International Trade and Technology Transfer : Obscured Economies under the 21st-century Trade Policy

By

VELIEV, Samir

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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ABSTRACT

International trade and technology transfer:

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by

VELIEV SAMIR

International trade has become more competitive in certain market domains that countries with various endowments are obscured in those domains, such as high technology exports. This research paper focuses on determinants of high technology exports across specific country groups, namely the members of the Organization for Economic Co-operation and Development (OECD), the Organization of the Petroleum Exporting Countries (OPEC), and BRICS (Brazil, Russia, India, China and South Africa) countries. Studying key determinants related to these country groups aims to explain the reasons why certain countries are leading in high technology exports, while others, cannot catch up in this frontier.

Based on the empirical data, this paper explores how their high technology exports are impacted by key determinants which are the number of patents by non-residents, the inflows of FDI, and global competitiveness of an economy through the use of Instrumental Variables 2SLS regression for selected countries in 2008-2019. However, the role of natural resources on high technology exports is negative.

Keywords: international trade; high technology exports; transfer of technology

DEDICATION

to my family

ACKNOWLEDGEMENTS

First of all, I would like to thank my family members for their love and commitment to me. They sacrificed their own life preferences to support me to get a quality education during the 1995-2000s. I owe them limitless love.

I am also deeply thankful to my teachers and professors for their priceless contribution to my academic and professional growth. Especially, I express my deepest gratitude to Professor Tabakis, Chrysostomos and Professor Shadikhodjaev Sherzod for their supervision during my studies at the KDI School. They were always ready for support and guidance on many issues. Without their support, it would have been difficult to succeed in my studies.

Finally, I want to thank all the people working at the KDI School for their continuous help to facilitate my stay during this period. I also express my sincere appreciation to all my friends from all over the globe who always lend a helping hand and support me whenever I need them most.

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CHAPTER ONE: INTRODUCTION

1.1. High technology exports in the global economy

Based on the World Bank data, both the value and volume of exports have been increasing since the global financial crisis in 2009. For example, the Export value index (2000 = 100) has grown by 55.1% higher in 2018 in comparison to 2009 (The World Bank, 2021), and the Export volume index (2000 = 100) also increased by 39.5% in 2018, compared to the respective figure in 2009 (The World Bank, 2021). 13.6 percentage increase during 2009-2018 (The World Bank, 2021) was observed in the export of goods and services as a percentage of GDP. A remarkable growth, namely 30.4 percentage points (The World Bank, 2021), was also recorded in high-technology exports (% of manufactured exports) during that period of time.

Considering the constantly growing tendency of exports, it is important to deep dive into certain aspects of such export growth numbers across various country groups. As (Hausmann, Hwang, & Rodrik, 2007) pointed out, the content of exports is highly significant for economic growth – countries with a set of higher quality goods spectrum perform better. Therefore, exporting high technology products, cited (The World Bank, 2021) as "*products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery*" is an important indicator for overall economic growth. In order to avoid possible growth traps, countries may need to focus more on exports of high-technology products in their participation in international trade in the 21st century rather than simply exporting more products every year. Increasing high-technology products may need more than applying conventional trade policy instruments.

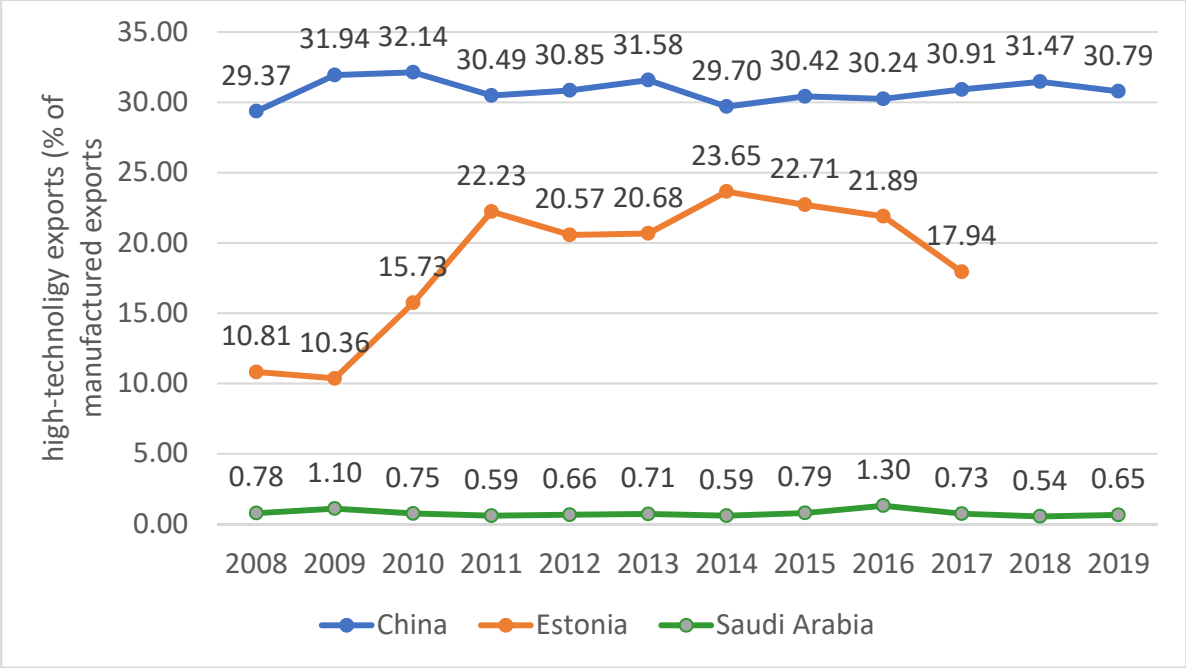


Figure 1. High-technology exports (as % of manufactured exports; 2008-2019) of China, Estonia, and Saudi Arabia

Significant variations can be observed across different countries based on exports of high-technology products. For example, exports of high technology (% of manufactured exports) of the Chinese economy contained 31.9% in 2009 and did not significantly change from that in 2019 (31.46%). While the same indicator for Saudi Arabia diminished from 1.09% to 0.54% in 2009-2018. On the other hand, Estonia's high-technology exports (% of manufactured exports) indicator grew from 10.36% in 2009 to 17.93% in 2017 (the latest available data) (The World Bank, 2021).

It is important to understand the reasons why some countries can export more (both in volume and value) but still cannot grow as other similar exporting economies which might be linked to what they export. Therefore, reasons behind such variations in exports of high-technology products are worth of paying attention in order to understand the real picture in the global economy. It is also crucial to understand through which channel they can increase their exports that potentially brings overall better economic outcomes.

1.2. The research problem and the importance of the study

It is important to understand the significance of certain determinants in the production and exports of high-technology products. Manufacturing products in aerospace or pharmaceuticals industries, by simple intuition, seems much more challenging than that in agriculture or hospitality industries. Therefore, countries may need endowments and advantages to be able to participate in the global trade of high-technology products.

According to (Tebaldi, 2011), factors such as openness to international trade, human capital, and inflows of FDI have a significant influence on a country's high-tech industry performance in the global market. Similarly, (Seyoum, Determinants of Levels of High-Technology Exports: An Empirical Investigation, 2005) also noted the importance of variables such as inward FDI, national technology infrastructure, and the sophistication of buyer needs in high-technology export performances of a country. By studying selected members of OECD, (Kabaklarli, Duran, & Üçler, 2017) also indicated that foreign direct investment and improvements in patent applications also positively affect high-technology exports, while investment and growth rate have a negative influence on such exports. If boosting human capital needs huge investment, attracting foreign direct investments requires certain prerequisite conditions, and being open to international trade is challenging for certain countries. It becomes clearer why particular economies over-perform others in this market niche. A recent study, (Güneş, Gürel, Karadam, & Akın, 2020) also investigates panel data set of 48 countries to draw a similar conclusion that inflows of foreign direct investment, per capita income levels and human capital are key determinants of high-technology exports for these countries in 1997-2017.

However, fast growth and possession of resources and endowments seem inconclusive to explain, as shown above, why Estonia with comparatively fewer endowments, could increase its

high-technology exports while in Saudi Arabia, the share of high-technology exports cannot still exceed 1% of manufactured exports in spite of its comparatively richer opportunities to attract foreign investment and achieve higher growth rates.

Since there are plenty of studies that mostly focus on the investigation of countries with more homogenous characteristics within the analyzed groups, it is uncertain why such variations exist in reality. This paper aims to review existing literature, and specifically investigate selected countries from less homogenous groups to reflect a more general picture. By applying purposive sampling, which allows involving selected groups of countries that have more opportunities to export more and enhance technological capabilities better than lower-income countries with resource scarcity.

1.3. Objectives of the study and hypotheses

This paper aims at delving into countries of OECD, OPEC, and BRICS groups which are more homogenous within the groups in spite of significant differences of structures of economies and other endowments. The paper aims to reveal the determinants, such as the ability to transfer technology and the rent of natural resources that may have a more significant impact on one specific group which is less significant on another group to explain the level of high-technology exports in 2008-2019.

This paper intends to find answers to the following, but not limited to, questions:

- Do the main key determinants (such as inflow of FDI, R&D expenditures, human capital, and patent applications) of high-technology exports reviewed in the literature have similar impacts for selected country groups?

- Are high-technology exports influenced by natural resource abundance?
- Does the competitiveness of economies affect their high-technology exports?

Based on the literature review in Chapter Two, as well as research questions raised above, this paper expects that:

- Due to the spillover effect, the inflow of foreign direct investments, patent applications, and human capital positively affect high-technology exports of all selected country groups;
- Natural resource dependence and abundance has a positive impact on high-technology exports in general; and
- the competitiveness of an economy positively affects high-technology exports in general.

1.4. The structure of the paper

This paper consists of five chapters. In the beginning, it introduces the recent picture of the global economy with a specific approach to high-technology exports and raises the research problem in Chapter One. In Chapter Two, the paper will review the existing literature written on the key determinants of high-technology exports. Chapter Three highlights methodological aspects of the study, while Chapter Four focuses on the empirical findings and discussions. In the end, Chapter Five summarizes the conclusions drawn from the study.

CHAPTER TWO: LITERATURE REVIEW

Existing literature mainly focuses on similar variables that have an impact on high-technology exports in their investigations. Therefore, this chapter will review the literature by the main determinants before making specific hypotheses accordingly.

2.1. Foreign Direct Investments

Literature highlights that one of the channels that technology transfers happens is FDI, and it is a dominant channel in terms of transferring technology to developing countries (Pack & Saggi, 1997). Moreover, FDI seems to be a major channel of technology transfer, given that foreign firms choose to produce in a developing economy (Saggi, 2002). Also, (Pottelsberghe & Lichtenberg, 2001) supported this argument. FDI benefits receiving countries strongly by FDI-related knowledge spillovers (Bitzer & Kerekes, 2008). (Javorcik, 2010) also underlines that "*FDI is indeed an important channel of transmitting technologies and know-how across countries*". By investigating horizontal and vertical FDI, (Keller & Yeaple, Multinational enterprises, international trade, and productivity growth: Firm-level evidence from the United States, 2009) also provided evidence that technology spillovers of horizontal FDI are mostly observed in high-technology sectors, and it is not evident in low-technology sectors. Based on similar argumentation, (Keller, *International Trade, Foreign Direct Investment, and Technology Spillovers*, 2010) highlights that "*high-tech sectors are where most technology creation takes place*".

However, while citing FDI as a significant channel of technology transfer, there are certain findings to consider. According to the argument of (Saggi, 2002), without additional supportive measures (such as human capital development, trade openness, R&D, etc.), spillovers from FDI

may not be attainable. Moreover, being subsidiaries of foreign firms more productive than the domestic ones, spillover from vertical FDI is another crucial aspect to be considered (Saggi, 2002).

Also, (Zhu & Fu, 2013) in the study of export upgrading concludes that being one of the principal channels of international knowledge transfer, FDI has a significant and positive impact on export sophistication. Therefore, inflows of FDI can be selected as a proxy variable to technology transfer for this paper to argue that it is one of the key determinants of high-technology exports.

Literature (for example, (Bayraktutan & Bıdırdı, 2018)) considers the inflow of FDI is considered as one of the key determinants of high-technology exports. Unlike outflows of FDI, inflows of FDI may become an important factor to influence a country's technological capacity.

A significant positive relationship can be observed between FDI and export quality of a host country, especially in developing economies. For example, (Harding & Javorcik, 2012) conclude that, compared to other sectors, the sectors with a special focus to attract FDI through national efforts have 11% higher unit values of exported products. The positive impact of inward FDI is revealed in several other papers as well. For example, (Tebaldi, 2011) concludes that opening the economy to FDI will improve high-technology exports. (Gökmen & Türen, 2013) analyzed EU-15 countries for 1995-2010 term, and also concluded that FDI inflow had a significant impact on high-technology exports. Another paper also shows FDI inflow as one of the key variables with a significant positive effect on high-technology exports, particularly in the emerging countries (Abedini, 2013). In a very recent study, (Konya, Küçüksucu, & Karaçor, 2021) also note that FDI significantly affects high-technology exports of fast-growing emerging countries (BRICS and Turkey) in 1996-2017. This is similar to a conclusion drawn by (Güneş, Gürel, Karadam, & Akın, 2020) as well.

Based on a vast number of studies in literature, this paper argues that inflows of FDI have a significant impact on high-technology exports of selected countries.

2.2. Human capital development

A very recent study from an industrial development perspective reveals that "*industries that use human capital relatively more intensively experience relatively lower prices and higher output. New industries are assumed to emerge in step with education productivity*" (Gillman, 2021). Human capital accumulation improves export sophistication in China's export. As highlighted in the study of factors (Wang & Wei, 2008), it contributes to the rise of sophistication of exports in Chinese cities.

Studies that specifically concentrate on the determinants of high-technology exports, such as (Tebaldi, 2011) and (Konya, Küçüksucu, & Karaçor, 2021) find that human capital has a significant positive impact on high-technology exports. Human capital's significant contribution to export upgrading, particularly in low-income country groups, has also been revealed by (Zhu & Fu, 2013). By comparing Visegrad countries with the core members of the European Union, (Śledziewska & Akhvlediani, 2017) estimate that human capital accumulation has a significant impact on high-technology exports of EU countries.

Based on literature, this paper argues that human capital development has a significant impact on high-technology exports of selected countries.

2.3. Patent applications

One of the papers on the relationship between trade and ideas by (Eaton & Kartum, 1996) concludes that almost all OECD countries improve their productivity growth from abroad by its

capacity to absorb technology. Therefore, countries that aim to improve their technology absorption capacity need to trade ideas – and it requires patenting infrastructure.

A leading paper by (Ivus, 2010) on this topic underlines the influence of patent rights on exports of developing countries in two separate time intervals, namely, 1960-1994 and 1994-2000. By focusing on Trade-Related Aspects of Intellectual Property Rights (TRIPS), the paper indicates that if patent rights protection is strengthened in developing countries, it increases the export value of the patent-sensitive industries, especially in medicinal and pharmaceutical products, in developed countries.

Although (Briggs, 2012) claimed non-identical role of patent rights across all industries, (Konya, Küçüksucu, & Karaçor, 2021) also make similar conclusions to (Ivus, 2010) about the impact of patent rights on high-technology exports of fast-growing emerging countries. (Kabaklarli, Duran, & Üçler, 2017) also find that patent applications positively impact high-technology exports – increasing patent applications by 1% generates 3,47% growth in high-technology exports. (Bayraktutan & Bıdırdı, 2018) also studied developing and developed countries from 1996 to 2012, as a result of which the number of patents was found to be statistically significant for high-technology exports in both country groups, particularly, with higher elasticity in developing countries.

Based on literature, the number of patent applications has a significant impact on high-technology exports.

2.4. Natural resources

It is clear that natural resources generate significant revenues for endowed countries. As a form of capital, natural resource revenues may create countries to invest in new forms of capital

and develop the overall economy.

Based on the analysis of the USA's imports from 58 countries, (Faruq, 2010) concludes that, unlike FDI and R&D, physical capital does not have a considerable effect on the export quality. On the other hand, (Asiedu, 2013) argues that natural resources had a negative impact on FDI in 22 developing countries during 1984-2011. Moreover, (Poelhekke & van der Ploeg, 2013) finds that natural resource abundance negatively affects aggregate FDI, as the authors claim "*aggregate FDI falls by 4% if the resource bonanza is doubled*". This effect is even more significant (10%) on the FDI in sectors other than natural resources in the long run if a country doubles the oil price.

The natural resources-knowledge economy perspective concludes that due to the domination of natural resources in the exports of abundant countries, their development does not impede the development of the knowledge economy (de Ferranti, Perry, Lederman, & Maloney, 2002). However, recent studies still demonstrate rather a pessimistic view. (Aljarallah, 2019) finds that increasing resource rents by one per cent decreases human capital by 0.16% in the case of the United Arab Amirates. Also, by reviewing the existing literature, (Mousavi & Edmund Clark, 2021) summarizes that there is, in general, natural resource abundance adversely affects education and health (as a measure of human capital accumulation). The empirical findings by (Zhu & Fu, 2013) demonstrate that some (e.g., oil and gas) natural resource reserves positively affect a nation's export technology upgrading. However, by including other natural resources, this impact becomes mixed and complex.

Unfortunately, there are a very limited number of studies directly focusing on the impact of natural resources on high-technology exports. For the purpose of this study, it can be argued that effect of natural resources may be ambiguous and indirect on high-technology exports, and this effect is negative.

2.5. Competitiveness of an economy

When explaining national competitiveness, (Porter, 1990) underlines that a country's companies must develop productivity in existing industries before boosting its capabilities to compete in new and more sophisticated ones. Because high-technology industries are more productive and sophisticated, being able to export more high-technology products is highly associated with a nation's competitiveness. (Marginean, 2006) distinguishes the concept of competitiveness from macro- and micro-perspectives. Within a macro-perspective, one of the ways to identify competitiveness is a nation's ability to sell abroad. Another study of 84 countries during 1980-2003 by (Fugazza, 2004) focuses on demand and supply-side factors. The study shows that poor supply-side conditions (such as infrastructure, macroeconomic soundness, institutional quality, trade openness) significantly impact a nation's export performance.

Literature is rich with findings on how various factors, such as domestic competition, affect competitiveness in foreign markets. For example, (Sakakibara & Porter, 2001) reveals that, for Japanese firms, the domestic rivalry is important for export performance, and trade protection weakens that performance. Another study by (Amiti & Khandelwa, 2013) about the impact of domestic rivalry and import tariffs focused on exports from 56 countries across 10,000 products to the USA. The study stressed that if the products are close to the world quality frontier, lower tariffs are associated with quality upgrading. By analyzing a relationship between trade liberalization and export performance for a selected group of OECD countries, (Ratnaike, 2012) reveals that domestic competitiveness and global demand are considerable drivers of export performance. Another study by (Seyoum, The role of factor conditions in high-technology exports: An empirical examination, 2004) also considered domestic rivalry as a significant factor.

Based on the vast source of literature on competitiveness and export performance,

particularly in high-technology exports, this paper claims that the more competitive the economy becomes, the more high-technology exports it will perform.

For this paper, the global competitiveness of an economy, measured by the Global Competitiveness Index (see in detail, Chapter Three) will be considered as one of the crucial variables that have a possible strong positive correlation with other factors, such as trade openness, domestic competitiveness, R&D expenditures, institutional quality and macroeconomic soundness. Each of these factors has also been investigated in the literature as determinants of high-technology exports.

2.6. Research and Development

Moreover, in finding answers to the question of whether countries can create comparative advantages, (Braunerhjelm & Thulin, 2008) conclude that one percentage point growth in R&D expenditures in selected OECD countries for 1981-1999 increase three percentage points of high-technology exports. By looking at EU economies, particularly the case of Romania, (Sandu & Ciocanel, 2014) confirm that total expenditures on R&D, especially private expenditures, have a positive correlation with the level of high-technology exports. Similar to (Zhang & Yang, 2016), (Zhu & Fu, 2013) highlights that the significant role of R&D in the export sophistication in high-income countries. (Sezer, 2018) looked at BRICS and Turkey between 1996 and 2014, and found out that an increase by one percentage in R&D expenditure leads to the 0.28% increase in high-technology exports. However, (Bayar, Remeikienė, & Gasparėnienė, 2020) demonstrate that R&D expenses have different effects on short- and long-run on high-technology exports. Unlike short-run results, it considerably contributed to the high technology export in the long run for EU transition economies.

Since expenditures on R&D is a sub-indicator of the Global Competitiveness Index scoring, there might an endogeneity problem. In the empirical investigation, this issue will further be checked.

CHAPTER THREE: METHODOLOGY

3.1. Data collection

For the aim of this study, this paper collected data for the selected factors (inflow of FDI, human capital, patents, natural resource rents and competitiveness) and high-technology exports from the following major sources for 2008-2019 years:

- High-technology exports – as a responding variable, its data is collected from the "High-technology exports (% of manufactured exports)" indicator by(The World Bank, 2021) where high-technology exports explained as "*products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery*".
- The inflow of FDI – this independent variable is measured by "Foreign direct investment, net inflows (% of GDP)" (The World Bank, 2021) as "*net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors and is divided by GDP*".
- Human capital development – for this factor, it would be more appropriate to choose "Human Development Index" score data (UNDP, 2019) instead of "Human Capital Index (HCI)" (The World Bank, 2021) scores because, unfortunately, the latter indicator is not available across years and some countries for the purpose of this paper.
- Patents – for this factor, as exclusive rights applied to an invention, "Patent applications, non-residents" (The World Bank, 2021) is selected to demonstrate an indication of technology transfer to an economy from abroad.
- Natural resource rents – for this factor, "Total natural resources rents (% of GDP)" (The World Bank, 2021) data is selected as "*the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents*".

- Competitiveness – since this factor encompasses other variables, such as trade openness, macroeconomic soundness, institutional quality, etc.) within itself, this paper uses the data on ranking scores from "*The Global Competitiveness Report series*" (The World Economic Forum) collected by the author for years between 2008-2019 from annual editions. Selecting this data is intentional because of its sub-indicators, such as enabling environment, innovation ecosystem, market sophistication, which incorporate, but not limited to, infrastructure, institutions, labor market, macroeconomic stability, financial system, market size, and business dynamism. Due to methodological changes in the scores in 2018 and 2019, the author stylized scores of these years in proportion to the scores of previous years. Please note that most of them are considered as significantly important determinants of high-technology exports, as mentioned in Chapter Two.

The purposive sampling method has been used to select members of OECD, OPEC, and BRICS. As certain countries lack data, a limited number of countries has been chosen. Moreover, outliers have been removed prior to estimation. Therefore, the following table illustrates the list of countries appropriately selected from OECD, OPEC and BRICS groups for this study, and totaling to 450 observations:

Table 1. Selection of countries:

OECD	OPEC	BRICS
1. Australia	39. Algeria	45. Brazil
2. Austria	40. Iran	46. Russian Federation
3. Belgium	41. Kuwait	47. India
4. Canada	42. Nigeria	48. China
5. Chile	43. Saudi Arabia	49. South Africa
6. Colombia	44. United Arab Emirates	
7. Costa Rica		
8. Czech Republic		
9. Denmark		
10. Estonia		
11. Finland		
12. France		
13. Germany		
14. Greece		
15. Hungary		
16. Iceland		
17. Ireland		
18. Israel		
19. Italy		
20. Japan		
21. Korea, Rep. of		
22. Latvia		
23. Lithuania		
24. Luxembourg		
25. Mexico		
26. The Netherlands		
27. New Zealand		
28. Norway		
29. Poland		
30. Portugal		
31. Slovak Republic		
32. Slovenia		
33. Spain		
34. Sweden		
35. Switzerland		
36. Turkey		
37. United Kingdom		
38. United States		

3.2. Descriptive statistics

Data collected for the selected 49 countries in 2008-2019 gives the sufficient number of observations to conduct further empirical analysis.

Table 2. Descriptive summary statistics

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
High-technology exports	450	13.73395	7.730143	.146971	39.79189
Patents by non-residents	450	7806.48	13641.31	1	62597
Natural resource rents	450	3.348133	6.135239	0	32.10489
Human development	450	.8229711	.08644884	.492	.957
FDI inflows	450	2.171305	2.586746	-8.486933	9.894891
GCI	450	4.7916	.5312205	3.3	5.8

As Table 2 describes, variables have 450 observations from the datasets. The minimum figure for the high-technology exports is 0.15%, while the maximum share is approximately 40%. Moreover, the minimum number of patent applications by non-residents is just 1, this figure reaches 62,597 as the largest observation. Although the mean for the total natural resource rents is 3.35% of GDP, the largest observation is 32.1%. While the mean for the Human Development Index score is 0.82, this figure is 4.79 for the Global Competitiveness Index score. Observations for the FDI inflows ranges from minimum -8.49 and maximum 9.89.

The data showed certain outliers that have to be removed for the reliability of the expected outcomes. Therefore, after deleting outliers, the distribution of observations is given as follows:

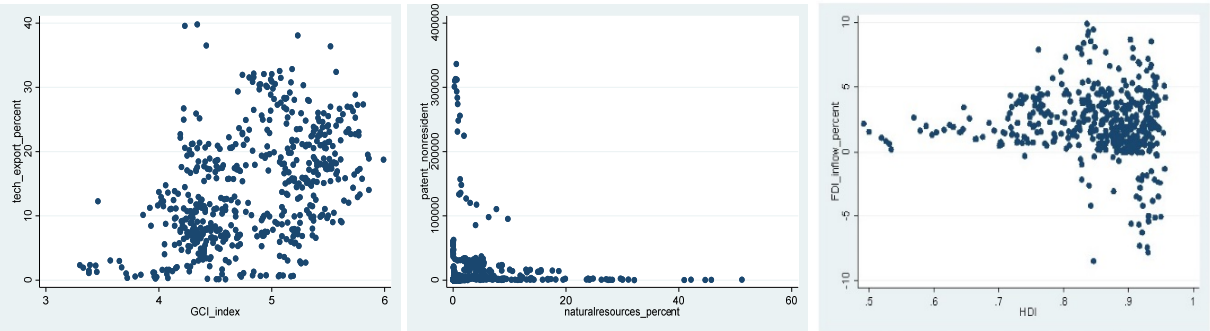


Figure 2. The distribution of observations of the variables

Two-way scatter plots illustrate observations without outliers for the two variables in each figure above.

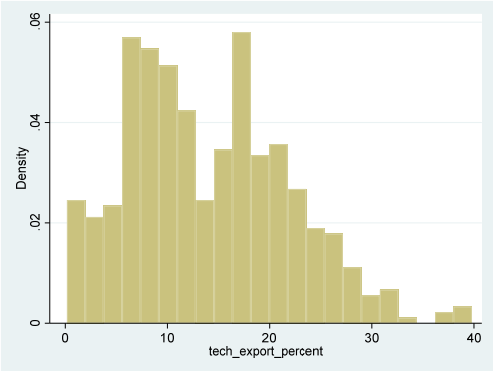
After checking possible correlations between explanatory and dependent variables, the Table 3 is given below:

Table 3. Correlations between variables

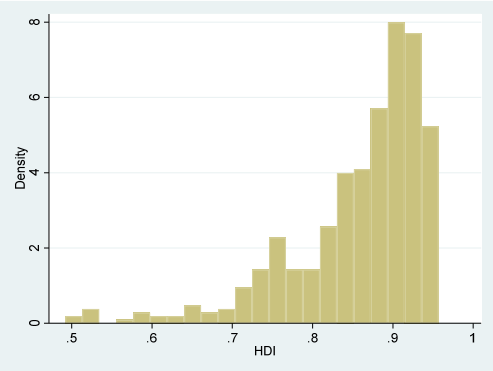
	High-technology exports	GCI	Patents by non-residents	Natural resource rents	Human Development Index
Patents by non-residents	1.0000				
Natural resource rents	-0.0635	1.0000			
Human development Index	-0.0312	-0.3644	1.0000		
FDI inflows	-0.0597	-0.0069	-0.0774	1.0000	
Global Competitiveness Index	0.2311	-0.2776	0.7700	-0.1081	1.0000

Table 3 demonstrates, there are no strongly correlated variables for the estimation model.

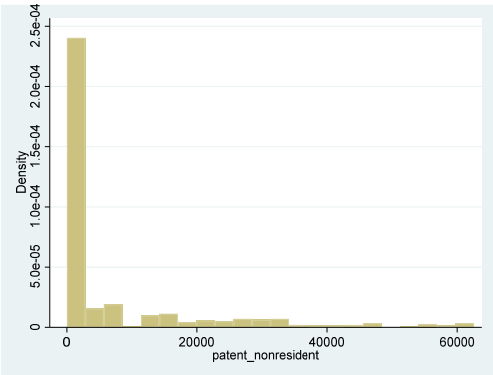
Moreover, The distribution of each variable is indicated in the histograms below in Figure 3:



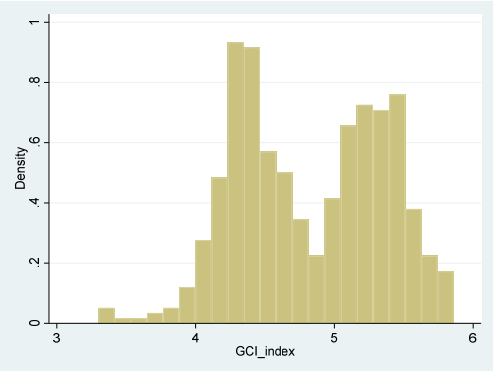
A) High-technology exports



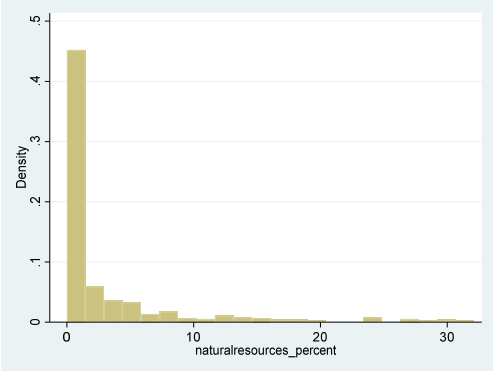
B) Human Development Index scores



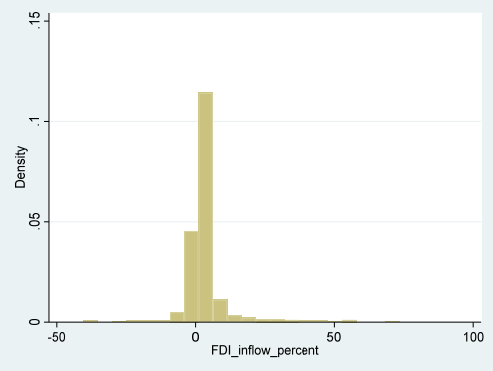
C) Patents by non-residents



D) The Global Competitiveness Index scores



E) Total natural resource rents



F) FDI inflows

Figure 3. Histograms for the variables

The histograms show high-technology exports, patents by non-residents, total natural resource rents, and FDI inflows are left-side squeezed, while Human Development Index scores

and the Global Competitiveness Index scores are right-side squeezed.

3.2. Estimated Model

The vast majority of literature, including (Gökmen & Türen, 2013), (Bayraktutan & Bıdırdı, 2018), (Güneş, Gürel, Karadam, & Akın, 2020), (Kabaklarli, Duran, & Üçler, 2017) (Tebaldi, 2011), (Sandu & Ciocanel, 2014), and others on the respective topic mostly employ Panel Data Analysis to explain the significance of each of the independent variables on a dependent variable across countries in a particular time frame to better demonstrate changes over time and control heterogeneity and collinearity.

For multivariate analysis, all explanatory variables have been added to the equation at the same time. Before regression results and interpretation, a diagnosis was made to check whether the analysis is appropriate, justified, theoretically sound and complete. The equation is as follows for multivariate analysis:

$$\mathbf{HTX = \beta_0 + \beta_1 * FDIinf + \beta_2 * PNR + \beta_3 * NRR + \beta_4 * HDI + \beta_5 * GCI + \varepsilon}$$

Where:

HTX – high-technology exports (as % of manufactured exports),

FDIinf - Foreign direct investment, net inflows (% of GDP),

PNR - Patent applications, non-residents,

NRR - Total natural resources rents (% of GDP),

HDI – Human Development Index score,

GCI - Global Competitiveness ranking score, and

ε – the error term.

The Hypothesis for each variable will be below:

H_0: Coefficient = 0 or Variables has no significant effect on high tech export (null hypothesis)

H_A: Coefficient ≠ 0 or Variable has a significant effect on high tech export (alternative hypothesis)

CHAPTER FOUR: EMPIRICAL FINDING AND RESULT DISCUSSION

First, estimations for the random and fixed effects have been tested and found out that the fixed effect is preferred to random effect. However, considering the possibility of endogeneity issue since expenditures on R&D as a percentage of GDP is a sub-indicator of the Global Competitiveness Index scoring, Hausman-Wu test is applied, and an endogeneity issue has been detected on the GCI score. Therefore, the 2-SLS model has been applied as a final model, using R&D expenditure as an instrument for the GCI score. Below the regression table shows the 2 SLS regression result:

Table 4. Instrumental Variables (2SLS) Regression

HTX	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
GCI	8.714783	2.328964	3.74	0.000***	4.1347	13.29487
PNR	.0000789	.0000345	2.29	0.023**	.0000112	.0001467
NRR	-.2566627	.0856356	-3.00	0.003***	-.4250714	-.0882539
HDI	-4.692875	12.07245	-0.39	0.698	-28.43425	19.0485
FDIinf	.3259664	.130378	2.50	0.013**	.0695681	.5823647
Instrumented: *GCI* Instruments: *PNR, NRR, HDI, FDIinf, R&D*						

Source	SS	df	MS	Number of obs. = 366 F (5, 360) = 27.52 Prob > F = 0.0000 R-squared = 0.2078 Adj R-squared = 0.1968 Root MSE = 6.5281
Model	4025.25317	5	805.050635	
Residual	15341.7964	360	42.616101	
Total	19367.0496	365	53.0604097	

Based on the final regression table, except the Human Development Index scores, it is

obvious that all explanatory variables are expected to have a statistically significant impact on High-Technology Exports. The Global Competitiveness Index scores and Total Natural Resource Rents are statistically significant at a 1% significance level, while Patents by Non-residents and FDI inflows are statistically significant at a 5% significance level.

It is worth mentioning that impact of the Global Competitiveness Index scores (similar to (Amiti & Khandelwa, 2013); (Seyoum, *The role of factor conditions in high-technology exports: An empirical examination*, 2004)), FDI inflows (similar to (Tebaldi, 2011); (Gökmen & Türen, 2013); (Abedini, 2013); (Güneş, Gürel, Karadam, & Akın, 2020); and (Konya, Küçüksucu, & Karaçor, 2021)) and Patents by Non-residents (similar to (Kabaklarli, Duran, & Üçler, 2017); (Konya, Küçüksucu, & Karaçor, 2021) and (Bayraktutan & Bıdırdı, 2018)) are expected to be positive, while Total Natural Resource Rents (similar to (Zhu & Fu, 2013)) is negative, which matches with the expectations. Unlike expectations, the impact of the Human Development Index scores is negative, but this is not statistically significant.

The highest impact magnitude is observed in the Global Competitiveness Index, nearly 8.7, which means that a 1-unit score increase in the Global Competitiveness Index scores will likely increase High-Technology Exports by 8.7%. Although the impact of the number of Patents by non-residents is statistically significant, it is economically not significant, showing a very small coefficient of 0.00007 % increase in High-Technology Exports, if increased by 1%. Further, a one percentage growth in FDI inflows is expected to increase High-Technology Exports by 0.32%. Unlike other statistically significant variables, Total Natural Resource Rents is expected to decrease High-Technology Exports by 0.25% if it increases by 1%.

CHAPTER FIVE: CONCLUSION

5.1. Concluding remarks

This paper has focused on the reasons why some countries, although with sufficient resources and endowments, are obscured in certain markets, specifically, in the high-technology markets. Therefore, by applying instrumental variables 2SLS regression, the key determinants of high-technology exports during 2008-2019 are investigated for selected economies from OECD, OPEC and BRICS country groups.

Similar to the literature review, the empirical results of this study conclude that as a technology transfer channel, FDI inflows significantly impacts high-technology exports. Global competitiveness of an economy and patents by non-residents also significantly and positively affects high-technology exports. As expected, natural resource endowments do not necessarily help countries to boost their high-technology exports, since the empirical model also reveal that total rents from the natural resources have a significantly negative impact. Only human capital development is not in accordance with the initial expectations, but its impact is not statistically significant.

Based on empirical findings above, this paper concludes that in order to not be obscured in high-technology markets, countries have to be capable of transferring technologies via FDI inflows, absorbing knowledge from non-residents along strengthening their competitiveness in the global economy. Natural resource-rich countries have to be more attentive in avoiding the negative consequences of resource dependence if they aim not to be obscured in high-technology markets. Although they might attract huge FDI inflows, such inflows need to be diversified to non-natural resource sectors as well. A more diversified economy may increase their competitiveness as well.

5.2. Limitations

Readers need to interpret the findings of this paper by considering certain limitations.

The datasets do not provide rich observations for all the countries this paper aimed to include. Especially, the lack of data for the developing and least-developed countries restricts the model only to the countries selected by purposive sampling. This might cause bias in findings compared to the findings of studies with randomly selected samples.

Also, this paper mostly considered FDI as a channel to transfer technologies. As (Pack & Saggi, 1997) and (Saggi, 2002) highlighted, multinational corporations (MNCs) also do transfer technologies to host countries. However, this transfer is mostly within-firm transfer. Therefore, for the study, this paper does not count technology transfers by MNCs as a factor to impact high-technology exports of host countries. However, this aspect might be further analyzed by future researchers.

Moreover, this paper could be further extended to analyze the impacts of each independent variable on high-technology exports for these selected groups, to compare and reveal real differences across the groups. Unfortunately, limitations in datasets and the number of observations make it challenging to conduct the fixed effect panel data analysis to have more reliable research outcomes.

References

Abedini, J. (2013). Heterogeneity of Trade Patterns in High-Tech Goods Across Established and Emerging Exporters: A Panel Data Analysis. *Emerging Markets Finance and Trade, 49*(4), 4-21. Retrieved from https://www.jstor.org/stable/24475336

Aljarallah, R. (2019). Impact of Natural Resource Rents and Institutional Quality on Human Capital: A Case Study of the United Arab Emirates. *Resources, 8*(3), 152. doi:https://doi.org/10.3390/resources8030152

Amiti, M., & Khandelwa, A. (2013). Import Competition and Quality Upgrading. *The Review of Economics and Statistics, 95*(2), 476-490. Retrieved from http://www.mitpressjournals.org/doi/pdf/10.1162/REST_a_00271

An, G., & Iyigün, M. (2004). The export technology content, learning by doing and specialization in foreign trade. *Journal of International Economics, 64*(2), 465-483. doi:https://doi.org/10.1016/j.jinteco.2003.11.001

Asiedu, E. (2013). Foreign Direct Investment, Natural Resources and Institutions. *(Working Paper) The International Growth Centre*. Retrieved from https://www.theigc.org/wp-content/uploads/2014/09/Asiedu-2013-Working-Paper.pdf

Bayar, Y., Remeikienė, R., & Gasparėnienė, L. (2020). Intellectual property rights, R&D expenditures, and high-tech exports in the EU transition economies. *Journal of International Studies, 13*(1), 143-154. doi:doi:10.14254/2071-8330.2020/13-1/9

Bayraktutan, Y., & Bıdırdı, H. (2018). Innovation and High-Tech Exports in Developed and Developing Countries. *Journal of International Commerce, Economics and Policy (JICEP), 9*(03), 1-21. doi:https://doi.org/10.1142/S1793993318500114

Bitzer, J., & Kerekes, M. (2008). Does foreign direct investment transfer technology across

borders: New evidence. *Economic Letters, 100*(3), 355-358.

Braunerhjelm, P., & Thulin, P. (2008). Can countries create comparative advantages? R&D expenditures, high-tech exports and country size in 19 OECD countries, 1981-1999. *International Economic Journal, 22*(1), 95-111. doi:10.1080/10168730801887026

Briggs, K. (2012). Patents, Technology Adaptation, and Exports to Developing Countries. *Global Economy Journal, 12*(1). doi:https://doi.org/10.1515/1524-5861.1785

de Ferranti, D., Perry, G., Lederman, D., & Maloney, W. (2002). From Natural Resources to the Knowledge Economy : Trade and Job Quality. *World Bank Latin American and Caribbean Studies - Viewpoints*. Retrieved from https://openknowledge.worldbank.org/handle/10986/14040 License: CC BY 3.0 IGO.

Eaton, J., & Kartum, S. (1996). Trade in ideas Patenting and productivity in the OECD. *Journal of International Economics, 40*(3-4), 251-278. Retrieved from https://ideas.repec.org/a/eee/inecon/v40y1996i3-4p251-278.html

Faruq, H. (2010). Impact of Technology and Physical Capital on Export Quality. *The Journal of Developing Areas, 44*(1), 167-185. Retrieved from https://www.jstor.org/stable/41428199

Fugazza, M. (2004). Export Performance and Its Determinants: Supply and Demand Constraints. *Policy Issues in International Trade and Commodities: Study Series, United Nations Conference on Trade and Development*. Retrieved from https://unctad.org/system/files/official-document/itcdtab27_en.pdf

Gillman, M. (2021). Steps in industrial development through human capital deepening. *Economic Modelling, 99*. doi:https://doi.org/10.1016/j.econmod.2021.02.011

Gökmen, Y., & Türen, U. (2013). The determinants of high technology exports volume: A panel data analysis of EU-15 countries. *International Journal of Management, Economics and*

Social Sciences, 2(3), 217-232. Retrieved from https://www.econstor.eu/bitstream/10419/83517/1/768197198.pdf

Güneş, S., Gürel, S. P., Karadam, D. Y., & Akın, T. (2020). The Analysis of Main Determinants of High Technology Exports: A Panel Data Analysis. *Kafkas University, Journal of Economics & Administrative Sciences Faculty of / Kafkas Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 11*(21), 235-260.

Harding, T., & Javorcik, B. S. (2012). Foreign Direct Investment and Export Upgrading. *The Review of Economics and Statistics, 94*(4), 964-980. doi:https://doi.org/10.1162/REST_a_00226

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What You Export Matters. *Journal of Economic Growth, 12*(1), 1-25. Retrieved from https://www.jstor.org/stable/40216112

Ivus, O. (2010). Do stronger patent rights raise high-tech exports to the developing world? *Journal of International Economics, 81*(1), 38-47. doi:https://doi.org/10.1016/j.jinteco.2009.12.002

Javorcik, B. (2010). Foreign Direct Investment and International Technology Transfer. In S. S. Stijn Claessens (Ed.), *Encyclopedia of Financial Globalization* (pp. 1-14). Elsevier Academic Press. Retrieved from https://users.ox.ac.uk/~econ0247/Encyclopedia.pdf

Kabaklarli, E., Duran, M. S., & Üçler, Y. T. (2017). The Determinants of High-technology Exports: a Panel Data Approach for Selected OECD Countries. *DIEM : Dubrovnik International Economic Meeting*, 888-900. Retrieved from https://hrcak.srce.hr/187437

Keller, W. (2010). International Trade, Foreign Direct Investment, and Technology Spillovers. In B. H. Hall, & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation* (Vol. 1, pp. 793-829). doi:https://doi.org/10.1016/S0169-7218(10)02003-4

Keller, W., & Yeaple, S. (2009). Multinational enterprises, international trade, and productivity

growth: Firm-level evidence from the United States. *The Review of Economics and Statistics, 91*(4), 821-831. Retrieved 2021, from https://www.jstor.org/stable/25651379

Konya, S., Küçüksucu, M., & Karaçor, Z. (2021). Panel Estimation of High-technology Export Determinants: Evidence from Fast-Growing Countries. In M. Bilgin, H. Danis, E. Demir, & V. S. (Eds.), *Eurasian Economic Perspectives. Eurasian Studies in Business and Economics* (Vol. 16, pp. 245-259). Springer.

Krammera, S., Strange, R., & Lashitew, A. (2018). The export performance of emerging economy firms: The influence of firm capabilities and institutional environments. *International Business Review, 27*(1), 218-230. doi:https://doi.org/10.1016/j.ibusrev.2017.07.003

Marginean, S. (2006). Competitiveness: From Microeconomic Foundations To National Determinants. *Studies in Business and Economics, 1*(1), 29-35. Retrieved from http://eccsf.ulbsibiu.ro/RePEc/blg/journl/113marginean.pdf

Mehrara, M., Seijani, S., & Karsalari, A. (2017). Determinants of High-Tech Export in Developing Countries Based on Bayesian Model Averaging. *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu/Proceedings of Rijeka Faculty of Economics: Journal of Economics and Business, 35*(1), 99-215. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2997399

Mousavi, A., & Edmund Clark, J. (2021). The effects of natural resources on human capital accumulation: A literature survey. *Journal of Economic Surveys*, 1073-1117. doi:10.1111/joes.12441

Pack, H., & Saggi, K. (1997). Inflows of Foreign Technology and Indigenous Technological Development. *Review of Development Economics, 1*(1), 81-98. Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1111/1467-9361.00007

Poelhekke, S., & van der Ploeg, F. (2013). Do Natural Resources Attract Nonresource FDI? *The Review of Economics and Statistics, 95*(3), 1046-1065. Retrieved from https://www.jstor.org/stable/43554811

Porter, M. (1990). The Competitive Advantage of Nations. *Harvard Business Review*. Retrieved from https://hbr.org/1990/03/the-competitive-advantage-of-nations

Pottelsberghe, B. v., & Lichtenberg, F. (2001). Does Foreign Direct Investment Transfer Technology across Borders? *The Review of Economics and Statistics, 83*(3), 490-497.

Ratnaike, Y. (2012). Is there an empirical link between trade liberalisation and export performance? *Economics Letters, 117*(1), 375-378. doi:https://doi.org/10.1016/j.econlet.2012.05.015

Saggi, K. (2002). Trade, Foreign Direct Investment, and International Technology Transfer: A survey. *World Bank Research Observer, 17*(2), 191-235. Retrieved from https://openknowledge.worldbank.org/handle/10986/16417

Sakakibara, M., & Porter, M. (2001). Competing At Home To Win Abroad: Evidence From Japanese Industry. *The Review of Economics and Statistics, 83*(2), 310-322. Retrieved from http://www.mitpressjournals.org/doi/pdf/10.1162/00346530151143842

Sandu, S., & Ciocanel, B. (2014). Impact of R&D and Innovation on High-tech Export. *Procedia Economics and Finance, 15*, 80-90. doi:https://doi.org/10.1016/S2212-5671(14)00450-X

Seyoum, B. (2004). The role of factor conditions in high-technology exports: An empirical examination. *Journal of High Technology Management Research, 15*(1), 145-162. doi:https://doi.org/10.1016/j.hitech.2003.09.007

Seyoum, B. (2004). The role of factor conditions in high-technology exports: An empirical examination. *The Journal of High Technology Management Research, 15*(1), 145-162. doi:https://doi.org/10.1016/j.hitech.2003.09.007

Seyoum, B. (2005). Determinants of Levels of High-Technology Exports: An Empirical Investigation. *Advances in Competitveness Research, 13*(1), 64-79.

Sezer, S. (2018). Impacts of R&D Expenditures on High Technology Product Exports in BRICST Countries. *The Journal of Social Sciences Research, 4*(10), 165-175. Retrieved from https://arpgweb.com/journal/journal/7

Śledziewska, K., & Akhvlediani, T. (2017). What Determines Export Performances in High-tech Industries. *Central European Economic Journal, 1*(48), 37-49. doi:https://doi.org/10.1515/ceej-2017-0006

Tebaldi, E. (2011). The Determinants of High-technology Exports: A Panel Data Analysis. *Atlantic Economic Journal*, 343-353.

The World Bank. (2021). Export value index (2000 = 100). *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/TX.VAL.MRCH.XD.WD

The World Bank. (2021). Export volume index (2000 = 100). *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/TX.QTY.MRCH.XD.WD

The World Bank. (2021). Exports of goods and services (% of GDP). *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS

The World Bank. (2021). Foreign direct investment, net inflows (% of GDP). *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS

The World Bank. (2021). High-technology exports (% of manufactured exports). *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS

The World Bank. (2021). Human Capital Index (HCI) (scale 0-1). *World Bank Open Data*. The

World Bank. Retrieved from https://data.worldbank.org/indicator/HD.HCI.OVRL

The World Bank. (2021). Patent applications, nonresidents. *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/IP.PAT.NRES

The World Bank. (2021). Research and development expenditure (% of GDP). *World Bank Open Data*. The World Bank. Retrieved 2021, from https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS

The World Bank. (2021). Total natural resources rents (% of GDP). *World Bank Open Data*. The World Bank. Retrieved from World Bank Open Data: https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS

The World Economic Forum. (n.d.). *The Global Competitiveness Report series*. The World Economic Forum. Retrieved 2021

Toe, D., & Helpman, E. (1995). International R&D spillovers. *European Economic Review, 39*(5), 859-887. doi:https://doi.org/10.1016/0014-2921(94)00100-E

UNDP. (2019). Human Development Index. UNDP. Retrieved 2021, from http://hdr.undp.org/en/indicators/137506

Wang, Z., & Wei, S.-J. (2008). What Accounts for the Rising Sophistication of China's Exports? In R. Feenstra, & S.-J. Wei (Eds.), *China's Growing Role in World Trade* (pp. 63-104). National Bureau of Economic Research, Inc.

Zhang, H., & Yang, X. (2016). Intellectual property rights protection and export quality. *International Journal of Development Issues, 15*(2), 168-180. doi:10.1108/IJDI-11-2015-0071

Zhu, S., & Fu, X. (2013). Drivers of Export Upgrading. *World Development, 51*, 221-233. Retrieved from https://www.sciencedirect.com/science/article/pii/S0305750X13001381