

## EXPORT DIVERSIFICATION AND INCOME NEXUS: THE CASE OF CHINA<sup>1</sup>

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### Diverzifikácia exportu a súvislosť s príjmom: prípadová štúdia Čína

**Abstract:** *Since the 21st century, Chinese trade in goods has evolved rapidly and has achieved some remarkable success. In the structure of exports, after the steady growth of primary products, Chinese capital-intensive and technologically demanding manufactured products have taken the lead. This paper takes a look at the current position of Chinese exports in terms of export sophistication and uses the findings to extract the most successful export articles (machinery and electrical equipment) and calculate the Herfindahl-Hirschman index to evaluate the degree of export diversification in this category since 2001. Linear regression analysis is then used to assess the relationship between the Herfindahl-Hirschman index and other indicators during the period of growing export concentration. The results show a strong correlation ( $R^2 > 0.9$ ) with the gross national income per capita (positive), number of employed persons in the primary industry (negative), number of employed persons in the tertiary industry (positive), the average wages of employed persons in urban units (positive) and the gross national income (positive).*

**Keywords:** *Herfindahl-Hirschman index, export concentration, export diversification, gross national income, employment*

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## 1 Introduction

Many authors argue that an increase in exports has a direct positive relationship with the national income. The growth of international trade also has a two-way relationship with income, meaning that the increased trade facilitates more income and more income produces more trade (Bhagwati [4]). This causality has been observed also by Grossman and Helpman [8], Wörz [17], Awokuse [1], Cetintas and Barisik [3], Jiyang and Wen [10]. Many developing countries use export revenue as a substitute to their lacking domestic demand, which significantly contributes to their income per capita. This has been the case of many countries in the Southeast Asia, as described by Baláž [2]. Although there has not been a consensus, it can be argued that embracing free trade, both internally and externally, has played a key role in lifting up to 800 million people out of poverty in China. Although high export growth has a proven positive effect on the GDP, it is necessary to note that many low-income countries suffer from a narrow export basket, often consisting of lower value added goods in the labor-intensive agricultural sector. Increased international fragmentation of global value chains opens up new opportunities to utilize individual strengths of low-income economies through specialization. After the export growth, breaking out of the simple production and export portfolios is the next step securing the economic expansion and the related transition of the international position of a country. While traditionally, economists believe that increasing technological complexity of production and exports is an outcome of “moving up the production ladder” (described by, for example, the flying geese paradigm), and there is a mass of empirical literature supporting the close association of technology and development, the notion that diversity in industrial production and exports is a key determinant for growth is relatively new. As studies suggest, export concentration is believed to be the major contributor to maintaining stability in export receipts, fostering long-term economic growth. The Prebisch-Singer hypothesis suggests that focusing on primary commodity production is inconsistent with the aim of many developing countries to lift their global economic status, because prices of primary commodities are negatively correlated with the prices of manufactured goods over the long term, causing the price scissors effect and deterioration of terms of trade. Based on the publication of Food and Agriculture Organization (FAO) [6], the lack of export diversification in developing countries has a negative impact on income, investment and employment. Countries utilizing production diversification are better hedged against the possible price fluctuations which leads to a predictability of export revenue and cushioning the economic impact of crises.

The opposite could discourage vital investments in the economy by risk-averse firms, increase macroeconomic uncertainty, and hinder the longer-term economic growth. Lederman and Maloney [14] confirm the positive effect of export diversification on per capita income growth. Many theorists find a negative relationship between resource abundance and economic growth and the empirical knowledge points toward the assumption that resource-based economies lack the incentive to invest in the human capital, which is supported by inverse relationship between resource intensity and education. This bolsters the motivation to push-down the market concentration and cultivate new industries.

It is important to note that income does not rise with the diversification of exports indefinitely. Past a certain level of income, economies start to re-concentrate the structure of their production. This U-shaped relationship between the concentration of production and the level of development has been confirmed by Koren and Tenreyro [12], Imbs and Wacziarg [9], Cadot, Carrère and Strauss-Kahn [5] or Klinger and Lederman [11]. Gozgor and Can [7] found that the product diversification of exports is positively related to the real GDP per capita in the low-, the lower middle-, and the upper middle income countries. However, the relationship is negative in the non-OECD- and the OECD member high income countries; i.e., the product concentration of exports promotes the real GDP per capita in these countries. These findings indicate that lower income countries first “set up” multiple promising production channels which diversify their exports and with the increasing market share of the successfully competing goods, their export structure narrows again, promoting trade specialization.

## **Methodology**

This research will adapt existing methodologies using data from multiple sources. The Trade Map tool from International Trade Centre, utilizing UN Comtrade yearly exports data, served as a basis for Herfindahl-Hirschman index calculation and top exports rankings. All exports data in this paper have been analyzed at the four-digit (HS-4) code level. Data on the gross national income per capita, the number of employed persons in the primary industry, the number of employed persons in the tertiary industry, the average wages of employed persons in urban units and the gross national income and other indicators were drawn from the National Bureau of Statistics of China database system.

Herfindahl-Hirschman index is a common measure used for calculating market concentration. In practice, it is used by the U.S. Department of Justice for evaluating various industries for the purpose of antitrust enforcement as an economic measure of competitiveness in the market. In our case, it is a sum of squared shares of each product in total export. A country with a perfectly diversified export portfolio has an index close to zero, whereas a country which exports only one product has the value of 10,000 (using percentage points for calculation).

$$HHI = ES_1^2 + ES_2^2 + ES_3^2 + \dots + ES_n^2$$

Where ES is the share of a subcategory in total exports in the HS-84 and HS-85 category and is the total number of analyzed subcategories belonging under both HS-84 and HS-85 category. These two categories are used to calculate export diversification as their sum accounts for about one third of total exports and they are the most impactful in the Chinese economic development. To investigate into the impact of export diversification on other indicators, Herfindahl-Hirschman index is included as a regressor.

## 2 Results

The current structure of Chinese goods exports had gone through a variety of changes dating back to the process of trade liberalization which started with the election of Deng Xiaoping in 1978. These succeeded three decades of the Soviet-style heavy-oriented development strategy adopted by the Chinese government. A new price system combined with a decreasing role of the state in allocating resources and expansion of foreign trade has spread the processing trade which serves as an attraction for FDI. The active promotion of processed goods exports in the 1970s has been supplemented by the large-scale government funded scientific and innovation projects since early 1990s. This development has created a fertile land for the impressive path of machinery and electrical machinery subcategory in manufactured goods exports, jumping from \$ 84 million in 2001 to nearly \$ 900 million in 2016. Table 1 and 2 show an HS-2 decomposition of the most exported goods in China. The abovementioned trajectory is clearly visible and showcases Chinese transition to high-tech production. Some authors argue that China is far from being a real high-tech exporter (Yuqing [19], Lawrence and Edwards [13]) and that high-tech sector in China is mostly the outcome of outsourcing activities of multinational corporations (in search of low labour costs) and Chinese high-tech producers are actually on the lowest part of the added value chains.

By examining the exports structure of China, there is a clear shift from lower tier goods towards the secondary sector. It is a result of China's industrial policies that help to foster domestic skills in machinery and electronics. Machinery and electronics were one of the most important product categories that helped change the structure of Chinese trade as their export volume grew by 800 percent during the period 1995-2004. The share of the top HS-4 category in total exports is almost twice as large in 2016 in comparison with the year 2001. This suggests higher export concentration.

Table 1

**Leading categories in exports of China (2001)**

HS-4 category name	Rank 2001	Rank 2016	HS-4 code	Category	Share in exports
Automatic data-processing machines and units thereof; magnetic or optical readers, machines ...	1	2	'8471	Machinery / Electrical	4,92%
Parts and accessories (other than covers, carrying cases and the like) suitable for use solely ...	2	10	'8473	Machinery / Electrical	3,07%
Transmission apparatus for radio-broadcasting or television, whether or not incorporating reception ...	3	43	'8525	Machinery / Electrical	1,93%
Women's or girls' suits, ensembles, jackets, blazers, dresses, skirts, divided skirts, trousers, ...	4	12	'6204	Textiles	1,84%
Jerseys, pullovers, cardigans, waistcoats and similar articles, knitted or crocheted (excluding ...	5	22	'6110	Textiles	1,81%
Tricycles, scooters, pedal cars and similar wheeled toys; dolls' carriages; dolls; other toys; ...	6	19	'9503	Miscellaneous	1,73%
Footwear with outer soles of rubber, plastics, leather or composition leather and uppers of ...	7	46	'6403	Footwear / Head-gear	1,61%
Men's or boys' suits, ensembles, jackets, blazers, trousers, bib and brace overalls, breeches ...	8	34	'6203	Textiles	1,56%
Trunks, suitcases, vanity cases, executive-cases, briefcases, school satchels, spectacle cases, ...	9	11	'4202	Raw Hides, Skins, Leather, & Furs	1,46%
Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	10	13	'8504	Machinery / Electrical	1,36%

**Source:** Own calculation based on WITS database [16].

Table 2

## Leading categories in exports of China (2016)

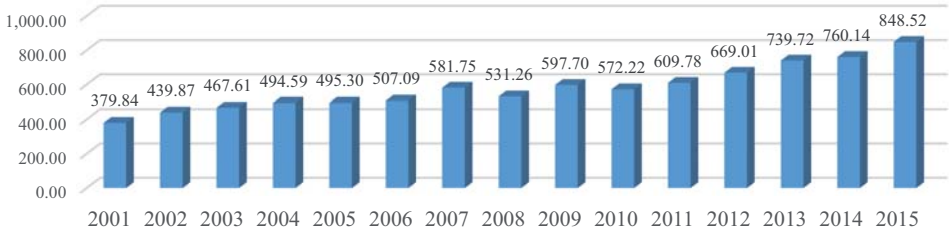
HS-4 category name	Rank 2016	Rank 2001	HS-4 code	Category	Share in exports
Telephone sets, incl. telephones for cellular networks or for other wireless networks; other ...	1	11	'8517	Machinery / Electrical	9,60%
Automatic data-processing machines and units thereof; magnetic or optical readers, machines ...	2	1	'8471	Machinery / Electrical	5,96%
Electronic integrated circuits; parts thereof	3	19	'8542	Machinery / Electrical	2,92%
Lamps and lighting fittings, incl. searchlights and spotlights, and parts thereof, n.e.s; illuminated ...	4	21	'9405	Miscellaneous	1,43%
Liquid crystal devices not constituting articles provided for more specifically in other heading; ...	5	104	9013	Miscellaneous	1,37%
Parts and accessories for tractors, motor vehicles for the transport of ten or more persons, ...	6	44	'8708	Transportation	1,35%
Monitors and projectors, not incorporating television reception apparatus; reception apparatus ...	7	36	'8528	Machinery / Electrical	1,35%
Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, ...	8	42	'8541	Machinery / Electrical	1,27%
Furniture and parts thereof, n.e.s. (excluding seats and medical, surgical, dental or veterinary ...	9	23	'9403	Miscellaneous	1,24%
Parts and accessories (other than covers, carrying cases and the like) suitable for use solely ...	10	2	'8473	Machinery / Electrical	1,23%

**Source:** Own calculation based on WITS database [16].

Results shown in Figure 1 point to the re-specialization pattern of Chinese exports. China's manufacturing infrastructure, built up during the country's industrial boom in recent decades, has led to thriving exports, providing a basis for businesses to produce higher value products. Despite the fact that Chinese companies compete in more sophisticated production lines, they detract from surplus inventory from strong industrial overcapacity in industries such as steel, which is irritating in global business relationships.

Figure 1

**Herfindahl-Hirschman index for HS-84 and HS-85 export categories in China**

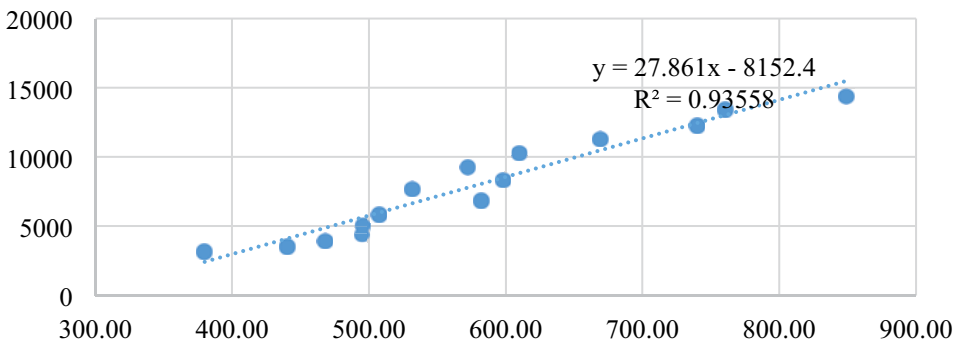


Source: Own calculation based on WITS database [16].

Generally speaking, trade liberalization will increase demand for labor-intensive goods, which will reduce unemployment and support wage growth. This will have a positive impact on the country’s income and will gradually increase the accumulation of capital. Eventually, the comparative advantage of the country will shift. Despite the fact that it is still labor-intensive compared to developed countries, the comparative advantage will shift to goods with bigger capital intensity. Therefore, the yearly Herfindahl-Hirschman index values for HS-84 and HS-85 export category are used as a predictor variable to model the conditional probability distribution of GNI per capita given the value of the index.

Figure 2

**Herfindahl-Hirschman index for HS-84 and HS-85 correlation with GNI per capita (2001–2015)**



Source: Own calculation based on WITS and National Bureau of Statistics of China database [15, 16].



Table 3

**Regression between Herfindahl-Hirschman index for HS-84 and HS-85 correlation and GNI per capita (2001–2015)**

<i>Regression Statistics</i>	
Multiple R	0,967252191
R Square	0,935576802
Adjusted R Square	0,930621171
Standard Error	980,3391965
Observations	15

## ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	181440089,1	181440089,1	188,7906649	4,05402E-09
Residual	13	12493844,22	961064,9403		
Total	14	193933933,3			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-8152,353794	1202,26737	-6,780815982	1,29985E-05
HHI (84, 85)	27,86100008	2,027712804	13,74011153	4,05402E-09

**Source:** Own calculation based on WITS and National Bureau of Statistics of China database[15, 16].

Correlation coefficient shows a strong positive linear relationship between the variables based on the sample of 15 observations (in this case years). Coefficient of determination is 0.93558, therefore about 94% of the variation of GNI per capita values around the mean is explained by the Herfindahl-Hirschman index values. Significance of F is small, therefore, there is only a small chance that the regression output was merely a chance of occurrence. The standard error is 1,202.27 which means that the average distance of the data points from the fitted line is about 1,202 dollars of GNI per capita. From the regression equation, it can be observed that the intercept value is -8,152.4 which is the value of GNI per capita if the Herfindahl-Hirschman index is zero. GNI per capita is predicted to increase by 27.861 dollars with each increase of the Herfindahl-Hirschman index by one.

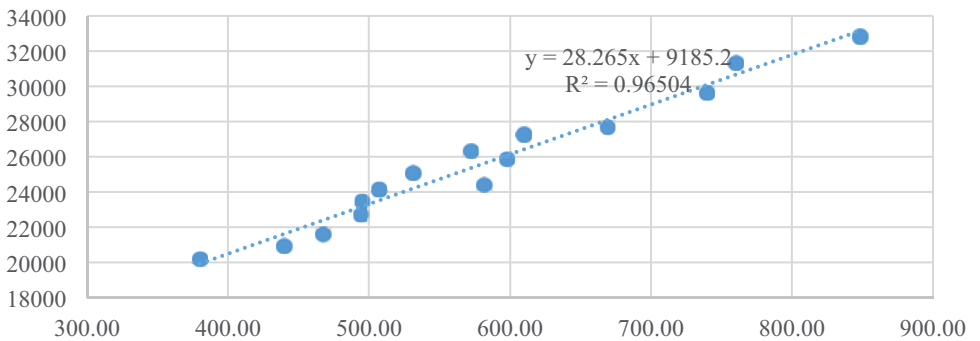
The fruitful findings in measuring the effect of Herfindahl-Hirschman index on gross national income of China lead us to further analysis of



its relationship with other variables. To extract the firmest relationships, the research will focus on the values of R-squared greater than 0.9. It was found that Herfindahl-Hirschman index values are interdependent with four other indicators, namely: the number of persons employed in the primary industry, the number of persons employed in the tertiary industry, the average wages of persons employed in urban units (measured in Chinese yuans) and the gross national income in current dollars (measured by Atlas methodology). The highest value of coefficient of determination can be found in the relationship between Herfindahl-Hirschman index and number of employed persons in tertiary industry, which leads us to believe that the Prebisch-Singer hypothesis is confirmed in the case of China.

Figure 3

**Herfindahl-Hirschman index for HS-84 and HS-85 correlation with thenumber of persons employed in the tertiary industry (2001–2015)**



**Source:** Own calculation based on WITS and National Bureau of Statistics of China database[15, 16].

Table 4

**Regression between Herfindahl-Hirschman index for HS-84 and HS-85 correlation and persons employed in the tertiary industry (2001-2015)**

<i>Regression Statistics</i>	
Multiple R	0,982363343
R Square	0,965037738
Adjusted R Square	0,962348333
Standard Error	721,3968382
Observations	15

## ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	186739671,4	1,87E+08	358,8295	7,52846E-11
Residual	13	6765374,177	520413,4		
Total	14	193505045,6			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	9185,246468	884,7059081	10,38226	1,16E-07
HHI (84, 85)	28,26495975	1,492121921	18,9428	7,53E-11

**Source:** Own calculation based on WITS and National Bureau of Statistics of China database[15, 16].

Correlation coefficient shows a strong positive linear relationship between the variables based on the sample of 15 observations (in this case years). Coefficient of determination is 0.965, therefore about 97% of the variation of employed persons in tertiary industry values around the mean is explained by the Herfindahl-Hirschman index values. Significance of F is small, therefore there is only a small chance that the regression output was merely a chance of occurrence. Standard error is 884.7 which tells us that the average distance of the data points from the fitted line is about 885,000 of employed persons in tertiary industry. From the regression equation, it can be observed that the intercept value is 9,185.2 which is the value of „employed persons in tertiary industry“ variable if the Herfindahl-Hirschman index is zero. Number of employed persons in tertiary industry is predicted to go up by 28,265 persons with each increase of the Herfindahl-Hirschman index by one.

### 3 Conclusions and Policy Implications

What is the relationship between structural transformation of trade and income development? This short paper examines this issue by revisiting some of the facts that can be found in the literature. While economic theory suggests that specialization is the result of trade openness, it is less clear what the overall outcome of the division of labor is in the global economy. National data shows that Chinese machinery and electrical equipment market (which makes up about one third of total exports) is getting more and more concentrated, suggesting that China is in the process of re-specialization. Data on gross national income reveals a transitional character of Chinese economy, moving the “Middle Kingdom” up the economic ladder. This paper

argues that China is in the latter half of the theoretically implied U-shape pattern which represents a turning point that occurs at a particular income level of a country, indicating that the increasing market concentration is only going to persist and intensify. Market concentration in the HS-84 and HS-85 product categories has a positive correlation with GNI per capita, the number of persons employed in the tertiary industry, the average wages of persons employed in urban units and the gross national income. Inverse relationship with the number of persons employed in the primary industry has been observed, implying the shift of the workforce from the primary industry to the secondary and tertiary industries which also contain the market leaders responsible for the ever-growing homogeneity of the exports. Policies to reduce vulnerability to external economic development (which may occur as a result of market concentration) should be considered.

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