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Article

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MANAGEMENT | RESEARCH ARTICLE

The development growth of China from its industrialization intensity

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Abstract: This paper investigates which technological levels of industry contributed most to the formation and development of the Gross Domestic Product (GDP) and the Human Development Index (HDI) in China from 2000 to 2010. These indexes were the dependent variables. The independent variables were selected from the United Nations Industrial Development Organization database, and encompass employees and manufacturing establishments from 23 industries bracketed into technological levels intensity. Ordinary least squares regressions were run to indicate the relationship of dependency and explanatory power between variables. The results showed that mid-low technology level industries have greater impact on the China's GDP; however, no technology level industry really influences the HDI.

Subjects: Asian Studies; Business, Management and Accounting; Industry & Industrial Studies

Keywords: China; industrialization; progress; development growth

1. Introduction

The economic, social and political changes that have occurred in recent years in China have brought about a series of measures, government actions and global changes that have resulted in attracting and retaining foreign direct investment (FDI) in the country. Not only in China, but in most of the

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PUBLIC INTEREST STATEMENT

This study investigates the technological levels of industries that most contributed to the economic and social development of China. With this paper, which is not written in a difficult or too technical language to read, the public is able have an overview about the recent Chinese industrialization processes and comprehend the rapid Chinese economic growth of the last decades.

Economic growth alone does not bring development, but it helps. Presenting in the article some main political decisions in the last century, the reader is able to understand the increase of the Chinese Human Development Index.

By identifying the technical levels that most contributed for this Chinese economic development, the government could direct investments to assist these industries and provide incentive to individuals to qualify themselves in these sectors. Important not to forget is to invest in education, which is the basic of any nation's improvement, independent of the industrial level.

developing countries, it is believed that foreign direct investment can positively increase economic growth (Sothan, 2017). Apart from economic growth, Glosny (2010) highlights that business (via multinational installation in overseas) has enabled innovation and management techniques for many developing countries, which did not have much management knowledge by staying “closed”, regardless of the reasons, to the external market.

According to Herzer, Klasen, and Nowak-Lehmann (2008), FDI is an unclear variable to express effective economic growth, so it seems that scholars prefer to study the GDP to correlate with it (Barro, 1991; Broadberry, Campbell, Klein, Overton, & Van Leeuwen, 2015; Hanushek, 2013).

Back to China, as this country’s growth has been fast and exponential in the last few decades, the understanding of which industrial intensity levels have actually contributed for the Gross Domestic Product (GDP) could help the understanding of the present situation of the country’s macro-economy. But what types of companies offer greater economic growth? For which industries intensity levels should the Chinese Government give more tax incentives in order to encourage the entry into the local market?

Economic growth can also contribute to the economic development of a region. When employed, the population can increase family income, improve their education and acquire durable goods, among other things (Vieira, Albert, & Bagolin, 2008), which can improve the people’s quality of life (QoL) and, over the years, social indicators (Cracolici, Cuffaro, & Nijkamp, 2009), which result in development growth. In this sense, the understanding of which technological industry levels impact on the HDI plays an important role in grasping why one region is more developed than another, or even why they have better qualified workers.

The paper is organized as follows: Section 2 reviews the literature. Section 3 describes the methodology used in this study. Section 4 explains the results. Finally, Section 5 concludes the research.

2. Literature review

This section presents a summary of the literature on the major historical events in China and shall help comprehend their industrial formation throughout the 20th and 21st centuries.

The effective beginning of the Chinese economic performance is dealt by Damas (2014) in two landmarks: from the Nationalist Revolution (1911), which defeated the Manchu dynasty, and by Maoism (1949–1976), with its communist revolution.

Damas (2014) reports that the framework of Chinese industrialization began in the twentieth century in its port cities with its textile and tobacco industries in the Manchuria region, and in north-eastern China at the Siberian border with base industries (Mining and infrastructure).

To this concentration of enterprises in a region, Long and Zhang (2011) attribute the term industrial clustering, where industries can have better access to markets, as well as sharing technological know-how, easy flow of ideas and relief in financial constraints such as loans. Agglomerate organizations propagate development to their surroundings, which is often measured by the Gini coefficient. Nevertheless, extreme geographic concentration may result in big variations in industry’s GDP share.

Until the mid-1930s, the country lived with a certain degree of social stability, but this was modified after the Japanese invasion to Nanjing in 1937, where the Japanese sought territorial expansion and exploitation of raw materials from the north-east region (Coble, 2007). Other academics claim that some policymakers learned a Japanese-style industrial policy in China, which focused on the use of exhibitions and schools to disseminate information and stimulate rural innovation, resulting in a labour-intensive industrialization focusing on improvements to labour quality (Duus, Myers, & Peattie, 2014; Lee, 2014).

Still, with this military upheaval that lasted until 1945, nationalist sentiments were exacerbated in the 1940s, something that, according to Coble (2007), provided the rise of Mao Tse Tung and the party called the People's Party, the Communist Party of China (CPC).

In 1949, after years of clashes between the rich, middle peasantry and the Communist party of Kai-Shek, Mao Tse Tung found the Chinese socialism (with a certain amount of communism). So, in 1952, Tsé Tung carried out the agrarian reform (Gittings, 2005) and from this year onwards both industrial and agricultural production surpassed the limit of production, as communist ideas were gradually abandoned, establishing conditions for the capital accumulation and to the industrialization of agriculture (Damas, 2014).

In the 1950s a progressive model called the "Five Year Plan" was developed, where Mao's government prioritized the heavy industry development focused on supplying the domestic and export markets as a means of capital accumulation (Damas, 2014).

It was only in the 1960s that the Chinese leader adopted a more conciliatory policy with the West, re-establishing contacts and with the participation in the United Nations. There was in this decade a gradual economic opening of the country with the contribution of innovative technologies (Szirmai, 2012).

Dutta (2005) and Deng (2014) agree that up until the death of the political leader Mao in 1976, 70% of the Chinese population, and consequently 70% of the economy, was destined to the agricultural sector and the development of the State-owned communications, transport and finance. After his death, the leadership of the new communist party had the challenge to put China into the world economy, as this was the desire of more than a billion Chinese wanting to "be rich and glorious" like the Russian and Japanese neighbours and like the Americans. In this context, Dutta (2005) presents the main changes that have taken place since the late 1970s by the new leader Deng Xiaoping:

- (1) The large collective units of rural production (the communes) were replaced by individual lots.
- (2) Focus on the industrial sector through the importation of goods capital and training of professionals to handle the new machines and equipment for the production of durable goods.
- (3) China develops the Special Economic Zones (EEZs) on its coast, with an intense opening to foreign capital, investments in port structures and tax exemptions.
- (4) Receipt of foreign capital attracted by abundant labour available and relatively low cost compared to developed countries.
- (5) Resumption of diplomacy with the Americans, with the purpose of raising investments for the country.

By means of these measures, mainly implemented in the 1970s, the Chinese GDP grew over the next two decades with an average of 10% a year. Along with the achievements challenges also arose, such as high social inequality, environmental problems and aging population.

According to Szirmai (2012), although Deng's structural changes caused initial imbalance in the social sphere, there are powerful empirical and theoretical arguments confirming that industrialization was the engine of the Chinese economic growth and development, namely:

- (1) There is a positive empirical correlation between the degree of industrialization and per capita income in developing countries, such as China, India and Brazil.
- (2) Productivity is higher in the industrial sector than in the agricultural sector.
- (3) The manufacturing sector provides more opportunities for capital accumulation than the agricultural sector.
- (4) Goods production generates technological development.

Thus, with the aforementioned changes, the labour transfer from agriculture to industry led to an increase in productivity and per capita income.

In terms of productivity, Bandt and Rawski (2008) point out to a Chinese increase of 0.5 to 3.8% between the periods 1978–2005. This achievement was largely conquered through professional qualification and technology investments by the Chinese themselves.

Although the state had control over finance, telecommunications, steel, oil and some other sectors of the Chinese economy, new entrepreneurs and investors began to participate in sectors formerly reserved for public enterprises, such as infrastructure and metals (Fan, 2014).

The changes in the Chinese economic and industrial structure, starting with the reforms initiated by Xiaoping (1970), evidenced a substantial flow of goods and services for all regions, not only for a specific region of the country.

Cai et al. (2008) reported on fiscal and centralized Chinese protectionism, the immediate incompatibility of economic policies of the time, but which over the years was becoming more flexible in order to meet market demands.

According to Bandt and Rawski (2008), the 1980s were marked by the international trade via the export production, installation of foreign companies, international production standards and new regulations for opening up to other economic segments such as steelmaking.

With a modified economic reality, the rural woman migrated to the industrial labour market. Huang's (2000) study shows that migrant women are disadvantaged in the labour market not because of their gender, but because of their rural identities and historical features. In this way, women got jobs with lesser prestige, earning less than men. Zhang and Kanbur (2005) emphasize that despite advances in economic indicators obtained throughout 1980, social inequality in the Chinese interior and informal labour contraction increased. Only from the 1990s on the Chinese living, working and financial conditions began to improve, as the government spent more money on education, as well as better wages offered by multinationals have also improved the results.

From 1990 onwards, the Chinese economy has stood out presenting high rates of economic growth when compared to other developing economies or even when compared with developed economies. Szirmai (2012) argues that high investment rates, greater trade liberalization, the exports stimulating policy and the attractiveness of foreign investments are the main actions that result in high economic growth. And these actions have been gradually implemented in China since the 1980s.

In the 1990s, there was an intensification of the European and American multinationals in the Chinese market. The era was also marked by the rapid growth of private companies. According to Motohashi (2006), high-tech companies migrated to the country, such as Volkswagen (1983), Microsoft (1992), Samsung (1992) and LG (1993). Motohashi (2006) and Wang and Lin (2009) argue that the major cause of this interest was the large Chinese domestic market. Regardless of the reason, the displacement of these factories to China generated employment, income and economic development for the country.

Long and Zhang (2011) point out that between 1990 and 2004, Chinese industry strengthened its clustering. This clustering was not only by industry type but also by region. The authors exemplify Shanghai with steel, oil and automobile cluster; Zhejiang with textile clusters, clothing, shoes, home appliances and Guangdong with clusters in clothing, computers and related. Although there was (and still there is) this clustering, the firms lacked of interest to seek cooperation and communication based on knowledge, technology or research and development activities with other firms in the same cluster (Wang, Lin, & Li, 2010).

From 2000 onwards, the economic growth has stabilized and factory workers have claimed for even higher wages, better working conditions and other benefits provided by multinationals that have immigrated to the country in the recent years, such as aid for transportation.

The first decade of the twenty-first century registered better economic and social indicators to China, resulting from the reformist measures taken in the previous decades. With better economic numbers, other challenges have arisen as a result of the “cost” of this improvement, such as the ecological imbalance and the increase of infectious diseases (Deng, 2014; Herzer et al., 2008).

Table 1 summarizes the main historical, economic and industrial facts in China since the 1930s.

It is noticeable the greater participation of China in the productive and commercial areas between the 1980s and 1990s. It all began with the multinationals installations. In terms of government investment, the national development has been directed to the manufacturing production, where raw materials are transformed through assembly into large-scale finished goods.

3. Methodology

This research focuses on the developing country China and its industrialization as a strong impetus not only for economic growth, but also for improvement of the population’s quality of life (development growth).

The highlight of the study is the analysis of the International standard Industrial Classification of All Economic Activities (ISIC) for China with variables that indicate economic development.

The United Nations Industrial Development Organization (UNIDO) was the source of the database chosen for this study, a database (INDSTAT2 REV.3 2013) that includes information on the industrial production of 169 countries from 1963 to 2010. However, due to a gap in the information in the time series, the authors decided to focus the analysis on the years 1990–2010. This was also justified by the parallel analysis of the Report on Human Development (UNDP), which was released in 1990, concurrently with the HDI.

Therefore, the data preparation was achieved through the use of two main secondary sources:

- (1) The first consisted of classic texts on the subject, government sites and scientific papers. By means of these sources, it was possible to understand the historical and evolutionary issues of industrial and economic development in China. The most used criterion for the selection of the papers was if they were papers from Scopus, the Web of Science or the Wiley database.
- (2) The second was the UNIDO database, which provides a set of categories of industrial production activities that can report on the following variables.
 - (i) Number of industry units.
 - (ii) Number of employees: the number of people who worked in or for the establishment during the reference year.

In this study, the industrial activities with the variables (1) and (2) were separated according to their technological levels, whose classification is based on indicators of (direct as well as indirect) technological intensity reflecting “technology-producer” or “technology-user” aspects: high (H)—modern industries from the techno-scientific revolution, Mid-High (MH), Mid-Low (ML) and low (L)—technology usage is simple and limited. Then, the effect of each of these independent variables on the economic growth, i.e. GDP, and on the HDI was estimated. As these two are highly correlated variables for addressing the same basic phenomena (physical capital and/or industry productivity), an estimate for each independent variable was made in order to avoid multicollinearity problems, aiming to test the robustness of the results.

Table 1. The main historical and economic facts in China since the 1930s

Period	Main facts	Main authors
Until 1930	Family Agricultural Economy; Port regions and Manchuria more industrially developed	Coble (2007), Damas (2014)
1940 Decade	Family Agricultural Economy; Capital shortage; Lack of government support; Nationalist sentiment in evidence; Ports at the east coast and Manchuria remain the most industrially regions	Damas (2014)
1950–1960 Decades	Soviet ideas influenced the economy for a short term. In the end of the 1960s, China began to approach with the West	Damas (2014)
1970 Decade	Communist party in power for more than 50 years; Employment predominantly aimed at the agricultural sector; Little industrial development	Bandt and Rawski (2008), Dutta (2005), Szirmai (2012)
1980 Decade	Improvement of the industrial techniques; Insertion of the first multinationals in the country; Population migration to urban centres; Regional imbalances due to migration and tax incentives on the coast; High investment in basic and technical education	Bandt and Rawski (2008), Zhang and Kanbur (2005)
1990 Decade	Domestic production and consumer goods increase; Effective beginning of the national development; Accumulation of capital by Chinese entrepreneurs; Growth in the number of employees in the industrial sector; Industrial agglomerations in certain Chinese regions	Long and Zhang (2011), Motohashi (2006)
2000–2010	Improvement of the higher education; Stability of the economic indicators; Climate, sustainability and public health issues are being discussed	Huang (2000), Liang and Xia (2005)

Table 2. The classification of industrial activities by technological level

Industrial categories	Technological level
Food and beverage	Low technology (L)
Tobacco	Low technology (L)
Textiles	Low technology (L)
Clothing	Low technology (L)
Leather	Low technology (L)
Wood products (excl. furniture)	Low technology (L)
Paper products	Low technology (L)
Printing and publishing	Low technology (L)
Petroleum coke and derivatives	Mid-low technology (ML)
Chemicals and chemical products	Mid-high technology (MH)
Rubber and plastic products	Mid-low technology (ML)
Non-metallic mineral products	Mid-low technology (ML)
Base metals	Mid-low technology (ML)
Metal products	Mid-low technology (ML)
Machinery and equipment	Mid-high technology (MH)
Machinery office and computer products	High technology (H)
Electrical machinery and equipment	Mid-high technology (MH)
Radio, TV and communication equipment	High technology (H)
Medical instruments, optical and precision	High technology (H)
Motor vehicles, trailers, semitrailers	Mid-high technology (MH)
Other equipment and transport vehicles	Mid-high technology (MH)
Furniture	Low technology (L)
Recycling	Low technology (L)

Source: UNIDO (2013).

Table 2 lists the industrial activities classified by the UN with their relative technological levels. The aggregation of these variables by technological level was selected in view of the literature inferences about the various effects that each technological level has on economic growth and development. In this regard, the OECD classification was used.

The HDI and the GDP were the dependent variables selected for the study because of the influence that production exerts them, as well as for their use as standard economic development parameters.

The HDI data were extracted from the UN website, and as some data were not available for the entire period, it was necessary to perform data interpolation with the data mining algorithm SMOReg, a role-based algorithm with a one application programming interface (API), which is used to forecast missing numbers (Shevade, Keerthi, Bhattacharyya, & Murthy, 2000). In relation to the GDP, the values (in millions of USD) were collected by the United Nations Conference on Trade and Development (UNCTAD) website. The data analysis procedures are summarized in Table 3.

In the OLS regression, the following four models were run:

- Regression (A): $GDP = \alpha + \beta_1 \cdot \Sigma \text{ Employees of the High Technology Industries} + \beta_2 \cdot \Sigma \text{ Employees of the Mid-high Technology} + \beta_3 \cdot \Sigma \text{ Employees of the Mid-low Technology Industries} + \beta_4 \cdot \Sigma \text{ Employees of the Mid-low Technology Industries} + \epsilon_t$

Table 3. Methodology’s procedure

Data analysis procedures	Software	Procedure
	Gretl software	Dickey–Fuller test to check the stationary condition of the series Models estimated by the ordinary least squares (OLS) method Ramsey RESET test to determine specification error models that may occur by the omission of a relevant variable White’s heteroscedasticity test to verify the occurrence of outliers or asymmetry in the distribution of one or more regressors Breusch–Godfrey test for autocorrelation conference between residues Variance Inflation Factor (VIF) test for determining the degree of multicollinearity of variables Multiple regression test to indicate the relationship of dependency and explanatory power between dependent and explanatory variables

- Regression (B): $HDI = \alpha + \beta_1 \cdot \Sigma \text{ Employees of the High Technology Industries} + \beta_2 \cdot \Sigma \text{ Employees of the Mid-high Technology} + \beta_3 \cdot \Sigma \text{ Employees of the Mid-low Technology Industries} + \beta_4 \cdot \Sigma \text{ Employees of the Mid-low Technology Industries} + \varepsilon_i$;
- Regression (C): $GDP = \alpha + \beta_1 \cdot \Sigma \text{ Establishments of the High Technology Industry} + \beta_2 \cdot \Sigma \text{ Establishments of the Mid-high Technology Industry} + \beta_3 \cdot \Sigma \text{ Establishments of the Mid-low Technology Industry} + \beta_4 \cdot \Sigma \text{ Establishments of the Low Technology Industry} + \varepsilon_i$; and
- Regression (D): $HDI = \alpha + \beta_1 \cdot \Sigma \text{ Establishments of the High Technology Industry} + \beta_2 \cdot \Sigma \text{ Establishments of the Mid-high Technology Industry} + \beta_3 \cdot \Sigma \text{ Establishments of the Mid-low Technology Industry} + \beta_4 \cdot \Sigma \text{ Establishments of the Low Technology Industry} + \varepsilon_i$, where $\alpha = y$ intercept, β_i = angular coefficients and ε_i = errors.

All the variables in all regressions were changed into their logarithmic forms. It is important to mention that before making the econometric estimates the augmented Dickey–Fuller (ADF) test was run for all variables to investigate the stationary condition of the series. In variables with a unit root, the authors applied the first differences to make them stationary. In sequence, after checking the stationary variable, the econometric model was run. With the results, statistical tests were done to identify potential econometric problems. Gujarati (1995) and Sweeney, Williams, and Anderson (2007) were the sources used to explain the following tests.

- (1) Ramsey RESET test: This was performed in order to check the absence of an important variable in the regression and/or inappropriate functional form. The null hypothesis is that the original regression was correctly specified.
- (2) White’s heteroscedasticity test: This was used to test if the standard errors of the estimated coefficients are biased. The test’s model is homoscedastic in the null hypothesis.
- (3) Autocorrelation test (Breusch–Godfrey): The presence of correlation in the residuals may indicate variable specification problems. The hypothesis of this test is that there is no serial correlation.
- (4) Variance inflation factor (VIF) test: This test was used to indicate the existence of strong correlations between two or more independent variables. An alternative remedy for multicollinearity is the removal of one of the variables (Gujarati, 1995). A value greater than 10 in the VIF test means a high multicollinearity.

For a better understanding of the statistics path, the data analysis procedures are summarized below:

Procedure and Data Analysis	Software	Procedure
	GRETl	Dickey–Fuller Test to check the series stationary
		Models estimated by the ordinary least squares (OLS) method
		Ramsey RESET test to determine specification error models that may occur by the omission of a relevant variable
		White’s heteroscedasticity test to verify the occurrence of outliers, or asymmetry in the distribution of one or more repressors
		Breusch–Godfrey test for autocorrelation conference between residues
		Inflation factor of the variance (IFV) test for determining the degree of multicollinearity of variables
Multiple regression test to indicate the relationship of dependency and explanatory power between dependent and explanatory variables		

Source: The Authors (2017).

Table 4. Regression (1): OLS 1990–2010. Regression of employees according to each technological level x GDP with the critical tests to the quality of the models

Variable	Coefficient	Standard error	p-value
Constant	0.137491	0.0168207	<0.00001
High	0.00651219	0.0143072	0.65597
Mid-high	0.12379	0.206055	0.55760
Mid-low	0.533525	0.166041	0.00625
Low	-0.561249	0.201996	0.01479
Reset = 1.56	White = 15.8	LM = 1.33	IFV
			High - 1.335
			Mid-High - 1.650
			Mid-Low - 2.049
			Low - 2.689
Normality test (Jarque–Bera sig 1%): 1.21			

Source: The Authors; adapted from Gretl (2017).

4. Results and discussion

The regression analysis was used to model the relationship between the proxies of the industry with the economic growth and development. The regressions enabled the measurement of the strength of the association between them. The estimate was made on Gretl free software after ensuring that all series were stationary series.

4.1. Regression models for the GDP and the HDI according to the variable “employees of the four technological levels”

The OLS was rolled in order to check the correlation for Employees x GDP (Table 4 and Graph 1) and Employees x HDI (Table 5 and Graph 2).

Analysing the results of Table 4, with a significance level of 95%, it can be said that the number of employees of the ML and low technology positively influences the Chinese GDP.

With a positive variation of 1% in the number of employees of the ML technology industries, the GDP is positively affected by approximately 0.5%. Another segment that also had significance was the low technology segment, although the segment tends to negatively influence the GDP. Possible explanation of this negative relation can derive from the marginal productivity of the workers of this technological level, which can already be nearly zero, even negative. That is, you can increase the workforce used in the industry, but in a non-sensitive way will improve production in the level of

Graph 1. Graph of the regression (1) result.

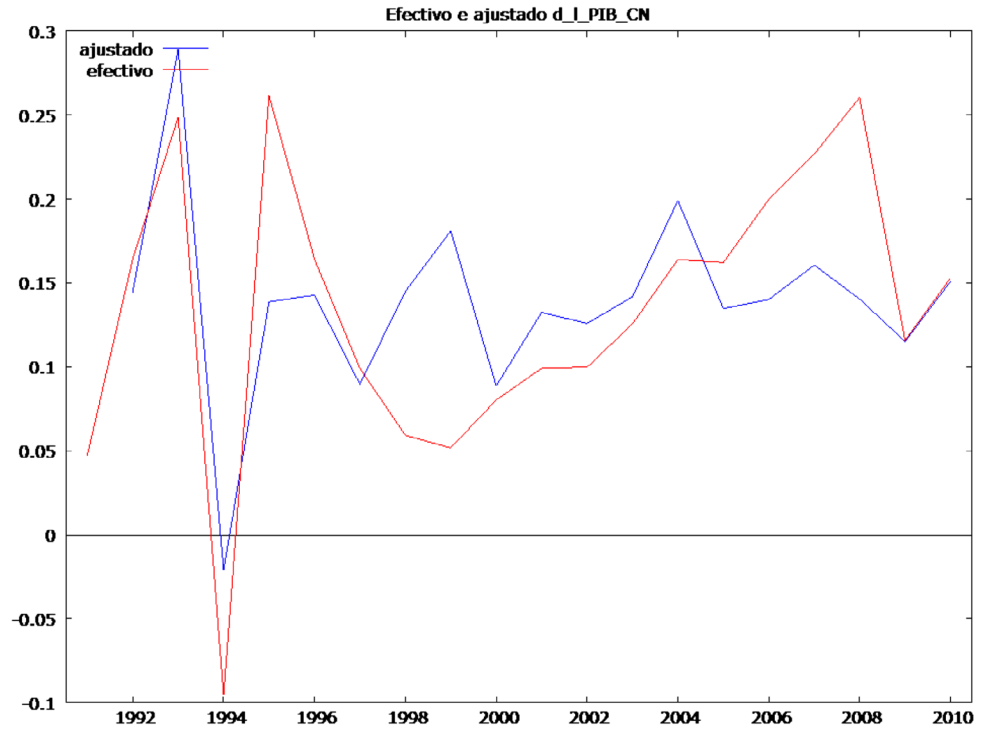


Table 5. Regression (2): OLS 1990–2010. Regression of employees according to each technological level x HDI with the critical tests to the quality of the models

Variable	Coefficient	Standard error	p-value
Constant	-0.000689182	0.00757635	0.92891
High	0.00472936	0.0062732	0.46435
Mid-high	-0.00101174	0.0903499	0.99124
Mid-low	-0.0107806	0.072809	0.88456
Low	0.0234465	0.0886207	0.79549
Reset = 2.58	White = 12.95	LM = 3.77 (p-valor 0.07)	IFV
			High - 1.335
			Mid-high - 1.64
			Mid-low - 2.04
			Low - 2.68

Normality test (Jarque-Bera sig 1%): 6.06

Source: The Authors; Adapted from Gretl (2017).

sensitizing the productivity. Another supposition, complementary, refers to the aggregation of value, which is lower in this level of technology than in the others (Bandt & Rawski, 2008). The MH and H technology levels do not significantly influence the GDP.

Considering the regression (2) presented on Table 5, the regression did not show any significance, so it is assumed that the variable “amount of employed people” does not significantly influence the HDI. However, there are studies that indicate positive relationship between employability and development (Lang & Kamiar, 1990; Ndedi, 2009). Lang and Kamiar (1990) say that, for the sub-Saharan region, job supply in the region directly reflects people’s QoL. However, such a relationship can be defined by the fact that there is not a middle class, but rather a little middle-class or even an upper

Graph 2. Graph of the regression (2) result.

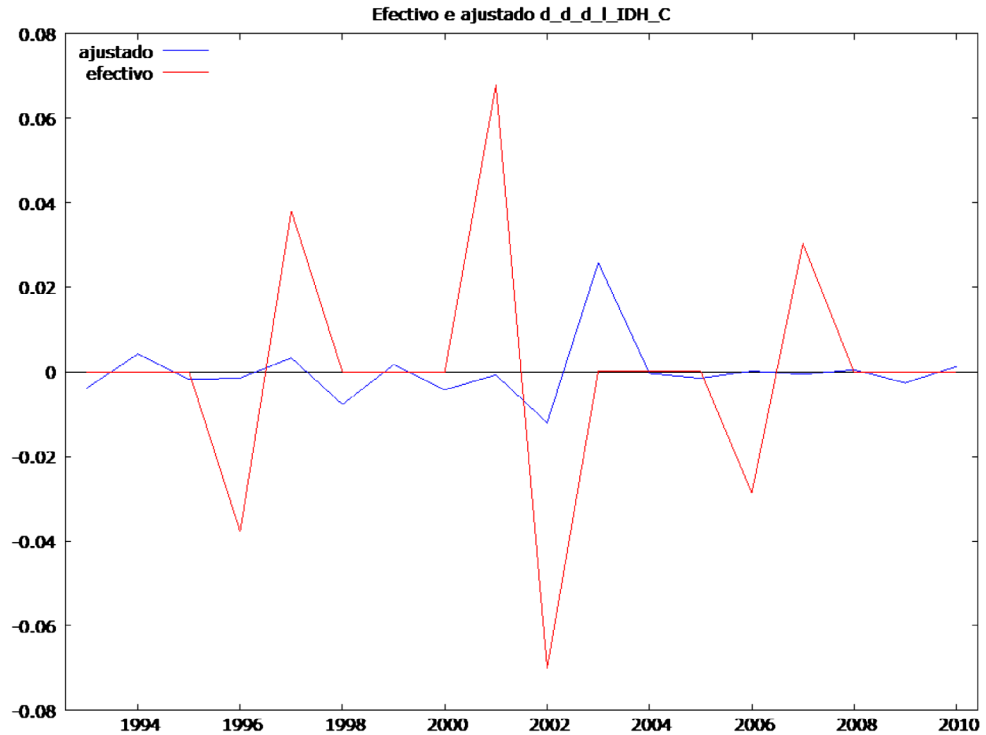


Table 6. Regression (3): Cochrane Orcutt model. Regression of employees according to each technological level x HDI

Variable	Coefficient	Standard error	p-value
Constant	-0.000579004	0.00395914	0.88616
High	-0.00488021	0.00458646	0.30825
Mid-high	0.131284	0.091499	0.17689
Mid-low	-0.0701947	0.0996116	0.49446
Low	0.0220084	0.0980616	0.82620

Source: The Authors; Adapted from Gretl (2017).

middle-class population, and a great amount of people living in extreme poverty. Indeed, any interference in the variable “employability” has an immediate effect on social indicators.

As the regression (2) showed some specification problems when running the autocorrelation test, the authors decided to apply the Cochrane Orcutt model, which can correct this problem (Gujarati, 1995). The results are presented on Table 6.

The results of the Orcutt model confirmed thus the non-significant influence of the number of employees in the HDI.

4.2. Regression models for the GDP and the HDI according to the variable “Number of establishments opened to each technological level”

Analyzing the variable “Number of Establishments Opened” x GDP and then for the HDI, we have (Table 7).

Even though Medium-High, Medium-Low and Low technology levels had low p-value, the Low Technology level is more statistically significant (p value: 0.007). In other words, the Chinese

Table 7. Regression (4): OLS 1990–2010. Regression of number of establishments opened according to each technological level x GDP with the critical tests to the quality of the models

Variable	Coefficient	Standard error	p-value
Constant	0.14311	0.0159368	<0.00001
High	0.0795691	0.0502174	0.13540
Mid-high	0.439423	0.206109	0.05120
Mid-low	0.810257	0.435296	0.08382
Low	-1.46646	0.469835	0.00751
Reset = 1.09	White = 16	LM = 1.33	IFV
			High - 3.72
			Mid-high - 17.02
			Mid-low - 17.55
			Low - 97.09

Source: The Authors; Adapted from Gretl (2017).

Table 8. Regression (5): OLS 1990–2010. Regression of the number of all establishments opened (TOTAL) x GDP with the critical tests to the quality of the models

Variable	Coefficient	Standard error	p-value
Constant	0.139036	0.0203217	<0.00001
Total	-0.0131706	0.0595917	0.82771
Reset = 1.11	White = 0.14	LM = 0.23	IFV
			N/A

Normality test (Jarque–Bera sig. 1%): 4.33

Source: The Authors; Adapted from Gretl (2017).

clustering not only determined the national industrialization type but also the regional, such as the development of the steel, chemical, metal mechanic and clothing industries, which were particularly important, as verified on Long and Zhang’s (2011) study. This labour-intensive production, that dominated China’s early industrial process, was already identified in the theory background, so, in a way, it was already expected.

When applying the statistical tests for the model validation, a high degree of multicollinearity and correlation was identified among the explanatory variables. There is, therefore, a strong correlation between the independent variables. In these cases, Gujarati (1995) advises the withdrawal of one of the variables to test again, or even the union of values of the similar variables. The decision was to add/join the variables, given the correlation between them. Table 8 and Graph 3 shows the new regression model.

The results infer the non-effect of the number of establishments on the economic dynamics of China, i.e. the establishments (considering all the technological levels) do not significantly influence the GDP. This result is possibly a reflection of the existence of an already consolidated productive park, in which the increase in the number of establishments is not the differential, but the change in the productive form, with technological innovations and/or product innovation. Another reason might be the “First Great Leap Industrialization” phase (1950–1960) in which Mao exerted money into industrial production, by using the money that before only went to agricultural means. The “Third Leap Industrialization” phase (from 1980 on) also contributed for this greater development, when diverse amount of multinationals landed in the country (Bijian, 2005).

Reviewing the HDI analysis, it is possible to find the following results (Table 9).

Graph 3. Graph of the regression (5) result.

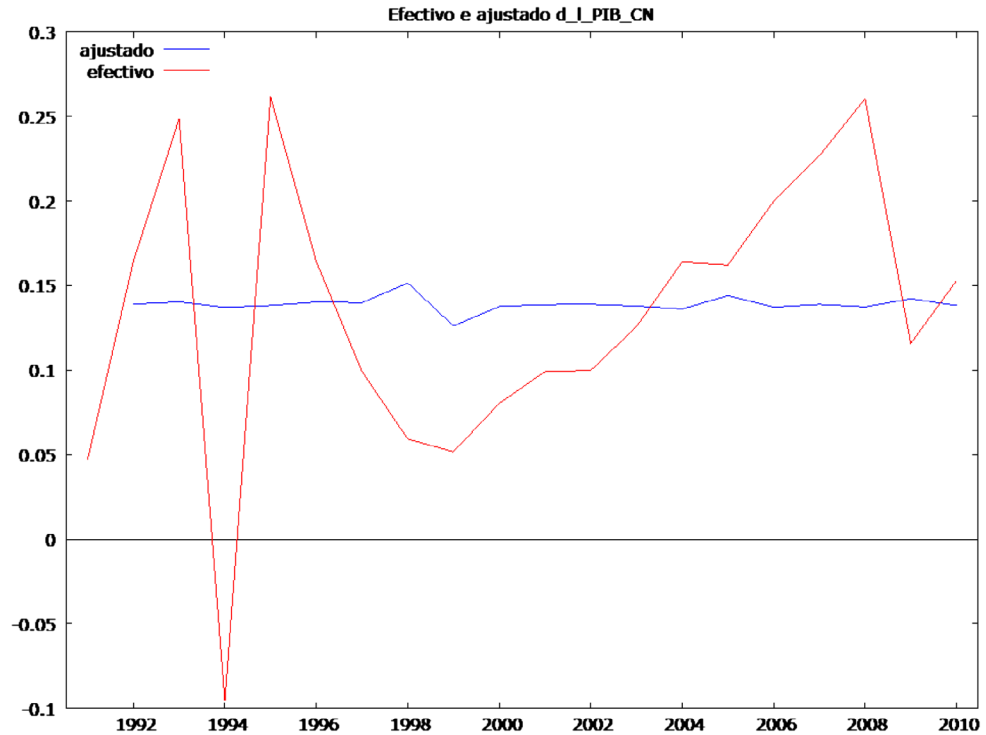


Table 9. Regression (6): OLS 1990–2010. Regression of number of establishments opened according to each technological level x HDI with the critical tests to the quality of the models

Variable	Coefficient	Standard error	p-value
Constant	3.24798e-05	0.00771873	0.99671
High	-0.00418439	0.0239043	0.86374
Mid-high	-0.0386619	0.0987948	0.70189
Mid-low	0.0374202	0.205582	0.85837
Low	-0.00502192	0.222848	0.98236
Reset = 0.17	White = 13.92	LM = 4.49	IFV
			High - 3.78
			Mid-high - 17.57
			Mid-low - 117.56
			Low - 97.93

Source: The Authors; Adapted from Gretl (2017).

The equation presented in the OLS equation has, basically, no significance. So, in order to test its effectiveness, statistical tests were run. The results demonstrated a high degree of multicollinearity and correlation among the independent variables. Seeking to solve this problem among the dependent variables, the authors decided to add the values of the variables. The new regression model is displayed below (Table 10 and Graph 4).

With the results, it is possible to say that there is no significance of any technological level in the Human Development Index. After checking the accuracy of the regression number 7 via statistical tests, it is possible to confirm that the HDI is not influenced by any technology level. Wade (1990) cites an example that can explain this.

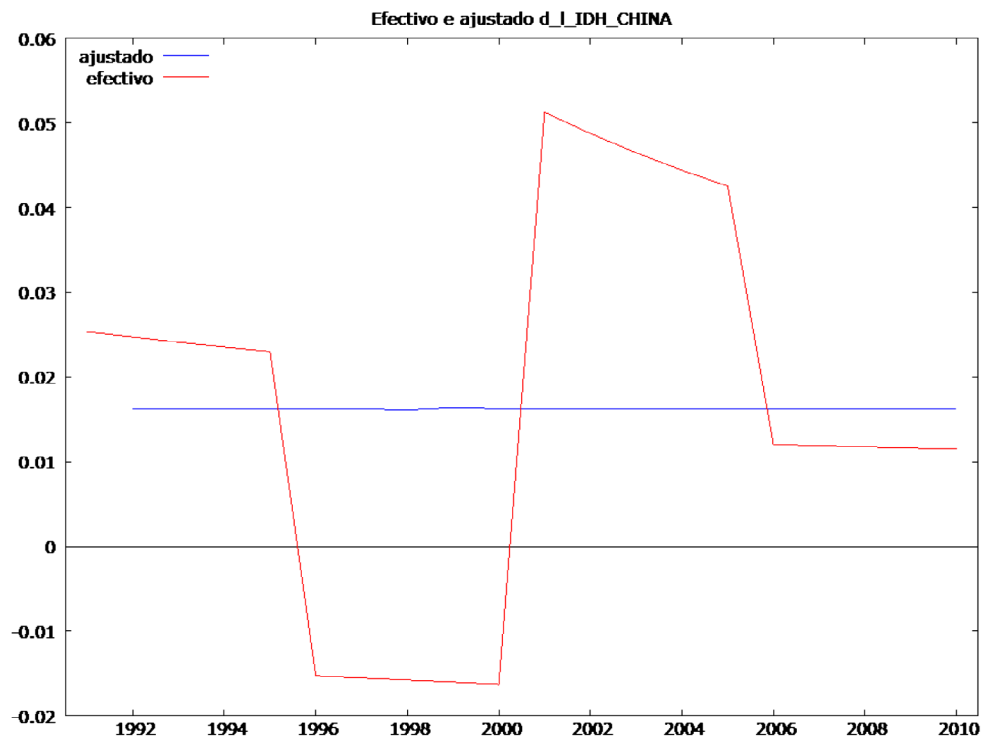
Table 10. Regression (7): OLS 1990–2010. Regression of the number of all establishments opened (TOTAL) x HDI with the critical tests to the quality of the models

Variable	Coefficient	Standard error	p-value
Constant	2.96719e-05	0.00700304	0.99667
Total	-0.000840285	0.0199882	0.96699
Reset = 0.005	White = 0.84	LM = 5.01 (p-value: 0.04)	IFV
			N/A

Normality test (Jarque–Bera sig. 1%): 1.30

Source: The Authors; Adapted from Gretl (2017).

Graph 4. Graph of the regression (7) result.



A place can have a large number of industries and still have a low HDI, as this indicator is more related to income distribution and QoL than to production or number of enterprises itself.

4.3. Compilation of the results

In order to provide a summary of the results presented for China, Table 11 compiles the dependent and independent variables with their results.

From Table 11 and from the regressions presented in this section of the study, it is possible to summarize that neither the number of employees nor the number of establishments influences the

Table 11. Summary of the estimated results for China

Employees x GDP	Mid-low technology
Employees x HDI	Not very significant
Establishments x GDP	Not very significant
Establishments x IDH	Not very significant

Source: The Authors (2017).

Chinese HDI. In the GDP sphere, only the amount number of employees can significantly wield influence on this indicator. Oluwatobi and Ogunrinola (2011) found in their studies about human capital and development that employability has a positive relation with GDP in the short term; however, in the long term, investment is more positively correlated with the HDI, given the market dynamics. Investment becomes the key to tackling the crisis of unemployment and poverty in developing countries. Thus, FDIs, or even government incentives, can direct the productive dynamics, stimulating entrepreneurship and attracting innovations, either in products or services (outputs) or in processes (Adenutsi, 2009).

Another possible strand for the results of this section is based on the Thirlwall law, which does not advocate economic growth through technological progress, nor by the labour force, but rather that on the balance of payments of a country's import and export (Esteves & Correia, 2010). According to Thirlwall's model, income elasticity of export demand and income elasticity of import demand are decisive in a country's economic growth, where the first one has a positive effect and the latter has a negative one. Thus, rather than producing, the importance for the dynamics of economic growth lies in the production of goods with high income elasticity and then exporting them.

5. Conclusion

The intensification of investments, particularly the direct external ones, in the Chinese economy has been perceived since the last decades of the twentieth century. This paper presented during the theoretical reference the importance of such investments in the economic development of China. Concomitant to the FDIs, the public policies from 1950 helped in this development with the increase of industrialization provided by FDIs.

It is understood that the population is consuming more, which helps economy because there is more money and opportunities in the market, and with this, more capital available. In parallel, there are comparative studies of developing countries with different income levels suggesting that they tend to present a common development process. So, based on this idea, the research compared whether the industrial segments that most favoured the evolution of the HDI and GDP in China between 1990 and 2010 were similar or different. To achieve this, linear regression models were performed for the GDP and the HDI, considering valid results with a significance level of 95%.

For China, only the number of employees in the mid-low tech industries influenced the GDP, whereas no technological sector was significant for the improvement of the HDI. Although the results culminated in the mid-low technology intensities, the importance of investments and development policies in the high and mid-high segments are necessary, evidenced not only by the real wage change that they cause in the worker's income, and consequently in their quality of life, but also by the fact that it enables the growth of the companies as a whole. It is, however, understood, that technology diffusion and improvement cannot be automatic; it is an effort process.

In another current strand, China is known for having serious problems with pollution. In this sense, the country should prioritize and encourage the transformation of some traditional industry and implement more green manufacturing projects, looking for clean production and low-carbon emission. Such policies can develop technology and innovation promoting social progress.

This study has some limitation. Firstly, an empirical investigation using a larger time series of data, perhaps from other sources, would give more statistical robustness to the study. Secondly, industrialization is a very complex and long topic, which cannot be completely analysed in a few pages. In terms of further research, it is suggested to include FDI as an independent variable.

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