

How much impact does the efficiency of capital markets and commodity markets have on GVC?

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Abstract: GVC status reflects an economy's potential for growth in world trade. We want to find out the key influencing factors from the mechanism management, capital market effectiveness and commodity market effectiveness, so that governments can target policies. In practice, the data showed an obvious dynamic panel pattern. Based on 48 countries data from 2005-2015, we used system GMM method to explore what factors affect GVC status and found that the first lagged term and commodity market effectiveness matter a lot.

1. Introduction and Literature Review

Issue Raised

Participation in global value chains (GVCs), the international fragmentation of production, can lead to increased job creation and economic growth. The World Bank is also committed to helping poor countries catch the GVC wave and realize the benefits GVCs can deliver. Thus, in order to reap the gains from GVC participation, countries must put in place the right kind of trade and governance policies.

GVC status refers to the degree of participation of a country in the GVCs. We want to know what are the breakthrough points for increasing GVC status. Starting from the Cobb-Douglas type production function, we found out two main policy indicators affecting GVC status significantly, the capital market effectiveness and the commodity market effectiveness. At the same time, we explored the effects of other variables, such as technological progress and the level of national economic development.

Econometrics Methods Summary

Many studies have focused on the impact factors after Koopman (2010) [9] and Wang (2017) [14] proposing generalized approaches to measuring GVC status. Specifically, Amiti & Wei (2005a) [10] in the United Kingdom, Michel and Rycx (2012) [12] in Belgium, Cadarso (2008) [13] in Spain focused on employment's effect. Hu & Nei (2020) [1] focused on globalization's effect.

It is widely considered that GVC status index has a serial correlation, GMM model has been widely used in these empirical researches of GVC status's influencing factors. For example, Pan (2020) [16] used GMM method and found that GVC activities have been significantly impacted by overall unemployment in the US.

In our study, we want to explore how capital market effectiveness and commodity market effectiveness affect GVC status, based on 48 countries' data from 2005-2015 using GMM dynamic

panel method.

2. Variables and Data

2.1 Variables

Explained Variable

GVC Level According to the GVC index defined by Koopman et al. (2014) [6], we can use the GVC position index ($ttVC$) to measure a country's position in the GVC. The higher the value is, the closer it is to the upstream of GVC and the higher the GVC status is, and vice versa. EVA_i donates country i 's total export value-added accounting; $IDVA_i$ donates country i 's purely exported added value of intermediate; FVA_i donates country i 's foreign part of added value. The data is from the *TIVA Database*.

$$GVC = \ln\left(1 + \frac{IDVA_i}{EVA_i}\right) - \ln\left(1 + \frac{FVA_i}{EVA_i}\right)$$

Mainly Explanatory Variables

Capital Market Effectiveness We measure the level of Capital Market Effectiveness by the share of Domestic Private Credit in GDP. The calculation formula is

$$Capmkt_{it} = \frac{private\ credit_{it}}{GDP_{it}}$$

The values are concentrated around the positive neighborhood of zero, trailing to the right. In our data, the average efficiency of capital markets in each country shows a steady increase. The figure 1 shows the change. This is an endogenous variable.

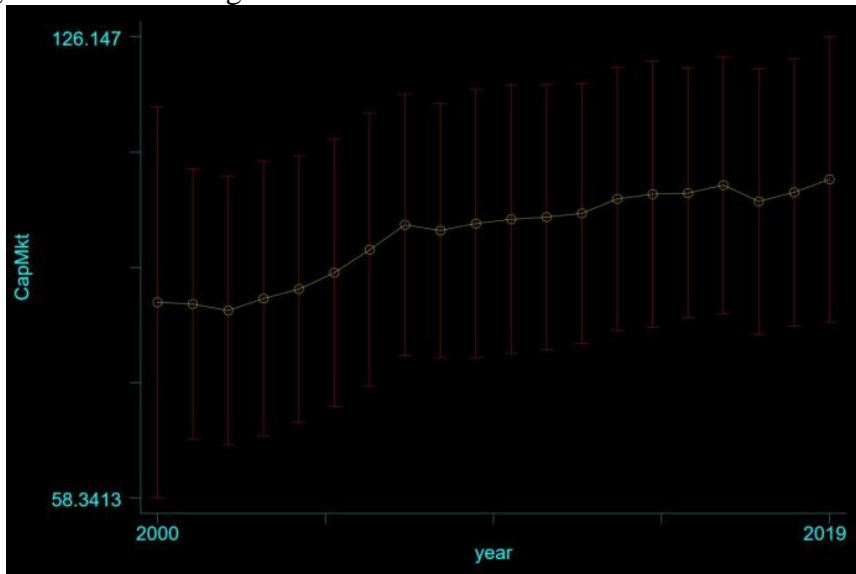


Figure 1: The Deepening Trend of Capital Market 2000-2019

Commodity Market Effectiveness We got Economy Freedom Index from The *Frazer Institute* to estimate the commodity market effectiveness ($Commkt$). The index using five aspects as specific measurement indicators: Regulation, International Trade Freedom, Government Scale Property Rights, Government Spending and Taxation. It represents the degree of economic freedom and equality. Since policy making is predetermined, it's an exogenous variable.

Control Variables

Tax & Non-Tax Barriers to Trade Tax and Non-tax Barriers are the two main manifestations of trade frictions. The nominal protection rate of tariffs (NRP) is generally equivalent to a country’s legal tariff rate and we used the World Bank’s data of national tariff to measure Tax Barrier(*TaxB*). Non-tax Barriers(*nTaxB*) refer to all measures except tariff taken by a country or region to restrict imports based on Koopman (2012)[5], derived from *The Fraser Institute* database

In our data, the change of tax barriers from 2000 to 2019 is shown in the figure 2, with different colored lines representing different countries.

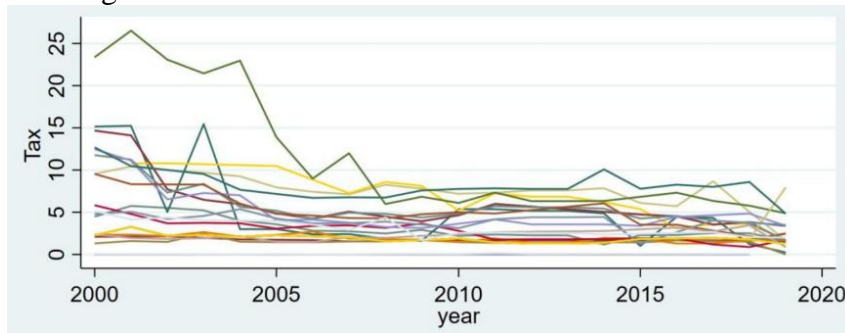


Figure 2: Tariff trend 2000-2019

Technology Progress This article uses the simplified analytic hierarchy process (AHP) method to construct an index of technological innovation capability. The hierarchy is shown in the figure 3.



Figure 3: AHP-Matrix and Structure of technology progress

The deepening of capital market is strongly correlated with technological progress. In the past 20 years, the tariff index has decreased significantly generally. By 2015, it has reached a peak of trade liberalization.

GDP per capita and Development Degree The relevant data is from *World Bank Database*.

According to *The International Monetary Fund*, countries with per capita GDP of more than **\$10,000** are developed countries, others are developing countries. We use dummy variable *Developed* to distinguish them.

Trade Dependence Trade Dependence estimate the degree to which the national economy is embedded in the international market. It is measured by the proportion of a country or region’s total import and export value in its GDP, namely the degree of dependence on import & export. We normalized the variable as *TradeDpd*₁. The calculation formula is

$$TradeDpd = \frac{Import_{it} + Export_{it}}{GDP_{it}}$$

The GMM dynamic Model:

$$GVC_{it} = \beta_0 + \beta_1 GVC_{it-1} + \beta_3 Capmkt_{it} + \beta_4 Capmkt_{it}^2 + \beta_5 GDP_{it} + \beta_6 Developed_i + \beta_7 Commkt_{it} + \epsilon_{it}$$

The Dependent Variable is GVC_{it} , whose one-period lag term GVC_{it-1} , was used as an independent variable; Endogenous ones in the Independent Variables are $Capmkt$ $Capmkt^2$ and their one-period lag terms $Capmkt_{it-1}$ $Capmkt^2_{it-1}$; Exogenous Variables are GDP_{it} , $Developd_{it}$ and $Commkt_{it}$ and Instruments Variables are $TaxB_{it}$, $nTaxB_{it}$ $TechPro_{it}$ $ln(TechPro)_{it-1}$ and $TradeDpd_{it-1}$. In system GMM method, exogenous variables must be used as instruments for any endogenous variables.

Our Hypothesis

1. First-order lag term affects GVC_{it} , significantly and positively.
2. Capital market effectiveness $Capmkt_{it}$ and its quadratic term $Capmkt^2_{it}$ affect GVC_{it} significantly, where $Capmkt^2_{it}$ effect is negative.
3. Commodity market effectiveness $Commkt_{it}$ affects GVC_{it} , negatively and significantly.
4. Economy size GDP_{it} affects GVC_{it} , significantly and positively.

3. The Underlying Economic Theory and Hypothesized Signs' Mean- ing

3.1 Basic Model of System Dynamic Panel-data GMM Estimation

Many researches subjectively believe that the efficiency of capital market or commodity market is conducive to the promotion of GVC's international status, but it is biased from the perspective of production function. Let us start from the Cobb-Dauglas production function.

The production function at country level is given by

$$Y = A(X)^\gamma L^\alpha GVC^\beta$$

and GVC can be written as

$$GVC = \frac{Y^{\frac{1}{\beta}}}{A(X)^\gamma L^{\frac{\alpha}{\beta}}}$$

After taking logarithm, we get the equation

$$\ln GVC = \frac{1}{\beta} \ln Y - \gamma \ln A(X) - \frac{\alpha}{\beta} \ln L$$

Where $\alpha + \beta < 1$, X represents other factors, and A is a function of X . We argue that $\frac{1}{\beta}$ reflects the GDP

Scale effect, γ reflects the influence from other factors mainly including $Commkt$, $Capmkt$ and $developed$.

We started from the basic Autoregressive Distributed Lag (ARDL) panel-data model. The explanatory variable contains the first-order lag of the explained variable y_{it-1} .

$$y_{it} = \lambda y_{it-1} + X_{it} \beta + \epsilon_{it}$$

$$\epsilon_{it} = \alpha_i + u_{it}$$

The idiosyncratic error term ϵ_{it} shall be serially uncorrelated. The unobserved unit-specific heterogeneity

α_i can be correlated with the regressors $X_{i,t-j}$.

We can see from equation 1 that the policy environment variables are included in X and the economy size variable is included in Y which implies negative coefficients of $Commkt$ and the quadratic term of $Capmkt$ while GDP 's coefficient is positive.

3.2 Reality Explanations

Today many developing countries are still locked in low value-added intermediate products, with their embedded position stuck at GVC's low status.

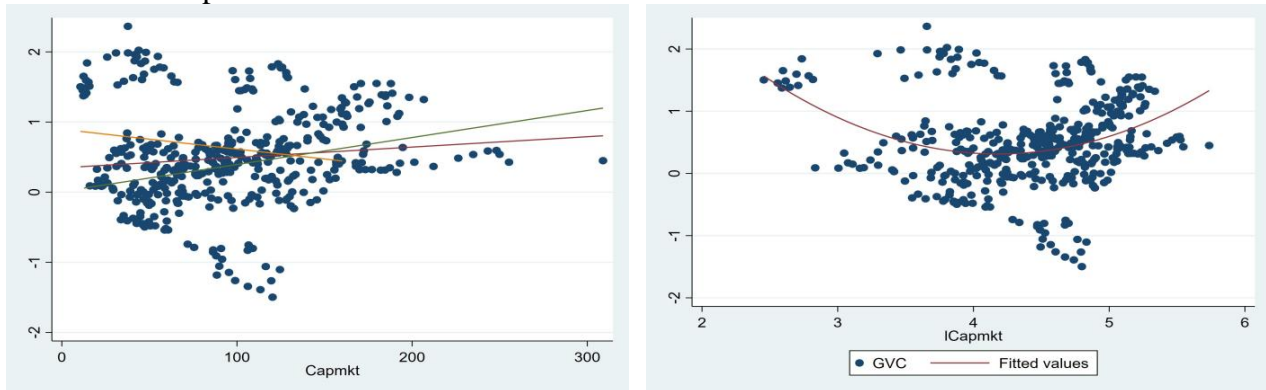


Figure 4: Linear or quadratic fitting

In the left of figure 4, Orange represents developing countries, Green the developed, and Red the whole sample. Many studies have found that the impact of capital market effectiveness on GVC status is related to the level of national economic development, such as Xiao & Tian (2020) [2] which explored the relationship between corporate financing leverage and GVC with GMM model. In our figure, with the deepening of capital markets, the position of developing countries in the GVC has declined. "Seized by the throat" is one explanation that the developed suppress fast-growing countries in the middle and lower reaches. Thus this curve should not be linear but U-shaped. Another explanation is that foreign investors are more inclined to invest in developing countries with high economic freedom rather than developed countries with mature capital markets. Thus an efficient capital market can reduce national participation in GVCs in the process of maturation.

Many studies also show that the commodity market effectiveness matters a lot. The commodity market effectiveness measuring the freedom degree will also affect GVC status, a negative effect, to some extent. A free market lacking certain government policy intervention will make firms more vulnerable to malicious influences in international trade. And it will result in a decline in GVC status.

3.3 Data Description and Basic Test

National data for 48 major countries from 2005 to 2015 (434 observations and 11 periods, slightly un- balanced panel data) were used. GVC is from *The TIVA* database. $nTaxB$ and $Commkt$ are derived from *The Fraser Institute* database. $GDPtri$, $TradeDpd$, $TaxB$, $Capmkt$ are from *The World Bank* database and $TradeDpd$ is normalized. $TechPro$ is constructed by AHP method.

variable	mean	sd	p5	p25	p50	p75	p95	min	max
GVC	0.49	0.67	-0.54	0.09	0.43	0.76	1.73	-1.50	2.36
Capmkt	95.47	50.43	26.05	53.59	91.64	128.10	184.89	10.65	308.98
TaxB	7.82	1.01	5.68	7.23	8.22	8.34	8.71	4.26	10.00
nTaxB	6.41	1.18	4.67	5.61	6.34	7.32	8.37	2.04	8.94
TechPro	5501.35	12350.76	87.33	342.17	1394.65	3487.86	27910.20	32.71	80304.89
TradeDpd	102.77	76.59	29.68	57.84	79.87	124.44	307.71	22.11	437.33
GDPtri	1313.34	2737.05	23.39	115.58	345.16	1222.64	5155.72	7.88	18219.30
Commkt	7.45	0.62	6.22	7.11	7.63	7.84	8.23	4.69	8.67

Figure 5: Descriptive Statistics of Variables

We added the country-dummy variable and year-dummy variable to the independent variables respectively, that was, make the following regression:

$$GVC_{it} = a + \beta_1 Commkt_{it} + \beta_2 Capmkt_{it} + \sum_{j=2}^{48} id_j \beta + u_{it}$$

$$GVC_{it} = a + \beta_1 Commkt_{it} + \beta_2 Capmkt_{it} + \sum_{j=2006}^{2015} year_j \beta + u_{it}$$

We found that there was an individual effect but no time effect. Thus we did the Woodridge test for autocorrelation in panel data for the random effect regression with heteroscedasticity robust standard error

$$GVC_{it} = a + Commkt_{it} + Capmkt_{it} + \epsilon_{it}$$

Where $p\text{-value} = 0.000$. The results showed that there was a first-order autocorrelation.

Under the following assumptions we could use dynamic panel model like system GMM method to estimate it. The short panel data was treated into a balanced type when using GMM method.

4. Analysis & Results

4.1 Regression Result Output

Preconditions:

1. There is no serial correlation in the error terms ϵ_{it} ;
2. Data is in the short panel type (big N and small T);
3. The dependent variables GVC_{it} are sequentially correlated;

System GMM Estimation:

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System dynamic panel-data estimation
Group variable: id
Time variable: year

Number of obs      =      290
Number of groups   =       29

Obs per group:
    min =      10
    avg  =      10
    max  =      10

Number of instruments =    71
Wald chi2(6)        =   554.66
Prob > chi2         =    0.0000

Two-step results

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	Coef.	WC-Robust Std. Err.	z	P> z	[95% Conf. Interval]	
gvc						
L1.	.6912771	.2180653	3.17	0.002	.263877	1.118677
capmkt	.0012278	.0090265	0.14	0.892	-.0164638	.0189194
capmkt_sq	-1.01e-06	.0000386	-0.03	0.979	-.0000767	.0000746
gdptri	.0000237	.0000262	0.90	0.367	-.0000277	.000075
developd	-.0137965	.0996758	-0.14	0.890	-.2091575	.1815644
commkt	-.1966648	.0556189	-3.54	0.000	-.3056758	-.0876538
_cons	1.490837	.4388766	3.40	0.001	.6306551	2.35102

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Instruments for differenced equation
GMM-type: L(2/3).gvc L(2/2).capmkt L(2/2).capmkt_sq
Standard: D.gdptri D.developd D.commkt taxb ntaxb techpro ltechpro_1
tradedpd_1

Instruments for level equation
GMM-type: LD.gvc LD.capmkt LD.capmkt_sq
Standard: cons

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Figure 6: System GMM Original Output

*** indicates the significant variables at the level of 0.05.

4.2 Statistical Test

Arellano-Bond Test for Sequence Correlation after Estimation Arellano-Bond test has a null hypothesis of no autocorrelation and is applied to the differenced residuals. p -value = 0.4526 > 0.05. There is no second-order autocorrelation and the data satisfying the first precondition to use system GMM model. Then the instrumental variables of the difference equation must select the second-order lag terms.

Identifcation of IV Here we no longer set the standard error in the model using the robust-form, so that we can use the Sargan test for overidentifying restrictions. The null hypothesis in 10 means that IVs are reasonable. Sargan-Hansen statistic is $Chi^2(64) = 26.589$ and p -value = 1.000 > 0.05. Thus the IV-setting is valid.

4.3 Significance and Meaning of the Coefficient Estimates

The result shows that GVC participation does have lag effect. If the current GVC increases by 1, next year's index will increase by 0.69. Moreover, there is an U-shaped relationship between GVC and capital market effectiveness $Capmkt$ & $Capmkt^2$, but the correlation is significant. The linear term coefficient (0.0012) reflects a positive effect, while the quadratic term's works the other way around.

As expected, the commodity market effectiveness *Commkt* has a significant negative effect. If it increases by 1, *GVC* will decrease by 0.167.

4.4 Bias Analysis

Measurement Error In our variables, R & D expenditure works as the proxy variable of technology progress. Thus there is measurement error in *TechPro*.

Omitted Variable The coefficients of some variables are not significant, and there may be bias of omitted variables in the model.

5. Conclusion

We found that the relationships between the commodity & capital market effectiveness and the *GVC* status are not simply positive. Due to the lagging influence, it's hard to change *GVC* status in a short period by governance policies. Moreover, compared with capital market, commodity market's effectiveness has a more significant negative impact on the *GVC* status. As for whether there is a more complicated relationship between the *GVC* status and the effectiveness of commodity market, further investigation is needed.

References

- [1] Zhaoling Hu, Yanfeng Nei. *The Impact of Economic Globalization on GVC Position: An Empirical Study Based on Transnational Panel Data* [J]. *International Economics and Trade Research*, 2020, 36(02): 56-71.
- [2] Yu Xiao, Kan Tian. *Financing Leverage Ratio and Chinese Enterprises' Global Value Chain Climb* [J]. *Economy and Management*, 2020, 42(01): 42-58.
- [3] Yue Li, Lihui Cai. *Can Structural Reform Promote the Rise of Global Value Chain? – An empirical study based on China's industrial panel data* [J]. *Nankai Economic Studies*, 2020(05): 46-65.
- [4] Hummels D, Ishii J, Yi K M. *The nature and growth of vertical specialization in world trade* [J]. *Journal of international Economics*, 2001, 54(1): 75-96.
- [5] Koopman R, Wang Z. *Tracing Value-Added and Double Counting in Gross Exports* [J]. *Social Science Electronic Publishing*, 2012, 104(2): 459-494.
- [6] Koopman, Robert, Zhi Wang, and Shang-Jin Wei. 2014. "Tracing Value-Added and Double Counting in Gross Exports." *American Economic Review*, 104 (2): 459-94.
- [7] Hausmann R, Hwang J, Rodrik D. *What you export matters* [J]. *Journal of Economic Growth*, 2007, 12(1):1-25.
- [8] Bernauer T, Engel S, Kammerer D, et al. *Explaining Green Innovation: Ten Years after Porter's Win-Win Proposition: How to Study the Effects of Regulation on Corporate Environmental Innovation?* [R]. *Center for Comparative and International Studies*, 2006.
- [9] Koopman, R., W. Powers, Z. Wang, and S.-J. Wei. 2010. "Give Credit Where Credit Is Due: Tracing Value Added in Global Production Chains." *NBER Working Paper Series, No.16426*. Cambridge, MA: National Bureau of Economic Research.
- [10] Amiti, M., and S.-J. Wei. 2005. "Fear of Service Outsourcing: Is It Justified?" *Economic Policy* 20: 308-347.
- [11] Michel, B., and F. Rycx. 2012. "Does Offshoring of Materials and Business Services Affect Employment? Evidence from a Small Open Economy." *Applied Economics* 44: 229-251.
- [12] Michel, B., and F. Rycx. 2012. "Does Offshoring of Materials and Business Services Affect Employment? Evidence from a Small Open Economy." *Applied Economics* 44: 229-251.
- [13] Cadarso, M. A., N. Gomez, L. A. Lopez, and M. A. Tobarra. 2008. "The EU Enlargement and the Impact of Outsourcing on Industrial Employment in Spain, 1993-2003." *Structural Change and Economic Dynamics* 19: 95-108.
- [14] Wang, Z., S. Wei, X. Yu, and K. Zhu. 2017. "Measures of Participation in Global Value Chain and Global Business Cycles." *NBER Working Papers No 23222*. Cambridge, MA: NBER.
- [15] Halit Yanikkaya & Abdullah Altun, 2020. "The Impact of Global Value Chain Participation on Sectoral Growth and Productivity," *Sustainability, MDPI, Open Access Journal*, vol. 12(12), pages 1-18, June.
- [16] Zuohong Pan, 2020. "Employment impacts of the US global value chain participation," *International Review of Applied Economics, Taylor & Francis Journals*, vol. 34(6), pages 699-720, November.