Global value chains' participation and logistics performance: the case of post-Soviet economies

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Global Value Chains' Participation and Logistics Performance: The Case of Post-Soviet Economies

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Abstract

This study evaluates the degree of global value chains (GVC)' backward participation in manufacturing in the post-Soviet countries, and to examine its quantitative linkage with host countries' logistics performances as a component of the service link. This study's major contributions are to target the post-Soviet countries that has never been discussed in the context of GVC analyses, to use the UNCTAD-Eora Global Value Chain database, and to applies a structural gravity trade model setting. The statistical observations presented a positive correlation between GVC backward participation in manufacturing and income level in the post-Soviet economies. The empirical estimation by the structural gravity trade model identified the quantitative linkage between GVC backward participation and the logistics performance of the host country, and also demonstrated that the level of logistics performance accounts for 70 – 80 percent of the degree of GVC backward participation. The policy implication of this study is that there should still be a policy space for the post-Soviet economies to improve their logistics performances by removing a negative legacy from the Soviet Union.

Keywords: Global value chains, Logistics performance, Post-Soviet countries, Manufacturing, UNCTAD-Eora Global Value Chain database, and Structural gravity trade model

JEL Classification: F12, F13, F14, O57

1. Introduction

The 15 post-Soviet countries were formed after the disintegration of the Soviet Union in 1991. In the early stages of their independence, their economies experienced severe hardships in a number of large-scale market-oriented reformations. They have made significant progresses, however, in their economic transition to a market-based economy and in their linkage with the world economy, as all of them at present are classified into the high- or middle- income groups according to the World Bank income classification in 2020.[1] Although they have commonalities of history, geographical closeness, culture and language, their profile represents heterogeneities among them as shown in Table 1. The population and the level of Gross Domestic Product (GDP) per capita differ widely, and regarding the income classification, Estonia, Latvia and Lithuania belong to high-income class and joins the member of European Union (EU) and Organization for Economic Co-operation and Development (OECD), where the others stay at middle-income class (Kyrgyz, Tajikistan, Ukraine and Uzbekistan are still classified into the lower-middle).

One of the key issues common in the post-Soviet countries is the underdevelopment of manufacturing sectors and the lack of the linkage in global value chains in the sector. Table 1 again reveals the value added of manufacturing as a percentage of GDP in 2020, and its average in the post-Soviet countries, 13.2 percent, is much lower than the average of East Asia and Pacific countries excluding high-income countries, 25.2 percent. Table 1 also presents the degree of global value chain (GVC) backward participation in manufacturing sector in 2017, expressed by "foreign value embedded in a country's manufacturing exports" in the UNCTAD-Eora Global Value Chain database[2] (UNCTAD-Eora database), and its average in the post-Soviet countries, 29.5 percent, is much lower than those of emerging ASEAN economies such as Malaysia (41.1 percent) and Thailand (36.7 percent).

The manufacturing sector is, as Kaldor (1967) demonstrated the eponymous Kaldor's law, is considered to be an engine of economic growth especially for developing countries. Rodrik (2013) also argued that the manufacturing sector shows unconditional labor productivity convergence, absorbs more unskilled labor than other sectors, and does not face the demand constraints of a home market due to its tradability in international markets. Thus, the sluggish manufacturing in the post-Soviet countries might be a detrimental factor for their sustainable economic development.

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[1] See the website: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519.

[2] See the website: https ://world mrio.com/unctadgvc/. The property of this database will be explained in Section 2.

Inactive GVC participation in manufacturing sector in the post-Soviet countries would be another side of the same coin of the sluggish manufacturing activities. The GVC, dominating global economic activities over the last two decades, have been described as the fragmentation of production processes and the international dispersion of tasks among economies in diversified developmental stages, which have led to the emergence of borderless production networks (e.g., UNCTAD, 2013). Kimura (2006) and Kimura et al. (2007) argued that the international production networks typically exist in manufacturing activities such as machinery industries involving many multi-layered vertical production processes. The GVC is considered to boost economic growth as the specialization in production processes enhances efficiency and productivity, and the durable firm-to-firm relationships promote the diffusion of technology along the chains (e.g., World Bank, 2020). Thus, the inactive GVC participation leads to the sluggish manufacturing activities.

From the theoretical perspective, the concept of GVC was initially introduced by Hummels et al. (2001) in terms of the "vertical specialization". Koopman et al. (2010) and (2014) then generalized the concept of vertical specialization by accounting for all the sources of value-added in gross exports in the framework of multi-countries and multi sectors, thereby integrating vertical specialization and value-added trade in the literature. In accordance with their GVC conceptualization, the value-added-trade data have been developed by international organizations such as OECD, WTO and UNCRAD, and the database has made it possible to analyze the value-added contributions of gross exports.

The GVC mechanics, characterized by vertical specialization, has also been discussed by the "fragmentation" model in the context of intra-industry trade, as in Jones and Kierzkowski (1990, 2005), Deardorff (2001), and Kimura (2006). Jones and Kierzkowski (1990, 2005) argued that a firm's decision on whether to fragment production processes depends on the differences in location advantages (e.g., the differences in factor prices such as wages) and the levels of the service-link costs. They define the service-link costs as bundles of activities to connect fragmented production blocks, comprising coordination, administration, transportation, and financial services. Thus, the service-link costs are composed of not only bilateral trade costs such as transportation costs, but also country-specific costs such as logistics performance for operating in a given country.

This study aims to assess the degree of GVC backward participation (defined by foreign value embedded in a country's exports) in manufacturing sector of the post-Soviet countries, and also to examine its quantitative linkage with host countries' logistics performance as a component of the service link. The hypothesis of this study is that there would be a substantial difference in GVC backward participation between high-income

countries (Estonia, Latvia and Lithuania) and the other middle-income countries, and that the difference would come from the gap in the logistics performance between them as host countries. The GVC data are retrieved from the UNCTAD-Eora Database. For the analytical methodology, this study applies a "structural" gravity trade model in the specification of estimated equations.

The contributions of this study to the literature are noted as follows. First, this study targets the post-Soviet economies in the GVC analysis. The GVC in manufacturing and logistics performance have been intensively discussed in emerging Asian and Latin American economies as in Kimura (2006), Kimura et al. (2007), and Gereffi (2018), whereas few studies have dealt with these issues in transition economies. Targeting transition economies such as the post-Soviet countries adds a meaningful contribution to the literature. The development paths of their countries differ considerably from those of emerging Asian and Latin American economies. In particular, the institutional factor such as logistics performance is of vital importance in post-Soviet economies because their institutional frameworks are required to change dramatically from a centrally planned economy to a market-based economy over the past three decades, and some of them may be still suffering from chronically immature market-based systems as a negative legacy from the Soviet Union. The institutional environment affects the development of the GVC and manufacturing sector.

The second contribution is that this study applies the UNCTAD-Eora Database (compiling value-added-trade data) for analyzing the GVC linkage. The GVC that is characterized by vertical trade could be expressed by trade in terms of value added as well as ordinary gross trade values. Previous studies such as Kimura et al. (2007) examined the vertical trade of the fragmented manufacturing products in an intra-industry by using their gross trade values in terms of parts and components in their gravity trade model. The gross trade values, however, do not necessarily express the vertical trade accurately, because the traded parts and components could also be used for fulfilling domestic final demands, not exclusively for processing them for exports. The value-added-trade data, on the other hand, stand precisely for the vertical trade in the GVC linkage. Thus, this study, by using the value-added-trade data, would contribute toward enriching evidence on the GVC linkage.

The third contribution is that this study applies a "structural" gravity trade model setting for the GVC analysis. The traditional gravity trade model had explained bilateral trade flows by the economic size of two countries and the distance between them. Piermartini and Yotov (2016), however, argued that the traditional model would lead to biased and even inconsistent estimates, and so presented a comprehensive and

theoretically consistent econometric specification, so-called a structural model.

The remainder of the paper is structured as follows. Section 2 illustrates the extent of GVC backward participation in manufacturing sector of the post-Soviet countries; Section 3 conducts an econometric analysis by estimating a structural gravity trade model, to examine the quantitative linkage between GVC backward participation and logistics performance in the host country; and Section 4 summarizes and concludes the paper.

2. GVC backward participation in post-Soviet countries

This section illustrates the extent of GVC backward participation in manufacturing sector of the post-Soviet countries by using the UNCTAD-Eora Database. Regarding the GVC forms, Koopman et al. (2010) presented the following two types of participations in a vertical specialization chain:

$$\text{GVC Participation} = FV / E + IV / E \quad (1)$$

where FV, IV, and E stand for "foreign value added embodied in gross exports", "domestic value added embodied as intermediate inputs in other countries' gross exports", and "gross exports," respectively. The first item (FV / E), representing a downstream GVC participation, corresponds to GVC backward participation in this study, while the second item (IV / E), showing an upstream GVC participation, is called GVC forward participation, following, for example, the World Bank (2020).

This study focuses on the backward participation in manufacturing sector, because the manufacturing in the post-Soviet economies is still in a premature stage as in Table 1, where their manufacturing exports depend on foreign inputs and have less capacity to supply industrial inputs (materials, parts and components for manufacturing) to the third countries' exports in their GVC participation process (the manufacturing in the post-Soviet economies show downstream contribution rather than upstream one to GVC). GVC backward participation is of significance in the manufacturing development of emerging market economies including the post-Soviet ones, because the participation could involve intermediate inputs containing foreign technology and thus boost the competitiveness of their exports by facilitating the combination of foreign technology with their own labor, capital, and technology (World Bank, 2016).

The UNCTAD-Eora database that this study uses offers the GVC data with global coverage (189 countries and a "Rest of World" region) and a time series from 1990 to

2017. The methodology of the database was described by Casella et al. (2019).[3] The UNCTAD-Eora database provides the country/sector by a country matrix of value-added decomposition in trade, so that the gross exports of countries and their sectors could be decomposed into home countries' value added and foreign countries' value added with each country origin. By using this database, this section computes the GVC backward participation of the post-Soviet economies by manufacturing industries[4], in terms of the foreign value added embodied in gross exports as the percentage of gross exports. This section also shows the foreign value added of the post-Soviet economies by foreign country origins, in terms of the percentage of the total foreign value added.

The other indicators used in this section are per capita GDP in real term and logistics performance index (LPI). The data of per capita GDP in real term, representing the development stage of the economies, is retrieved from UNCTAD Stat database[5] in terms of "US dollars at constant prices (2015) per capita." LPI is supplied by the World Bank[6], and it measures the performances of customs, infrastructure, international shipments, logistics quality and competence, tracking and tracing, and timeliness, taking the number ranging from 1 (very low in the performances) to 5 (very high). This study targets 14 post-Soviet countries: Armenia, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyz, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.[7]

Figure 1 displays the relationship between GVC backward participation (the foreign value-added share of gross exports) in manufacturing and per capita GDP in real term in the post-Soviet countries in 2017. It shows a positive correlation between them and a gap in the degree of GVC backward participation between high-incomers (Estonia, Latvia and Lithuania) and middle-incomers. Table 2 presents the foreign value added share by foreign country origins in the post-Soviet countries in 2017. The large shares of Russia, China and Germany are commonly observed in sample countries. Figure 2 displays the relationship between GVC backward participation in manufacturing (in 2017) and LPI (in 2018) in sample economies, which is related to this study's main issue. It reveals that the deeper GVC participation is positively correlated with the higher level of logistics performances. This observation should be statistically tested by a more sophisticated manner in the subsequent section.

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[3] The value-added-based trade data originated from the work of the OECD and WTO as the "Trade in Value Added (TiVA)" dataset (see OECD and WTO 2012). Thus, Casella et al. (2019) also provided a comparison of the results of the UNCTAD-Eora database against the TiVA database.

[4] The manufacturing sector is extracted from the matrix by reorganizing the industry and commodity classifications as shown in Appendix.

[5] See the website: https ://uncta dstat .uncta d.org/EN/.

[6] See the website: https ://lpi.world bank.org/.

[7] Azerbaijan is excluded from the sample, because it does not have the data for LPI.

3. Econometric Analysis

This section conducts an econometric analysis by estimating a structural gravity trade model, to verify the quantitative linkage between GVC backward participation and logistics performance in the host country, targeting the post-Soviet economies. The section first specifies the estimation models and the sample data, and then presents estimation outcomes with discussions.

3.1 Specification of estimation models

This study applies the structural gravity trade model for examining the manufacturing GVC by using directional fixed effects (Equation 1), and the logistics performance of host countries instead of the host country's fixed effects (Equation 2). The models are specified as follows:

$$\ln FVA_{ij,t} = \alpha_0 + \mu_{ij} + \pi_i + \chi_j + \nu_t + \varepsilon_{ij,t} \quad (1)$$

$$\ln FVA_{ij,t} = \beta_0 + \mu_{ij} + \beta_1 LPI_{i,t} + \chi_j + \nu_t + \varepsilon_{ij,t} \quad (2)$$

where the subscripts i, j, and t denote host countries (receiving foreign value added in exports), origin countries (offering foreign value added in exports), and trading years, respectively; FVA is the foreign value added in exports in manufacturing; μ_{ij} is the pair fixed effects between countries i and j; π_i and χ_j are the fixed effects of countries i and j, respectively; LPI is the logistics performance index; ε is an error term; α_0, β_0, β_1 are estimated coefficients of Equations (1) and (2), respectively; and ln shows a logarithm form. The LPI in Equation (2) contains the overall index and its sex components: customs (LPI_cus), infrastructure (LPI_inf), international shipments (LPI_shp), logistics quality and competence (LPI_lgs), tracking and tracing (LPI_ttr), and timeliness (LPI_tim). These LPI indexes are inserted separately as independent regressors in the equation, since their indexes have a multicollinearity problem. Table 3 reports the bivariate correlations and the variance inflation factors (VIF), a method of measuring the level of collinearity between regressors. It shows that the indexes have a high bivariate correlation in each combination by 0.6 – 0.8, and high VIF values that are far beyond the criteria of collinearity, namely, ten points.

The structural gravity model setting was proposed by Piermartini and Yotov (2016). They suggested the following six recommendations: (i) use panel data, (ii) use interval

data to allow for adjustment in trade flows, (iii) include intra-national trade flows, (iv) use directional time-varying fixed effects, (v) employ pair fixed effects, and (vi) estimate gravity with the Poisson Pseudo Maximum Likelihood (PPML). Equation (1) conforms to the above recommendation with some modifications due to the data property. (i) and (ii) are satisfied in this study's estimation, which will be explained in the next section. (iii) is not applied because this study focuses on the comparison in the GVC among the post-Soviet economies. Regarding (vi), this study adopts not time-varying fixed effects but time-invariant ones (π_i and χ_j) because the sample period is just eleven years from 2007 to 2017, and instead inserts time dummy (ν_t) to reflect the time-varying factors. The country fixed effects absorb all the observable and unobservable country-specific characteristics that influence bilateral trade. This study treats the high-income countries of Estonia, Latvia and Lithuania as benchmark host countries, because these countries show high performances in GVC participation and logistics as shown in Section 2. (v) is incorporated in Equation (1) in terms of μ_{ij}, accounting for the effects of all time-invariant bilateral trade costs. Following (vi), this study applies the PPML estimator as well as the ordinary least square (OLS) estimator, to manage the heteroscedasticity of trade data.

The question is where the service-link costs are positioned in this equation. As mentioned in the introduction, the service-link costs contain not only bilateral trade costs such as transportation costs, but also country-specific costs such as the costs for operating in a given country. Thus, the service-link costs occupy some portions of the fixed effects of host and origin countries (π_i and χ_j) and the pair fixed effects (μ_{ij}). This study focuses on the logistics performance of the host country side as one part of the service-links costs. Thus, the major concern in Equation (1) in this study is the volume of the fixed effects of host countries (π_i). Equation (2), in this context, replaces the fixed effects (π_i) with the logistics performance ($LPI_{i,t}$) of the host countries. Then, this study demonstrates the contribution of the host country's logistics performance to the country-specific fixed effects, by using the estimated coefficient β_1.

3.2 Data

The data of FVA and LPI are retrieved from the UNCTAD-Eora and the World bank database, as in Section 2. The sample economies and period are set as follows. The host countries are the 14 post-Soviet countries as in Section 2, and the origin countries of foreign value added are selected from the top seven trading partners with the host countries as shown in Table 2, which cover more than half out of the total foreign value added on average in the host countries. As for the sample period, the study selects such

discrete years as 2007, 2010, 2012, 2014, 2016, and 2017 because of the constraint of data availability of the LPI.[8] The study then constructs panel data for six years with the combinations between host and origin countries (6 * 14 * 7 = 588) for the estimation.

For the subsequent panel estimation, this study investigates the stationary property of the constructed panel data of ln FVA and LPI by employing panel unit root tests: the Levin, Lin, and Chu test (Levin et al. 2002) as a common unit root test; and the Fisher-ADF and Fisher-PP tests (Maddala and Wu 1999; Choi 2001) and the Im, Pesaran and Shin, test (Im et al. 2003) as individual unit root tests. The common unit root test assumes that there is a common unit root process across cross-sections, and the individual unit root test allows for individual unit root processes that vary across cross-sections. These tests are conducted based on the null hypothesis that a level of panel data has a unit root by including "intercept" in the test equations. Table 4 reports that all the tests identifies the rejection of the null hypothesis of a unit root at the 99 percent significance level in all the variables. Thus, using the level of panel data for the estimation is justified in this study.

3.3 Estimation outcomes and discussion

Table 5 reports the estimation outcomes, where column (i) and (ii) correspond to those of Equations (1), and column (iii) – (x) to Equation (2); and the OLS estimation is presented by column (i) and (iii), and the PPML by column (ii) and (iv) – (x). Since both OLS and PPML estimations show similar results, this section focuses mainly on the results from the PPML estimation.

Starting with the results of Equation (1), the major concern in this equation is the coefficients on the fixed effects in host countries (those in origin countries and the coefficients on the pair fixed effects are omitted for brevity). Most of coefficients show significantly negative values, except those of Russia, Turkmenistan, and Ukraine, because the benchmark countries (Estonia, Latvia and Lithuania) show high performances in GVC participation. This result is almost consistent with the observation in Figure 1. Looking at the Ramsey RESET p-values at the bottom of Table 5, both OLS and PPML estimations of Equation (1) pass the misspecification test. The test detects model specification errors from possible omission of variables with the null hypothesis that model does not suffer from misspecification errors, and the hypothesis is not rejected in the estimation of Equation (1), thereby justifying the model specification.

Turning to the outcomes of Equation (2) replacing the fixed effects with the LPI of

[8] The UNCTAD-Eora database has the data range by 2017, and the LPI data in 2018 is applied to the data as 2017, since the LPI does not have the data in 2017.

host countries, the coefficients of LPI have significantly positive values as expected: the overall index and six components have almost the same size of positive coefficients, around three. The RESET p-values, however, suggest that the OLS and PPML estimations of Equation (2) do not pass the misspecification test. It seems to be probably because there are omitted variables in the estimations so that logistics performance itself cannot cover all the host country-specific fixed effects. However, the significantly positive coefficients of LPI imply that the logistics performance of host countries has some effects to explain the degree of their GVC backward participation. This result leads to questioning the statistical degree of the logistics performance's contribution to the fixed effects on host countries that reflect the extent of GVC backward participation.

Table 6 and Figure 3 compares the host countries' fixed effects and their effects of logistics performances with a focus on the overall LPI in the period average of 2007-2017. Column (a) of Table 6 re-displays the coefficients of the host countries' fixed effects in column (ii) (PPML estimation) of Table 5. Column (b) shows the period-average LPIs of the host countries, and column (c) computes their LPI deviations from the average LPI of the benchmark countries (Estonia, Latvia and Lithuania). The LPI effects in column (d) are then calculated by multiplying the LPI deviations with the LPI coefficient (3.440) estimated in column (ii) of Table 5. In column (e), the LPI effects in column (d) are divided by the coefficients of fixed effects in column (a) for their comparison. Kazakhstan, Russia, Turkmenistan, and Ukraine are excluded from the ratio calculation in column (e), because Russia and Ukraine have positive fixed effects, and Kazakhstan and Turkmenistan do not have robust fixed effects in that their coefficients are insignificant in the OLS estimation in column (i) of Table 5.

The result in column (e) of Table 6 and Figure 3 suggest that the host countries' logistics performances accounts for their country-specific effect to a comparable extent, with the reasonable range of the LPI-fixed effect ratio of 0.7 – 0.8 except for Moldova. This finding implies the existence of robust linkage between the host countries' logistics performances and the degree of their GVC backward participations in the post-Soviet economies. This outcome is also consistent with the analyses by the World Bank (2016 and 2020) that GVC integrations are highly sensitive to logistics performances.

4. Concluding Remarks

The majority of post-Soviet countries have been plagued with the underdevelopment of manufacturing sectors and the lack of the linkage in GVC in the sectors despite the heterogeneities of their economic profiles. This study attempted to assess the degree of

GVC backward participation in manufacturing in the post-Soviet countries, and to examine its quantitative linkage with host countries' logistics performances as a component of the service link. This study's major contributions were to target the post-Soviet countries that has never been discussed in the context of the GVC participation and logistics performance, to use the UNCTAD-Eora Database for analyzing the GVC linkage, and to applies a structural gravity trade model setting for the specification of estimated equations.

The statistical observations presented a positive correlation between GVC backward participation in manufacturing and income level in the post-Soviet economies, and a gap in the GVC participation among them: higher GVC participation in high-incomers (Estonia, Latvia and Lithuania) and lower one in middle-incomers. They also showed that higher GVC backward is positively correlated with higher level of logistics performance. The empirical estimation by the structural gravity trade model identified the quantitative linkage between GVC backward participation and the logistics performance of the host country. The factor analysis also demonstrated that the level of logistics performance accounts for 70 – 80 percent of the degree of GVC backward participation.

The policy implication of this study is that there should still be a policy space for the post-Soviet economies, in particular, middle incomers, to improve their logistics performances, because the logistics performances are one of manageable elements by removing a negative legacy from the Soviet Union. Improving logistics performances contributes to their GVC backward participations, thereby bringing in foreign technology through foreign intermediate inputs, and leading to manufacturing development, which would be an engine of economic growth.

The limitation of this study is the lack of detailed researches on individual countries and thus further research should be conducted so that country-specific policy prescriptions and recommendations to improve logistics performances for their GVC participations in manufacturing could be extracted, based on scientific evidence.

References

Casella, B., Bolwijn, R., Moran, D. and Kanemoto, K. 2019. Improving the analysis of global value chains: the UNCTAD-Eora Database. *Transnational Corporations*, 26(3). New York: United Nations.

Choi, I. 2001. Unit Root Tests for Panel Data. *Journal of International Money and Finance*, 20: 249–272.

Deardorff, A.V. 2001. Fragmentation in simple trade models. *North American Journal of Economics and Finance*, 12: 121-137.

Gereffi, G. 2018. *Global Value Chains and Development: Redefining the Contours of 21st Century Capitalism*. Cambridge: Cambridge University Press.

Hummels, D., Ishii, J. and Yi, K. M. 2001. The nature and growth of vertical specialization in world trade. *Journal of International Economics*, 54: 75-96.

Im, K.S., Pesaran, M. H. and Shin, Y. 2003. Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*, 115: 53-74.

Jones, R.W. and Kierzkowski, H. 1990. The role of services in production and international trade: a theoretical framework. In Jones, R.W. and Krueger, A. (eds.), *The Political Economy of International Trade: Essays in Honor of Robert E. Baldwin*. Oxford: Blackwell.

Jones, R.W. and Kierzkowski, H. 2005. International trade and agglomeration: an alternative framework. *Journal of Economics*, 10: 1-16.

Kaldor, N. 1967. *Strategic Factor in Economic Development*. Ithaca: Cornell University.

Kimura, F. 2006. International Production and Distribution Networks in East Asia: Eighteen Facts, Mechanics, and Policy Implications. *Asian Economic Policy Review*, 1(2): 326–344.

Kimura, F., Takahashi, Y. and Hayakawa, K. 2007. Fragmentation and Parts and Components Trade: Comparison between East Asia and Europe. *North American Journal of Economics and Finance*, 18(1): 23–40.

Koopman, R., Powers, W., Wang, Z. and Wei, S. J. 2010. Give Credit Where Credit Is Due: Tracing Value Added in Global Production Chains. *NBER Working Paper*, No. 16426.

Koopman, R., Wang, Z. and Wei, S.J. 2014. Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*, 104: 459-494.

Levin, A., Lin, C.F. and Chu, C. 2002. Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108: 1–24.

Maddala, G.S. and Wu, S.A. 1999. Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics*, 61: 631–652.

Piermartini, R. and Yotov, Y.V. 2016. Estimating trade policy effects with structural gravity. *WTO Staff Working Papers*, ERSD-2016-10.

Rodrik, D. 2013. Unconditional Convergence in Manufacturing. *Quarterly Journal of Economics*, 128(1): 165–204.

UNCTAD 2013. *World investment report—global value chains: investment and trade for development*. New York and Geneva: The United Nations.

World Bank 2016. *Making global value chains: work for development*. Washington: the World Bank.

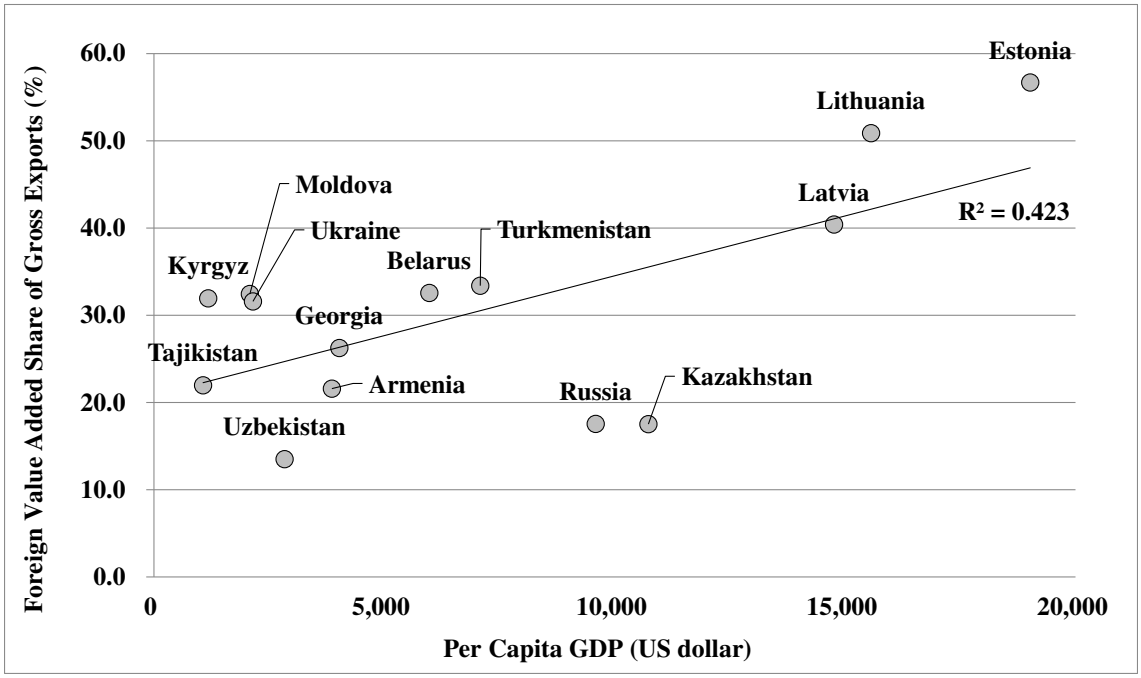
World Bank 2020. *World development report—trading for development in the age of global value chains*. Washington: the World Bank.

Table 1 Profile of 15 Post-Soviet Countries

	Population thousand in 2020	GDP per capita USD in 2020	Income Class in 2020	Manufacturing % of GDP in 2020	GVC Participation in Mnugacturing in 2017
Armenia	2,963	4,267	Upper Middle	12.4	21.6
Azerbaijan	10,110	4,232	Upper Middle	5.8	14.2
Belarus	9,399	6,398	Upper Middle	21.5	32.6
Estonia	1,331	23,036	High	12.9	56.7
Georgia	3,714	4,275	Upper Middle	9.3	26.3
Kazakhstan	18,754	9,071	Upper Middle	13.1	17.5
Kyrgyz	6,592	1,189	Lower Middle	17.0	31.9
Latvia	1,902	17,549	High	10.8	40.4
Lithuania	2,795	19,981	High	15.7	50.9
Moldova	2,618	4,523	Upper Middle	10.5	32.5
Russia	144,104	10,115	Upper Middle	13.3	17.6
Tajikistan	9,538	844	Lower Middle	13.4	22.0
Turkmenistan	6,031	7,674	Upper Middle	-	33.4
Ukraine	44,135	3,741	Lower Middle	10.1	31.6
Uzbekistan	34,232	1,767	Lower Middle	19.4	13.5
Average	-	-	-	13.2	29.5

Sources:
Population and Manufacturing, value added (% of GDP): World Bank Open Data, https://data.worldbank.org/
GDP per capita: World Economic Outlook Database, IMF, https://www.imf.org/en/Publications/WEO/weo-database/2021/October
Income Classification: World Bank, https://datahelpdesk.worldbank.org/knowledgebase/articles/906519
GVC participation: UNCTAD-Eora Global Value Chain Database https://worldmrio.com/unctadgvc/

Figure 1 Relationship between GVC Backward Participation in Manufacturing and per capita GDP in Post-Soviet Countries in 2017



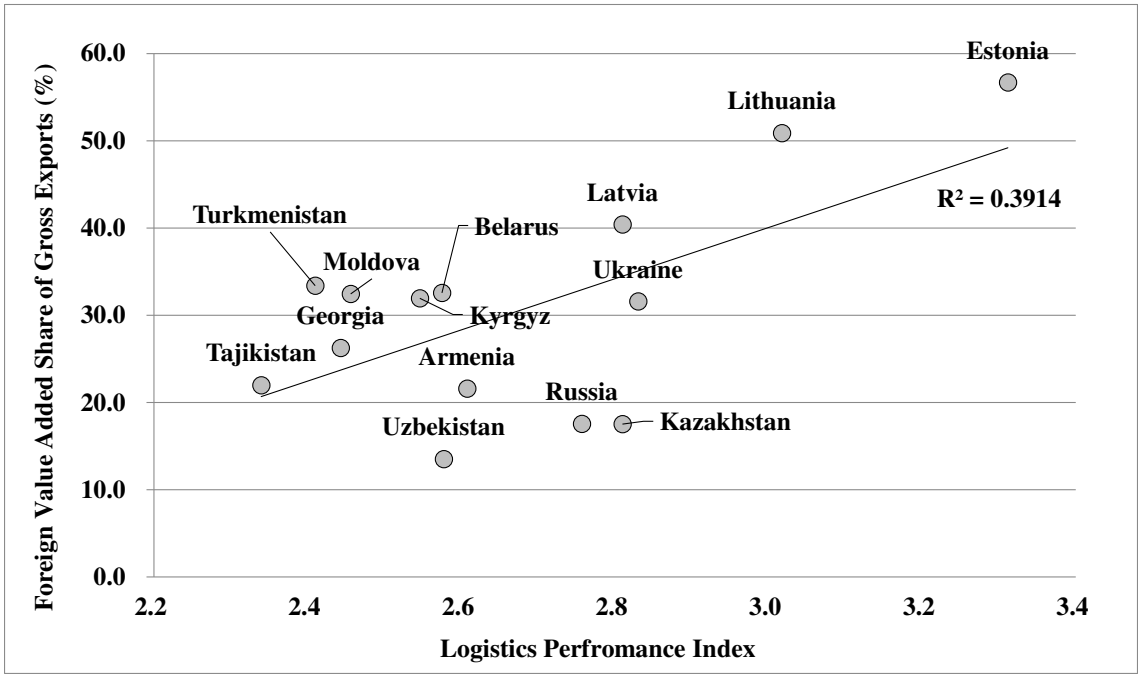
Source: Author's calculation based on UNCTAD-Eora database and UNCTAD Stat.

Table 2 Foreign Value Added Share by Foreign Country Origins in Post-Soviet Countries in 2017

Armenia	Iran	Germany	Russia	UAE	USA	Turkey	China
	13.7	9.0	7.9	6.7	6.0	5.9	5.2
Belarus	Jordan	Bangladesh	China	Tanzania	Viet Nam	Myanmar	Singapore
	6.5	6.1	5.1	5.0	4.9	4.3	3.5
Estonia	China	Germany	Finland	Russia	Sweden	USA	UK
	18.0	11.4	9.9	8.9	5.7	3.4	3.1
Georgia	Russia	China	Germany	Turkey	Azerbaijan	USA	Ukraine
	14.6	10.4	8.0	6.5	5.9	4.8	4.0
Kazakhstan	Russia	China	Germany	USA	UK	Ukraine	Turkey
	40.1	6.7	5.6	5.4	3.0	2.5	2.1
Kyrgyzstan	China	Russia	Uzbekistan	USA	Kazakhstan	Germany	Turkey
	7.8	7.7	5.9	5.7	4.0	3.8	2.7
Latvia	Germany	Russia	China	Lithuania	Sweden	Poland	Finland
	14.9	14.1	11.8	4.7	4.3	3.5	3.0
Lithuania	Russia	Germany	Netherlands	China	Poland	Italy	USA
	26.2	10.8	7.7	7.5	4.0	3.5	3.3
Moldova	Panama	USA	China	Australia	India	Japan	Iran
	6.2	4.9	4.6	3.8	3.5	2.9	2.3
Russia	USA	Germany	Ukraine	China	Belarus	Poland	Netherlands
	17.5	9.4	8.2	8.1	4.4	3.5	2.9
Tajikistan	Iran	China	Russia	India	Turkey	Germany	Kazakhstan
	17.4	8.2	5.3	5.1	4.5	4.4	3.9
Turkmenistan	UAE	Iran	Russia	Ukraine	Turkey	China	Kazakhstan
	15.7	12.5	11.7	7.1	6.7	5.9	4.7
Ukraine	Russia	Germany	China	Poland	USA	Italy	Turkmenistan
	37.0	9.5	6.0	4.3	3.3	3.1	2.4
Uzbekistan	Russia	China	USA	Turkey	Germany	Iran	Kazakhstan
	11.3	6.8	5.9	4.6	4.4	4.4	4.2

Source: Author's calculation based on UNCTAD-Eora database and UNCTAD Stat.

Figure 2 Relationship between GVC Backward Participation in Manufacturing (in 2017) and Logistics Performance Index in Post-Soviet Countries (in 2018)



Source: Author's calculation based on UNCTAD-Eora database and the World Bank.

Table 3 Correlation Matrix and Variance Inflation Factors

	LPI	LPI_cus	LPI_inf	LPI_shp	LPI_lgs	LPI_ttr	LPI_tim
LPI	1.000						
LPI_cus	0.885	1.000					
LPI_inf	0.883	0.829	1.000				
LPI_shp	0.893	0.752	0.712	1.000			
LPI_lgs	0.950	0.821	0.870	0.808	1.000		
LPI_ttr	0.906	0.729	0.748	0.750	0.841	1.000	
LPI_tim	0.893	0.677	0.679	0.777	0.828	0.828	1.000
VIF	$6.210*10^3$	$2.306*10^2$	$1.605*10^2$	$2.626*10^2$	$1.650*10^2$	$2.204*10^2$	$2.821*10^2$

Sources: Author's estimation

Table 4 Panel Unit Root Tests

	Levin, Lin & Chu Test	Fisher ADF Chi-square	Fisher PP Chi-square	Im, Pesaran & Shin W-stat
ln (FVA)	-25.842 ***	351.194 ***	602.400 ***	-5.184 ***
LPI	-47.373 ***	423.403 ***	578.876 ***	-11.329 ***
LPI_cus	-21.499 ***	286.212 ***	371.256 ***	-5.330 ***
LPI_inf	-26.030 ***	272.602 ***	399.744 ***	-4.899 ***
LPI_shp	-35.725 ***	474.218 ***	619.338 ***	-11.823 ***
LPI_lgs	-22.562 ***	331.651 ***	474.004 ***	-6.880 ***
LPI_ttr	-35.173 ***	407.355 ***	540.026 ***	-9.654 ***
LPI_tim	-26.902 ***	353.682 ***	378.350 ***	-7.687 ***

Note: *** denotes statistical significance at 99 percent level.
Sources: Author's estimation

Table 5 Estimation Outcomes

Estimation	(i)	(ii)	(iii)	(iv)
Equation	(1)	(1)	(2)	(2)
Methodology	OLS	PPML	OLS	PPML
LPI			3.308 ***	3.440 ***
			(27.886)	(11.095)
Dummy: Armenia	-2.939 ***	-2.940 ***		
	(-12.802)	(-31.525)		
Dummy: Belarus	-2.652 ***	-2.660 ***		
	(-10.003)	(-6.953)		
Dummy: Georgia	-2.332 ***	-2.336 ***		
	(-10.775)	(-8.295)		
Dummy: Kazakhstan	-0.192	-0.193 **		
	(-0.838)	(-2.144)		
Dummy: Kyrgyz	-2.919 ***	-2.921 ***		
	(-12.713)	(-33.249)		
Dummy: Moldova	-5.417 ***	-5.401 ***		
	(-23.592)	(-21.125)		
Dummy: Russia	2.285 ***	2.279 ***		
	(9.955)	(11.130)		
Dummy: Tajikistan	-4.199 ***	-4.196 ***		
	(-12.267)	(-12.947)		
Dummy: Turkmenistan	-0.650	-0.651 *		
	(-1.280)	(-1.952)		
Dummy: Uktaine	0.436 *	0.433 ***		
	(1.899)	(4.865)		
Dummy: Uzbekistan	-2.589 ***	-2.583 ***		
	(-11.959)	(-9.373)		
i Fixed Effects	Yes	Yes	No	No
j Fixed Effects	Yes	Yes	Yes	Yes
i,j Fixed Effects	Yes	Yes	Yes	Yes
t Fixed Effects	Yes	Yes	Yes	Yes
RESET p-vals	0.484	0.882	0.000	0.002

Estimation	(v)	(vi)	(vii)	(viii)	(ix)	(x)
Equation	(2)	(2)	(2)	(2)	(2)	(2)
Methodology	PPML	PPML	PPML	PPML	PPML	PPML
LPI_cus	3.068 *** (6.070)					
LPI_inf		3.197 *** (6.683)				
LPI_shp			3.148 *** (6.571)			
LPI_lgs				3.494 *** (10.282)		
LPI_ttr					3.098 *** (6.648)	
LPI_tim						2.712 *** (8.393)
i Fixed Effects	No	No	No	No	No	No
j Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
i,j Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
t Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
RESET p-vals	0.000	0.000	0.000	0.002	0.000	0.000

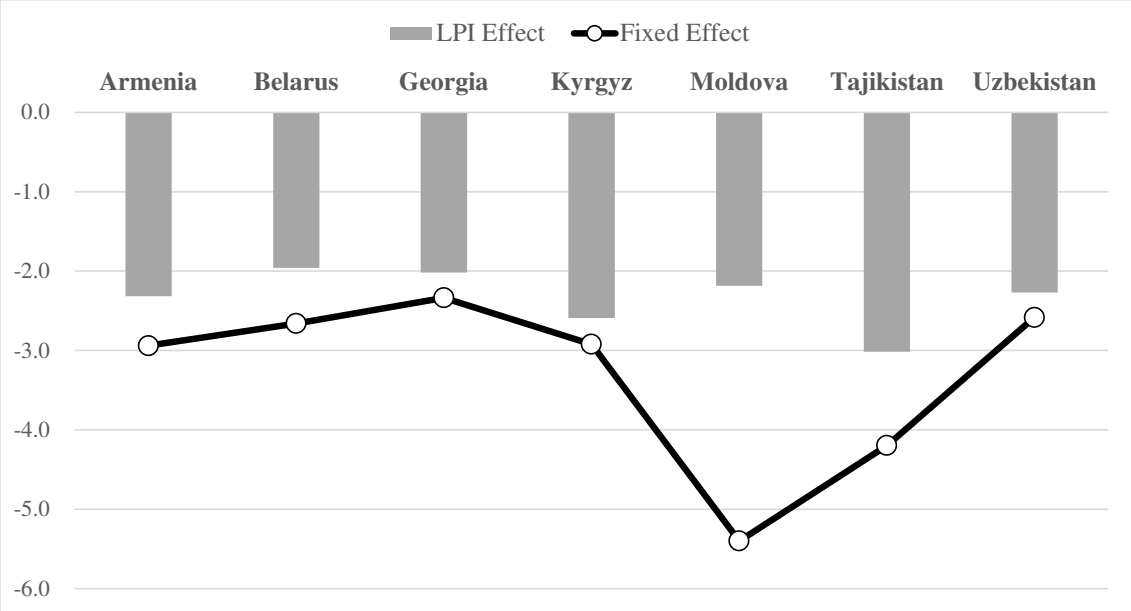
Note: ***, **, and * denote statistical significance at 99, 95, and 90 percent level, respectively. T-statistics are in parentheses.
Sources: Author's estimation

Table 6 Host Country's Fixed Effect and Logistics Performances

	Host Countries' Fixed Effects	LPI	LPI (b) - Benchmark LPI	(c) × 3.440 *** [coefficient]	(d) / (a)
	(a)	(b)	(c)	(d)	(e)
Armenia	-2.940 ***	2.452	-0.673	-2.316	0.788
Belarus	-2.660 ***	2.556	-0.569	-1.958	0.736
Georgia	-2.336 ***	2.538	-0.587	-2.019	0.865
Kazakhstan	-0.193 **	2.652	-0.473	-1.627	-
Kyrgyz	-2.921 ***	2.372	-0.753	-2.590	0.886
Moldova	-5.401 ***	2.490	-0.635	-2.185	0.405
Russia	2.279 ***	2.597	-0.528	-1.815	-
Tajikistan	-4.196 ***	2.249	-0.876	-3.014	0.718
Turkmenistan	-0.651 *	2.309	-0.816	-2.808	-
Ukraine	0.433 ***	2.754	-0.371	-1.275	-
Uzbekistan	-2.589 ***	2.465	-0.660	-2.271	0.879

Note: ***, **, and * denote statistical significance at 99, 95, and 90 percent level, respectively. T-statistics are in parentheses.
Sources: Author's estimation

Figure 3 Comparison between Host Country's Fixed Effect and LPI Effect



Source: Author's calculation based on Table 6

Appendix Classification for Manufacturing

Sample Economies	Items of Manufacturing
Armenia Belarus Moldova Tajikistan Turkmenistan	Food & Beverages; Textiles and Wearing Apparel; Wood and Paper; Petroleum, Chemical and Non-Metallic Mineral Products; Metal Products; Electrical and Machinery; Transport Equipment; Other Manufacturing
Estonia Latvia Lithuania	Products of agriculture, hunting and related services; Products of forestry, logging and related services; Fish and other fishing products; services incidental of fishing; Coal and lignite, peat; Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying; Uranium and thorium ores; Metal ores; Other mining and quarrying products; Food products and beverages; Tobacco products; Textiles; Wearing apparel; furs; Leather and leather products; Wood and products of wood and cork (except furniture), articles of straw and plaiting materials; Pulp, paper and paper products; Printed matter and recorded media; Coke, refined petroleum products and nuclear fuels; Chemicals, chemical products and man-made fibres; Rubber and plastic products; Other non-metallic mineral products; Basic metals; Fabricated metal products, except machinery and equipment; Machinery and equipment n.e.c.; Office machinery and computers; Electrical machinery and apparatus n.e.c.; Radio, television and communication equipment and apparatus; Medical, precision and optical instruments, watches and clocks; Motor vehicles, trailers and semi-trailers; Other transport equipment; Furniture, other manufactured goods n.e.c.; Secondary raw materials
Georgia	Cereals and other crops n.e.c.; Fruit, nuts, beverage and spice crops; Vegetables, horticultural specialities and nursery; Live animals and animal products; Agricultural services; Products of forestry, logging and related services; Fish and other fishing products, services incidental to fishing; Coal and lignite, peat; Crude petroleum and natural gas, services incidental to oil and gas extraction excluding surveying; Uranium and thorium ores, metal ores; Other mining and quarrying products; Grain mill products, starches and starch products, prepared animal feeds; Bread, fresh pastry goods and cakes, rusks and biscuits, preserved pastry goods and cakes; Meat and meat products, processed and preserved fish and fish products; Animal and vegetable oils and fats; Dairy products and ice cream; Other food products; Mineral waters and soft drinks; Alcoholic beverages; Tobacco products; Textiles and wearing apparel, furs; Leather and leather products; Wood and products of wood and cork (except furniture), articles of straw and plaiting materials; Pulp, paper and paper products; Coke, refined petroleum products and nuclear fuels, industrial gases; Chemicals, chemical products and man-made fibres; Rubber and plastic products; Other non-metallic mineral products; Basic metals and fabricated metal products; Office machinery and computers, machinery, equipment and apparatus n.e.c.; Radio, television and communication equipment and apparatus, medical, precision and optical instruments, watches and clocks; Transport equipment; Furniture, other manufactured goods n.e.c.

Sample Economies	Items of Manufacturing
Kazakhstan Ukraine Uzbekistan	Oil Products; Refineries; Gas & Gas Products; Coal; Combustible Shales; Peat; Ferrous Ores; Ferrous Metals; Coking Products; Fire Resistant Mater; Metal Products; Non-ferrous Ores; Non-ferrous Metals; Mineral ChemistryBasic Chemicals; Chemical Fibers; Synthetic Resins; Plastic Products; Paints & Lacquers; Synthetic Paints; Synthetic Rubber; Organic Chemicals; Tires; Rubber & Asbestos; Other Chem. Products; Energy & Power Equip.; Hoisting Technology; Mining M&E; TransportationRailway Equipment; Electrotechnical M&E; Cable Products; Pumps &Chem. Equip.; Machine Tools; Forging/Pressing M&E; Casting M&E; Precision Instruments; Synthetic Diamonds; Tools and Dies; Autos & Parts; Bearings; Tractors & Agri. M&E; Construction M&E; Communal M&E; Light Industry M&E; Processed Food M&E; Trade & Dining M&E; Printing M&E; Household Appliances; Sanitary Engineering; Shipbuilding; Radio Electronics; Other Industries M&E; Metal Construction; Metal Products; M&E Repair; Logging; Sawmills & Lumber; Plywood; Furniture; Paper & Pulp; Wood Chemistry Prod.; Cement; Asbestos Products; Roofing & Insulation; Prefab Concrete; Wall Materials; Construction Ceramics; Linoleum Products; Other Costr. Materials; Glass & Porcelain; Cotton Products; Flax Products; Wool Products; Silk Products; Hosiery/Knitwear; Other Textile Prod.; Sewn Goods; Leather; Sugar; Bread & Baked Prod.; Confections; Vegetable Oils; Perfume Oils; Distilleries; Wines; Fruit/Vegetables; Tobacco; Other Food; Meat Products; Dairy Products; Fish Products; Microbiology; Flour & Cereals; Animal Feed; Pharmaceuticals; Medical Eguipment; Medical Products; Other Products
Kyrgyz	Flour milling; Sugar refining; Meat processing; Dairy industry; Animal feed industry; Juices, fruits & vegetables processing and canning; Beer and Vodka production; Miniral water; Other food industry; Tobacco processing; Tobacco products (cigarettes); Cotton ginning; Cotton yarn; Cotton fabric; Wool yarn; Wool facric; Knitted items production (cotton + wool + synthetics); Clothing (cotton + wool + synthetics); Hides and skins processing; Final leather cloths; Shoes, other; Timber production and woodwork; Paper and cardboard production, publishing and printing; Oil refining; Fertiliser production; Paint production; Pharmaceutical production; Other chemicals; Rubber and plastic production; Glass sheets; Bricks; Production of products of concrete, asbestos and cement; Cement; Other non-metal mineral products; Gold; Other metallurgy; Metal fabrics production; Machinery and equipment; House appliances; Electric machines and equipment; Bulbs; Production of spare parts and engines for vehicles; Other machinery and equipment; Furniture production; Other industry sectors and reprocessing
Russia	Food products, beverages and tobacco; Textiles, textile products, leather and footwear; Wood and products of wood and cork; Pulp, paper, paper products, printing and publishing; Coke, refined petroleum products and nuclear fuel; Chemicals excluding pharmaceuticals; Pharmaceuticals; Rubber & plastics products; Other non-metallic mineral products; Iron & steel; Non-ferrous metals; Fabricated metal products, except machinery & equipment; Machinery & equipment, nec; Office, accounting & computing machinery; Electrical machinery & apparatus, nec; Radio, television & communication equipment; Medical, precision & optical instruments; Motor vehicles, trailers & semi-trailers; Building & repairing of ships & boats; Aircraft & spacecraft; Railroad equipment & transport equip nec.; Manufacturing nec; recycling (include Furniture)

Source: The UNCTAD-Eora Global Value Chain Database