OVERCOMING THE MIDDLE-INCOME TRAP

The Role of Global Value Chain Integration for Climbing up the Income Ladder[1]

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Abstract

Does integration in global value chains (GVCs) help countries avoiding a "middle-income trap"? This study addresses this question, and more specifically the broader issue of the role that GVC integration may play in supporting countries graduation to higher income levels. The main findings of the paper are the following. Expanding and strengthening a country's GVC participation increases the probability of transitioning to a higher income class, as defined by the World Bank's World Development Indicators income group classification. The probability is higher for low and lower-middle income countries than for higher-middle income countries. Similarly growth in output per capita is highest for lower income groups. Assessing the impacts on GDP growth suggests however that the lack of the effect on income growth in high-income countries may be due to unobserved heterogeneity. In fact, once macro-economic conditions and time-invariant heterogeneity are controlled for, integration into global production networks is positively correlated with GVC integration, irrelevant of the income level. Differentiating between intra-industry and inter-industry linkages suggests that intra-industry linkages have a larger effect for income. This might be caused by specific transmission mechanisms between GVC integration and GDP that dependent on industry similarity such as technology spillovers.

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1 INTRODUCTION

Does integration in global value chains (GVCs) help countries avoiding a "middle-income trap,"? The "middle-income trap," is defined as a country's inability to move from middle to high-income status as measured in average per capita income. While openness to trade and foreign direct investment (FDI) have been identified in the economic literature as factors that can help countries escape the middle-income trap, no study to our knowledge has looked at role of GVC integration. Looking at GVC integration specifically is worthwhile, as there are important conceptual differences between the latter and openness to trade and FDI. GVCs imply a denationalization of comparative advantage. Sharing production to serve the highly competitive global markets allows to specialize while reaching scale thanks to the access to the global markets – a phenomenon not accounted for by traditional trade and FDI literature. It also opens access to unprecedented flows of knowledge, skills, capital, and sophisticated inputs which can lead to an accelerated path of structural transformation and income growth.

This study addresses the identified gap in the literature by focusing on the impact of GVC integration on income growth and the likelihood of climbing up the income ladder. While the public debate on income growth often focuses on the middle-income trap, this is a ill-defined concept. For this reason, and because GVCs, in principle, should matter at multiple stages of development, the paper is framed as focusing on the broader impact of GVC integration on income growth. Global value chain upgrading is a main structural issue that may affect income growth. This paper combines two strands of literature which have been relatively vibrant in recent years: the role of country characteristics for economic growth and for escaping the middle-income trap (for recent contributions, see, e.g., Eichengreen, Park, and Shin 2013; Pritchet and Summers 2014; Bulman, Eden, and Nguyen 2014; for a literature review, see Raiser 2014); and the effect of GVC integration on economic upgrading (see, e.g., Kummritz, Taglioni, and Winkler 2015, OECD 2014). Economic upgrading is largely about gaining competitiveness in higher-value added processes, products, tasks, and sectors.

More specifically, the underlying key hypothesis of this study is that GVC participation enhances growth and hence helps countries climb up the income ladder. Expanding and strengthening a country's GVC participation can lead to higher output, productivity, value added, and jobs. The transmission channels include backward links, i.e. GVC-linked purchases of local inputs, spurring production in various upstream sectors, and forward links, i.e. sales of GVC-linked intermediates to the local economy, spurring production in various downstream sectors. Second, technology spillovers lead to improved productivity of local firms in the same or related downstream or upstream sectors as a result of GVC production. Third, skills upgrading is similar to technology spillovers, but transferred through the training of and demand for skilled labor. Fourth, GVC participation may stimulate investments in infrastructure that would otherwise not be profitable and that may spur local production in other sectors through minimum scale achievements. Finally, GVC participation can translate into pro-competitive market restructuring effects that are not limited to GVC participants, but also extend to nonparticipants (Taglioni and Winkler 2015).

The paper starts with a descriptive analysis to describe the experiences of countries' GVC integration and income growth. It illustrates the development of per capita incomes between 2000 and 2011, taking into account the respective income thresholds of those years. It also shows bivariate correlations between the growth of GVC integration and that of per capita income over the period 2000-2011, and examines if there are differences across different income categories. Finally, the paper estimates the likelihood of switching to higher income status over the period as well as the impact of GVC integration on GDP per capita growth. The study uses a panel dataset covering 187 countries over the period 2000-2011. The first set of regressions uses the likelihood of switching to higher income status as the dependent variable and applies a Probit/Logit approach. The second set of regressions uses log GDP per capita as dependent variable and applies an Ordinary Least Squares (OLS) estimation strategy that controls

for fixed effects. The study also tests whether the impacts change at different income levels. Finally, the paper assesses what role sectoral differences (e.g. between services and manufacturing) play and whether direct vs. cross-sector linkages make a difference.

The main findings of the paper are the following. GVC integration increases the probability of transitioning to a higher income class, as defined by the World Bank's World Development Indicators income group classification. The probability is highest for low and lower-middle income countries than for higher-middle income countries. Similarly growth in output per employee is highest for lower income groups. Assessing the impacts on GDP growth suggests however that the lack of the effect on income growth at the level of individual employees may be due to pro-technology bias in GVC integration at the higher levels of development. In fact, once macro-economic conditions and time-invariant heterogeneity are controlled for, integration into global production networks is positively correlated with GVC integration, irrelevant of the income level. Differentiating between intra-industry and inter-industry linkages suggests that there is a stark difference between buyer and seller dimensions of GVC integration in the way cross-industry vs intra-industry linkages work. In intra-industry linkages, only GVC integration on the buying side generates robust gains. GVC integration on the selling side has weakly significant effects, which moreover, disappear if the analysis controls for R&D intensity. Meanwhile, cross-industry linkages have starkly positive and significant coefficients both on the buying and on the selling side. We conclude therefore that GVC integration on the buying side may benefit per capita income through a wider set of channels. Nevertheless, GVC integration on the selling side may be particularly helpful for individuals' income gains through inter-sectoral upgrading.

The rest of the paper is organized as follows. Section 2 describes the data and provides descriptive statistics on the correlation between GVC participation and the transition to higher income groups. Section 3 computes the probability of transitioning to higher income levels as a function of different types of GVC participation and controlling for the capital stock per employee. Section 5 focuses on the relationship between income growth, measured as GDP per employee growth and measures of GVC participation. It discusses differences for countries at different income level and differences with aggregate income growth, also looking at whether results for aggregate income growth are driven by manufacturing and services. Section 4 looks at the differences between intra-industry and inter-industry linkages. Section 6 concludes. Robustness checks in the appendix replicate the analysis on the OECD-WTO Trade in Value Added Database, available for a smaller subset of countries, and report key results by world regions.

2 DATA AND DERSCRIPTIVE STATISTICS

In this study we use five databases: the Eora input-output tables, the Penn World tables, the World Bank's World Development Indicators (WDI), the WITS database, and the OECD-WTO Trade in Value Added database (TiVA). From the Eora database we construct two measures of GVC participation at the country, and country-sector level: foreign value added embodied in exports (FVAX) and domestic value added embodied in third country exports (DVAX). From the 8th Penn World tables we take the macroeconomic variables, including population, GDP and employment. We use the World Bank's World Development Indicators to assign countries to one of four income categories: Low income, lower-middle income, upper-middle-income and high income. In total we have data for 165 countries and 11 years (2000-2011), with a break-down in 26 sectors for each country and year of observation. Finally we use the TiVA database, which is available for a smaller set of countries, for checking the robustness of the results.

The years 2000-2011 have been marked by significant upward mobility, particularly for middle-income countries; overall 62 countries improved their income class over the period[2]. Table 1 shows a two period transition matrix from 2000 to 2011. It shows for every income class, the percentage of countries who transition to another income status. We observe that while 56 % of low income countries in 2000 have remained in the same class in 2011, 40 % moved to the next category and 3 % have managed to achieve upper-middle income status. Mobility in the lower-middle income group of countries is the highest. About 53 % of them have managed to reach Upper-middle income status in 2011 (but none high-income status). Of the Upper-middle income countries, 38% managed to become high income countries.

Table 1: Transition matrix

		Income class in 2011				
		Low income	Lower-middle income	Upper-middle income	High Income	Total
Income class in 2000	Low income	56.67	40.00	3.33	0	100
	Lower-middle income	0	46.81	53.19	0	100
	Upper-middle income	0	0.00	62.07	37.93	100
	High income	0	0.00	0	100	100
	Total	18.58	25.14	24.59	31.69	100

Note: Authors calculation on WDI income group classification. The underline ranking table is produced by the World Bank according to the Atlas method and it is expressed in purchasing power parity (PPP), controlling for real growth, price inflation, and exchange rates.

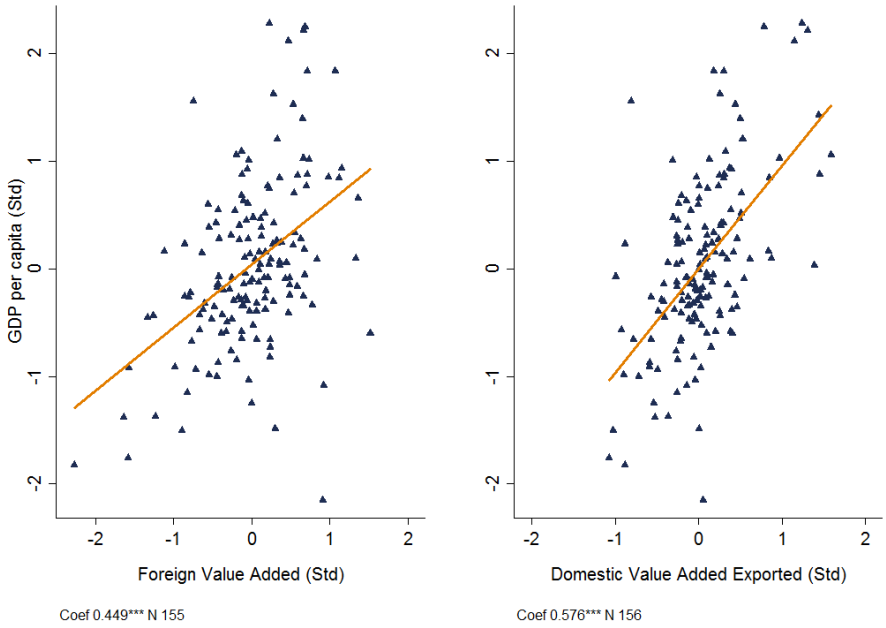
Changing income category requires real output growth. Figure 1 shows that this is correlated with GVC participation. For illustrative purposes we take annualized growth rates from 2000 to 2011 for all variables. In the right panel we report the correlation between the growth rates of GDP per capita[3] and valued added exported to other countries ($dvar$). The left panel shows instead the correlation between real output and foreign value added embodied in domestic exports ($fvax$). In the overall sample we observe a positive correlation between the two variables of interest of 0.449 for $fvax$ and 0.576 for $dvar$ respectively.

In Figure 2 and Figure 3 we control if the pattern that we observe for the whole sample is driven by results for a particular income category. We find that the overall positive correlation is corroborated by the sample split. Figure 2 includes countries that changed income category from 2000 to 2011. Hence, as a next step, we check if the growth

2 Note that 12 countries were downgraded at some point over the period, see Appendix I for a detailed list of all the switchers.
3 The variable is constructed as gross output (Eora) over population (Penn World Table).

rate of the GVC participation variables is correlated with upgrading in income category. After dropping outliers from the sample (observations above and below 3 standard deviation from the mean) we plot the Kernel distribution of income-switchers (upgrade) vs. non-switchers in Figure 3. The Top panel shows the distribution of the annualized growth rate of foreign value added in exports ($fvax$) and the Bottom panel for the distribution of domestic value added exported to other countries ($dvar$). In both cases the mean difference between two groups is statistically significant at 1% suggesting that, over the considered period, countries that managed to improve income group have also recorded a significantly higher integration into production networks either as buyers or sellers[4].

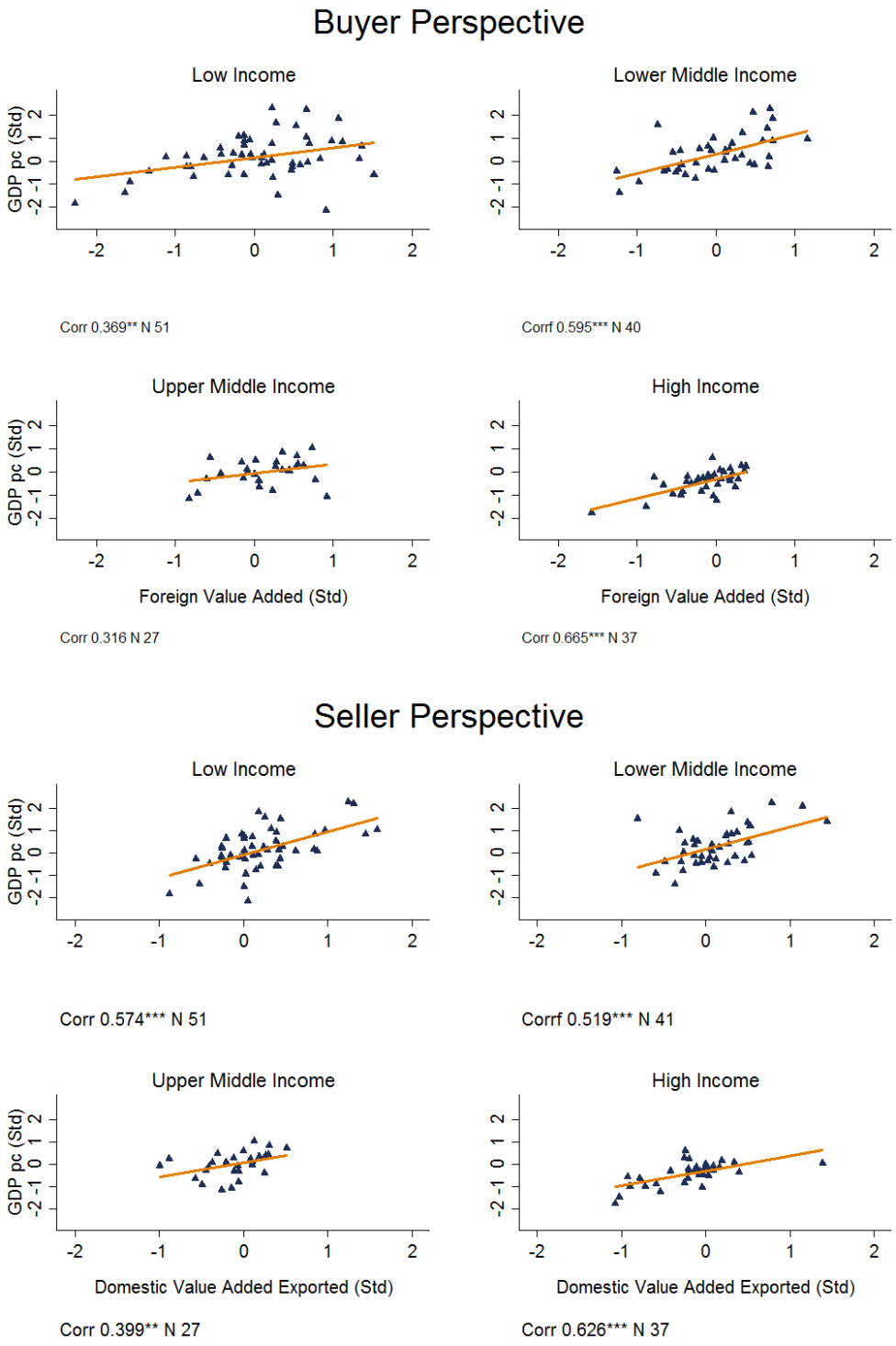
Figure 1: GVC participation and output growth



Source: Authors Calculation. All variables are expressed in annualized growth rates between 2000 and 2011 and have been standardized to have zero mean and standard deviation equal to 1. Observations above and below 3 standard deviation from the mean have been excluded from the sample. Below each graph is reported the standardized beta coefficient and the sample size (N). One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively.

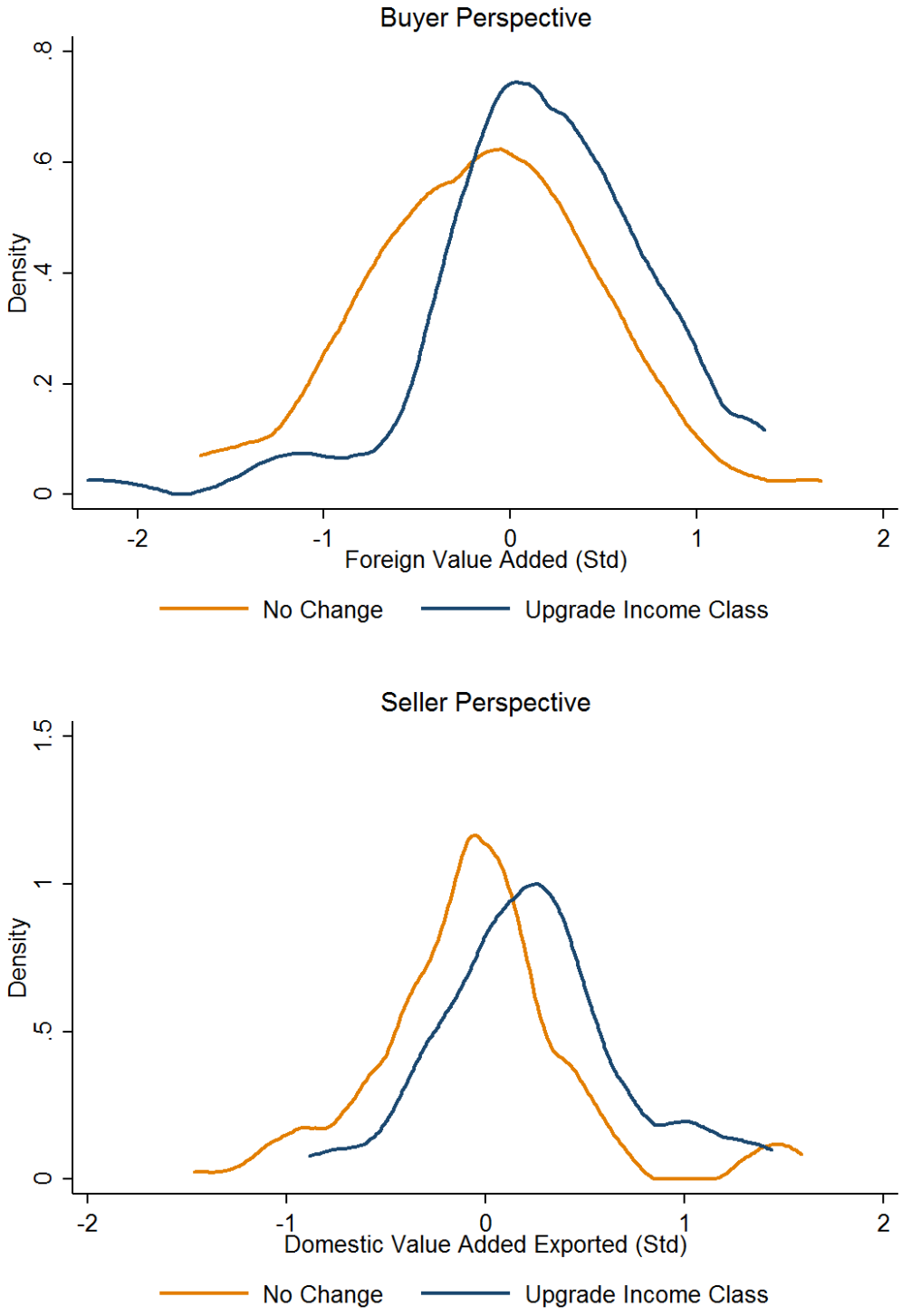
[4] A t-test on the standardized growth rate comparing means reports a statistically significant difference (at 1%) between countries that improve their income classification and those that does not change of 0.326 (for buyers) and 0.278 (for sellers).

Figure 2: GVC participation and output growth by Income, Buyer (Top) and Seller Perspective (Bottom)



Source: Authors Calculation. All variables are expressed in annualized growth rates between 2000 and 2011 and have been standardized to have zero mean and standard deviation equal to 1. Income group refers to year 2000. Observations above and below 3 standard deviation from the mean have been excluded from the sample. Below each graph is reported the standardized beta coefficient and the sample size (N). One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively.

Figure 3: Kernel density differences for upgrading countries



Source: Authors Calculation. All variables are expressed in annualized growth rates between 2000 and 2011 and have been standardized to have zero mean and standard deviation equal to 1. Income group refers to year 2000. Observations above and below 3 standard deviation from the mean have been excluded from the sample.

3 PROBABILITY OF SWITCHING INCOME GROUP

As shown in the transition matrix reported in Table 1, 53% of the countries in the Low-Middle Income group in 2000 managed to improve domestic economic conditions ending up in the Upper-Middle class by 2011; whereas 38% of those starting from Upper-middle income group moved to High Income class. In order to quantify how the integration into global production chains affects the probability of switching over the period we estimate the following generalized ordered Logit (Probit) model[5]:

$$P(Y_{ct} > j) = \frac{exp\left(\alpha_j + \beta_j' X_{ct-1}\right)}{1+\left\{exp\left(\alpha_j + \beta_j' X_{ct-1}\right)\right\}}, \qquad j = 1, \dots M-1 \tag{1}$$

Where M is the number of income groups of the ordinal dependent variable (Low=1, Lower Middle=2, Upper Middle=3, High =4)[6]. The vector X_{ct-1} includes controls at the country level as well as year dummy. Participation into global value chains is captured by two variables $fvax$ (value of foreign value added in exports) and $dvar$ (value of domestic value added to third countries), both variables are lagged one year. We also include the capital stock per employee (*K/L*) in year t to control for the dynamic of the overall economy and year fixed effects, α_t, controls for unobservable heterogeneity common across countries, e.g. the global macro-economic cycle.

Regression results are reported in Table 2, where we consider global production chains for the whole economy[7]. The estimated coefficients reveal that the probability of climbing the income ladder thanks to participation in global production networks (once we control for the capital intensity) is higher for Low (Column 1 and 4) and Lower Middle countries (Column 2 and 5) with respect to Upper Middle income countries (Column 3 and 6). Results are robust to the use of both buyer ($fvax$) and seller ($dvar$) integration measures and across both Logit (Top panel) and Probit (Bottom Panel) estimators.

A Wald test for Proportionality across response categories – i. e. difference of estimated coefficients across income categories – confirm that the probability of improving national wealth increases with the participation into GVCs but it is heterogeneous across income groups.

5 The generalized ordered logit model relax the assumption of proportional odds (parallel lines models) estimated by the ordered logit. In Appendix 2 we report the results of the ordered Logit (Probit) model and relative diagnostics which confirm the violation of the proportionality assumption.

6 We estimated the model using the Stata command gologit2, developed by Williams (2006).

7 In Appendix 2 we consider alternatively the integration into only manufacturing or service sectors (see Table 14).

Table 2: Probability of Switch to a higher income level (WDI country classification)

$P(Y_{ct} > j)$	L to LM	LM to UM	UM to H	L to LM	LM to UM	UM to H
J = Income Group	(1)	(2)	(3)	(4)	(5)	(6)
			Generalized Ordered Logit			
$\ln(fvax)_{ct-1}$	0.402***	0.247***	0.110**			
	(0.066)	(0.036)	(0.045)			
$\ln(dvar)_{ct-1}$				0.283***	0.172***	0.019
				(0.047)	(0.039)	(0.053)
$\ln(K/L)_{ct}$	2.653***	2.963***	3.986***	2.760***	3.027***	4.151***
	(0.169)	(0.162)	(0.248)	(0.168)	(0.154)	(0.251)
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
			Generalized Ordered Probit			
$\ln(fvax)_{ct-1}$	0.236***	0.136***	0.044*			
	(0.034)	(0.020)	(0.023)			
$\ln(dvar)_{ct-1}$				0.165***	0.091***	-0.010
				(0.026)	(0.022)	(0.027)
$\ln(K/L)_{ct}$	1.473***	1.707***	2.143***	1.510***	1.749***	2.264***
	(0.083)	(0.091)	(0.122)	(0.084)	(0.086)	(0.129)
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,731	1,731	1,731	1,731	1,731	1,731

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. **L to LM** specifies the switch from Low to Lower Middle Income group; **LM to UM** specifies the switch from Lower Middle to Upper Middle Income group; **UM to H** specifies the switch from Upper Middle to High Income group. A constant is included in all the regressions but not reported.

Table 3: Test for Proportionality across response categories

	Wald test of proportionality			
Response Categories	*Generalized Ordered Logit*		*Generalized Ordered Probit*	
	$fvax$	$dvar$	$fvax$	$dvar$
[L to LM]; [LM to UM]	4.53	3.64	6.82	5.35
	(0.033)	(0.056)	(0.001)	(0.021)
[L to LM]; [UM to H]	13.64	13.93	22.09	22.27
	(0.000)	(0.000)	(0.000)	(0.000)
[LM to UM]; [UM to H]	6.97	6.51	11.19	10.30
	(0.008)	(0.011)	(0.001)	(0.001)

Note: Wald test for difference in coefficients across response categories and estimated models, p-values in parenthesis. A significant test provides evidence that the parallel regression assumption has been violated.

4 THE IMPACT OF GVC INTEGRATION ON PER CAPITA INCOME

4.1 COUNTRY LEVEL BASELINE MODEL

Baseline Model. Following Kummritz, Taglioni, and Winkler (2015), the analysis first estimates a standard reduced-form fixed effects model for country *c* at time *t* of the following form:

$$\boldsymbol{GDPpc_{ct} = \alpha + \beta_1 x_{ct} + \beta' C_{ct} + \alpha_c + \alpha_t + \varepsilon_{ct}.} \quad (5)$$

We use the level of GDP per capita of country *c* as our measure of economic upgrading. Since we are interested in the effects of GVC participation, we use two standard GVC indicators as proxies for x_{ct}. The first indicator is the amount of foreign value added embodied in exports (*fvax*), while the second indicator is the amount of domestic value added re-exported by third countries (*dvar*). *Fvax* quantifies a country's backward linkages into GVCs – or GVC integration as a buyer, while *DVAR* quantifies a country's forward linkages into GVCs – or GVC integration as a seller. We use lagged values to minimize reverse causality concerns and allow for a delayed response of GDP per capita.

Our set of controls (*C*) includes the capital stock per employee (*K/L*) and R&D intensity (*R&D*). We are guided here by a standard production function of the form:

$$GDP_{ct} = A * L^{\beta_2} * K^{(1-\beta_2)}$$

GDP is generated combining labor with capital stock and is dependent on countries' technology shifters (A). Transforming this to a per capita equation we get:

$$GDPpc_{ct} = A * (K/L)^{(1-\beta_2)}$$

The technology shifter is assumed to be a function of international trade and innovation, which is consistent with the trade literature.

Finally, we employ a set of country (α_c) and year (α_t) fixed effects to account for potentially correlated omitted variables and take the natural logarithm of all level variables. Our benchmark specification is thus given by:

$$\boldsymbol{GDPpc_{ct} = \alpha + \beta_1 x_{ct} + \beta_2 (K/L)_{ct} + \beta_4 R\&D_{ct} + \alpha_c + \alpha_t + \varepsilon_{ct}.} \quad (6)$$

Our dependent variable is calculated with GDP data from the EORA MRIO database[8] and population data from the 8th Penn World Tables. Our GVC indicators are also based on EORA while the control variables are taken from the 8th edition of the Penn World tables except for R&D intensity, which is from the World Development indicators of the World Bank.

8 The EORA database contains data for regions. However, these regions do not necessarily correspond to independent countries but might also include autonomous regions. Since the Penn World Tables do not report data for these areas they have to excluded. In addition, the Penn World Tables do not report data for a set of other countries, such as North Korea, for other reasons. The country-level regression analysis therefore only covers 158 countries. The excluded areas are as follows: Afghanistan, Algeria, Andorra, Aruba, British Virgin Islands, Cayman Islands, Cuba, Eritrea, French Polynesia, Gaza Strip, Greenland, Guyana, Haiti, Libya, Liechtenstein, Monaco, Myanmar, Netherlands Antilles, New Caledonia, Nicaragua, North Korea, Papua New Guinea, Samoa, San Marino, Seychelles, Somalia, South Sudan, Sudan, UAE, and Vanuatu.

Results.

Table 4 shows the results for the baseline equation. Columns 1 and 3 exclude *R&D* intensity since data for these indicators is available only for a subset of countries. As expected higher levels of capital per employee translate into higher GDP per employee, whereas the same does not apply to R&D intensity, which may suggest that the country fixed effects effectively control for differences in technology and openness given our short time period of 11 years. It could, however, also point to issues in data quality or to the inadequateness of R&D intensity to proxy for technology. Moving to our key variables of interest, those of GVC participation, we find that both buyer and seller linkages lead to a robust, positive and significant increase in our dependent variable.

Focusing on the specification including R&D intensity, we find that a 1% increase of GVC integration as a buyer (*fvax*) or seller (*dvar*) has a statistically significant effect on GDP per capita of 0.2% to 0.3% (columns 2 and 4). In other words, GVC integration stimulates a country's growth and thus fosters economic upgrading. This is in line with recent theoretical literature that emphasizes the role of technology transfer and productivity spillovers in motivating why GVCs may constitute an accelerated pattern to development compared to arm's length trade of final goods (e.g. Li and Liu 2014, Baldwin and Robert-Nicoud 2014). Hence, the results in

Table 4 suggest that the preferable strategy for overcoming the middle-income trap may be to strengthen buyer and seller linkages into GVCs.

Table 4: The role of GVC integration for income

Dep Variable: $\ln(GDPpc)_{\mathrm{ct}}$	(1)	(2)	(3)	(4)
$\ln(fvax)_{ct-1}$	0.2047***	0.2523**		
	(0.0523)	(0.1117)		
$\ln(dvar)_{ct-1}$			0.2342***	0.2348***
			(0.0445)	(0.0731)
$\ln(K/L)_{ct}$	0.3122**	0.4259**	0.2800**	0.3352*
	(0.1339)	(0.2041)	(0.1297)	(0.1866)
$\ln(R\&D)_{ct}$		-0.0351		-0.0273
		(0.0365)		(0.0325)
Constant	8.9743***	7.1355***	8.8495***	8.3702***
	(1.5551)	(2.5972)	(1.3966)	(2.0728)
Observations	1,731	924	1,730	923
R-squared	0.7912	0.8719	0.8021	0.8782

Robust standard errors clustered at country level in parentheses. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. FVAX and DVAR lagged one year. Country- and year-fixed effects included.

4.2 MODEL BY INCOME CATEGORY

Baseline model. As we are interested in economic growth experienced by countries as different levels of the income ladder and its relationship with GVC participation, we include also in this section an interaction term between a variable capturing a country's income category and our GVC indicators. We adopt the same procedure of Section 2, i.e. we include four types of income categories: low income (L), lower-middle income (LM), upper-middle income (UM), and high income (H) countries, based on the World Bank WDI classification system. To avoid reverse causality we use a country's status at the beginning of the sample period, i.e. in 2000. The revised model is then given by:

$$\boldsymbol{GDPpc_{ct} = \alpha + \beta' x_{ct} * I' + \beta_2 (K/L)_{ct} + \beta_4 R\&D_{ct} + \alpha_c + \alpha_t + \varepsilon_{ct},} \quad (7)$$

where *I* is a vector of income category-specific dummies that take the value 1 for one of the four categories. Equation (7) allows thus for a heterogeneous effect of GVC integration dependent on the income-level of the different countries and enables us to see if the role of GVCs changes as countries climb up the income ladder.

Results. Table 5 reports the corresponding results. Columns 1 and 3 show the coefficients without *R&D* intensity while columns 2 and 4 include it. Independent of the employed sample, we observe that the interaction terms between GVC integration and our low and lower middle income dummies are positive and statistically significant for both buyer and seller linkages. The coefficients for the upper-middle income countries are equally positive and statistically significant for seller linkages (column and 4) but the positive effect of buyer linkages is not significant once we control for *R&D* intensity. Finally, the coefficients for high-income countries are positive in the specification excluding *R&D* intensity but significant only for seller linkages. However, controlling for *R&D* intensity leads to negative and insignificant estimates for high-income countries.

In line with our results in Section 2, from the logit model on the probability of switching income groups, this is evidence that the beneficial effect of GVCs on per capita income is weaker at higher incomes. This means that our preliminary logit results do not indicate a threshold effect that matters only for switching income groups but rather that the benefits of GVC integration are smaller at high income. This implies for the middle-income trap that the growth-stimulating impact of buyer and seller linkages into GVCs can in fact help middle-income countries to overcome such sluggish periods in growth. GVCs could thus help these countries to reach a more sustained growth path.

The dampened effect for high-income countries is slightly puzzling and not in line with previous literature (e.g. Kummritz 2015). Therefore, we exploit in the next section the existence in the EORA database of an industry dimension, which allows us to employ a wider set of fixed effects and therefore control better for possible omitted variables bias caused by unobserved heterogeneity.

Table 5: The role of GVC integration for income at different stages

Dep Variable: $\ln(GDPpc)_{ct}$	(1)	(2)	(3)	(4)
$\ln(fvax)_{ct-1} * Income_L^{2000}$	0.1913***	0.2751***		
	(0.0632)	(0.0933)		
$\ln(fvax)_{ct-1} * Income_{LM}^{2000}$	0.2360***	0.2126*		
	(0.0768)	(0.1196)		
$\ln(fvax)_{ct-1} * Income_{UM}^{2000}$	0.1988***	0.1490		
	(0.0608)	(0.1098)		
$\ln(fvax)_{ct-1} * Income_H^{2000}$	0.0116	-0.0747		
	(0.0666)	(0.1268)		
$\ln(dvar)_{ct-1} * Income_L^{2000}$			0.2375***	0.2789***
			(0.0473)	(0.0657)
$\ln(dvar)_{ct-1} * Income_{LM}^{2000}$			0.2505***	0.2419**
			(0.0623)	(0.0951)
$\ln(dvar)_{ct-1} * Income_{UM}^{2000}$			0.2557***	0.1759**
			(0.0534)	(0.0788)
$\ln(dvar)_{ct-1} * Income_H^{2000}$			0.0852*	-0.0276
			(0.0479)	(0.0776)
$\ln(K/L)_{ct}$	0.2707**	0.2892	0.2523*	0.2144
	(0.1367)	(0.1748)	(0.1319)	(0.1532)
$\ln(R\&D)_{ct}$		-0.0208		-0.0192
		(0.0318)		(0.0285)
Constant	10.0903***	10.9767***	9.5770***	11.3018***
	(1.6411)	(2.5046)	(1.4643)	(1.7893)
Observations	1,731	924	1,730	923
R-squared	0.7993	0.8943	0.8075	0.8986

Robust standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. FVAX and DVAR lagged one year. Country- and year-fixed effects included. L = Low Income; LM = Lower Middle Income; UM = Upper-middle income; H = High income.

4.3 EFFECTS ON AGGREGATE INCOME AT THE COUNTRY-INDUSTRY LEVEL

In what follows we replicate the above specification by income categories on data at the country-industry level. The additional dimension provides greater scope for controlling unobserved heterogeneity via fixed effects. This allows to assess if the observed lack of effect on per capita income growth for high income countries is associated to unobserved heterogeneity at the country-time level, due to the absence of adequate country-time controls. The sectoral variation in the data also allows to quantify eventual differences between manufacturing and services. Regressions are carried out for aggregate income, as proxies of per capita income by sector are not available. The specification therefore becomes:

$$ln(GDP)_{cst} = \beta_1 \, ln \, x_{cst-1} + \alpha_{ct} + \alpha_{st} + \alpha_{cs} + \varepsilon_{cst} \quad (8)$$

Where the dependent variable is the natural logarithm of country-by-sector Gross Domestic Product and x_{cst} are the same indicators of GVC participation as in previous regressions. That is, in order to proxy for country-sector

integration into global production chains we use two indicators: the amount of foreign value added embodied in exports (*FVAX*), and the amount of domestic value added re-exported by third countries (*DVAR*). The technology shifter – defined above – is assumed to be a function of country specific characteristics that are controlled for by a full set of country-by-year fixed effects α_{ct}. Noteworthy the α_{ct} dummy allow also to control for industrial policy, institutional quality or exchange rate shocks. Sector specific demand shifters are accounted for using a full set of sector-by-year fixed effects α_{cs}[9]. Finally, the fixed effect α_{cs} controls for all time-invariant unobserved heterogeneity whereas ε_{cst} is an idiosyncratic error term.

Table 6 report the estimation results for Equation (8), standard errors are clustered at the country level to control for the sectoral cross-sectional dependence within the same country. The empirical evidence suggests that, once macro-economic conditions and time-invariant heterogeneity are controlled for, integration into global production networks is positively correlated with GDP at the country and industry levels (Column 1 and 2). Comparing the estimated elasticity across income groups indicates a relative lower effect for low-middle and upper-middle income countries from a buyer perspective (Column 3): the estimated coefficient, in fact, is significantly higher for high Income countries. From the seller perspective (Column 4) the effect is significantly stable across income classes. These results are fully consistent with the empirical findings from the TiVA database; see Annex 4 for a description of the alternative data and the associated results.

The differences in results for Table 5 and Table 6 suggest that that the lack of the effect on income growth at the country-level might in fact be due to omitted variables bias caused by unobserved heterogeneity. The fixed effects included in the industry-level regression seem to correct this bias and indicate that the positive effects of GVC integration are present at all income levels.

Are the results for aggregate income reflected in different ways for manufacturing and services? In Table 7 we estimate the effect for the manufacturing sector only. For the aggregate sample (Column 1 and 2) the correlation of GDP is stronger for buyer integration (column 2) than for seller linkages (Column 1). More interestingly, the effect seems to be marginally increasing across income groups (Column 3), the estimated elasticity is significantly higher for Upper-Middle income countries, in particular with respect to Low income economies. Those results suggest that externalities (e.g. though technology spillovers) in the manufacturing sector are positively associated with economic development in the recipient country. Notwithstanding buyer linkages, the estimated coefficients for seller linkages (Column 4) reveal an interesting pattern. The estimated effect, in fact, changes significantly across income groups: Low-Middle Income countries seem to benefit more from being integrated as supplier of value added to other economies with respect to Upper Middle and High Income countries. Table 8 focuses on the service sectors; regression results suggest that the scope for buyer integration is significantly lower for Upper-Middle and High income countries (Column 3) with respect to Low and High income economies, whereas integration on the selling side of GVCs does not reveal a statistically significant difference across income groups.

Table 6: Structural integration in GVCs and Income level (WDI country classification) - EORA

Dep Variable: lnGDP_{cst}	Whole Economy			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.121***			
	(0.015)			

9 Note that since the macro-economic characteristics captured by the fixed effects are unlikely to fully adjust in a single year, we consider 3 year intervals for both country-year and sector-year dummies. Results are robust to different time windows.

$\ln(dvar)_{cst-1}$		0.092***		
		(0.012)		
$\ln(fvax)_{cst-1} * Income_{L}^{2000}$			0.112***	
			(0.032)	
$\ln(fvax)_{cst-1} * Income_{LM}^{2000}$			0.121***	
			(0.021)	
$\ln(fvax)_{cst-1} * Income_{UM}^{2000}$			0.109***	
			(0.018)	
$\ln(fvax)_{cst-1} * Income_{H}^{2000}$			0.159***	
			(0.021)	
$\ln(dvar)_{cst-1} * Income_{L}^{2000}$				0.094***
				(0.022)
$\ln(dvar)_{cst-1} * Income_{LM}^{2000}$				0.099***
				(0.013)
$\ln(dvar)_{cst-1} * Income_{UM}^{2000}$				0.083***
				(0.027)
$\ln(dvar)_{cst-1} * Income_{H}^{2000}$				0.087***
				(0.025)
Observations	40,689	40,689	40,689	40,689
R-squared	0.051	0.067	0.051	0.067
Number of ID (Country-Sector)	3,699	3,699	3,699	3,699
FEs	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. "Private Households", "Public Administration", "Education, Health and Other Services", "Re-exports and Re-imports", along with "Mining and Quarrying" have been excluded from the sample. The estimation sample covers the following years: 2000-2011. Income levels refer to the World Bank classification for the year 2000. L = Low Income; LM = Lower Middle Income; UM = Upper-middle income; H = High income.

Table 7: Structural integration in GVCs and Income level (Manufacturing) – EORA

Dep Variable: $\ln GDP_{cst}$	Manufacturing			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.197***			
	(0.027)			
$\ln(dvar)_{cst-1}$		0.084***		
		(0.021)		
$\ln(fvax)_{cst-1} * Income_{L}^{2000}$			0.164***	
			(0.047)	
$\ln(fvax)_{cst-1} * Income_{LM}^{2000}$			0.214***	
			(0.049)	
$\ln(fvax)_{cst-1} * Income_{UM}^{2000}$			0.261***	
			(0.044)	
$\ln(fvax)_{cst-1} * Income_{H}^{2000}$			0.245***	
			(0.033)	
$\ln(dvar)_{cst-1} * Income_{L}^{2000}$				0.086**
				(0.044)
$\ln(dvar)_{cst-1} * Income_{LM}^{2000}$				0.114***
				(0.037)
$\ln(dvar)_{cst-1} * Income_{UM}^{2000}$				0.071*
				(0.040)

$\ln(dvar)_{cst-1} * Income_H^{2000}$				0.069**
				(0.028)
Observations	16,280	16,280	16,280	16,280
R-squared	0.100	0.040	0.102	0.041
Number of ID (Country-Sector)	1,480	1,480	1,480	1,480
FEs	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. "Re-exports and Re-imports", along with "Mining and Quarrying" have been excluded from the sample. The estimation sample covers the following years: 2000-2011. Income levels refer to the World Bank classification for the year 2000. L = Low Income; LM = Lower Middle Income; UM = Upper-middle income; H = High income.

Table 8: Structural integration in GVCs and Income level (Services) – EORA

Dep Variable: $\ln GDP_{cst}$	Services			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.097***			
	(0.010)			
$\ln(dvar)_{cst-1}$		0.092***		
		(0.013)		
$\ln(fvax)_{cst-1} * Income_L^{2000}$			0.105***	
			(0.025)	
$\ln(fvax)_{cst-1} * Income_{LM}^{2000}$			0.089***	
			(0.014)	
$\ln(fvax)_{cst-1} * Income_{UM}^{2000}$			0.071***	
			(0.016)	
$\ln(fvax)_{cst-1} * Income_H^{2000}$			0.124***	
			(0.018)	
$\ln(dvar)_{cst-1} * Income_L^{2000}$				0.089***
				(0.017)
$\ln(dvar)_{cst-1} * Income_{LM}^{2000}$				0.098***
				(0.012)
$\ln(dvar)_{cst-1} * Income_{UM}^{2000}$				0.108***
				(0.029)
$\ln(dvar)_{cst-1} * Income_H^{2000}$				0.087**
				(0.035)
Observations	18,304	18,304	18,304	18,304
R-squared (Between)	0.042	0.084	0.042	0.083
Number of ID (Country-Sector)	1,664	1,664	1,664	1,664
FEs	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. "Private Households", "Public Administration", "Education, Health and Other Services" have been excluded from the sample. The estimation sample covers the following years: 2000-2011. Income levels refer to the World Bank classification for the year 2000. L = Low Income; LM = Lower Middle Income; UM = Upper-middle income; H = High income.

5 INTRA-INDUSTRY VS INTER-INDUSTRY LINKAGES

We complete the analysis by controlling if differences exist for intra-industry and inter-industry linkages. The former refers to value added sourced from or sold to the same industry while the latter defines cross-industry linkages. Thereby we can see if intra-industry GVCs allow for more income gains than cross-sectoral linkages. Potential reasons for this could be that technology spillovers and transfers tend to be easier when the linkages are intra-industry. On the other hand, cross-sectoral linkages might help countries benefitting from complementarity effects, and to move up the value chain by occupying more stages or by moving into stages with higher value added and higher paid jobs.

Table 9 and Table 10 show the results with the usual sample difference coming from the included controls. We find independent of the employed specification that both buyer linkages (*fvax*) and seller linkages *(dvar)* generate robust gains through intra- and cross-industry linkages. Looking at magnitudes, we observe that intra-industry integration might lead to more gains. The coefficients indicate a 0.05% to 0.10% larger effect. This is suggestive evidence that certain channels between GVC integration and income are dependent on industry similarity. This could hold in particular for technology spillovers.

Table 9: The role of intra-industry GVC integration for income

Dep Variable: $\ln(\text{GDPpc})_{ct}$	(1)	(2)	(3)	(4)
$\ln(fvax)_{ct-1}$	0.2427***	0.3024**		
	(0.0653)	(0.1264)		
$\ln(dvar)_{ct-1}$			0.3135***	0.3039***
			(0.0550)	(0.1048)
$\ln(K/L)_{ct}$	0.3051**	0.4416**	0.2877**	0.3464*
	(0.1283)	(0.1823)	(0.1273)	(0.2012)
$\ln(R\&D)_{ct}$		-0.0280		-0.0325
		(0.0356)		(0.0334)
Constant	9.0314***	6.7926***	8.3735***	7.8558***
	(1.6128)	(2.4358)	(1.3901)	(2.2247)
Observations	1,731	924	1,729	922
R-squared	0.7943	0.8802	0.8103	0.8806

Robust standard errors clustered at country level in parentheses. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. FVAX and DVAR lagged one year. Country- and year-fixed effects included.

Table 10: The role of cross-industry GVC integration for income

Dep Variable: $\ln(\text{GDPpe})_{ct}$	(1)	(2)	(3)	(4)
$\ln(fvax)_{ct-1}$	0.1944***	0.2380**		
	(0.0495)	(0.1052)		
$\ln(dvar)_{ct-1}$			0.2168***	0.2179***
			(0.0409)	(0.0655)
$\ln(K/L)_{ct}$	0.3141**	0.4289**	0.2848**	0.3441*
	(0.1347)	(0.2067)	(0.1303)	(0.1862)
$\ln(R\&D)_{ct}$		-0.0361		-0.0265
		(0.0370)		(0.0327)
Constant	2.6603***	2.2304	2.5047***	2.4886
	(0.9133)	(1.7542)	(0.8883)	(1.6230)
Observations	1,731	924	1,730	923
R-squared	0.6173	0.6813	0.6295	0.6908

Robust standard errors clustered at country level in parentheses. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. FVAX and DVAR lagged one year. Country- and year-fixed effects included.

Finally, also for the direct vs indirect effects we compare results on income level with results for aggregate income at the industry level. In Table 11 we focus on the value added flow within the same industrial sector (direct effect). Interestingly for GVC integration on the buying side, the estimated effect (Column 1) is remarkably similar to the overall (direct + indirect) effects reported in Table 6. Meanwhile GVC integration on the selling side is significantly higher than the overall (direct + indirect) effect (Column 2). In terms of sectoral heterogeneity it appears that the marginally lower elasticity for Upper-Middle income countries is driven by manufacturing industries, whereas for services the effect if not statistically different to that of other income groups. Results for the indirect effect, reported in Table 12, show marginally lower point estimates but confirms the heterogeneity across income class.

Table 11: Structural integration in GVCs and Income level (WDI country classification) Direct Effect- EORA

Dep Variable: $\ln GDP_{cst}$	Whole Economy			Manufacturing	Services
	(1)	(2)	(3)	(4)	(5)
$\ln(fvax)_{cst-1}$	0.120***				
	(0.015)				
$\ln(dvar)_{cst-1}$		0.179***			
		(0.018)			
$\ln(dvar)_{cst-1} * Income_{L}^{2000}$			0.209***	0.147***	0.256***
			(0.022)	(0.042)	(0.025)
$\ln(dvar)_{cst-1} * Income_{LM}^{2000}$			0.189***	0.158***	0.205***
			(0.023)	(0.043)	(0.024)
$\ln(dvar)_{cst-1} * Income_{UM}^{2000}$			0.124***	0.080*	0.213***
			(0.045)	(0.044)	(0.024)
$\ln(dvar)_{cst-1} * Income_{H}^{2000}$			0.172***	0.125***	0.177***
			(0.033)	(0.033)	(0.050)
Observations	40,689	40,689	40,689	16,280	18,304
R-squared	0.049	0.109	0.111	0.059	0.158
Number of ID (Country-Sector)	3,699	3,699	3,699	1,480	1,664
FEs	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st

Cluster	Country	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. "Private Households", "Public Administration", "Education, Health and Other Services", "Re-exports and Re-imports", along with "Mining and Quarrying" have been excluded from the sample. The estimation sample covers the following years: 2000-2011. Income levels refer to the World Bank classification for the year 2000. L = Low Income; LM = Lower Middle Income; UM = Upper-middle income; H = High income.

Table 12: Structural integration in GVCs and Income level (WDI country classification) Indirect Effect- EORA

Dep Variable: $\ln GDP_{cst}$	Whole Economy			Manufacturing	Services
	(1)	(2)	(3)	(4)	(5)
$\ln(fvax)_{cst-1}$	0.121***				
	(0.015)				
$\ln(dvar)_{cst-1}$		0.092***			
		(0.012)			
$\ln(dvar)_{cst-1} * Income_{L}^{2000}$			0.094***	0.087**	0.089***
			(0.022)	(0.044)	(0.017)
$\ln(dvar)_{cst-1} * Income_{LM}^{2000}$			0.098***	0.111***	0.098***
			(0.013)	(0.034)	(0.012)
$\ln(dvar)_{cst-1} * Income_{UM}^{2000}$			0.084***	0.073*	0.108***
			(0.026)	(0.040)	(0.029)
$\ln(dvar)_{cst-1} * Income_{H}^{2000}$			0.087***	0.069**	0.087**
			(0.025)	(0.028)	(0.035)
Observations	40,689	40,689	40,689	16,280	18,304
R-squared	0.051	0.068	0.067	0.041	0.083
Number of ID (Country-Sector)	3,699	3,699	3,699	1,480	1,664
FEs	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st
Cluster	Country	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. "Private Households", "Public Administration", "Education, Health and Other Services", "Re-exports and Re-imports", along with "Mining and Quarrying" have been excluded from the sample. The estimation sample covers the following years: 2000-2011. Income levels refer to the World Bank classification for the year 2000. L = Low Income; LM = Lower Middle Income; UM = Upper-middle income; H = High income.

6. CONCLUSION

This study addresses the issue of the role that GVC integration may play in supporting countries graduation to higher income levels. The paper finds that expanding and strengthening a country's GVC participation increases the probability of transitioning to a higher income class, as defined by the World Bank's World Development Indicators income group classification. The probability is higher for low and lower-middle income countries than for higher-middle income countries. Similarly growth in output per capita is highest for lower income groups. Nevertheless, results also indicate that the lack of the effect on income growth in high-income countries may be due to unobserved heterogeneity. Once macro-economic conditions and time-invariant heterogeneity are controlled for, integration into global production networks is positively correlated with GVC integration, irrelevant of the income level. Finally, intra-industry linkages appear to have a larger effect for income. Further research is warranted to identify the mechanisms mediating GVC participation and leading to per capita income growth.

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APPENDIX 1: COUNTRY COVERAGE AND INCOME CLASSIFICATION IN EORA AND TIVA

Table 13: Countries in EORA, WB income classification for year 2000

Low		Lower Medium		Upper Medium	High	
AFG	NIC	ALB	SUR	ARG	ABW	PYF
AGO	NPL	BGR	SWZ	ATG	ADO	QAT
ARM	PAK	BIH	SYR	BHR	ARE	SGP
AZE	PRK	BLR	THA	BRA	AUS	SMR
BDI	RWA	BLZ	TKM	BWA	AUT	SVN
BEN	SDN	BOL	TUN	CHL	BEL	SWE
BFA	SEN	CHN	VUT	CRI	BHS	TWN
BGD	SLE	COL	WBG	CZE	BMU	USA
BTN	SOM	CPV	WSM	EST	BRB	
CAF	STP	CUB		GAB	BRN	
CIV	TCD	DJI		HRV	CAN	
CMR	TGO	DOM		HUN	CHE	
COG	TJK	DZA		KOR	CYM	
ERI	TZA	ECU		LBN	CYP	
ETH	UGA	EGY		LBY	DEU	
GEO	UKR	FJI		MEX	DNK	
GHA	UZB	GTM		MUS	ESP	
GIN	VNM	GUY		MYS	FIN	
GMB	YEM	HND		OMN	FRA	
HTI	ZAR	IRN		PAN	GBR	
IDN	ZMB	IRQ		POL	GRC	
IND	ZWE	JAM		SAU	GRL	
KEN		JOR		SVK	HKG	
KGZ		KAZ		SYC	IRL	
KHM		LKA		TTO	ISL	
LAO		LTU		TUR	ISR	
LBR		LVA		URY	ITA	
LSO		MAR		VEN	JPN	
MDA		MDV			KWT	
MDG		MKD			LIE	
MLI		NAM			LUX	
MMR		PER			MAC	
MNG		PHL			MCO	
MOZ		PNG			MLT	
MRT		PRY			NCL	
MWI		ROM			NLD	
NER		RUS			NOR	
NGA		SLV			NZL	

Table 14: Countries in TiVA, WB income classification for year 2000

Low Income (Including Low Medium)	Medium Income	High Income
BGR	ARG	AUS
CHN	BRA	AUT
COL	CHL	BEL
IDN	CRI	BRN
IND	CZE	CAN
KHM	EST	CHE
LTU	HRV	CYP
LVA	HUN	DEU
PHL	KOR	DNK
ROM	MEX	ESP
RUS	MYS	FIN
THA	POL	FRA
TUN	SAU	GBR
VNM	SVK	GRC
	TUR	HKG
	ZAF	IRL
		ISL
		ISR
		ITA
		JPN
		LUX
		MLT
		NLD
		NOR
		NZL
		PRT
		SGP
		SVN
		SWE
		TWN
		USA

APPENDIX 2: TRANSITION MATRIX, DETAILED COUNTRY LIST

During the sample period (2000-2011) 62 countries managed to switch to a higher income group while 12 were temporarily downgraded.

Low to Lower Middle income: Armenia, Bhutan, Cameroon, Congo, Cote d'Ivoire, Georgia, Ghana, India, Indonesia, Laos, Lesotho, Moldova, Mongolia, Nicaragua, Nigeria, Pakistan, Sao Tome and Principe, Senegal, Sudan, Ukraine, Uzbekistan, Viet Nam, Yemen and Zambia.

Low to Upper Middle Income: Angola, Azerbaijan.

Lower Middle to Upper Middle: Algeria, Belarus, Bosnia and Herzegovina, Bulgaria, China, Colombia, Cuba, Dominican Republic, Ecuador, Iran, Jamaica, Jordan, Kazakhstan, Latvia, Lithuania, Maldives, Namibia, Peru, Romania, Russia, Suriname, TFYR Macedonia, Thailand, Tunisia and Turkmenistan.

Upper Middle to High Income: Bahrain, Croatia, Czech Republic, Estonia, Hungary, Oman, Poland, Saudi Arabia, Slovakia, South Korea, Trinidad and Tobago.

DOWNGRADED COUNTRIES

- ***Albania:*** from Lower Middle to Upper Middle in 2009, back to Lower Middle in 2011
- ***Antigua and Barbuda:*** from Upper Middle to High income in 2002, back to Upper Middle in 2003, from Upper Middle to High in 2005 and back to Upper Middle in 2009
- ***Belize*:** from Lower Middle to Upper Middle in 2002 and back to Lower Middle in 2008
- ***Brazil:*** from Upper Middle to Lower Middle in 2002 and back to Upper Middle in 2006
- ***Barbados:*** from High to Upper Middle in 2001, back to High income in 2002, from High to Upper Middle in 2003 and back to high income in 2006
- ***Fiji:*** from Lower Middle to Upper Middle in 2007, back to Lower Middle in 2010
- ***Latvia***: from Lower Middle to Upper Middle in 2001, from Upper Middle to High in 2009 and back to Upper Middle in 2010
- ***Malta***: from High to Upper Middle in 2001, back to High income in 2002
- ***Mauritania***: from Low to Lower Middle in 2010, back to Low in 2011
- ***Papua New Guinea***: from Lower Middle to Low income in 2001 and back to Lower Middle in 2008
- ***South Africa***: from Upper Middle to Lower Middle in 2001 and back to Upper Middle in 2004
- ***Turkey***: from Upper Middle to Lower Middle in 2001 and back to Upper Middle in 2004

APPENDIX 3: PROBABILITY MODEL DIAGNOSTICS AND ROBUSTENSS CHECKS

In Table 15 we estimate an Ordered Logit (Probit) model for the probability of switching to a higher income category under the assumption of proportionality of odds (parallel lines) across the different response categories. The main results indicate that integration into GVCs increase the probability of climbing up the income ladder (even controlling for capital intensity), however the Proportionality test rejects the null hypothesis violating the underlying proportionality assumption.

In Table 16 we run the same model as in Equation (1) but we compute the GVCs integration measures using only Manufacturing sectors (Top Panel) and Services (Bottom Panel). Both analyses confirm the empirical evidence obtained using the whole economy.

Table 15: Probability of Switch to a higher income level – Ordered Logit (Probit)

$Y_{cst} = 1$ if Income Group Improves	Ordered Logit		Ordered Probit	
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.239***		0.133***	
	(0.029)		(0.016)	
$\ln(dvar)_{cst-1}$		0.176***		0.095***
		(0.028)		(0.016)
$\ln(K/L)_{cst}$	3.032***	3.098***	1.665***	1.706***
	(0.110)	(0.110)	(0.053)	(0.052)
Year Fes	Yes	Yes	Yes	Yes
Constant Cut 1	*32.296****	*32.257****	*17.769****	*17.743****
	(1.088)	*(1.079)*	*(0.522)*	*(0.517)*
Constant Cut 2	*36.539****	*36.423****	*20.057****	*19.993****
	(1.215)	*(1.202)*	*(0.579)*	*(0.573)*
Constant Cut 3	*38.161****	*38.988****	*21.496****	*21.406****
	(1.279)	*(1.264)*	*(0.606)*	*(0.599)*
Proportionality Test	56.36	56.33	61.01	61.38
P-value	0.000	0.000	0.000	0.000
Observations	1,731	1,731	1,731	1,731

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 16: Probability of Switch to a higher income level (WDI country classification) - *Generalized Ordered Logit*

$P(Y_{ct} > j)$	L to LM	LM to UM	UM to H	L to LM	LM to UM	UM to H
J = Income Group	(1)	(2)	(3)	(4)	(5)	(6)
			Manufacturing integration into GVCs			
$\ln(fvax)_{ct-1}$	0.333***	0.229***	0.105***			
	(0.055)	(0.032)	(0.040)			
$\ln(dvar)_{ct-1}$				0.238***	0.156***	0.022
				(0.040)	(0.034)	(0.048)
$\ln(K/L)_{ct}$	2.654***	2.964***	3.985***	2.749***	3.014***	4.136***
	(0.170)	(0.163)	(0.247)	(0.169)	(0.155)	(0.250)
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
			Services integration into GVCs			
$\ln(fvax)_{ct-1}$	0.457***	0.289***	0.172***			
	(0.076)	(0.044)	(0.057)			
$\ln(dvar)_{ct-1}$				0.296***	0.189***	0.022
				(0.048)	(0.041)	(0.056)
$\ln(K/L)_{ct}$	2.669***	2.949***	3.934***	2.752***	3.025***	4.149***
	(0.168)	(0.161)	(0.253)	(0.168)	(0.155)	(0.252)
Year Fes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,731	1,731	1,731	1,731	1,731	1,731

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1. **L to LM** specifies the switch from Low to Lower Middle Income group; **LM to UM** specifies the switch from Lower Middle to Upper Middle Income group; **UM to H** specifies the switch from Upper Middle to High Income group. A constant is included in all the regressions but not reported. Results obtained through Ordered Probit are fully robust and available upon request.

APPENDIX 4: ROBUSTNESS CHECK USING OECD-WTO TIVA DATABASE

A key concern for this study is the data quality behind the GVC integration measures. Such indicators typically rely on inter-country input-output (ICIO) tables. While ICIO tables such as the WIOD Database or OECD ICIO Database are more reliable, they cover fewer countries, and in particular less low-income countries. The EORA ICIO Database, by contrast, covers 187 countries which come at the expense of strong underlying assumptions. Since national Input-Output tables are not available for many (developing) countries or at different periods of time, EORA infers and extrapolates the data using the information of countries for which they are available. This might cause measurement error and biases if the input-output structure of countries is correlated with GVC participation and influenced by national policies. Hence, there is a trade-off between data quality and country coverage. Therefore, this study also uses alternative databases with higher data quality as robustness check. This includes mainly the OECD ICIO database, which mostly avoids extrapolation strategies. The main downside of this database is that it covers only 61 countries for the years 1995, 2000, 2005, and 2008-2011.

A second challenge for the empirical model is that the results could be biased by endogeneity. Countries with lower income growth, for example, could enforce strategies to self-select into more GVC integration in the hope to foster growth. Similarly, countries with high income growth could choose to increase their GVC integration efforts to maintain high growth. Causality between GVC integration and income growth is thus not clear-cut. The econometric analysis therefore relies on lagged GVC measures and potentially on instrumental variables to obtain a clean identification strategy. Potential instruments have to be correlated with the GVC integration measures, but not with income growth. Such measures could include third-country trade costs, total number of production stages, distance to final demand, bilateral visas, and bilateral business flights, among others.

In order to check the robustness of our empirical findings using the EORA dataset we replicate the analysis using the Inter Country Input-Output (ICIO) tables developed by the OECD-WTO partnership. In the current version the OECD-WTO global input-output tables are available for 61 countries (plus the Rest of the World) with a breakdown into 34 industries (based on the ISIC Rev. 3) and the time coverage includes: 1995, 2000 2005, 2008-2011[10]. To ensure consistency of growth rates, we only consider five year changes.

Consistently with the baseline specification we keep in the sample the following years 2000, 2005 and 2008-2011. The estimated specification is the same as in equation (8).

Results reported in Table 17 confirm that for middle income countries, identified at the beginning of the estimation sample, i.e. year 2000, using the World Bank classification, show a relatively lower elasticity of GDP to global value chain integration; measured both in terms of backward (fvax) and forward (dvar) linkages. This evidence suggest that those countries are likely to benefit relatively less from integration into global production networks vis à vis Low and High income countries. Table 18 replicates the same specification restricting the sample to the manufacturing sector (NACE 15 to 37), interestingly the estimated elasticity for the three groups of countries are not statistically different from each other suggesting for a common positive effect from GVCs integration on Gross Domestic Products. Finally, Table 19 focus on the Business Services sectors (NACE 65 to 95); interestingly the estimated coefficients now show a significant difference between Low/Middle/High income countries. Low income countries seem to benefit from the backward linkages (import of foreign Value Added) whereas High income counties show a positive and significant effect of forward linkages (export of Value Added). Table 20 focuses on the traditional services (NACE 40 to 64).

10 See www.oecd.org/trade/valueadded

Table 17: Structural integration in GVCs and Income level (WDI country classification) - TIVA

Dep Variable: $\ln GDP_{cst}$	Whole Economy			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.075***			
	(0.011)			
$\ln(dvar)_{cst-1}$		0.105***		
		(0.013)		
$\ln(fvax)_{cst-1} * Income_L^{2000}$			0.058***	
			(0.015)	
$\ln(fvax)_{cst-1} * Income_M^{2000}$			0.037**	
			(0.019)	
$\ln(fvax)_{cst-1} * Income_H^{2000}$			0.102***	
			(0.016)	
$\ln(dvar)_{cst-1} * Income_L^{2000}$				0.085***
				(0.022)
$\ln(dvar)_{cst-1} * Income_M^{2000}$				0.072***
				(0.021)
$\ln(dvar)_{cst-1} * Income_H^{2000}$				0.138***
				(0.020)
$\ln(trade)_{cst-1}$	0.014*	0.023***	0.013*	0.022***
	(0.007)	(0.008)	(0.007)	(0.007)
Observations	9,340	9,340	9,340	9,340
R-squared (between)	0.045	0.061	0.051	0.066
Fes	cs, ct	cs, ct	cs, ct	cs, ct
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. Agricultural products (NACE 01 to 05), Minerals and Oil (NACE 10 to 14, NACE 23) have been excluded from the sample. A constant is included in all the regressions but not reported. The estimation sample includes the following years 2000, 2005, 2008-2011. Income levels refer to the World Bank classification for the year 2000.

Table 18: Structural integration in GVCs and Income level (WDI country classification) - TIVA

Dep Variable: $\ln GDP_{cst}$	Manufacturing			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.129***			
	(0.017)			
$\ln(dvar)_{cst-1}$		0.155***		
		(0.019)		
$\ln(fvax)_{cst-1} * Income_L^{2000}$			0.121***	
			(0.034)	
$\ln(fvax)_{cst-1} * Income_M^{2000}$			0.114***	
			(0.032)	
$\ln(fvax)_{cst-1} * Income_H^{2000}$			0.144***	
			(0.019)	
$\ln(dvar)_{cst-1} * Income_L^{2000}$				0.147***
				(0.042)
$\ln(dvar)_{cst-1} * Income_M^{2000}$				0.135***
				(0.028)
$\ln(dvar)_{cst-1} * Income_H^{2000}$				0.170***
				(0.026)
$\ln(trade)_{cst-1}$	0.014	0.026**	0.013	0.025**
	(0.011)	(0.011)	(0.011)	(0.011)
Observations	4,575	4,575	4,575	4,575
R-squared (between)	0.069	0.073	0.070	0.074
FEs	cs, ct	cs, ct	cs, ct	cs, ct
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. Manufacturing sector only (NACE 15 to 37). A constant is included in all the regressions but not reported. The estimation sample includes the following years 2000, 2005, 2008-2011. Income levels refer to the World Bank classification for the year 2000.

Table 19: Structural integration in GVCs and Income level (WDI country classification) - TIVA

Dep Variable: $\ln GDP_{cst}$	Business Services			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.034***			
	(0.011)			
$\ln(dvar)_{cst-1}$		0.033***		
		(0.010)		
$\ln(fvax)_{cst-1} * Income_L^{2000}$			0.037***	
			(0.014)	
$\ln(fvax)_{cst-1} * Income_M^{2000}$			0.029	
			(0.024)	
$\ln(fvax)_{cst-1} * Income_H^{2000}$			0.034*	
			(0.018)	
$\ln(dvar)_{cst-1} * Income_L^{2000}$				0.028
				(0.020)
$\ln(dvar)_{cst-1} * Income_M^{2000}$				0.034*
				(0.018)
$\ln(dvar)_{cst-1} * Income_H^{2000}$				0.035**
				(0.015)
$\ln(trade)_{cst-1}$	0.023***	0.028***	0.023***	0.027***
	(0.007)	(0.008)	(0.007)	(0.008)
Observations	2,935	2,935	2,935	2,935
R-squared (between)	0.038	0.035	0.038	0.035
FEs	cs, ct	cs, ct	cs, ct	cs, ct
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. Business Services only (NACE 65 to 95). A constant is included in all the regressions but not reported. The estimation sample includes the following years 2000, 2005, 2008-2011. Income levels refer to the World Bank classification for the year 2000.

Table 20: Structural integration in GVCs and Income level (WDI country classification) - TIVA

Dep Variable: $\ln GDP_{cst}$	Traditional Services			
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1}$	0.025*			
	(0.013)			
$\ln(dvar)_{cst-1}$		0.063***		
		(0.019)		
$\ln(fvax)_{cst-1} * Income_L^{2000}$			0.025	
			(0.025)	
$\ln(fvax)_{cst-1} * Income_M^{2000}$			0.007	
			(0.032)	
$\ln(fvax)_{cst-1} * Income_H^{2000}$			0.031**	
			(0.016)	
$\ln(dvar)_{cst-1} * Income_L^{2000}$				0.046**
				(0.021)
$\ln(dvar)_{cst-1} * Income_M^{2000}$				0.051
				(0.049)
$\ln(dvar)_{cst-1} * Income_H^{2000}$				0.084***
				(0.029)
$\ln(trade)_{cst-1}$	0.000	0.006	-0.000	0.005
	(0.014)	(0.013)	(0.014)	(0.013)
Observations	1,830	1,830	1,830	1,830
R-squared (between)	0.009	0.020	0.010	0.022
FEs	cs, ct	cs, ct	cs, ct	cs, ct
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. Traditional Services only (NACE 40 to 64). A constant is included in all the regressions but not reported. The estimation sample includes the following years 2000, 2005, 2008-2011. Income levels refer to the World Bank classification for the year 2000.

APPENDIX 5: REGIONAL DECOMPOSITION

Table 21: The role of GVC integration for income by region

Dep Variable: $\ln(GDPpe)_{ct}$	(1)	(2)	(3)	(4)
$\ln(fvax)_{ct-1} * EAP$	0.1781**	0.1960		
	(0.0782)	(0.1353)		
$\ln(fvax)_{ct-1} * ECA$	0.2282***	0.2448**		
	(0.0637)	(0.1157)		
$\ln(fvax)_{ct-1} * LAC$	0.1789**	0.3056**		
	(0.0722)	(0.1340)		
$\ln(fvax)_{ct-1} * MENA$	0.1515**	0.1516		
	(0.0618)	(0.1269)		
$\ln(fvax)_{ct-1} * NA$	-0.2358*	-0.1692		
	(0.1197)	(0.1928)		
$\ln(fvax)_{ct-1} * SA$	0.1891***	0.2468**		
	(0.0559)	(0.0963)		
$\ln(fvax)_{ct-1} * SSA$	0.1097	0.1709		
	(0.0794)	(0.1154)		
$\ln(dvar)_{ct-1} * EAP$			0.2183***	0.1880**
			(0.0600)	(0.0869)
$\ln(dvar)_{ct-1} * ECA$			0.2755***	0.2398***
			(0.0584)	(0.0780)
$\ln(dvar)_{ct-1} * LAC$			0.2515***	0.3204***
			(0.0667)	(0.0969)
$\ln(dvar)_{ct-1} * MENA$			0.1889***	0.1225*
			(0.0480)	(0.0702)
$\ln(dvar)_{ct-1} * NA$			-0.0508	-0.0978
			(0.1064)	(0.1629)
$\ln(dvar)_{ct-1} * SA$			0.1859**	0.3098***
			(0.0768)	(0.0727)
$\ln(dvar)_{ct-1} * SSA$			0.1889***	0.1979**
			(0.0571)	(0.0869)
$\ln(K/L)_{ct}$	0.2907**	0.4640**	0.2635**	0.3738*
	(0.1316)	(0.2152)	(0.1263)	(0.1927)
$\ln(R\&D)_{ct}$		-0.0355		-0.0274
		(0.0383)		(0.0326)
Constant	2.7721*	0.3027	2.2453	1.2541
	(1.5840)	(2.7874)	(1.3574)	(2.1496)
Observations	1,731	924	1,730	923
R-squared	0.7949	0.8764	0.8053	0.8829

Robust standard errors clustered at country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. FVAX and DVAR lagged one year. Country- and year fixed effects included.

Table 22: The role of GVC integration for income by aggregated regions (country-sector)

Dep Variable: $\ln GDP_{cst}$			Direct Effect	
	(1)	(2)	(3)	(4)
$\ln(fvax)_{cst-1} * EAP$	0.131***		0.110***	
	(0.024)		(0.030)	
$\ln(fvax)_{cst-1} * ECA$	0.192***		0.197***	
	(0.027)		(0.026)	
$\ln(fvax)_{cst-1} * LAC$	0.090***		0.084***	
	(0.017)		(0.017)	
$\ln(fvax)_{cst-1} * MENA$	0.081***		0.080***	
	(0.016)		(0.015)	
$\ln(fvax)_{ct-1} * NAM$	0.126***		0.115***	
	(0.016)		(0.016)	
$\ln(fvax)_{ct-1} * SA$	0.184***		0.172***	
	(0.045)		(0.041)	
$\ln(fvax)_{ct-1} * SSA$	0.087**		0.096**	
	(0.038)		(0.041)	
$\ln(dvar)_{ct-1} * EAP$		0.085**		0.167***
		(0.042)		(0.053)
$\ln(dvar)_{ct-1} * ECA$		0.102***		0.212***
		(0.023)		(0.031)
$\ln(dvar)_{ct-1} * LAC$		0.086***		0.168***
		(0.011)		(0.021)
$\ln(dvar)_{ct-1} * MENA$		0.082***		0.126***
		(0.029)		(0.046)
$\ln(dvar)_{ct-1} * ROW$		0.075***		0.100***
		(0.017)		(0.020)
$\ln(dvar)_{ct-1} * SA$		0.220***		0.282***
		(0.055)		(0.047)
$\ln(dvar)_{ct-1} * SSA$		0.081***		0.179***
		(0.022)		(0.020)
Observations	40,689	40,689	40,689	40,689
R-squared	0.059	0.070	0.057	0.113
Number of ID (Country-Sector)	3,699	3,699	3,699	3,699
FEs	cs, ct, st	cs, ct, st	cs, ct, st	cs, ct, st
Cluster	Country	Country	Country	Country

In parentheses standard errors clustered at the country level. One, two, and three asterisks denote statistical significance at the 10%, 5%, and 1% level, respectively. "Private Households", "Public Administration", "Education, Health and Other Services", "Re-exports and Re-imports", along with "Mining and Quarrying" have been excluded from the sample. The estimation sample covers the following years: 2000-2011. Regions are defined according to the World Bank classification. EAP: East East Asia & Pacific; ECA: Europe & Central Asia; LAC: Latin America & Caribbean; MENA: Middle East & North Africa; NAM: North America; SA: South Asia; SSA: Sub-Saharan Africa.