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GVC and Labor Market Outcomes:

Evidence from MENA

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Abstract

This paper studies the effect of global value chains (GVC) participation on wages in Egypt, Jordan, and Tunisia. Although theoretical predictions suggest an upward GVC effect on wages, this benefit is heterogeneous in accordance with GVC position (high vs. low value-added) signaled by sectoral technology intensity as well as labor divide (skilled vs. unskilled). By merging World Bank Enterprise Surveys (WBES) and Labor Market Panel Surveys (LMPs) data, this paper contributes to the literature as follows. First, it differentiates between GVC participation margins (extensive vs. intensive) and capture the effect of each on wages and wage premium. Second, it explores the GVC mediating effects of technology and skill levels to the end of capturing conventional biases against developing countries endowed with unskilled labor. This study shows that the homogenously upward GVC effect on wages and wage premium is strengthened with skill requirement. Results remain consistent when using Heckman correction analysis to control for selection bias.

Research area: International trade
Keywords: Wages – Global value chains
JEL classification: F16 – J23

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1. Introduction

Recently, a surge of research prospects the benefits of global value chains (GVC) participation on country and firm levels. Apparent GVC gains include productivity growth, technological progress, and increased labor wages. Based on "skill biased technological change" theory (Feenstra and Hanson 1996), GVC upward effect on wages is biased towards skilled labor singling out advanced economies endowed with skilled labor in realizing GVC gains in terms of labor conditions. From another angle, GVC driven labor productivity is unleashed when accounting for trade in tasks rather than manufacturing (Grossman and Rossi-Hansberg 2008). Hence, in light of the consistently increasing trade in services, GVC participation is likely to have an upward wage effect in developed and developing countries alike. This paper aims at scrutinizing the GVC effect on individuals' wages in selected Middle East and North African (MENA) countries namely Egypt, Jordan and Tunisia whilst capturing the GVC mediating effect of sectoral technology intensity and skill requirement.

The wide strand of literature on the nexus between trade liberalization and labor market outcomes display mixed results. While some studies indicate a job displacement effect of free trade (Hanson 2001 and Autor et al. 2013), others adversely show that trade liberalization creates more jobs and increases wages across industries. Among others, Autor et al. (2013) show that US workers' job losses are concentrated in heavily exposed regions and sectors to Chinese imports. In the same vein, increased trade upscales labor productivity and wages only for unexposed industries to import competition (Pavcnik 2002). From a contrasting lens, increased trade leads to more job creation and higher wages for Mexican workers in manufacturing with a concentrated effect in regions and industries heavily involved in exporting (Goldberg and Pavcnik 2007). Indeed, the well-studied positive effect of exports on skilled labor demand (Bernard and Jensen 1997; Bernard et al. 2007) is mitigated in MENA countries by labor market rigidity limiting job creation (Selwaness and Zaki 2019).

From a theoretical standpoint, traditional trade contributes to improving labor conditions through a twofold channel. First, international trade leads to standardizing labor conditions (Gereffi and Fernandez-Stark 2011) that is directly advantageous to developing countries with middling conditions compared to developed counterparts. Second, international trade has a growth effect that indirectly fosters various development milestones including labor market conditions in developing countries. Yet, due to the GVC consequential interweaving of employment across borders, the relationship between the former and labor market outcomes is complicated (Jihang and Milberg 2013) to the extent that growing empirical literature do not coincide on a straightforward positive GVC effect on wages across countries. In regard to employment, a GVC driven job creation in manufacturing (Amighini et al. 2013) and services (Los et al. 2012; Johnson and Noguera 2012) is evidenced in both developed and developing countries. In contrast, sectoral micro data show a homogenously inverted GVC effect on individual wages for high routine jobs in GVC participating industries (Parteka and Wolszczak-Derlacz 2019) and services (Los et al. 2012; Johnson and Noguera 2012).

Unlike the well-recognized job losses effect, fragmentation of production diffuses GVC employment gains (De Backer 2011). The mechanism through which GVC participation fosters labor conditions is threefold. First, the demand effect stimulates skilled labor wages across GVC participants (Feenstra and Hanson 1996; Grossman and Rossi-Hansberg 2008). Second, employees training in GVC participating firms escalates labor productivity (Lall 2000; Humphrey and Schmitz 2002). Third, the spillover effect transmitting embodied foreign knowledge enhances productivity across GVC participants (Taglioni and Winkler 2016; Eissa and Zaki 2023). Undoubtedly, GVC driven labor gains are enlarged by directly contributing to domestic human capital and industries' development (Gereffi et al. 2011 and Bamber et al. 2017).

Focusing on developing countries, studies conclude that workers in traded sectors earn higher than their counterparts in non-traded sectors (Kabeer and Tran 2006; Roberts and Thoburn 2004). Likewise, workers at the high edge of chain activities earn higher than their counterparts at the base activities (Shingal 2015). Indeed, a GVC driven upward wage effect is heterogenous in accordance with firms' GVC position, industries, and regions. By definition, GVC participation reallocates labor intensive manufacturing from advanced to low waged developing countries (Pahl et al. 2022). Despite the GVC advantage of decreased cost and job creation in unskilled labor-endowed countries, some studies remain skeptical of a GVC driven upward wage effect in developing countries (Baldwin and Forslid 2020; Rodrik 2018). To contribute to the literature on the nexus between GVC and labor market outcomes in developing countries, this paper is centered on estimating the direct GVC effect on wages and wage premium as well as capturing the sectoral technology intensity and skill requirement GVC mediation in Egypt, Jordan and Tunisia. To reach this objective, I employ a one stage human capital model, a hackman correction procedure, and a wage premium two stage estimation analysis. Results evidence an upward GVC effect on both wages and wage premium strengthened with skill requirement.

This paper is composed of five sections proceeding as follows: Section 2 presents some stylized facts on GVC and wages in Egypt, Jordan, and Tunisia. Section 3 presents the empirical strategy and data. Section 4 presents the empirical results and Section 5 concludes.

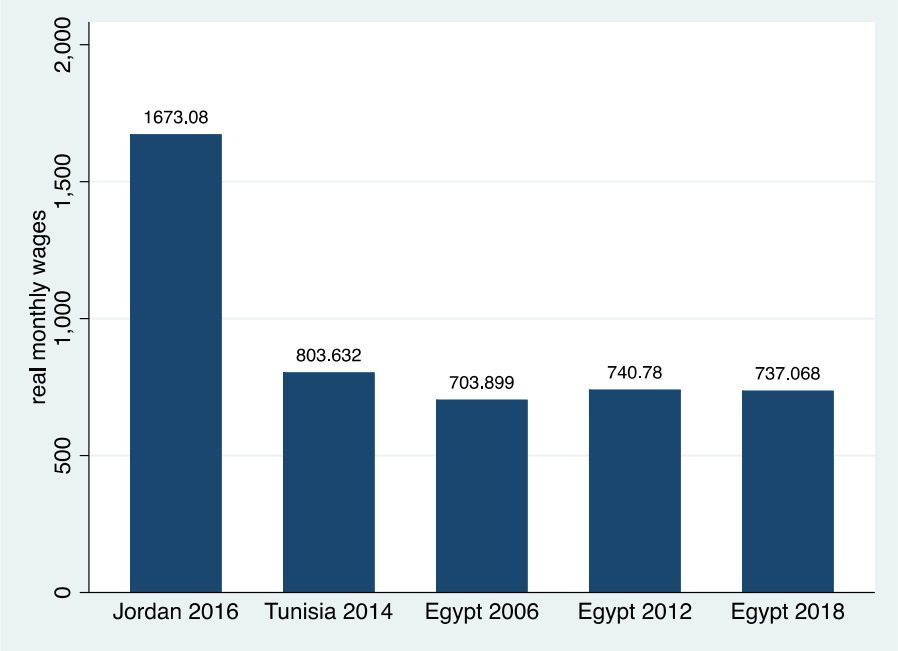
2. Stylized facts

Despite the homogenous regional belonging, data shows that real wages are asymmetrically higher in Jordan (year 2016) compared to Tunisia (year 2014) and Egypt (years 2006, 2012 and 2018). Alongside data representation, it is worth mentioning that the majority of workers in Jordan earn minimum wage and only a minority earn living wages (Kraft and Hannafi 2022).

As presented in Figure 1, although real monthly wages increased by 5.2% from the year 2006 to the year 2012 in Egypt, the former declined by 3.7% in the year 2018. In parallel to the recent decline in real wages, Figure 2 shows that the share of employment in manufacturing declined by 15% in Egypt in the year 2020 compared to the year 2016. The depicted recent rise in services' employment share in Jordan and Egypt reflects the relevance of services in contributing to value added growth and job creation in MENA countries. Unlike non-tradable traditional services, transportation, logistics and communication, business processes, and other modern services cross borders benefiting from reduced costs. Indeed, due to missing value-added information, increased employment shares is an insufficient condition to prospecting a service led growth path in MENA

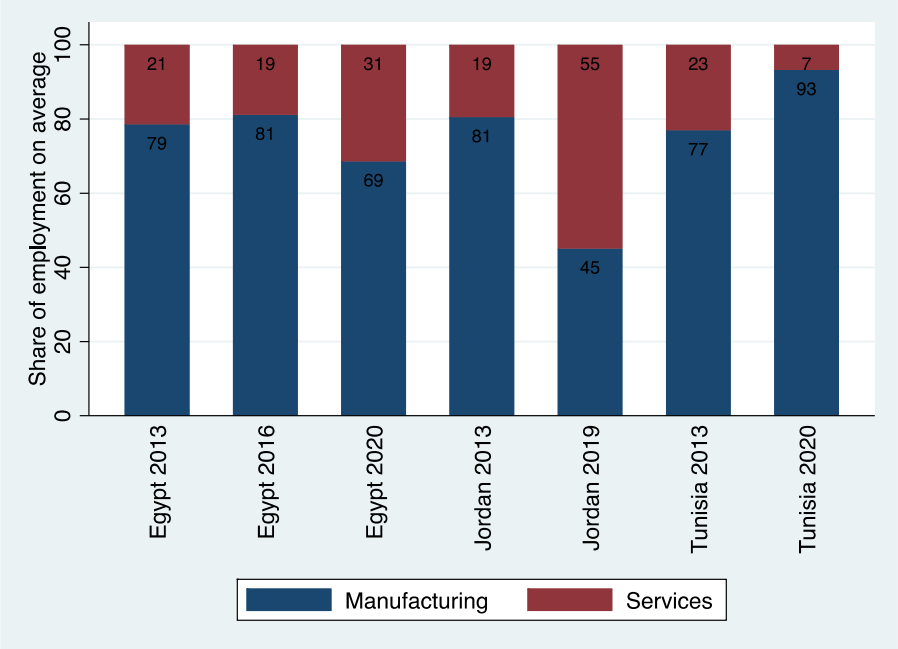
countries. In contrast to Egypt and Jordan, Tunisia has a declining employment share in services reaching 7% in the year 2020. Conventionally, manufactured goods are more tradable than services making the former more exposed to realizing GVC participation gains.

Figure 1 Real 2018 PPP monthly wages



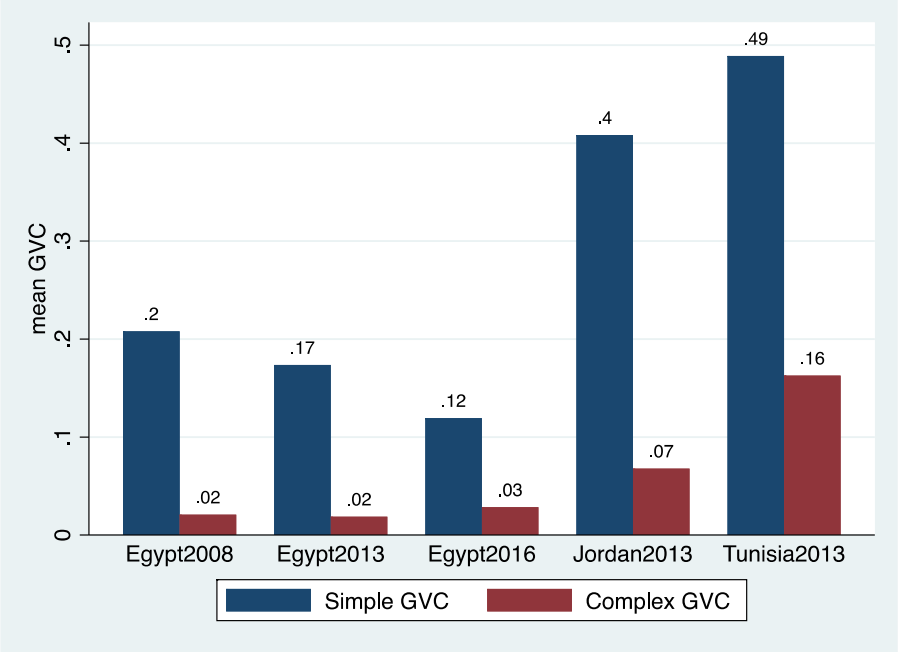
Source: Own construction based on Integrated LMPs v4.0

Figure 2 Employment share across sectors



Source: Own construction based on WBES dataset

Figure 3 Simple and complex GVC participation on average



Source: Own construction based on WBES comprehensive dataset

Figure 3 shows simple and complex extensive margin GVC participation on average by country and year. Followed by Jordan, Tunisia has the highest participation on average in both simple and complex GVC aligning with Tunisia's higher labor share in more tradable manufacturing activities. On the other hand, GVC participation in Egypt is stickily low with a declining simple GVC trend from the year 2006 to the year 2018.

Table 1 summarizes labor market characteristics by country. Despite inhibited GVC participation[2], Egypt has the highest job market skill requirement of 43.3% compared to 27.71% and 25.77% in Jordan and Tunisia respectively. Nevertheless, followed by Tunisia, Egypt has the highest share of informality (53%). High informality in Egypt is expected to be higher post the Covid-19 pandemic due to constrained job creation by deteriorated investment climate and lower finance access to private sector (Zaki 2023).

As presented in Table 1, sectors are intensified in low rather than medium technology suggesting a concentrated GVC participation in low value-added activities. Low technology intensive sectors include food, furniture, textiles, construction, and other services excluding information technology and communication. It is worth mentioning that technology is measured by the weight of sectoral R&D intensity and not related to factor intensity (labor vs. capital). Indeed, the recent high concentration of Egypt's activities in construction and petroleum related activities (Zaki 2023) limits quality and quantity job creation and locks the economy in low value added GVC participation.

[2] Egypt's low GVC participation can be attributed to high time and cost to trade (OECD 2021).

Table 1 Labor market characteristics by country on average

	Jordan	Tunisia	Egypt
Informal	34.37%	50.52%	53%
Formal	65.63%	49.48%	47%
Total	100	100	100
No skill required	72.29%	74.23%	56.57%
Skill required	27.71%	25.77%	43.43%
Total	100	100	100
Low technology	90.27%	93.13%	89.76%
Medium technology	9.73%	6.87%	10.24%
Total	100	100	100

Source: Own construction based on Integrated LMPs v4.0 and Gualindo-Rueda and Verger (2016)

In light of the undersized GVC participation in the countries under study, econometric modelling is necessary in capturing the impact of the former on labor market outcomes. By collapsing[3] and merging WBES with LMPs fourth wave dataset, a threefold empirical strategy is used to guarantee a robust GVC effect on individual wages along with the GVC mediation of technology intensities and skill levels.

3. Methodology and data

Relying on the recent World Bank Enterprise Surveys (WBES) comprehensive dataset and following GVC definitions in the literature (Dovis and Zaki 2020; Urata and Baek 2021), I measure extensive (simple and complex) and intensive GVC measures as follows:

$$GVC_{si} = \begin{cases} 1, \ if \ X_i \ and \ M_i > 0 \\ 0, otherwise \end{cases} \quad (1) \qquad GVC_{ci} = \begin{cases} 1, \ if \ X_i, M_i, C_i, and \ FS_i > 0 \\ 0, otherwise \end{cases} \quad (2)$$

$$GVC_{int} = X_i * M_i \quad (3)$$

where: GVC_{si}, GVC_{ci}, and GVC_{int} are simple, complex, and intensive GVC participation[4] in firm i respectively, X_i is the share of exports in total sales in firm i, M_i is the share of foreign inputs in total inputs in firm i, C_i is international quality certification provision in firm i, and FS_i is the share of foreign ownership in firm i.

To capture a robust GVC effect on labor wages, I follow a threefold empirical strategy as follows:

3.1 One step human capital model

[3] GVC measures are collapsed by industry, country, year, and geographical regions. These covariates are matched with LMPs fourth wave dataset.

[4] Simple GVC participation suggests that the firm is engaged in importing intermediate goods and exporting with at least one foreign country. Complex GVC participation suggests that the firm is engaged in importing intermediate goods and exporting across different countries and regions conveying more exposure to foreign resources.

Using human capital model (Mincer 1974 and Zaki 2014), I assess the effect of GVC on wages directly by adding GVC variables successively as follows[5]:

$$\log(w)_{igjst} = \beta_0 + \beta_1 X_{igjst} + \beta_2 GVC_{gjst} + \gamma_g + \gamma_j + \varepsilon_{igjst} \quad (4)$$

where $\log(w)_{igjst}$ is the real monthly wage rate in logarithm for individual i in governorate g, country j, sector s, and year t. X_{igjst} is a vector of individual characteristics including education level, age, age squared, gender, parents' level of education, living in a rural area, and belonging to a trade union. GVC_{gjst} is the participation in GVC on the extensive and intensive margins. γ_g and γ_j are vectors of region and country dummies respectively to control for unobservable. ε_{igjst} is the discrepancy term.

3.2 Heckman two step selection analysis

To correct for self-selection of low wage earners in local forms due to individual characteristics, I employ Heckman's (1979) selection procedure. In this strategy, inverse Mills ratio is calculated in the first stage using exclusion restriction[6]. To bypass the downward bias on wages, inverse Mills ratio is included in the second stage regression as an explanatory variable.

3.3 Two step industry wage premia analysis

Following the literature (Gaston and Trefler 1994; Salem and Zaki 2019; Falcone and Galeano 2017), industry wage premia are retrieved from the wage equation for each country and year separately in the first step as follows:

$$\log(w)_{igs} = \beta_0 + \beta_1 X_{igs} + \varphi I_s + \gamma_g + \varepsilon_{igs} \quad (5)$$

where $\log(w)_{igs}$ is the real monthly wage rate in logarithm for individual i in governorate g, sector s. X_{igs} is a vector of individual characteristics including education level, age, age squared, gender, parents' level of education, living in a rural area, and belonging to a trade union. I_s is a vector of sector dummies[7]. γ_g is a vector of regional dummies to control for unobservable heterogeneity. ε_{igs} is the discrepancy term.

Retrieved industry coefficients form equation 5 are pooled for all countries and years (φ_{sjt}) and normalized to express each coefficient as deviation from the employment-weighted average industry wage premia as follows:

$$W_s = \sum_j (\varphi_s * l_s) \quad (6)$$

[5] Standard errors are clustered by industry and country and weights are employed in regressions.

[6] Parent job irregularity is the exclusion restriction. It's relevance on employment is captured by estimating the likelihood of being employed using a weighted probit regression as follows:

$$P(employment)_{igjst} = \beta_0 + \beta_1 X_{igjst} + \gamma_g + \gamma_j + \varepsilon_{igjst}$$

where, employment is a binary variable equals 1 if the individual is employed and 0 otherwise. X_{igjst} is a set of individual characteristics illustrated in strategy 1. Region and country dummies are added to control for unobservable heterogeneities, ε_{igjst} is the discrepancy term.

[7] Including 17 manufacturing and services sectors.

$$IP_s = \varphi_s - W_s \quad (7)$$

where, l_s is the share of waged employment in sector s, $IP_s$is the normalized industry wage premia. Hence, normalized industry wage premium[8] is defined as the proportional difference in wages for a given worker in a given industry relative to an average worker in all industries with homogeneous observable characteristics (Falcone and Galeano 2017). Normalized industry wage premium is regressed on GVC measures as follows:

$$\log(IP_{sjt}) = \beta_0 + \beta_1 GVC_{sjt} + \gamma_s + \gamma_j + \varepsilon_{sjt} \quad (8)$$

where, $\gamma_s and\ \gamma_j$ are industry and country fixed effects respectively to control for unobservable heterogeneities.

To study GVC mediation of technology and skill levels, I interact categorical variables of RD intensity (low vs. medium) and skill requirement (no skill vs. skill) consecutively with GVC measures using OLS and Heckman correction procedures. This step is important to disentangle the GVC effect on wages in respect to firms' position along the chain.

The merged dataset includes 9,773 individual observation for 17 industries in 26 regions in Egypt (years 2006, 2012 and 2018), Jordan (year 2016), and Tunisia (year 2014). All data is individual and industry specific and rely on LMPs v4.0 and WBES comprehensive dataset[9].

4. Empirical results

Tables 2, 3, 4, 5, 6 report the results on the effect of GVC participation on labor wages[10]. As presented in Table 2, results of a one-step human capital regression show an upward effect of both extensive (simple and complex) and intensive GVC participation. Likewise, the magnitude of the effect is higher in complex compared to simple GVC showing the extent of relevance of foreign interlinkages concentration on labor conditions. Indeed, higher foreign interlinkages lead to more foreign knowledge GVC spillovers (Eissa and Zaki 2023) leading to increased productivity mirrored in higher real wages. In addition, intensive GVC is stronger in terms of magnitude and significance compared to extensive GVC participation. This result shows that the higher the trading volume, the stronger the GVC upward effect on labor wages[11].

To control for self-selection of low waged workers due to individual characteristics in non GVC participating firms, Table 3 presents the results of Heckman correction procedure. Following the bias exclusion criteria[12] and including inverse Mills ratio, the second stage regression confirms that the GVC upward wage effect is exclusive to complex and intensive measures. Despite the varying magnitude when controlling for downward bias, both GVC measures remain positive and significant. Aligning with baseline results, Table 4 shows a significant and positive effect of the

[8] This normalization is necessary in order to dilute omitted industry coefficients' bias.
[9] Appendix 1 presents a table of data descriptive statistics.
[10] All regressions are weighted, and standard errors are clustered by country and industry.
[11] Appendix 2 and Appendix 3 show similar regression results when controlling for time unobserved heterogeneity by singling out Egypt.
[12] Appendix 4 presents the probit regression showing the relevance of father's irregular occupation on the probability of being employed.

three GVC measures on industry wage premium[13]. However, after controlling for country unobserved heterogeneity, simple GVC again reveals insignificance. Both Heckman correction and wage premium procedures' results are consistent in the positive wage effect of complex and intensive GVC[14].

Although firms' position along the chain is uncertain, R&D intensity and skill requirement signal the heterogenous GVC wage effect at different value-added activities. Table 5 and Table 6 present the results of industry R&D intensity and skill requirement interaction with GVC respectively using OLS and Heckman correction methodologies. As presented, including R&D intensity and skill requirement results in an insignificant simple GVC effect on wages across the two methodologies. Again, both complex and intensive GVC measures remain positive and significant. Despite the direct positive effect of medium R&D intensity, the latter does not mediate the GVC upward wage effect except with intensive GVC in Heckman correction. Although results show a dampening GVC effect of medium R&D on wages at the 10% significance level, the net GVC effect remains positive. Moving to skill requirement, using different methodologies, Table 6 shows a consistently positive direct effect of skill requirement on real wages across GVC measures at the 1% significance level. Exclusive to OLS, results show a strengthening complex GVC effect of skill requirement on wages[15].

Table 2 WLS baseline

Dependent variable	Log (real monthly wages)		
	Simple	Complex	Intensive
GVC	.066**	.282**	.744***
	(.025)	(.078)	(.059)
Years of schooling	.009***	.009***	.009***
	(.001)	(.001)	(.001)
Experience	.021***	.02***	.021***
	(.002)	(.002)	(.002)
(Experience)^2	-.0002***	-.0002***	-.0002***
	(.001)	(.001)	(.001)
Female	-.16***	-.159***	-.159***
	(.016)	(.014)	(.014)
Father education	.097***	.096***	.095***
	(.009)	(.008)	(.009)
Mother education	.086***	.091***	.081***
	(.013)	(.015)	(.013)
Trade union	.17***	.175***	.172***
	(.012)	(.01)	(.01)
Rural	-.127	-.124	-.124
	(.065)	(.064)	(.063)
Constant	2.559***	2.568***	2.547***
	(.113)	(.093)	(.102)
No. of Observations	9,773	9,737	9,773
R^2	.184	.185	.186
Country FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

*Clustered standard errors by country and sector are in parentheses*** p<.01, **

[13] Appendix 5 presents the results of first stage regression.
[14] Appendix 6 shows that when the same methodology is applied on Egypt, only complex GVC remains significant.
[15] Appendix 7 and Appendix 8 show consistent results on Egypt.

*p<.05, * p<.1*

Table 3 Heckman correction

Dependent variable	Log (real monthly wages)					
	Simple		Complex		Intensive	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
GVC	.074***	.044	.322***	.316**	.867***	.756***
	(.02)	(.032)	(.062)	(.074)	(.155)	(.112)
Irr job father	-.035*		-.035*		-.036*	
	(.019)		(.02)		(.019)	
Years of schooling	.008***	.009***	.008***	.009***	.008***	.009***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Experience	.019***	.018***	.018***	.018***	.019***	.018***
	(.002)	(.003)	(.002)	(.003)	(.002)	(.003)
(Experience)^2	-.0002***	-.0002***	-.0002***	-.0002***	-.0002***	-.0002***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Female	-.192***	-.174***	-.19***	-.173***	-.191***	-.176***
	(.015)	(.018)	(.015)	(.016)	(.015)	(.014)
Father education	.09***	.104***	.091***	.104***	.089***	.103***
	(.019)	(.009)	(.019)	(.007)	(.019)	(.009)
Mother education	.081***	.094***	.082***	.101***	.076***	.088***
	(.029)	(.013)	(.029)	(.014)	(.029)	(.013)
Trade union	.159***	.183***	.164***	.186***	.161***	.183***
	(.013)	(.015)	(.013)	(.013)	(.013)	(.012)
Rural	-.142**	-.202	-.14**	-.196	-.138**	-.196
	(.067)	(.11)	(.067)	(.11)	(.067)	(.109)
Inverse Mills		-.242***		-.234***		-.239***
		(.084)		(.084)		(.084)
Constant	2.465***	2.525***	2.409***	2.442***	2.409***	2.459***
	(.423)	(.23)	(.434)	(.174)	(.423)	(.216)
No. of Observations	5949	5949	5925	5925	5949	5949
R^2		.206		.208		.208
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes

*Clustered standard errors by country and sector are in parentheses*** p<.01, ** p<.05, * p<.1*

Table 4 Wage premium

Dependent	Log (wage premium)					
	Simple	Complex	Intensive	Simple	Complex	Intensive
GVC	1.687**	7.422***	7.505***	.697	8.846***	6.41*
	(.67)	(2.447)	(2.737)	(.799)	(2.792)	(3.316)
Constant	.988	.563	1.168	2.476***	.919	2.121**
	(.849)	(.834)	(.829)	(.861)	(.865)	(.836)
No. of Observations	58	58	58	58	58	58
R^2	.177	.369	.204	.342	.506	.356
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	Yes	Yes	Yes

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*

Table 5 GVC interaction with technology intensity

Dependent variable	Log (real monthly wages)					
	OLS			Heckman correction		
	Simple	Complex	Intensive	Simple	Complex	Intensive
GVC	.042	.305***	.727***	.012	.346**	.723**
	(.042)	(.073)	(.132)	(.056)	(.074)	(.202)
RD	.06**	.067*	.062**	.044	.055	.056*
	(.019)	(.029)	(.021)	(.022)	(.037)	(.021)
RD*GVC	-.019	-.208	-.333	.023	-.077	-.3*
	(.02)	(.232)	(.178)	(.033)	(.309)	(.114)
Years of schooling	.009***	.009***	.009***	.009***	.009***	.009***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Experience	.02***	.02***	.02***	.018**	.018**	.018**
	(.002)	(.002)	(.002)	(.005)	(.005)	(.005)
$(\text{Experience})^2$	-.0002***	-.0002***	-.0002***	-.0002*	-.0002*	-.0002*
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Female	-.162***	-.161***	-.162***	-.165***	-.166***	-.168***
	(.012)	(.012)	(.012)	(.009)	(.004)	(.005)
Father education	.094***	.095***	.093***	.098***	.099***	.098***
	(.009)	(.008)	(.008)	(.007)	(.004)	(.005)
Mother education	.099***	.1***	.096***	.099***	.106***	.097***
	(.004)	(.004)	(.003)	(.005)	(.006)	(.002)
Trade union	.17***	.171***	.17***	.183***	.185***	.183***
	(.01)	(.01)	(.009)	(.013)	(.009)	(.01)
Rural	-.129*	-.122*	-.123*	-.197	-.188	-.187
	(.063)	(.059)	(.061)	(.108)	(.103)	(.111)
Invers Mills				-.26***	-.241***	-.249***
				(.007)	(.025)	(.016)
Constant	2.579***	2.572***	2.555***	2.553***	2.429***	2.464***
	(.112)	(.087)	(.098)	(.235)	(.171)	(.22)
No. of Observations	9,363	9,327	9,363	5,676	5,652	5,676
R^2	.188	.19	.19	.21	.213	.213
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

*Clustered standard errors by country and sector are in parentheses*** p<.01, ** p<.05, * p<.1. RD is a dummy variable equals zero if low/medium-low intensity and equals 1 if medium/medium high intensity. Heckman first stage regressions are removed for brevity.*

Table 6 GVC interaction with skill requirement

Dependent variable	Log (real monthly wages)					
	OLS			Heckman selection		
	Simple	Complex	Intensive	Simple	Complex	Intensive
GVC	.02	.28***	.625***	.035	.355***	.795**
	(.037)	(.035)	(.118)	(.053)	(.021)	(.21)
Skill	.021***	.041***	.034***	.044***	.048***	.046***
	(.001)	(.009)	(.003)	(.001)	(.002)	(.005)
Skill*GVC	.075**	-.009	.438**	-.001	-.085	.135
	(.023)	(.095)	(.134)	(.038)	(.077)	(.24)
Years of schooling	.009***	.009***	.009***	.009***	.009***	.009***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Experience	.02***	.02***	.02***	.019**	.018**	.018**
	(.002)	(.002)	(.002)	(.006)	(.006)	(.006)
(Experience)^2	-.0002***	-.0002***	-.0002***	-.0002*	-.0002	-.0002*
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Female	-.159***	-.157***	-.159***	-.174***	-.174***	-.177***
	(.016)	(.015)	(.013)	(.018)	(.016)	(.013)
Father education	.092***	.091***	.09***	.097***	.097***	.095***
	(.011)	(.01)	(.011)	(.014)	(.012)	(.014)
Mother education	.092***	.096***	.086***	.102***	.108***	.095***
	(.012)	(.014)	(.011)	(.015)	(.015)	(.013)
Trade union	.164***	.167***	.164***	.175***	.178***	.174***
	(.011)	(.011)	(.009)	(.013)	(.012)	(.009)
Rural	-.119	-.117	-.118	-.186	-.182	-.176
	(.065)	(.065)	(.061)	(.109)	(.107)	(.109)
Inverse Mills				-.239***	-.227***	-.23***
				(.025)	(.007)	(.015)
Constant	2.562***	2.552***	2.536***	2.476***	2.393***	2.375***
	(.124)	(.105)	(.11)	(.23)	(.18)	(.212)
No. of Observations	9,768	9,732	9,768	5,948	5,924	5,948
R^2	.188	.189	.19	.211	.213	.214
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

*Clustered standard errors by country and sector are in parentheses*** p<.01, ** p<.05, * p<.1. Skill is a dummy variable equals 0 if no skill is required and equals 1 if skill is required.*

In summary, employing a threefold empirical strategy evidence an upward GVC effect on labor wages in Egypt, Jordan, and Tunisia. The upward wage effect is robust with complex extensive as well as intensive GVC participation measures. In addition, firms' GVC position signaled from R&D intensity and skill requirement do not alter the GVC advantage on labor market outcomes. Put differently, despite unskilled labor and low technology abundance in the countries under study, R&D intensity and skill requirement do not dampen the GVC upward effect on wages. Likewise, while both OLS and Heckman correction methodologies show a consistent positive effect of skill requirement on wages, the latter's strengthening GVC effect on wages is merely revealed in OLS regression analysis. Based on empirical findings, we draw a principal conclusion that encouraging GVC participation and fostering skill levels accelerate the convalesces of labor market conditions in MENA countries.

5. Conclusion

By exploring the nexus between GVC participation and labor wages, this paper provides a twofold conclusion. First, opposing the conventional view that GVC participation is biased towards advanced economies with skilled labor abundance, results show an upward GVC effect on wages in developing MENA countries namely Egypt, and Tunisia. This benefit is particularly evident for complex extensive and intensive GVC measures. Second, neither unskilled labor abundance nor low technology intensity constitute mitigating conditions for the GVC upward wage effect in developing countries. In fact, countries' constrained GVC participation hinders conceivable development of labor market conditions. To name a few, business environment, institutional quality, and unnecessary trade costs hinder GVC participation and therefore wedge wage equality between countries.

From a policy standpoint, evidence based GVC driven higher wages in developing countries leads to a threefold policy implication. First, encouraging firms' GVC participation by downsizing tariff and non-tariff trade barriers. Second, recovering the business environment by minimizing time and cost of doing business is necessary to encouraging foreign interlinkages. Third, investing in human capital and skill upgrading directly boosts wages and strengthens the GVC upward wage effect in developing countries.

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Appendix

Appendix 1 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Real monthly wages in 2018 PPP	35,534	875.321	7032.216	1.374	970657.56
Simple GVC	14,761	.204	.225	0	1
Complex GVC	14,717	.042	.072	0	1
Intensive GVC	14,761	.026	.035	0	.281
Years of schooling	163389	7.42	5.325	0	61
Age	197345	26.92	20.171	0	115
Gender	197205	.502	.5	0	1
Father education	163193	.074	.261	0	1
Mother education	163097	.042	.201	0	1
Trade union	48086	.184	.387	0	1
Rural area	197437	1.518	.5	1	2
Sector	25300	12.381	4.06	1	17
Technology	25251	.072	.258	0	1
Skill requirement	53528	.373	.484	0	1
Employment	152008	.347	.476	0	1
Normalized industry premium	58	9.069	7.742	-3.336	21.275
Father irregular job	84273	.283	.45	0	1

Appendix 2 WLS baseline (Egypt)

Dependent variable	Log (real monthly wages)		
	Simple	Complex	Intensive
GVC	.065**	.364***	.822**
	(.029)	(.058)	(.303)
Years of schooling	.009***	.009***	.009***
	(.002)	(.002)	(.002)
Experience	.021***	.021***	.021***
	(.002)	(.003)	(.002)
(Experience)^2	-.0002***	-.0002***	-.0002***
	(.001)	(.001)	(.001)
Female	-.166***	-.167***	-.166***
	(.031)	(.032)	(.03)
Father education	.099***	.098***	.098***
	(.015)	(.015)	(.015)
Mother education	.094***	.103***	.09***
	(.026)	(.026)	(.025)
Trade union	.159***	.161***	.16***
	(.017)	(.017)	(.017)
Rural	-.216***	-.214***	-.211***
	(.056)	(.058)	(.054)
Constant	2.448***	2.462***	2.457***
	(.074)	(.075)	(.072)
No. of Observations	8863	8827	8863
R^2	.187	.19	.189
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

*Clustered standard errors by region and sector are in parentheses*** p<.01, ** p<.05, * p<.1*

Appendix 3 WLS Heckman selection stage 2 Egypt

Dependent variable	Log (real monthly wages)		
	Simple	Complex	Intensive
GVC	.051	.387***	.812**
	(.035)	(.063)	(.309)
Inverse Mills	-.222**	-.195*	-.214*
	(.1)	(.095)	(.101)
Years of schooling	.009***	.009***	.009***
	(.002)	(.002)	(.002)
Experience	.02***	.019***	.02***
	(.003)	(.004)	(.003)
(Experience)^2	-.0002***	-.0002***	-.0002***
	(.001)	(.001)	(.001)
Female	-.173***	-.174***	-.175***
	(.029)	(.03)	(.027)
Father education	.103***	.104***	.103***
	(.015)	(.016)	(.015)
Mother education	.099***	.11***	.093***
	(.024)	(.023)	(.022)
Trade union	.177***	.178***	.176***
	(.022)	(.022)	(.022)
Rural	-.272***	-.265***	-.266***
	(.073)	(.079)	(.071)
Constant	2.582***	2.578***	2.583***
	(.123)	(.124)	(.119)
No. of Observations	5891	5867	5891
R^2	.211	.215	.213
Year FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes

*Clustered standard errors by region and sector are in parentheses*** p<.01, ** p<.05, * p<.1*

Appendix 4 Weighted Heckman stage 1

Dependent variable	Employment	
	(1)	(2)
Years of schooling	.009**	.01**
	(.005)	(.005)
Experience	.044***	.046***
	(.008)	(.008)
(Experience)^2	0***	0***
	(0)	(0)
Female	-.033	-.005
	(.055)	(.054)
Father irregular job	-.131***	-.157***
	(.05)	(.05)
Father education	.065	.058
	(.106)	(.104)
Mother education	.018	.008
	(.179)	(.178)
Trade union	.472***	.451***
	(.082)	(.078)
Rural	-.067	-.052
	(.124)	(.122)
Constant	.825***	1.094***
	(.29)	(.281)
No. of Observations	28619	28619
Pseudo R^2	.074	.055
Year FE	Yes	No
Country FE	No	Yes
Region FE	Yes	Yes

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Appendix 5 Wage premium stage 1 WLS

Dependent variable:	Log (real monthly wages)				
	Egypt 2006	Egypt 2012	Egypt 2018	Jordan 2016	Tunisia 2014
Years of schooling	.006***	.009***	.007***	.025***	.006
	(.001)	(.001)	(.001)	(.003)	(.004)
Experience	.027***	.019***	.025***	.018***	.027***
	(.002)	(.003)	(.003)	(.005)	(.007)
(Experience)^2	-.0002***	-.0002***	-.0002***	-.0002***	-.0002***
	(.001)	(.001)	(.001)	(.001)	(.001)
Female	-.176***	-.113***	-.173***	-.096***	-.089*
	(.017)	(.019)	(.028)	(.026)	(.049)
Father education	.172***	.122***	.049*	.024	-.135**
	(.027)	(.025)	(.027)	(.031)	(.067)
Mother education	.017	.099**	.083**	.016	
	(.055)	(.05)	(.038)	(.044)	
Trade union	.104***	.127***	.164***	.159***	.107
	(.013)	(.018)	(.026)	(.03)	(.073)
Rural	-.08***	-.193	-.152***	-.084**	-.033
	(.015)	(.131)	(.021)	(.034)	(.032)
Chemicals	.009	-.057		-.192*	-.012
	(.05)	(.05)		(.115)	(.067)
Fabricated metals	.008	-.041	-.15**	-.232**	-.124**
	(.065)	(.043)	(.062)	(.115)	(.06)
Furniture and wood	.068**	-.013	-.293***	-.219*	.014
	(.034)	(.042)	(.094)	(.114)	(.058)
Textiles and garments	0	-.106***	-.115**	-.305***	-.005
	(.03)	(.039)	(.049)	(.116)	(.078)
Printing and publishing	-.004	-.069	-.094*	-.142	.031
	(.029)	(.064)	(.057)	(.114)	(.051)
Non-metallic minerals	.133***	-.056		-.087	-.008
	(.047)	(.046)		(.131)	(.048)
Plastics and rubber	.071	.067	.022	-.125	
	(.049)	(.044)	(.053)	(.117)	
Machinery & eq.	.027	.001		-.156	-.01
	(.03)	(.047)		(.118)	(.059)
Other manufacturing	.032	-.136**	-.109	-.217	
	(.056)	(.061)	(.096)	(.171)	
Construction	.078***	-.074**	-.114***	-.28**	-.067*
	(.027)	(.037)	(.044)	(.116)	(.039)
IT and communication	.01	.001	.062	-.126	.119
	(.036)	(.049)	(.071)	(.116)	(.077)
Accommodation	.058*	-.078**	-.093**	-.193*	-.038
	(.031)	(.04)	(.046)	(.114)	(.046)
Wholesale and retail	-.006	-.11***	-.152***	-.238**	-.116**
	(.027)	(.037)	(.045)	(.113)	(.046)
Transportation & st.	.104***	-.079**	-.107**	-.192*	-.058
	(.027)	(.037)	(.045)	(.111)	(.062)
Other services	-.178***	-.181***	-.196***	-.333***	-.111**
	(.031)	(.04)	(.047)	(.117)	(.055)
Food		-.098**	-.121**	-.213*	-.094**
		(.043)	(.047)	(.114)	(.046)
Constant	2.244***	2.554***	2.478***	2.645***	2.348***
	(.054)	(.147)	(.071)	(.155)	(.153)
No. of Observations	3,731	5,218	5,112	3,382	637
R^2	.319	.181	.146	.151	.127
Region FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Appendix 6 Wage premium Egypt

Dependent variable:	Log (wage premium)					
	Simple	Complex	Intensive	Simple	Complex	Intensive
GVC	-.762	9.397**	5.138	.681	33.853***	8.904
	(.98)	(3.539)	(3.758)	(1.041)	(3.536)	(10.418)
Constant	2.057***	1.309***	1.711***	.83	-.804*	.844
	(.307)	(.393)	(.274)	(1.356)	(.404)	(1.341)
No. of Observations	36	36	36	36	36	36
R^2	.01	.115	.008	.199	.87	.21
Industry FE	No	No	No	Yes	Yes	Yes

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Appendix 7 RD intensity interaction with GVC in Egypt

Dependent variable	Log (real monthly wages)					
	OLS			Heckman		
	Simple	Complex	Intensive	Simple	Complex	Intensive
GVC	.048	.365***	.894**	.028	.397***	.88*
	(.036)	(.077)	(.398)	(.051)	(.082)	(.46)
RD	.061**	.063**	.061***	.06*	.067*	.067***
	(.025)	(.027)	(.019)	(.031)	(.032)	(.021)
RD*GVC	-.057	-.428	-.834**	-.026	-.381	-.776
	(.057)	(.241)	(.359)	(.083)	(.308)	(.458)
Years of schooling	.009***	.009***	.009***	.009***	.009***	.009***
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Experience	.02***	.02***	.02***	.018***	.018***	.018***
	(.002)	(.003)	(.002)	(.003)	(.003)	(.003)
$(Experience)^2$	-.0002***	-.0002***	-.0002***	-.0002*	-.0002*	-.0002*
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Female	-.16***	-.163***	-.161***	-.162***	-.165***	-.164***
	(.029)	(.03)	(.029)	(.026)	(.026)	(.025)
Father education	.095***	.095***	.095***	.097***	.098***	.098***
	(.015)	(.016)	(.016)	(.016)	(.017)	(.016)
Mother education	.104***	.106***	.103***	.104***	.109***	.103***
	(.023)	(.022)	(.023)	(.02)	(.019)	(.019)
Trade union	.162***	.162***	.162***	.181***	.181***	.18***
	(.016)	(.016)	(.016)	(.022)	(.022)	(.022)
Rural	-.215***	-.209***	-.211***	-.261***	-.255***	-.255***
	(.053)	(.056)	(.052)	(.075)	(.08)	(.076)
Inverse Mills				-.253**	-.227**	-.238**
				(.104)	(.1)	(.107)
Constant	2.446***	2.447***	2.447***	2.579***	2.567***	2.568***
	(.069)	(.068)	(.069)	(.122)	(.118)	(.12)
No. of Observations	8454	8418	8454	5618	5594	5618
R^2	.19	.193	.192	.215	.219	.218
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

*Clustered standard errors by region and sector are in parentheses*** p<.01, ** p<.05, * p<.1 RD is zero for low and medium low intensities and high for medium and medium high intensities. Skill equals 1 if the job requires a skill and zero otherwise.*

Appendix 8 WLS Skill requirement interaction with GVC in Egypt

Dependent variable	Log (real monthly wages)					
	OLS			Heckman		
	Simple	Complex	Intensive	Simple	Complex	Intensive
GVC	.028	.371***	.71*	.045	.407***	.786*
	(.04)	(.087)	(.371)	(.048)	(.116)	(.375)
Skill	.012	.027**	.023**	.039**	.041***	.039***
	(.011)	(.009)	(.01)	(.014)	(.01)	(.011)
Skill*GVC	.068*	-.041	.413	.002	-.076	.272
	(.032)	(.092)	(.274)	(.043)	(.151)	(.281)
Years of schooling	.009***	.009***	.009***	.009***	.009***	.009***
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Experience	.021***	.021***	.021***	.019***	.019***	.019***
	(.003)	(.003)	(.002)	(.004)	(.004)	(.004)
(Experience)^2	-.0002***	-.0002***	-.0002***	-.0002*	-.0002	-.0002*
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Female	-.165***	-.165***	-.165***	-.172***	-.173***	-.176***
	(.03)	(.032)	(.029)	(.028)	(.029)	(.026)
Father education	.093***	.094***	.092***	.096***	.096***	.094***
	(.014)	(.015)	(.015)	(.015)	(.015)	(.015)
Mother education	.099***	.106***	.093***	.104***	.114***	.098***
	(.025)	(.024)	(.023)	(.022)	(.021)	(.019)
Trade union	.157***	.158***	.156***	.173***	.174***	.171***
	(.017)	(.017)	(.016)	(.022)	(.021)	(.021)
Rural	-.207***	-.206***	-.202***	-.258***	-.252***	-.25***
	(.06)	(.061)	(.059)	(.073)	(.079)	(.073)
Inverse Mills				-.232**	-.204*	-.223*
				(.102)	(.097)	(.102)
Constant	2.424***	2.434***	2.425***	2.424***	2.434***	2.425***
	(.076)	(.078)	(.074)	(.076)	(.078)	(.074)
No. of Observations	8860	8824	8860	5890	5866	5890
R^2	.19	.192	.192	.215	.219	.218
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes

*Clustered standard errors by region and sector are in parentheses*** p<.01, ** p<.05, * p<.1 RD is zero for low and medium low intensities and high for medium and medium high intensities. Skill equals 1 if the job requires a skill and zero otherwise.*