows the decomposition of gross exports into value-added terms. Gross exports are composed of domestic value-added (DVA) which measures the value-added content by domestic factors embodied in the exported output and the foreign value-added (FVA) which represents imports of intermediate inputs used in exports. The foreign value-added (FVA) and the indirect value-added (DVX)

constitute GVC-related trade.[7] DVX denotes the value-added in intermediates that are re-exported to a third economy by partners.

(Figure 3: Decomposition of Gross Exports)

In this paper, we deflate the nominal gross exports and DVX data using the consumer price index (CPI), while the nominal FVA series are deflated using a GVC trade-weighted index of partners' CPI. This trade-weighted index constitutes the import price index.

We approximate the measure of the Tunisian value-added contribution to the final good in the global supply chain by the share of FVA in its GVCs participation. This step helps quantify the response of GVC-related trade to an appreciation or depreciation in local currency. The FVA share is defined as follows:

$$FVA\ share\ = \frac{FVA_{TUN,k}}{FVA_{TUN,k}\ +\ DVX_{TUN,k}} \qquad (1)$$

K denotes sectors, $FVA_{TUN,k}$ is the foreign value-added of Tunisia in sector k and $DVX_{TUN,k}$ represents the indirect value-added in k.

The main variable of interest is the Real Effective Exchange Rate (REER). Conventional REER is from the International Monetary Fund (IMF). In the next section, we give more details on the calculations of the sectoral REER index which is based on value-added terms. Nominal exchange rates used in the calculations are from the Central Bank of Tunisia (CBT).

We include in the baseline model some of the control variables: Liner Shipping Bilateral Connectivity Index (LSCI) accounts for maritime connectivity, air transport accounts for air connectivity, and the measure of political stability. We proxy domestic demand by real GDP.

[7] GVC indicators are generated from EORA Multi-Region Input-Output tables (MRIOs). Casella et al. (2019) give more details about the calculations of foreign value-added (FVA) and the indirect value-added (DVX).

Trade-weighted geometric average of trading partners' real GDP proxies foreign demand. GDP data are from the World Bank. Table A.1 in the appendix gives summary statistics and data description.

5.2 Real effective exchange rates in value-added terms

The Real Effective Exchange Rate (REER) is often used to proxy the competitiveness of prices in international markets. Implementing a new REER based on value-added terms does not change the REER formula. However, we are concerned about the data required to calculate the index. In this paper, REER is a measure of the value of the dinar against a weighted average of several foreign currencies of GVC partners divided by a price deflator which is the GDP deflator.

We construct the REER index for Tunisia following the methodology of Bems and Johnson (2012), Cheng et al. (2016), and Lee et al. (2005) as follows:

$$REER_{TUN,k} = \prod_{j=1 \neq TUN} \left(\frac{P_{TUN} R_{TUN}}{P_j R_j} \right)^{W_{TUN\ j,k}} \qquad (2)$$

where j denotes trade GVC partners of Tunisia, K refers to sector, P_{TUN} (P_j) is the GDP deflator of Tunisia (country j). We apply the GDP deflator to measure changes in relative prices. R_{TUN} (R_j) is the bilateral nominal exchange rate of Tunisia (country j), and $W_{TUN\ j,k}$ is the share of value-added of Tunisia.

The conventional REER measure applies weights based on gross trade. Since we are interested in the demand for value-added, we calculate trade weights in value-added terms. $W_{TUN\ j,k}$ is the share of GVC-related trade in the Tunisian total exports. $W_{TUN\ j,k}$ determines REER (DVX-based) and REER (FVA-based). Weights for REER (DVX-based) and REER (FVA-based) are calculated as follows respectively:

$$W\ (DVX-based)_{TUN\ j,k} = \frac{DVX_{TUN,k}}{\sum DVX_{TUN\ j,k}} \quad (3)$$

And,

$$W\ (FVA-based)_{TUN\ j,k} = \frac{FVA_{TUN,k}}{\sum FVA_{TUN\ j,k}} \quad (4)$$

where $DVX_{TUN,k}$ is the GVC-related indirect value-added in Tunisian exports and $FVA_{TUN,k}$ is its foreign value-added.

5.3 Empirical methodology

We aim to capture the impact of the real effective exchange rate (REER) and other controls on gross exports and GVC-related trade using the export demand equation following Cheng et al., (2016) and Tan et al., (2019). The specification for gross exports is as follows:

$$\ln(\text{real gross exports})_{k,t} = \alpha_0 + \alpha_1 \ln(\text{REER})_{k,t-1} + \alpha_2 \text{FVA share}_{k,t-1} + \alpha_3 \ln(\text{REER})_{k,t-1} \times \text{FVA share}_{k,t-1} + \alpha_4 \ln(\text{Foreign Demand})_{t-1} + \alpha_5 \ln(\text{controls})_t + \mu_k + \varepsilon_{k,t} \quad (5)$$

where $\ln(\text{real gross exports})_{k,t}$ is the log of real gross exports of Tunisia in sector k and in year t; $\ln(\text{REER})_{k,t-1}$ is the lagged log of Tunisia REER; $\text{FVA share}_{k,t-1}$ is the lagged share of FVA in GVCs; $\ln(\text{Foreign Demand})_{t-1}$ indicates the log of trade-weighted geometric average real GDP of trading partners. $\ln(\text{controls})_t$ is the log of a set of control variables. They consist of the Liner Shipping Connectivity Index (LSCI), air transport, and political stability. Last but not

least, μ_k is sector fixed effects and $\varepsilon_{k,t}$ is the error term. Lag values are used to avoid endogeneity. We include a term interacting REER and FVA share to capture the dampening effect of REER when FVA share is large.

GVC-related trade consists of FVA and DVX. The model is expressed in equation (6) as follows:

$$\ln(\text{DVX or FVA})_{k,t} = \beta_0 + \beta_1 \ln(\text{REER})_{k,t-1} + \beta_2 \ln(\text{Domestic Demand})_{k,t-1} + \beta_3 \ln(\text{Foreign Demand})_{k,t-1} + \beta_3 \ln(\text{controls})_{k,t} + \vartheta_k + \varepsilon_{k,t} \quad (6)$$

DVX denotes forward participation and FVA denotes backward participation in GVCs. The domestic demand is proxied by GDP. In addition, foreign demand for exports is proxied by trade-weighted geometric average of trading partners' real GDP. We note that demand measure varies with the dependent variable. Trade-weighted GDP is used as a regressor for gross exports and DVX showing foreign demand of the Tunisian value-added exports. However, Tunisia GDP is used as explanatory variable for FVA to consider domestic demand of imported intermediate inputs. ϑ_k is sector fixed effects. Lags are used to avoid endogeneity concerns. We use a fixed-effects estimation to account for the responsiveness of gross exports and GVC-related trade to changes in the REER.

6 Results

Table 1 aims at estimating REER elasticities of exports and GVC-related trade. The dependent variable is the real gross exports in columns (1) and (2) and the real indirect value-added (DVX) in column (3). The real foreign value-added (FVA) is the dependent variable in column (4).

We find that Real gross exports are negatively and significantly associated with REER with an elasticity of -2.160 for the conventional REER from IMF and -1.556 for REER (DVX-based). REER (DVX-based) and REER (FVA-based) coefficients are equal to -0.989 and -1.015 respectively where REER (DVX-based) is significantly associated with DVX. The coefficient of

REER (FVA-based) is insignificant. In column (2), we incorporate FVA share to the model to assess how the use of intermediate inputs affects exports. Results show that the interaction term of FVA share with REER (DVX-based) is positively related to gross exports. This may be explained by the fact that FVA share in gross exports dampens the response of REER to exports. The dampening effect[8] is equal to - 21 percent. Thus, Tunisia participation in backward linkages (use of imported intermediates as inputs in domestic production) offset the effect of REER appreciation or depreciation on real gross exports by - 21 percent.

Our results are consistent with Cheng et al. (2016). They find that a depreciation rises exports of the domestic value-added. The results are in line with the literature of the relationship between exchange rates and exports. However, in GVCs, exports depend on FVA imports. Thus, they conclude that when REER depreciates imports of FVA increase. This result is unconventional. Therefore, the REER elasticity of response depends on imports and use of intermediate inputs.

Considering the control variables[9] in table 1, both the real gross exports and the GVC-related trade are positively associated with Liner Shipping Connectivity Index (LSCI), political stability, domestic demand proxied by GDP, and foreign demand proxied by weighted GDP. These relationships are statistically significant across all specifications except for LSCI and political stability in column (4). Meanwhile, the air transport coefficient is insignificant except for DVX where it is positively and significantly associated with the forward participation of Tunisia in GVCs.

(Table 1: REER (value-added based) elasticities of exports and GVC-related trade (FVA and DVX))

Table 2 presents the results at the sectoral level. We study REER elasticity of indirect value-added (DVX) in columns 1-5 and foreign value-added (FVA) in columns 6-10. We report regression results of 5 sectoral classifications: High-Tech Manufacturing (HTM), High-Tech Services (HTS), Low-Tech Manufacturing (LTM), Low-Tech Services (LTS), and Primary sectors.

[8] Following Tan et al. (2019), the dampening effect of FVA share which alter the impact of REER appreciation/ depreciation on gross exports at average FVA share (= 0.42484213) is calculated as follows: $\frac{0.764 \times average\ FVA\ share}{-1.556} \times 100\% \simeq -21\ \%.$

[9] We will not discuss the results of the control variables in table 2 and table 3 giving the fact that they hold the same coefficient signs with slight changes.

As shown in the first row of table 2, the REER coefficients for DVX, presented in columns 1 and 5, are negative and insignificant. The estimated REER elasticity for indirect value-added is negative and significant at the 1 percent threshold for High-Tech Services, at the 5 percent threshold for Low-Tech Manufacturing sectors, and the 10 percent threshold for Low-Tech Services. Exchange rate responses differ, as it is strong for LTS and weak for HTS and LTM. Tunisian service and primary sectors engage in forward GVCs. Services contribute more in forward linkages compared to primary sectors. This explains the REER responses to DVX in services. However, manufacturing sectors are engaged in backward linkages. Interestingly, the depreciation in REER (DVX-based) rises indirect value-added exports among the Tunisian Low-Tech manufacturing and service sectors.

We capture the heterogeneous REER effects on different sectors in the Tunisian FVA. It is claimed that foreign value-added does not contribute directly to Tunisian GDP as we consider it the domestic value-added of Tunisia partners. Results are presented in Table 2. Columns 6, 7, and 10 show insignificant coefficients. The coefficient of REER (FVA-based) is strongly statistically significant for Low-Tech manufacturing and service sectors with higher elasticity for services. This shows that backward participation in those sectors increases with depreciation in REER (FVA-based). A depreciation leads to using more intermediate inputs in Tunisian Low-Tech manufacturing and service sectors.

(Table 2: REER (value-added based) elasticities of sectoral GVC-related trade (DVX and FVA).)

Table 3 summarizes the results for REER's impact on manufacturing and service sectors in terms of forward participation and backward participation. Sectors are classified into manufacturing and service sectors without going in-depth as in table 2. We use time dummies to capture heterogeneities across periods. Broadly speaking, the results show negative signs in the coefficients of REER (DVX-based) and REER (FVA-based).

Regarding the forward participation in GVCs, the coefficients on DVX retain negative signs and high statistical significance for services compared to manufacturing in all periods. The magnitude of the coefficients differs significantly from the benchmark model. For instance, REER elasticity in the years 1990 to 2010 is equal to -0.08 and the elasticity in the baseline model is equal to -

0.784 at the 1 percent threshold. When Manufacturing sectors take part in forward GVCs, REER (DVX-based) becomes more responsive over time reaching an elasticity of -0.122 at the 1 percent threshold. REER elasticity of service indirect value-added exports grew over time. More precisely, column (2) shows that this elasticity has increased from -0.08 for the period 1990–2010 to -0.149 for the period between 2014 and 2017. However, in 2011, REERI (DVX-based) response is weak compared to other periods.

Our findings show that the REER elasticity of foreign value-added in manufacturing sectors increased over time, although slightly, with a high significance level in recent years. This indicates that the backward participation of Tunisian manufacturing sectors in GVCs is responsive to changes in REER. Remarkably, the elasticities of REER (FVA-based) are statistically insignificant in column (4) when we have service sectors participating in backward linkages. In other words, backward participation of service sectors in GVCs is not responsive to changes in REER. However, Tunisia foreign value-added does not respond to changes in REER (FVA-based) in 2011 (surprisingly, we have positive insignificant coefficients).

(Table 3: Heterogeneity across periods of REER impact on sectoral GVC-related trade)

Our results differ from those of Ahmed et al. (2017) except for one point where they found that integration in GVCs decreases the REER elasticity of manufacturing exports by 22 percent. Although we did not use the same methodology, we find a similar conclusion for growing exports. First, the calculation of REER are based on value-added weights. It accounts for the importance of participation in GVCs. Second, comparison of the REER elasticities from IMF to elasticities from our findings shows that the first ones are superior to the second ones measured in value-added terms.

Furthermore, Ahmed et al. (2017) argue that the REER elasticity of manufacturing exports decreases over time. This differs from what we find in table 3. Our results show that REER elasticity of service and manufacturing indirect value-added exports grew over time. The REER elasticity of foreign value-added in manufacturing sectors increased.

7 Concluding Remarks

Global Value Chains (GVCs) are attracting widespread interest because of their roles in economic activity. The proliferation of GVCs increases the fragmentation of production. Nowadays, there is a high level of trade in parts and components than the trade in final goods. Global Value Chains (GVCs) enhance trade in intermediate and final goods and services. It also encourages production linkages between countries of the world.

A growing body of literature has examined the impact of exchange rates on international trade but only a few has studied real effective exchange rate (REER) impact on GVCs. It is crucial to reflect the high levels of integration in GVCs when measuring competitiveness for exports. Thus, rethinking the way REER is calculated (the common measure of price competitiveness) is important. In this respect, this study examines the impact of REER (calculated in value-added terms) on GVC-related trade flows in Tunisia in 5 broad sectors: High-Tech Manufacturing (HTM), High-Tech Services (HTS), Low-Tech Manufacturing (LTM), Low-Tech Services (LTS) and Primary sectors. Indirect value-added represents forward participation and foreign value-added denotes backward participation in GVC-related trade.

Our results indicate that REER effects on GVC-related trade differ from their impact on traditional trade. Researchers argue that depreciation in REER improves the competitiveness of exports of final goods excluding value-added exports which are linked to GVCs. In the same line, we find that FVA share in gross exports dampens the response of REER to exports. Tunisia participation in backward linkages (use of imported intermediates as inputs in domestic production) offset the effect of REER appreciation or depreciation on real gross exports by – 21 percent.

High integration levels in GVCs can change the way we interpret REER responses on gross exports and GVC-related trade. Ahmed et al. (2017) find that integration in GVCs decreases the REER elasticity of manufacturing exports by 22 percent. Similarly, we find that REER elasticity (in value-added terms) is inferior to REER from IMF. Our findings show that REER elasticity of

service and manufacturing indirect value-added exports and REER elasticity of foreign value-added in manufacturing sectors grew over time.

The sectoral composition of gross exports alters the impact of REER. Exchange rate responses differ as it is strong for LTS and weak for HTS and LTM. Interestingly, the depreciation in REER (DVX-based) rises indirect value-added exports in Tunisian Low-Tech manufacturing and service sectors. Furthermore, we capture the heterogeneous REER effects on different sectors in Tunisia FVA. The coefficient of REER (FVA-based) is strongly statistically significant for Low-Tech manufacturing and service sectors with higher elasticity for services. This shows that REER depreciation leads to using more intermediate inputs in Tunisian Low-Tech manufacturing and service sectors.

Findings indicate that the REER elasticity of foreign value-added in manufacturing sectors increased over time, although slightly, with a high significance level in recent years. This shows that the backward participation of the Tunisian manufacturing sectors in GVCs responds to changes in REER. Remarkably, backward participation of service sectors in GVCs is not responsive to changes in REER. Tunisia foreign value-added does not respond to changes in REER (FVA-based) in 2011. This study helps identify the extent to which REER devaluation policy in Tunisia boosts international trade. These results have important policy-relevant implications. Competitiveness is determined by the whole supply chain in GVCs. Small economies like Tunisia with low integration in GVCs compared to its partners in the supply chain and with high participation in GVCs (the share of GVC-related trade in gross exports is important especially for FVA) are subject to have a negligible role in the value chain when the exchange rate changes. Then it might be said that changes in Tunisian REER have a little effect on its domestic value-added or the DVX of its partners in the same value chain. Thus, gross exports responses from a change in REER are muted when Tunisia does not contribute much with its domestic value-added. Here, REER fluctuations will have a modest effect on the competitiveness of the value chain. Therefore, a call for larger movements in REER is needed in small economies with higher integration in GVCs and a modest contribution to the entire value chain.

Changes in REER in sectors with a higher share of FVA and high integration in backward linkages will not promote gross exports and domestic value-added exports in particular. Export-

oriented and import-dependent companies will face enormous expenses when engaging in GVCs. Those companies will not benefit from depreciating REER.

Thus, understanding the landscape of GVCs based on sectoral value-added contribution will help set suitable policies for export promotion.

References

Ahmed, S., Appendino, M. & Ruta, M. (2017), 'Global value chains and the exchange rate elasticity of exports', The BE Journal of Macroeconomics 17(1), 1–24.

Ali, A. A. & Msadfa, Y. (2016), 'Industrial policy, structural change and global value chains participation: Case study of morocco, tunisia and egypt', Research papers Policy papers 1604.

Auboin, M. & Ruta, M. (2013), 'The relationship between exchange rates and international trade: a literature review', World Trade Review 12(3), 577–605.

Bang, H. & Park, M. (2018), 'Global value chain and its impact on the linkage between exchange rate and export: Cases of china, japan and korea', The World Economy 41(9), 2552–2576.

Bayoumi, M. T., Saito, M. & Turunen, M. J. (2013), 'Measuring competitiveness: Trade in goods or tasks?', IMF Working Paper (13/100).

Bayoumi, T., Faruqee, H. & Lee, J. (2005), 'A fair exchange?: Theory and practice of calculating equilibrium exchange rates', IMF Working Papers 2005(229), A001.

Bems, R. & Johnson, R. C. (2012), 'Value-added exchange rates', NBER working paper (18498).

Bems, R. & Johnson, R. C. (2017), 'Demand for value added and value-added exchange rates', American Economic Journal: Macroeconomics 9(4), 45–90.

Casella, B., Bolwijn, R., Moran, D. & Kanemoto, K. (2019), 'Improving the analysis of global value chains: the unctad-eora database', Transnational Corporations 26(3), 115–142.

Chebbi, H. E. & Olarreaga, M. (2019), 'Investigating exchange rate shocks on agricultural trade balance: the case of tunisia', The Journal of International Trade & Economic Development 28(5), 628–647.

Cheng, K. C., Hong, G. H., Seneviratne, D. & van Elkan, R. (2016), 'Rethinking the exchange rate impact on trade in a world with global value chains', International Economic Journal 30(2), 204–216.

Dellas, H. & Zilberfarb, B.-Z. (1993), 'Real exchange rate volatility and international trade: a reexamination of the theory', Southern Economic Journal pp. 641–647.

Fanizza, D., Laframboise, N., Martin, E., Sab, R. & Karpowicz, I. (2002), 'Tunisia's experience with real exchange rate targeting and the transition to a flexible exchange rate regime', IMFWorking Papers 2002/190.

Guizani, B. (2019), 'The impact of exchange rate shocks on trade in times of uncertainties: evidence from three oil-importing countries in the mena region', Stateco p. 113.

Koopman, R., Powers, W., Wang, Z. & Wei, S.-J. (2010), 'Give credit where credit is due: Tracing value added in global production chains', National Bureau of Economic Research.

Patel, N.,Wang, Z. &Wei, S.-J. (2019), 'Global value chains and effective exchange rates at the countrysector level', Journal of Money, Credit and Banking 51, 7–42.

Siedschlag, I. & Murphy, G. (2015), Firms' engagement in global value chains, in 'Europe in the Age of Global Value Chains: Maps and Policy Issues', pp. 175–186.

Tan, K. G., Trieu Duong, L. N. & Chuah, H. Y. (2019), 'Impact of exchange rates on asean's trade in the era of global value chains: An empirical assessment', The Journal of International Trade & Economic Development 28(7), 873–901.

WB (2020), Trading for Development in the Age of Global Value Chains, World Development Report. The World Bank Washington, DC, USA.

Weldzius, R. M. (2021), 'The end of currency manipulation? global production networks and exchange rate outcomes', Economics & Politics 33(3), 514–532.

Appendix

Table A.1: Summary Statistics and data description

Variable	Description	Obs	Mean	Min	Max	Source
Real DVX	Real indirect value-added	699	84617.03	135.257	994000	UNCTAD-Eora Global Value Chain (GVC) database
Real FVA	Real foreign value-added	699	81077.61	64.311	887000	
Real exports	Real gross exports	699	293000	1187.515	2200000	
REER (DVX-based)	Real Effective Exchange rate based on indirect value-added weights	699	106.755	86.353	127.371	Author's calculation using data of nominal exchange rates from the Central Bank of Tunisia (CBT)
REER (FVA-based)	Real Effective Exchange rate based on foreign value-added weights	699	105.851	85.573	122.19	
FVA share	Tunisia foreign value-added contribution to GVCs	699	.407	.036	.868	UNCTAD-Eora Global Value Chain (GVC) database
Political Stability	indicator	699	39.598	11.429	59.788	World Bank governance indicators database
Domestic Demand	real GDP	699	3.39e+10	1.83e+10	4.97e+10	World Bank (WB)
Foreign Demand	GVC-related trade-weighted geometric average of Tunisia trading partners' real GDP	699	2.36e+12	1.90e+12	2.89e+12	Author's calculation using GDP data from the WB
Air transport	freight (million ton-km)	699	16.587	8.096	20.818	WB
LSCI	Liner shipping connectivity index (maximum value in 2004 = 100)	699	9.535	7.62	11.461	UNCTAD statistics
Conventional REER (IMF)	Real effective exchange rate index (2010 = 100)	699	114.958	84.397	133.105	International Monetary Fund (IMF)

Source: Authors' elaboration

Table A.2: Sector description

Classification	Eora sectors
Primary sectors	Agriculture Fishing Mining and Quarrying
Low-Tech Manufacturing	Food & Beverages Textiles and Wearing Apparel Wood and Paper Metal Products Other Manufacturing Recycling
High-Tech Manufacturing	Petroleum, Chemical, and Non-Metallic Mineral Products Electrical and Machinery Transport Equipment
Low-Tech Services	Electricity, Gas, and Water Construction Maintenance and Repair Wholesale Trade Retail Trade Hotels and Restaurants Transport Private Households Others
High-Tech Services	Post and Telecommunications Financial Intermediation and Business Activities Public Administration Education, Health and Other Services

Note: Classification of sectors is according to Foster-Mcgregor et al. (2015)

Tables

Table 1: REER (value-added based) elasticities of exports and GVC-related trade (FVA and DVX)

VARIABLES	(1) Exports	(2) Exports	(3) DVX	(4) FVA
Lag of ln REER (IMF)	-2.160***			
	(0.183)			
Lag of ln REER (FVA-based)				-1.015
				(0.709)
Lag of ln REER (DVX-based)		-1.556***	-0.989***	
		(0.266)	(0.170)	
Lag of FVA share		-3.655*		
		(2.066)		
Lag of ln REER (DVX-based) × lag of FVA share		0.764*		
		(0.441)		
Ln LSCI	0.230**	0.387***	0.695***	0.0492
	(0.0833)	(0.0809)	(0.110)	(0.156)
Ln Air Transport	0.0243	-0.0543	0.137**	-0.0684
	(0.0506)	(0.0512)	(0.0527)	(0.107)
Ln Political Stability	0.256***	0.157***	0.301***	0.00483
	(0.0319)	(0.0287)	(0.0272)	(0.0595)
Lag of ln Foreign Demand	1.635***	3.054***	4.254***	
	(0.280)	(0.203)	(0.176)	
Lag of ln Domestic Demand				1.171***
				(0.147)
Constant	-26.27***	-69.38***	-109.4***	-14.25**
	(8.791)	(6.458)	(5.565)	(5.695)
Observations	699	699	699	699
Number of sectors	25	25	25	25

Source: Authors' computation.
Notes: Robust standard errors in parentheses (2) *** p<0.01, ** p<0.05, * p<0.1.

Table 2: REER (value-added based) elasticities of sectoral GVC-related trade (DVX and FVA)

Indirect Value Added (DVX)

VARIABLES	(1) High-Tech Manufacturing	(2) High-Tech Services	(3) Low-Tech Manufacturing	(4) Low-Tech Services	(5) Primary sectors
Lag of ln REER (DVX-based)	-0.576	-1.007*	-0.672**	-1.329***	-1.026
	(1.156)	(0.328)	(0.224)	(0.211)	(0.359)
Lag of ln Foreign Demand	5.163**	4.343***	4.170***	4.046***	4.030**
	(1.088)	(0.232)	(0.271)	(0.237)	(0.666)
Ln LSCI	0.645	0.753**	0.879***	0.809***	0.134
	(0.315)	(0.130)	(0.130)	(0.167)	(0.340)
Ln Air Transport	0.278	0.150	0.188*	0.145*	-0.171
	(0.232)	(0.0959)	(0.0827)	(0.0712)	(0.151)
Ln Political Stability	0.296	0.290**	0.336***	0.340***	0.168
	(0.111)	(0.0498)	(0.0422)	(0.0408)	(0.100)
Constant	-136.1*	-111.5***	-109.6***	-102.7***	-100.0**
	(35.67)	(7.684)	(8.479)	(7.468)	(19.52)
Observations	83	112	168	252	84
Number of sectors	3	4	6	9	3

Foreign Value Added (FVA)

VARIABLES	(6) High-Tech Manufacturing	(7) High-Tech Services	(8) Low-Tech Manufacturing	(9) Low-Tech Services	(10) Primary sectors
Lag of ln REERI (FVA-based)	-0.605	1.802	-1.260**	-2.395***	-0.331
	(1.271)	(4.477)	(0.385)	(0.624)	(0.307)
Lag of ln Domestic Demand	1.918	1.473***	1.282***	0.690**	1.283**
	(0.772)	(0.172)	(0.185)	(0.246)	(0.187)
Ln LSCI	0.0110	-0.0127	0.114	-0.00529	0.237
	(0.431)	(0.556)	(0.145)	(0.222)	(0.266)
Ln Air Transport	0.169	0.228	-0.163	-0.296*	0.267
	(0.289)	(0.454)	(0.0835)	(0.137)	(0.198)
Ln Political Stability	0.0826	-0.178	0.0612	-0.0609	0.189
	(0.143)	(0.260)	(0.0453)	(0.0891)	(0.0879)
Constant	-31.93	-36.15	-14.56*	3.277	-21.35**
	(24.82)	(24.79)	(6.239)	(5.518)	(4.362)
Observations	83	112	168	252	84
Number of sectors	3	4	6	9	3

Source: Authors' computation.
Notes: Robust standard errors in parentheses (2) *** p<0.01, ** p<0.05, * p<0.1.

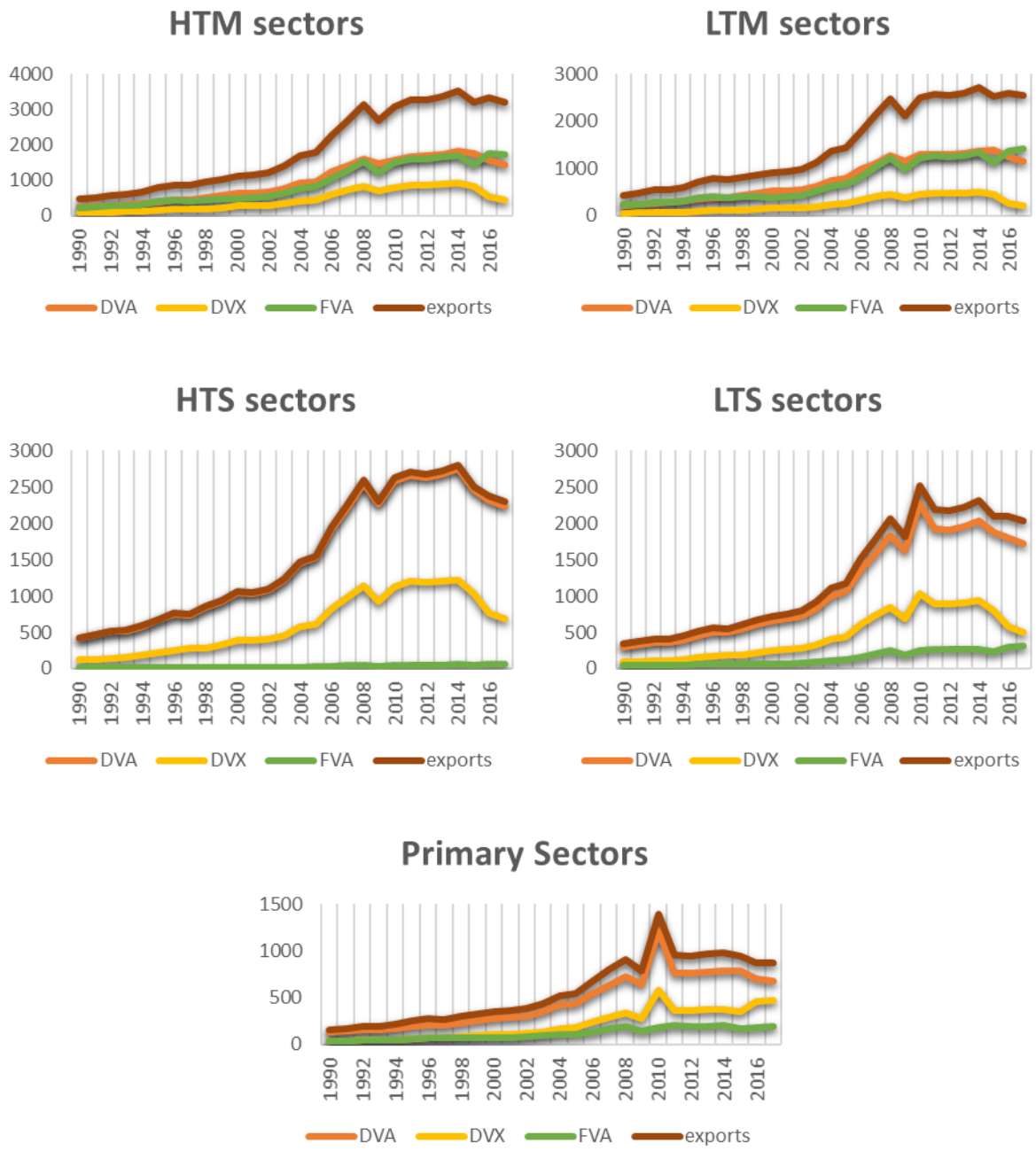
Table 3: Heterogeneity across periods of REER impact on sectoral GVC-related trade

	DVX		FVA	
VARIABLES	(1) Manufacturing	(2) Services	(3) Manufacturing	(4) Services
Lag of ln REER (DVX-based)	-0.342	-0.784***		
	(0.261)	(0.160)		
Year: 1990-2010 × lag of ln REER (DVX-based)	-0.0547**	-0.0800***		
	(0.0212)	(0.0167)		
Year: 2011 × lag of ln REER (DVX-based)	-0.0466**	-0.0585***		
	(0.0164)	(0.0128)		
Year: 2014-2017 × lag of ln REER (DVX-based)	-0.122***	-0.149***		
	(0.0131)	(0.00571)		
Lag of ln Foreign Demand	4.373***	4.053***		
	(0.317)	(0.179)		
Ln LSCI	0.489***	0.617***	0.0429	-0.0996
	(0.151)	(0.109)	(0.157)	(0.263)
Ln Air Transport	-0.325***	-0.383***	-0.0741	-0.101
	(0.0924)	(0.0680)	(0.144)	(0.266)
Ln Political Stability	0.272**	0.353***	0.0428	0.0175
	(0.110)	(0.0897)	(0.150)	(0.150)
Lag of ln REER (FVA-based)			-0.773**	-1.181
			(0.345)	(1.338)
Year: 1990-2010 × lag of ln REER (FVA-based)			-0.00997	-0.0433
			(0.0283)	(0.0277)
Year: 2011× lag of ln REER (FVA-based)			0.0176	0.0194
			(0.0224)	(0.0227)
Year: 2014-2017× lag of ln REER (FVA-based)			-0.0448***	-0.00468
			(0.00975)	(0.0319)
Lag of ln Domestic Demand			1.431***	0.849***
			(0.219)	(0.212)
Constant	-113.5***	-103.0***	-20.07**	-6.678
	(9.927)	(5.612)	(6.758)	(9.498)
Observations	335	364	335	364
Number of sectors	12	13	12	13

Source: Authors' computation.
Notes: Robust standard errors in parentheses (2) *** p<0.01, ** p<0.05, * p<0.1.

Figures

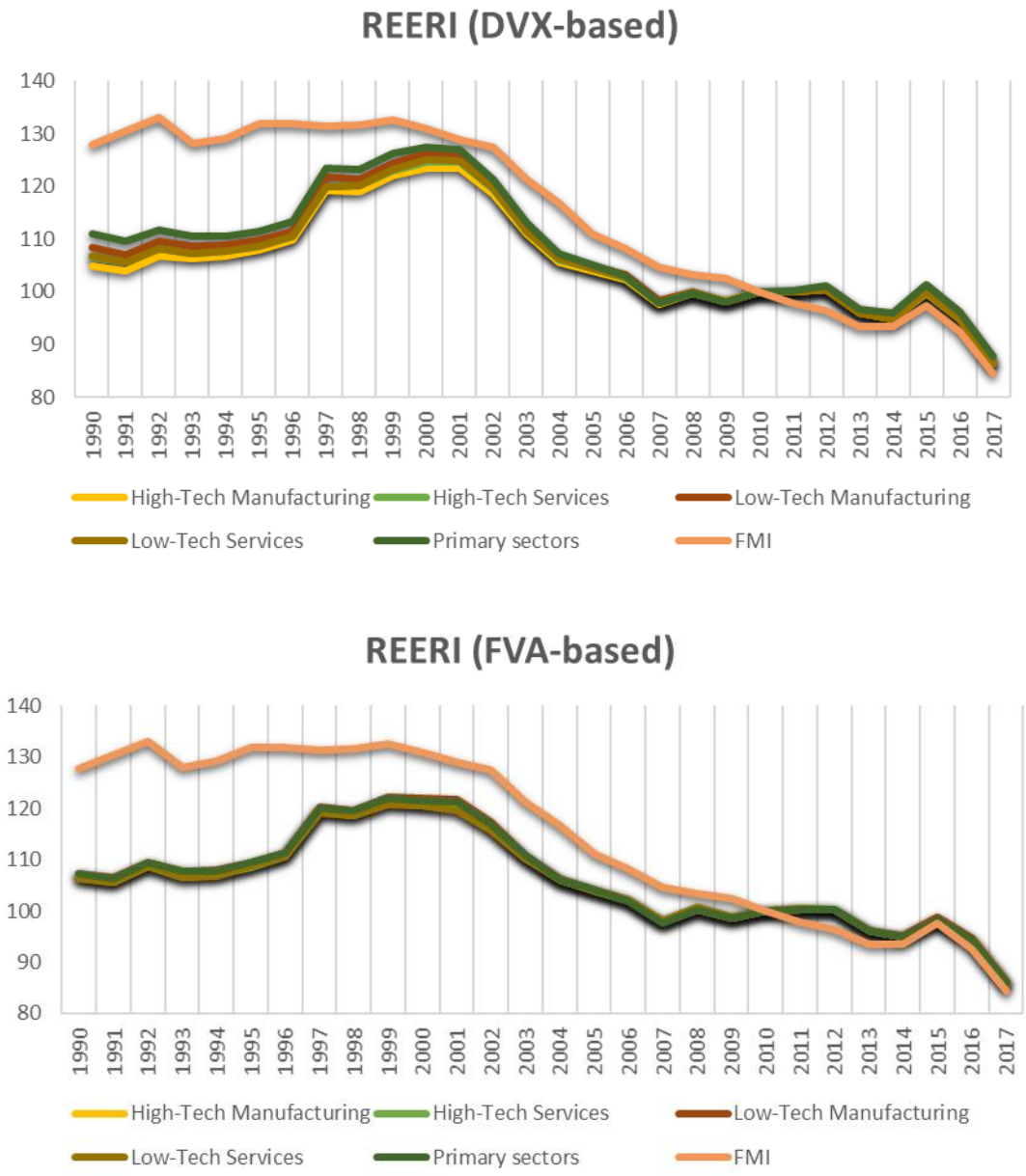
Figure 1: Tunisia Global Value Chain (GVC) participation by sector, million US dollars



Source: Authors elaboration from UNCTAD-EORA GVC database.

Note: HTM = High-Tech Manufacturing, LTM = Low-Tech Manufacturing, HTS = High-Tech service, LTS = Low-Tech service.

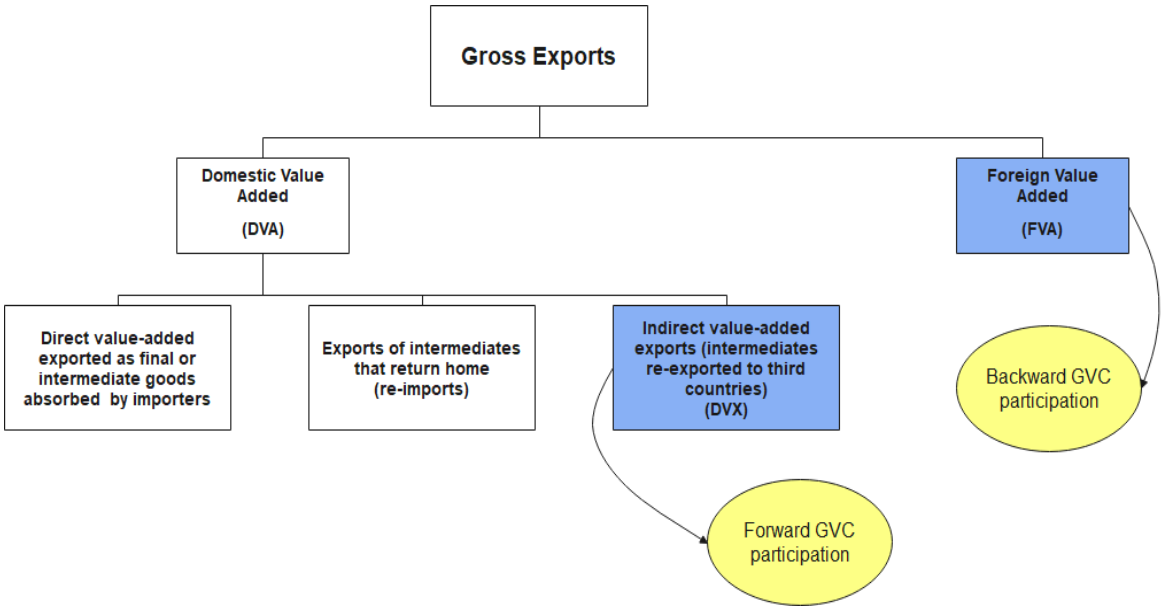
Figure 2: Tunisia Real Effective Exchange Rate (REER)



Source: Authors calculations.

Note: REER index from IMF is not sectoral.

Figure 3: Decomposition of Gross Exports



Source: Authors elaboration, adapted from Koopman et al. (2010).