

Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies



BACHELOR THESIS

THE WORLD TURNED UPSIDE DOWN

Author: **Dominika Nettwallová**

Supervisor: **doc. Ing. Tomáš Cahlík, CSc.**

Academic Year: **2012/2013**

Declaration of Authorship

The author hereby declares that she compiled this thesis independently, using only the listed resources and literature.

The author grants to Charles University permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, May 17, 2013

Signature

Acknowledgments

The author is grateful to doc. Ing. Tomáš Cahlík, CSc., who kindly and with peerless enthusiasm supervised her bachelor thesis work.

Special thanks go to her family and close friends for their support and consults, especially to Ye Chum.

Bibliographic record

NETTWALLOVÁ, Dominika. *The World Turned Upside Down*. Prague, 2013. 56 pg. Bachelor thesis (Bc.) Charles University in Prague, Faculty of Social Sciences, Institute of Economic studies. Supervisor: doc. Ing. Tomáš Cahlík, CSc.

Abstract

This bachelor thesis is dedicated to China and to the determinants of its GDP growth. During 20th century, this formerly developing country has earned a place among economic giants. The following report, quietly admiring such achievement, is focused on analysis of individual growth factors and causes of their development; and followed by quantitative estimation of their size. The main topic, then, is a triad of factors - R&D, education and human capital – projected on the Chinese economy via several chosen econometric methods.

JEL Classification

C33, I25, J01, O15, O32, O40, O53

Keywords

China, economic growth, R&D, labour force, education, panel data analysis

Author's e-mail

d.nettwall@gmail.com

Supervisor's e-mail

cahlik@fsv.cuni.cz

Abstrakt

Tato bakalářská práce je věnována Číně a determinantům růstu jejího HDP. V průběhu 20. století si tato země, která původně patřila k zemím rozvojovým, dokázala vydobýt místo mezi ekonomickými giganty. Následující ekonomická analýza, skládající se z několika vybraných ekonometrických metod, je zaměřena na rozbor jednotlivých růstových faktorů, příčiny jejich rozvoje a následný kvantitativní odhad jejich velikosti. Středobodem celé práce je pak triáda R&D, vzdělání a lidské zdroje, která se prostřednictvím několika vybraných ekonometrických metod promítá na plátno rozvoje čínské ekonomiky.

Klasifikace

C33, I25, J01, O15, O32, O40, O53

Klíčová slova

Čína, ekonomický růst, R&D, lidské zdroje, vzdělání, analýza panelových dat

E-mail autora

d.nettwall@gmail.com

E-mail vedoucího práce

cahlik@fsv.cuni.cz

CONTENTS

LIST OF TABLES	ii
LIST OF FIGURES	iii
ACRONYMS	iv
BACHELOR THESIS PROPOSAL	v
1 INTRODUCTION	1
2 THE RISE OF CHINA	2
2.1 THE DAYS OF CHAIRMAN MAO	2
2.2 KEY REFORMS TO SUCCESS	4
3 DETERMINING GROWTH FACTORS	6
3.1 TIME FOR LIBERALIZATION	7
3.2 ATTRACTING THE WORLD	10
3.3 HOW TO COMPETE?	15
3.4 RESOURCES IN HUMAN CAPITAL	16
3.5 ABANDONING A DUAL-SECTOR MODEL	20
3.6 CHALLENGING TASK FOR THE GOVERNMENT	22
3.7 FINANCIAL SECTOR	24
3.8 CONCLUDING REMARKS	28
4 QUANTITATIVE ANALYSIS	29
4.1 DATA	31
4.1.1 <i>Modelling procedure</i>	31
4.1.2 <i>Limitations</i>	32
4.2 EMPIRICAL EVIDENCE	33
4.2.1 <i>Methodology</i>	34
4.2.2 <i>Overall model</i>	36
4.2.3 <i>R&D sector modelling</i>	42
4.2.4 <i>Effects of education</i>	44
4.2.5 <i>Instrumental variable approach</i>	46
4.3 CONCLUDING REMARKS	48
5 CONCLUSION	49
BIBLIOGRAPHY	51
APPENDIX	54

LIST OF TABLES

Table 1: China's GDP as percent of GDP for other large nations	30
Table 2: China's per capita GDP as a percent of figures for other nations	31
Table 3: Overall model - list of variables	36
Table 4: Overall model - testing of assumptions	37
Table 5: Overall model - Summary of estimates	37
Table 6: R&D sector - Summary of estimates - short vs. long perspective	43
Table 7: Education sector - Summary of estimates - short vs. long perspective	45
Table 8: IV & 2SLS approach - Summary of estimates	46
Table 9: Instrumental variable approach - testing of assumptions	48
Table 10: R&D sector model - testing of assumptions	54
Table 11: Education sector model - testing of assumptions	54
Table 12: List of variables	55

LIST OF FIGURES

Figure 1: Direct investment inward - China	11
Figure 2: Total expenditure on R&D - comparison	13
Figure 3: Total expenditure on R&D - China	14
Figure 4: Qualified engineers	17
Figure 5: Demographic transition - China case	19
Figure 6: Kuznets Curve - cross sectional study	21
Figure 7: Kuznets Curve - China case	22
Figure 8: Total PPP Converted GDP	24
Figure 9: GDP PPP growth rate	25
Figure 10: Outstanding Shares	27
Figure 11: Overall productivity - real growth	38
Figure 12: Adaptability of companies	39
Figure 13: Employment by sector / Industry	40
Figure 14: Total expenditure on R&D (%)	41

ACRONYMS

2SLS	Two Stage Least Squares
FDI	Foreign direct investment
FE	Fixed effects
GDP	Gross domestic product
GDP PPP	Gross domestic product Purchasing Power Parity
G-K method	Geary-Khamis method
HAC	Heteroskedasticity and Autororelation Consistent
IMD	Institute for Management Development
IMF	International monetary fund
IV	Instrumental variable
LM	Lagrange Multiplier
MCAR	Missing Completely At Random
MNAR	Missing Not At Random
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PhD	Philosophiæ doctor
pp	Percentage point
PWT	Penn World Table
R&D	Research and development
RE	Random effects
RMB	Renminbi
S&E	Science and engineering
SE	Standard Error
SME	Small and Medium Enterprise
USA	United States of America
WCY	World Competitiveness Yearbook
WTO	World Trade Organization

BACHELOR THESIS PROPOSAL

UNIVERSITAS CAROLINA PRAGENSIS
založena 1348

Univerzita Karlova v Praze
Fakulta sociálních věd
Institut ekonomických studií



Opletalova 26
110 00 Praha 1
TEL: 222 112 330,305
TEL/FAX:
E-mail:
ies@mbox.fsv.cuni.cz
<http://ies.fsv.cuni.cz>

TEZE BAKALÁŘSKÉ PRÁCE

Student:	Dominika Nettwallová
Obor:	Ekonomie
Konzultant:	Doc. Ing. Tomáš Cahlík CSc.

Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

Předpokládaný název BP:

The world turned upside down

Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

The economic world has known the developing countries mainly as a source of cheap labour. Producers all over the world saw the potential of minimizing production costs. That's why emerging markets, such as China and India, passed for good locations to move the production to. What is the situation now? Those emerging markets truly kept to their names and have successfully emerged. Not only are they coming up with new products and services that are cheaper than their western competitors, but also are becoming leaders in innovation! Their position on global market is getting stronger. So, the real question at the end is: Do the developed countries even have the chance to compete?

Struktura BP:

Abstract:

The aim of my thesis is based on economic development and current situation of developing countries, China and India in particular, to measure the competitiveness of those countries in global terms and perhaps to forecast their future position on global market.

I would direct my attention to the economic impact of the foreign investment, the presence of foreign firms using local low-cost production, the investment into education, R&D and other factors.

I would also like to base my statements and conclusions on IMF, OECD, UNDP and World Bank annual reports, selected works etc.

Outline:

Introduction

Summary of historical economic development, starting point

Entrance on global market (advantages, disadvantages) – which position they took

Further economic development – investments, role of government ...; comparison

Taking the lead? – current situation

Supposed development in the future – prognoses, estimates

Conclusions

Seznam základních pramenů a odborné literatury:

UNCTAD: TDR2002 - Developing Countries in World Trade

UNCTAD: TDR2008 - Commodity prices, capital flows and the financing of investment

UNCTAD: LDC2007 - Knowledge, Technological Learning and Innovation for Development

UNCTAD: LDC2006 - Developing Productive Capacities

UNCTAD: WIR2006 - FDI from Developing and Transition Economies: Implications for Development

Tarun Khanna and Jan W. Rivkin, "ESTIMATING THE PERFORMANCE EFFECTS OF BUSINESS GROUPS IN EMERGING MARKETS.," *Strategic Management Journal* 22, no. 1 (January 2001): 45.

Tarun Khanna and Krishna G. Palepu, "Emerging Giants. (cover story)," *Harvard Business Review* 84, no. 10 (October 2006): 60-69.

Yasheng Huang and Tarun Khanna, "Can India Overtake China?," *Foreign Policy*, no. 137 (July 2003): 74.

Yadong Luo and Rosalie L Tung, "International expansion of emerging market enterprises: A springboard perspective," *Journal of International Business Studies* 38, no. 4 (4, 2007): 481-498.

1 INTRODUCTION

The economic world has known the developing countries – from the production point of view – mainly as a source of cheap labour. Producers all over the world, according to the thesis of rational behaviour, seeking the opportunities of minimizing production costs saw their unutilized potential. That is why emerging markets, such as China or India, passed for good locations where to reallocate the production.

Those emerging markets truly kept to their names and have successfully emerged. Not only are they coming up with new products and services that are cheaper than what their western competitors can offer, but they are also becoming leaders in development and innovation.

Let us¹ introduce the world situation with a quote from an article by Adrian Wooldrige in (The Economist, 2010): “The United Nations World Investment Report calculates that there are now around 21,500 multinationals based in the emerging world. The best of these, such as India’s Bharat Forge in forging, China’s BYD in batteries and Brazil’s Embraer in jet aircraft, are as good as anybody in the world. The number of companies from Brazil, India, China or Russia on the Financial Times 500 list² more than quadrupled in 2006-08, from 15 to 62. Brazilian top 20 multinationals more than doubled their foreign assets in a single year, 2006.”

Especially China’s rapid growth stands out even among its Asian neighbours during the late 20th century – called Asian tigers. Based on China’s economic growth and worldwide recognition many wonder if this phenomenon will continue and whether this emerging country can truly become the world leader. This thesis sets ahead of itself the task of exploring such questions. We will focus especially on the fields of Chinese R&D, education and their specific labour force endowment.

¹ According to the common practice in academic literature, the author refers to herself by ‘we’.

² FT Global 500 is an annual report providing a snapshot of the world’s largest companies ranked by market capitalisation. This ranking gives a picture of how corporate fortunes have changed in the past year.
<http://www.ft.com/intl/companies/ft500>

To better understand the whole context of China's rise, in SECTION 2, we will briefly summarize the Chinese development in 20th century and cover its most important milestones. In SECTION 3, we will discuss more current features of Chinese economy and the influence of different growth factors. Prime focus, in SECTION 4, will be quantitative analysis of China's significant growth factors. In SECTION 5, we will represent the results and provide conclusion.

2 THE RISE OF CHINA

At the beginning of 20th century, China struggled with natural disasters, civil unrest, imperial decline and foreign invasion. Levels of income and consumption were remarkably low, and life expectancy was 36 years.

The years of pre-World War II registered only a mild growth, which helped to shape two growth epicentres – the Yangzi Delta area around Shanghai and the north-eastern provinces mediating Japanese capital and technology. It is interesting to point out that China's share of world trade and ratio of foreign trade to GDP before the collapse of international trade caused by the Great Depression were not retrieved for over sixty years (Lardy, 1994; Brandt & Rawski, 2008).

2.1 The days of Chairman Mao

Following years, marked by war against Japanese invaders and later by civil feud between Communist and Kuomintang (translated as the Chinese Nationalist Party) forces, left newly established the People's Republic of China (October 1949) with economy ravaged by costly war and inflation. New political order and macroeconomic policies were quickly installed and massive social reconstruction and 'modernization' of China begun.

Our survey based on data from Penn World Table database covering 1953-1976, a period roughly concurrent with the hardest communism era in China, shows that China recorded an average annual growth of 6.88% in per capita GDP. During these years, China's economy

under central planning outperformed other populous developing nations, such as Brazil, India, Indonesia, Egypt and Mexico, often by considerable margins (Morawetz, 1978; Brandt & Rawski, 2008).

Chinese nation welcomed new order, modelled after Soviet experience based on state ownership and central control system, since it brought longing stability, curbed inflation and brought economic revival with 10% annual growth rate. With a Soviet help, they also managed to modernize industry and bring new technologies. On the other hand, China had to cope with stagnating productivity and inefficiencies due to central planning policy, which among others emphasised quantity rather than quality, neglected innovations and services. With this chosen path, China has also concluded itself from the rest of the world. For example, according to the U.S. Department of State – Office of the Historian, the events of 1949 causing China to fall under communism, “have led the United States to suspend diplomatic ties with the People’s Republic of China for decades”. Furthermore, such international isolation hindered Chinese economy and kept it below its potential.

Under plan system in to 1950s, China introduced better healthcare program which helped to lower infant mortality and increase life expectancy from 42.2 (45.6) years in 1950 to 66.4 (69.4) years in 1982 for males (females) (Brandt & Rawski, 2008). Census data also confirmed a spread of education. The proportion of people aged 16-65 without complete primary education reduced from 74% to 40% between 1952 and 1978. However, one of the biggest problems, which had not been resolved till at least the 1970s, was a food scarcity.

The situation in the villages was even harder than for the city dwellers. It was necessary to limit migration to the cities, due to considerable differences in income and chances for better education, housing and pensions. Hence, the regime instituted controls over the distribution of urban housing, food grains etc. and revived the *hukou* system of household registration (sometimes called *huji* system – the law in People's Republic of China requires a household registration record).

An important milestone for the People’s Republic of China was a death of Mao Zedong in 1976. At this point, the need for a change was a widespread notion. Even though, compared

to low-income countries China had performed well, China's position among its Asian brothers – Japan, South Korea, Taiwan and Hong Kong – was weak.

2.2 Key reforms to success

When economy operates well below its potential and is left with neglected opportunities to expand the production frontier, even a limited reform that at least partially encourages marketing, competition, mobility, price flexibility and innovation, could accelerate growth. Chronically malnourished labour force, which partly stands behind the underperforming economy, if properly encouraged, could release the desired additional energy. Recent work (Brandt & Rawski, 2008) states that partial market revival and an opening of at least minor opportunities for international trade and investments are necessary as well. China's experience, in contrast with Eastern Europe and former Soviet Union, showed that such simple initiatives can stimulate growth without actually significantly changing political structure and trade flows.

Collective farming was replaced by household cultivation. Subsequently, farmers gained extra motivation as they were allowed to claim the gains from their effort, rather than receive a small share of collective production, which contributed to raising productivity. Under these conditions, official purchase prices, particularly for grain, were increasing. Hence, farmers were given additional rewards from the extra effort. Subsequently, farm output increased, even though, the reformed agriculture sector embodied free market less than in early 1950s. Despite all of the distortions caused by government control, the reforms in the form of fitting incentives were able to give rural economy the right push.

Reforms quickly outreached the farm sector. What followed afterwards were urban reforms focused on performance of state-owned industry. These reforms had only limited impact on improving the performance of state-owned enterprises, however, they contributed to the upswing of rural industry and urban collective enterprises. All of that was achieved by opening new markets and new sources of materials, as well as technical expertise.

Another relevant reform step was a creation of dual price system based on splitting transactions into the plan and market components. In practice, after satisfying plan requirements, producers could distribute residual production at flexible prices. Hence, they were motivated to ‘grow out of plan’ (Naughton, 1995). This reform breathed economic life into businesses and households without a need for full liberalization of prices or privatization. It also helped to improve market allocation without endangering the importance of plan sector and causing a political turmoil.

Expanded price flexibility also supported the transfer of capital, labour, commodities, which have been hindered by the *hukou* system under the planned system. Entrepreneurs were given profit opportunities, and rural migrants could pursue new chances of employment first in nearby towns, later in distant cities. Also, long neglected tertiary sector was reviving. These market-oriented price reforms were the right stimulus for accelerated growth.

The late 1970s showed also need for a reform approach to international trade and investment. China established special economic zones in the South – in the Guangdong and Pujian provinces. The important fact is that these zones attracted entrepreneurs especially from Hong Kong and Taiwan, centres for small-scale manufacturing of labour-intensive exports. Such supply of entrepreneurial force turned these zones into a driving force of national growth and created a connection to world markets (Brandt & Rawski, 2008).

Low-cost Chinese labour and overseas market knowledge and capabilities created a new prospect of export opportunities, which they, as a result, embraced towards economic globalization and industrial upgrading. The emergence of foreign joint ventures brought Chinese workers in contact with new technical standards and engineering processes needed to become competitive on the global market, which further enhanced introduction of others reforms – such as public advertisements for recruiting employees (introduced in 1980s) or an equipment leasing (legally founded in 1990s).

The number of enterprises in China increased from 377,000 in 1980 to almost 8 million in 1996; according to the 2004 economic census, manufacturing firms accounted for 1.33 million, excluding enterprises with annual sales below RMB 5 million (Jefferson & Rawski,

1999; Economic Census, 2004). China's economy was revived by market competition, marked by advertising, price wars and the pursuit of financial gain. New orientation of Chinese economy on market competition also prompted households to reckon new benefits of further education. Despite the fact, the state policy increased costs of education paid by students.

One of the latest trends in Chinese economy is a perceptible growth of R&D spending, which amounted 1.39% of GDP in 2006 and 1.77% of GDP in 2010. An important role played also the shift of R&D activities from government agencies to enterprises. The second is the increasing influence of foreign firms, which gives Chinese firms the push for dynamic behaviour in order to beat the competition.

As we have shown in Section I, since 1970s China has implemented a number of necessary economic reforms and chosen a gradual path of transition. Following sections show that these reforms gave Chinese economy the right push. However, a rather conservative approach of the Chinese government left the country with still unfinished institutional reconstruction and other limitations caused by its planned system legacy.

3 DETERMINING GROWTH FACTORS

Three solid global players – United States, Europe and Japan – have slowly lost their dominance on the world market. In 2007, the developing world accounted for 49% of global GDP, up from 39% in 1990, and is likely to surpass the developed world within the next two decades (Accenture, 2007).

According to (Accenture, 2007), we can see the world today has been divided into multiple centres of economic power and activity because of three mutually-reinforcing trends:

First of all, due to the World Trade Organization's (WTO) support, which China accessed in 2001, governments successfully implemented policies to increase economic openness and trade liberalization. This had a huge impact on economic interdependence.

Secondly, as advanced technologies allowed faster communication and information gained increasing power, businesses were able to disaggregate their functions and activities geographically. As a result, not only brought such actions wide range of service activities but many were located in developing countries.

Thirdly, as we already mentioned above, the search for new opportunities – new markets, economies of scale – and new sources of capital and labour brought multinational companies in emerging markets.

3.1 Time for liberalization

What allowed the shifts and changes in economic development were especially waves of liberalization which helped to overcome protectionist barriers in developing countries.

In case of China, such actions seem to have been inevitable. In order to become successfully competitive, China's state enterprises had to change their business model. One of the changes came in 1997 with ownership reforms of the state-owned firms and legalization of private enterprises. Such epoch-making legislative measure and following reduction of legal barriers caused rapid growth of private enterprises in every sector of the economy. According to (Xiaodong, 2012), the share of total urban employment in domestic private enterprises and foreign-invested enterprises between 1998 and 2007 increased from 8 to 24%.

However, in the pursuit of recreating themselves as capitalist companies they found their own way. It is fair to say that not all forms of capitalism are the same. Scholars ordinarily distinguish two main capitalist industrial models with different approaches – market-oriented neo-liberal capitalism, illustrated by the United States or Britain, and a non-neoliberal organization-oriented capitalism, the case of Japan and Germany.

The main focus of Anglo-American model is the enterprise's share-market price. The research of (Chan & Unger, 2009) explains that enterprises following this model mainly try to boost short-term profits whilst putting a stress on accountability to shareholders. They prefer to treat the workforce under the conditions of a free labour market. Theoretically, every employee

decides regularly whether to seek the highest price for his or her skill; and management weighs the returns from its training costs and the risk that an employee may choose to leave. There is no further obligation above the labour contract. On the other hand, in Japan and Germany, enterprises rely more on bank-based financing; therefore, they are relatively insulated from the stock market's influence. That allows Japanese and German firms to focus more on long-term goals and reinvesting their profits, rather than distributing extensive dividends. It means that a firm is more inclined to provide an employee with a job security and seniority-based career in return of his or hers subsequent almost life-long commitment.

These differences are caused by their different path dependency effects, their own cultural background and historical development. Generally speaking, each system, based on the existing principle, has adapted to the political and economic conditions it faced. Hence, applying the same logic we can distinguish China's unique business model.

The 1920s and 1930s during Republican era in China brought new legal framework for industrial relations, state-corporatist tendencies and state interventions with efforts to limit a high labour turnover rate among skilled workers. In short, these were the preconditions for the *danwei* (socialist or the Maoist work unit) system (Chan & Unger, 2009).

1950s were marked by the power of Communist Party and nationalization of factories. At first, the obvious solution was to implement a Soviet-style wage system based on skills and output quotas. Nevertheless, under the influence of, *inter alia*, their cultural legacy, especially their traditional mark – Chinese respect for elders, and deeply held Maoist beliefs, they soon inclined to a work-year seniority system. The Chinese socialist *danwei* became something more than the usual workplace. It stood for a community which provided for everyday needs of the whole employees' families, jobs for their children etc. Alongside with no work mobility, in-house training and life-time employment security the *danwei* system shows a good resemblance to the Japanese system then. The Maoist industrial system had a centrally planned, authoritarian, nationalistic and collectivistic economy.

In the post-World War II times, Japan and China took different paths. In Japan, the collective welfare of the enterprise was preferred to those of the state and the individual. China, on the

other hand, was taken over by Mao's personality cult and the will of the Communist Party-state. *Danwei's* functions were affected by political control followed by purges and the need of meeting the targets set by Communist Party-state and relevant bureaus.

Extensive changes came after Mao's death, with economic reforms of Deng Xiaoping in the 1980s. These allowed firms to keep a great deal of their profits and enable management to a greater extent to decide how to spend the funds. After countless years of loyal service and what some may call self-denial, many thought that it is the right time for retribution and sharing of the new-found profits. A widespread phenomenon occurred in the 1980s – state-oriented enterprises started to evolve into organisation-oriented as employees' loyalties and business strategies focused on the welfare of the organization's community. A study of (Xie & Wu, 2008) observes, "it became the common expectation that managers would secure the retained funds and use them to upgrade workers' living standards. The better they fulfilled the expectation, the more legitimacy and popularity they would gain as *danwei* leaders".

The common practice in the Anglo-American system today is that the remuneration for work (across different companies in the same industry) is determined by the labour market, depending on his or hers skills. In China, on the other hand, workers employed in a more profitable *danwei* can earn up to 2.5 times more than those (otherwise comparable) employed in an unprofitable one (Xie & Wu, 2008).

The research of (Chan & Unger, 2009) also mentioned that the overall evidence of the prevailing business model is mixed. Under the influence of self-enrichment tendencies, there is also a strong pull in favour of the Anglo-American model of capitalism. However, the history implanted in many Chinese minds the idea of an 'enterprise family' (as Japanese call it) and important sense of loyalty. So, as long as the economy is growing, it may seem very probable that their specific organization-model will survive.

Until today, the biggest profitable enterprises remain under direct public ownership and in line with the central government policy. In 2007 state-owned or majority-controlled industrial firms accounted for only 20,680. According to (Chan & Unger, 2009), 10,074 of these industrial enterprises remained entirely state-owned (China Statistical Yearbook, 2008). The

smaller enterprises have been privatized, even though, a part of these have preserved similar characteristics, such as management style, labour relations and employee benefits, to the state-owned.

Nonetheless, gains from liberalizing changes and China's transition period have been already depleted. It seems that, as (Holz, 2005) study puts it, the economic transition could not be the sole cause of China's economic growth as China's economy have not stopped growing nor slowing down since.

3.2 Attracting the world

The dawn of 21th century proved China to be the world's largest emerging economy. Naturally, that could not escape the attention of any multinational corporation, and it did not. The paper (Jiatao & Jing, 2003) cites: "In 2000, more than \$40 billion was invested in China from companies around the world, and a further \$62 billion was committed as contractual FDI, investment pledged for future projects". These have further accelerated in following years as China entered the WTO, also became a major production centre for many multinational corporations. FIGURE 1 displays precisely the amount of direct investment flows. As we can see, since 2000 to 2011 the investments in 2011 even tripled.

Direct investment inward - China

Percentage of total employment

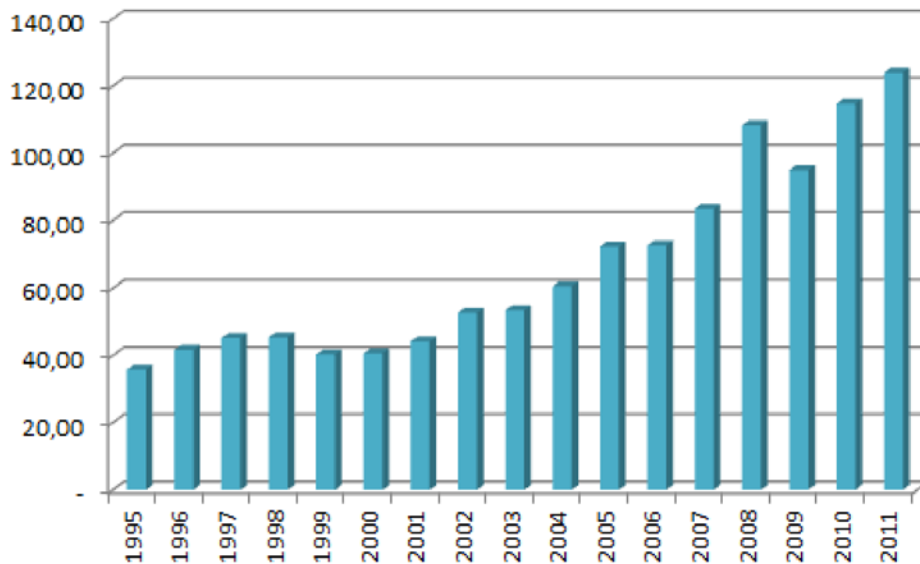


Figure 1 - own processing; data source: IMD World Competitiveness Yearbook Online

We have looked into the most recent analysis from 2007, which looked into the structure of foreign firms on the Chinese market. These data show that most of the foreign firms were involved in electronic products, textiles, clothes and shoes. Speaking in relative terms, FDI was substantial in computers, office machines, furniture, footwear, sport goods, where more than two thirds of the value added came from foreign-owned firms (Lundin, et al., 2007). The same study confirms that the foreign share of R&D expenditures was generally lower than the shares of other economic indicators. (Lundin, et al., 2007) research also states the following findings: the foreign share of R&D expenditures accounted for 50% or above in only three sectors – musical instruments and sport goods; leather and footwear; furniture.

Undeniably, China is one of the world's biggest recipients of foreign direct investment. For example, the number of foreign-owned firms increased by 150%, and in terms of absolute values, from 3,489 in 1998 to 8,745 in 2004 (Lundin, et al., 2007). The same report mentions a prevailing concern that FDI does not support indigenous technology development as it contributes to production and exports. The foreign share of R&D expenditures accounted

for 21% in 1998 and in 2004 increased only to 29%. (Lundin, et al., 2007) conclude that the effect of FDI on R&D can be indirect as the domestic firms pick up new experience and skills, and new competitive pressure on the market occurs; all because of an influx of foreign investors.

The faster spread of new information technologies led to an internationalization of industrial R&D, in other words multinational corporations were able to organize research activities more efficiently. In 1996-2000, more than 100 foreign R&D centres have been established in China (People's Daily, 2000). Such behaviour was partly a reflection of Chinese policy makers. They believed in technology's contribution to economic growth, and partly a demonstration of foreign firms' long-term commitment to China – one of the most important markets in the making.

By using international R&D alliances, firms can take advantage of the allied country and its scientific inputs. Multinationals can also modify their products or services to meet the local needs, achieve economies of scale and monitor their local competitors. One of many examples – Microsoft set up its research facility in Beijing in 1998 with a guarantee of 80 million dollars, the second outside the United States then (2003).

FIGURE 2 shows the development of the indigenous expenditures on R&D in China, Japan, South Korea and USA since 1995 till 2010. We might argue that developed economies, such as USA (with 2.73% of GDP) or geographically closer Japan (with 3.26% of GDP), are still ahead of China.

Total expenditure on R&D - comparison as a percentage of GDP

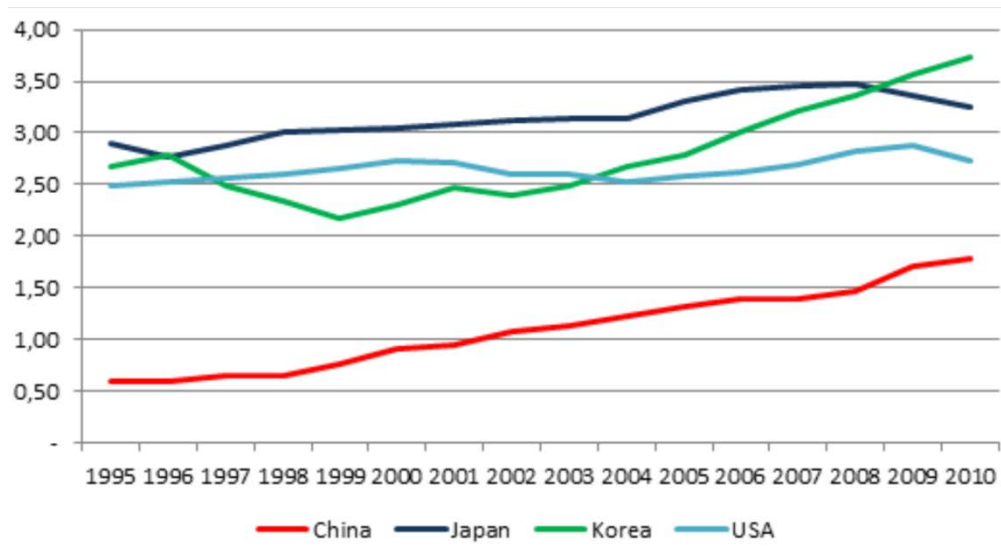


Figure 2 - own processing; data source: IMD World Competitiveness Yearbook Online

The question is why China should attract a special attention. First, since 1990s the global trend is to extend the investment focus from already traditional manufacturing to the knowledge-based services. By locating new R&D in China, the multinational corporations are able to adapt their products or services to the needs of the local market correspondingly. Let us also remind that Chinese population accounts for over 1.3 billion people. That is a considerable market indeed.

Second motivation for multinational corporations to conduct R&D activities in China is the overall fact that science and technology work here have been growing rapidly. FIGURE 3 depicts the rising interest of China in the R&D area. As we can see, in 2010 China has spent over \$100 billion on research and development, amounting 1.77% of total GDP. Since 2007, the total sum of expenditures on R&D in China more than doubled.

Total expenditure on R&D - China

in millions of dollars

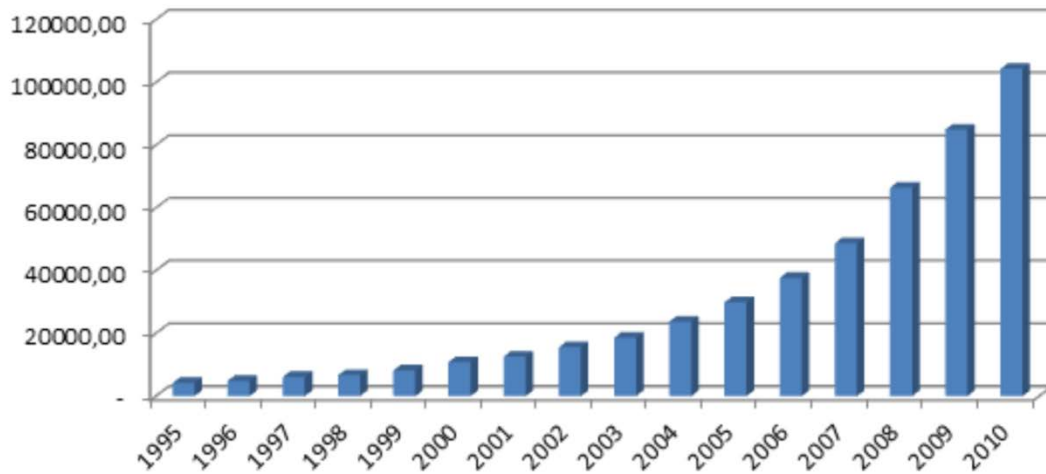


Figure 3 - own processing; data source: IMD World Competitiveness Yearbook Online

Chinese investment interest lays especially in pharmaceuticals, machinery, transport equipment, electronics, computers and office machinery; but there is, again, a big difference between domestic and foreign firms. Foreign R&D intensity is higher than domestic in only three sectors: non-metallic mineral products, ferrous metals, and non-ferrous metals (Lundin, et al., 2007).

The third reason for foreign investors to pay attention is that China offers one of the most abundant sources of human capital. The Chinese government estimates that over 2500 PhDs, 20 000 individuals with master's degrees, and 3000 other students have come back to China after finishing their studies abroad (Jiatiao & Jing, 2003). Multinationals can be motivated to expand R&D activities in China because of the fairly low cost of China's skilled labour force. (Khanna & Palepu, 2006) study argues that "local companies hire these people at salaries much lower than those that engineers in developed markets earn, since institutional voids pervade the talent market in India. However, it is very difficult for foreign companies to capitalize on the same human resources." We will cover the topic of China's human resources hereafter.

Fourth, China has shown an encouraging attitude towards foreign R&D establishments and enacted several preferential policies, such as duty free import of certain equipment, lower overall costs in comparison to the establishments in the USA. Since R&D centres established in China, by foreign and local partners or only by foreign partners, tend to cooperate extensively with Chinese universities and institutes, they also provide employment for many skilled Chinese researchers and serve as an additional source of R&D financing.

R&D alliances in China are distributed in three regions – metropolitan cities of Beijing and Shanghai, special economic zones and coastal cities, and the rest of the country. According to (Jiatao & Jing, 2003), most of the foreign R&D investors came from North America, followed by European multinational corporations and investors from Hong Kong, Taiwan and Japan.

Earlier studies, (Voelker & Stead, 1999) and (Ronstadt, 1977), showed that initially research was undertaken at the home country, whilst development facilities were established abroad when foreign markets became sufficiently large. These were at first supposed to help to adapt their products or services to local market conditions. However, lately the trend has changed. The international R&D facilities do not serve as a source of cost savings but more as an opportunity to gain access to new technologies or local knowledge, and within the multinational corporations network are together creating an integrated whole.

3.3 How to compete?

A problem, which arose afterwards, was how to compete on the market already taken over by well-known and established brands with effective management systems, innovation processes and in comparison easier access to capital, both physical and human, and which benefits from better setting of the whole institutional framework.

(Khanna, et al., 2005) study, which is further analysed in (Khanna & Palepu, 2006), states that this problem can be overcome because of three reasons. First, the firms from developed countries “must confront the same institutional voids that local companies face” and have to cope with some extra difficulties, for example, how to fit their business models into a different

environment (Khanna, et al., 2005). Such companies simply tend to implement their standardized strategies with a little bit of local twist. Nonetheless, locals already possess the knowledge, how to identify with customers and meet their specific needs and preferences effectively. They also know how to work around local regulatory systems, contract-enforcing mechanisms and infrastructure – which are mostly missing or underdeveloped.

Knowing that, many firms with multinational desires now rather carefully think through pros and cons of such global expansions. According to (Khanna & Palepu, 2006) analysis, American corporations invest rather in developed countries because they are aware of these difficulties and perform better in developed markets.³ However, the solution is not to look away but to adjust strategies to the unique features of the institutional context.

Several transnational corporations founded in emerging markets have even successfully entered North America and Europe with their low-cost oriented strategies and new business models (e.g. China's Haier Group in household electrical appliances, India's Infosys in information technology services). Resulting, as the emerging markets have accustomed to the new order and looked for convenient niches and opportunities on the market, they grew stronger, and some managed to fight for their places on the global market extremely well.

3.4 Resources in human capital

The fact is that companies from many developing countries cannot access human capital as easily as those from Western Europe or America, mainly because of underdeveloped infrastructure. Hence, they often have troubles to invest in R&D or to go global.

However, China has successfully managed to implement the advanced technology and with taking advantage of well accessible cheap labour they quickly reached the world. Many

³ (Khanna, et al., 2005) study states the following: „By the end of 2002 - according to the Bureau of Economic Analysis, an agency of the U.S. Department of Commerce-American corporations and their affiliate companies had \$1.6 trillion worth of assets in the United Kingdom and \$514 billion in Canada but only \$173 billion in Brazil, Russia, India, and China combined. That's just 2.5% of the \$6.9 trillion in investments American companies held by the end of that year. In fact, although U.S. corporations' investments in China doubled between 1992 and 2002, that amount was still less than 1% of all their overseas assets.“

developed countries moved their production to China to lower their costs of production. Such actions, as a result, brought the needed capital for locals, which they conveniently invested in R&D, innovation and education. The development of China's investments in R&D we have shown in the previous section. Let us in greater detail look into another growth factor – human capital.

According to (The Economist, 2010), China produces 75,000 people with higher degrees in engineering or computer science every year. FIGURE 4 depicts the results of executive survey of International Institute for Management Development published in World Competitiveness Yearbook 2012. It is clear that China still lags behind its western competitor, the USA. Nonetheless, China is undeniably on the rise.

Qualified engineers

Qualified engineers are available in labour market - index 1 to 10

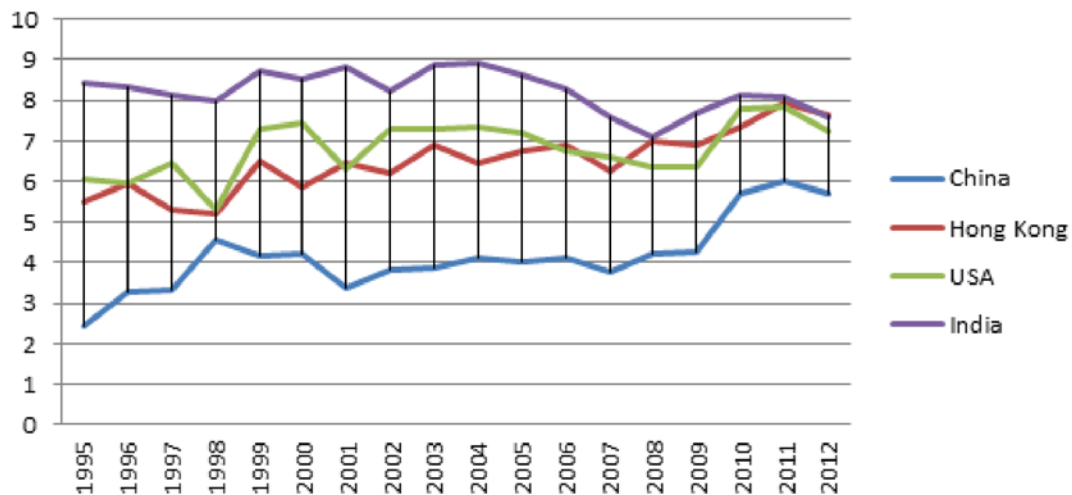


Figure 4 - own processing; data source: IMD World Competitiveness Yearbook Online

(Science and Engineering Indicators, 2012) report supports this allegation by following findings:

- From 2000 through 2008, the ‘number of S&E first university degrees awarded in China and Taiwan more than doubled’.
- ‘In 2007, China overtook the United States as the world leader in the number of doctoral degrees awarded in the natural sciences and engineering.’
- In China and Japan more than half of bachelor degrees were awarded in S&E fields in 2008. For a comparison, S&E degrees accounted for around one-third of all first degrees awarded in the United States.
- In China, about 31% of all bachelor degrees awarded in the same year were in engineering. In the United States, they accounted for just about 4%.
- Almost two thirds of the foreign S&E graduates in the United States in November 2010 came from India and China.
- Nearly 40,000 undergraduates from China enrolled in a U.S. institution in 2009-2010.

Nonetheless, China finds itself in a substantial demographic transition and has to cope with it within a short period. The causes of such profound changes are – strict one-child policy, fast economic growth and essential social transformation. During the reform period, China’s demography experienced a steep drop in fertility. China enjoyed a sufficient labour supply at first, due to productive population structure (Cai & Wang, 2012). In the following years, though, the growth of the working-age population became slowing and population ageing speeded up. The development of China’s demographic transition we can observe in FIGURE 5.

Demographic transition - China case

Population for corresponding years in thousands

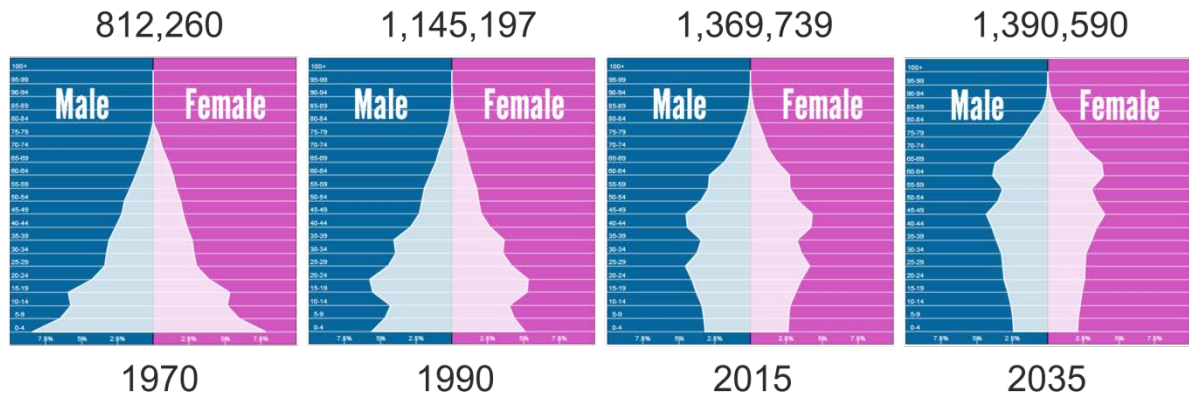


Figure 5 - source: <http://populationpyramid.net>, data from United Nations, Department of Economic and Social Affairs, Population Division (2011). World Population Prospects: The 2010 Revision.

According to a prediction (United Nations, 2009), “the year 2015 will be China’s turning point when the population aged 15 to 64 will stop increasing and begin shrinking.”⁴ The official report China's Total Population and Structural Changes in 2011 released by National Bureau of Statistics of China states following: “At the end of 2011, the national population in the age group of 60 and over accounted for 184.99 million persons, occupied 13.7% of the total, rose by 0.47 percentage points over the end of the 2010. The national population in the age group of 65 and over accounted for 122.88 million persons, occupied 9.1% of the total, increased by 0.25 percentage points. The proportion of the population in working-age at 15-64 firstly fell down since 2002, which occupied 74.4% in 2011, slightly dropped 0.10 percentage points over the previous year, due to the continued low level of fertility and the accelerated process of population aging. Although there will be slight fluctuations in the next few years, the labour supply issues need to pay more attention.”

That is a good point. With the emergence of labour shortages in agricultural and non-agricultural sectors, wages have been forced to grow rapidly in both sectors (Wang, 2010).

⁴ Even if we take into account the impacts of rural-to-urban migration, according to (Cai & Wang, 2012) “by 2015 the incremental working age population in urban areas will be less than that of the reduced working-age population in rural areas, and the total working-age population will begin to shrink. This implies that, without substantial enhancement of wages and other incentives, migrant workers will not fill the gap vacated by rapid reduction of the urban labour force.”

Such actions brought along intensive labour disputes, especially after issuing or updating several Chinese labour laws in 2008.

3.5 Abandoning a dual-sector model

In a dual economy, we distinguish two separate economic sectors divided by different levels of development and technology. Julius Herman Boeke originally created the concept to describe a colonial economy. The dual concept was further developed by Sir Arthur Lewis to support his labour supply theory of rural-urban migration in less developed countries.

The assumption of the model says that a developing economy has an excess of unproductive labour in the agricultural sector, characterized by low (substantial) wages and low productivity. Since the substantial (agricultural) sector faces the conditions of fixed input – limited land to cultivate – the marginal product of additional worker is zero, due to the law of diminishing marginal returns). These workers are transferred to the growing manufacturing sector (private or public), controlled by the capitalist, who offer higher wages. This period, whilst the gap between marginal productivity of labour between agricultural and non-agricultural sectors prevails, can be interpreted as the Lewis Turning Point (Lewis, 1972; Ranis & Fei, 1961; Cai & Wang, 2012). Capitalists' profit over time allows them to invest in the capital stock. Eventually, the modern industrial sector promotes industrialization and stimulates development. However, as the marginal productivity of workers increases because of capital formation and decreases by additional workers attracted to work in the non-agricultural sector, the wage rates in both sectors will equilibrate. In the end of this process, the agricultural wage equals the manufacturing wage, as well as the agricultural and manufacturing marginal product of labour.

(Cai & Wang, 2012) study implies that China is facing its Lewis Turning point, and base it on the facts of unskilled labour shortages and wage increases. They also mention that such phenomenon is usually accompanied by the Kuznets Turning Point.

Kuznets Curve - China case

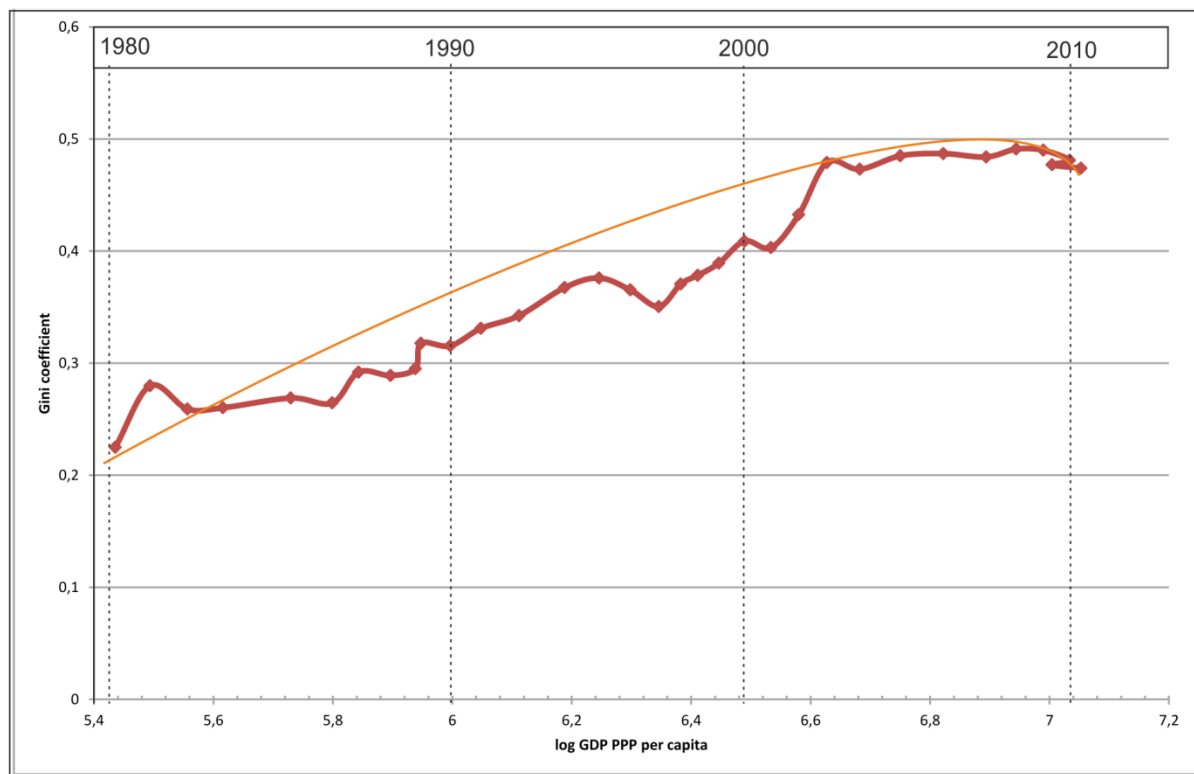


Figure 7 - own processing; data source: The Penn World Table 7.1, Ravallion & Chen (2004), China's (Uneven) Progress Against Poverty,

Nonetheless, the setup of income distribution cannot be modified spontaneously. Workers gain more bargaining power as they have more job opportunities and a stronger voice in labour disputes. The theory of Lewis Turning Point explains it as a simple result of labour market changes. Such changes clearly display a demand for labour market institutions able to preserve social cohesion.

3.6 Challenging task for the government

Facing the ageing population and growing voice of Chinese labour force throughout the country Chinese government has to face a challenging task how to diminish the negative

impacts caused by structural and demographic changes, and thus secure sustainable economic development.

The Chinese government has undertaken necessary steps to build a social security system. In the 12th Five-Year Plan approved by the National People's Congress in March 2011, the expenses for urban pensions and health care were established as compulsory objectives for the next five years. However, the creation of labour market institutions has not been specifically scheduled in the plan.

In February 2013, China's State Council also revealed guidelines to reform the income distribution mechanism which focus on increasing residents' income, regulate the distribution and narrowing the income distribution disparity.

According to these guidelines, the state owned enterprises will be required to pay higher taxes and dividends to individual shareholders in the future. These additional funds might be used to fund social security, health care or education. On the agenda was also the topic of interest rate liberalisation; regulated interest rates brought not only cheap credit to state owned enterprises, but reduced yields of household savers as well. The guidelines remember that local governments should be supported by sustainable revenue source in terms of their fiscal expenditure obligations. Their existing revenue system is dominated by land sales. The new proposition is to link the system to more profitable imposition of property taxes. Finally, as China's *hukou* residency system impeded the poor from country to move to urban areas, the government promise to help rural migrant workers to register as urban residents.

An article (Laurenceson, 2013), of a senior lecturer at School of Economics at University of Queensland, mentions another motivating factor for releasing these guidelines, besides social stability. Faster 'income growth at the lower end of the income distribution' may help to achieve economic growth driven by household consumption (Laurenceson, 2013).

3.7 Financial sector

Other factors, which helped China to sustained economic growth, are undeniably financial sector reforms and development. A remarkable growth of China's GDP is depicted in FIGURE 8.

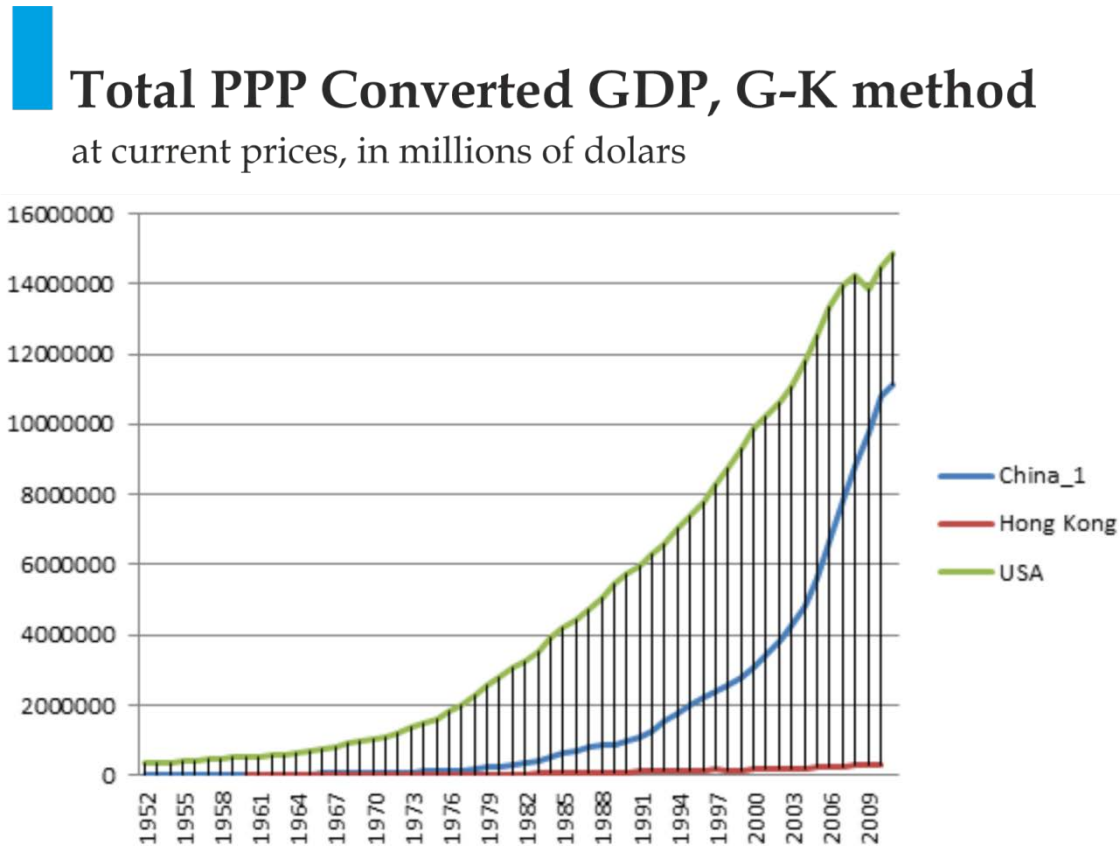


Figure 8 - own processing; data source: The Penn World Table 7.1,

The relevant change can be traced to the 1980s, when the growth was pulled by increasing domestic consumption, which accounted for 70% of total GDP. In 1990s, consumption started to weaken and investment took over. Private consumption decreased from 49% of GDP in 1990 to 35% in 2008. On the other hand, investment increased from 35% to 44% of GDP in the same period. The rise regarded foreign investment and domestic capital investments as well (The Economist, 2009; Zhang, 2008).

FIGURE 9 clearly describes the growth rate development throughout decades since 1950s. At first sight, there are two clear falls down below zero in otherwise admirable positive growth.

The first one coincides with the period of the Great Leap Forward and the second one with the Great Proletarian Cultural Revolution.

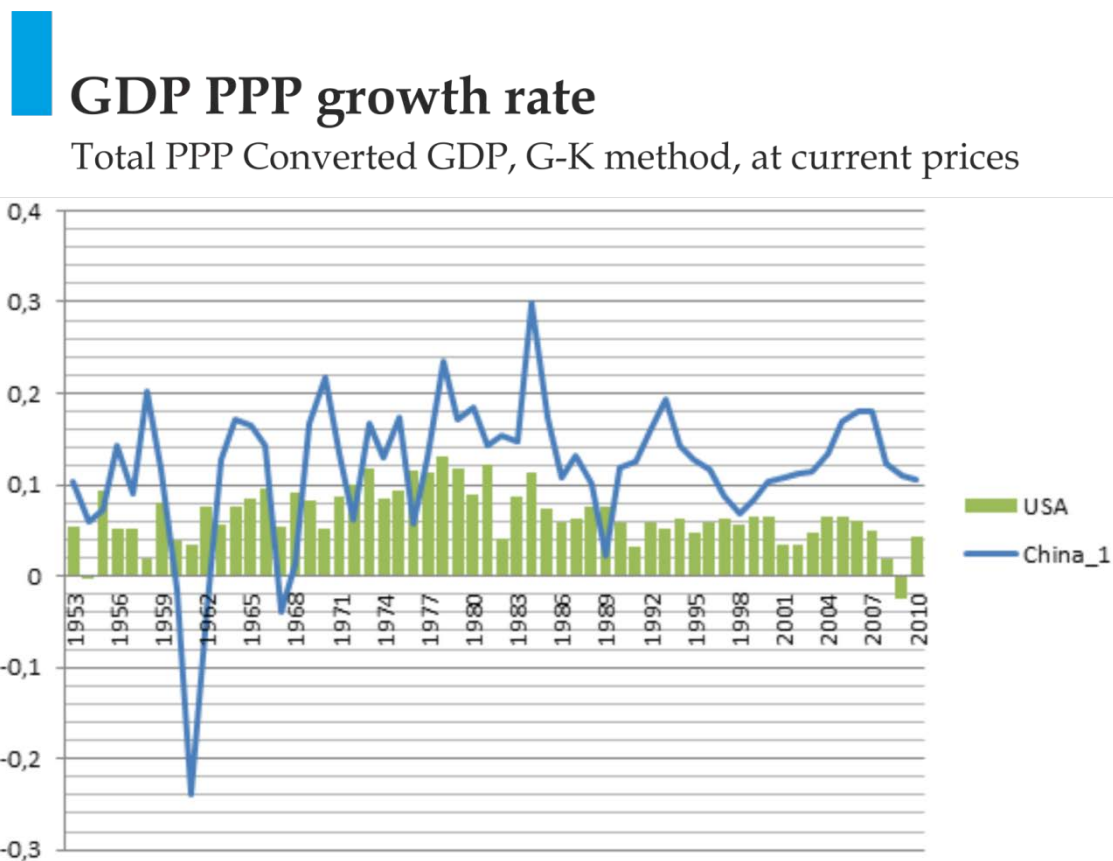


Figure 9 - own processing; data source: The Penn World Table 7.1

The Great Leap Forward policy, a forced industrialization and agricultural collectivization, was carried in the spirit of well-known slogan ‘overtake the British, race the Americans’. The primary goal was to increase Chinese production, get China into position of a world power and establish communism. Nonetheless, both political and economic mismanagement and low agricultural production led to extensive famine caused, as demographers officially agree, estimated 25–30 million deaths and vast economic regression. It is not surprising that Mao Zedong’s unsuccessful and expensive campaign faced strict criticism within the communist party. In response, he initiated another campaign – the Cultural Revolution, officially taking place in 1966–1969.

The Cultural Revolution was a social-political movement initiated by Mao Zedong, then Chairman of the Communist Party. Its active phase lasted until the death of his supporter,

military leader, Lin Biao in 1971. His motivation was to return to his position of power after failing with his former policy of the Great Leap Forward, appease his opponents – particularly Liu Shaoqi and Deng Xiaoping, and enforce communism by removing capitalist (among others) elements from Chinese society.

Mao's movement, though, halted economic activity for quite a while. Vast expenses went on numbers of Red Guards, the railway system was disordered and countless pieces of cultural heritage and fine arts were destroyed. Years of the Cultural Revolution took a toll on the education system as well. Intellectuals were persecuted, sent to rural labour camps or left China. What has been China left with was a generation of inadequately educated people.

After Mao's death in 1976 and the arrest of the Gang of Four, members of radical communist faction, China has under reforms of Deng Xiaoping and other reformers begun to open to the Western civilizations. Crucial reforms regarded a financial sector as well – commercial banking replaced the old 'monobank' system, new regulatory bodies were established, and stock markets emerged (Burzynska, 2009).

Stock market were established in 1990, one in Shanghai, another in Shenzhen. Most of the trading took place in Shanghai, old financial centre of China, the rest in Shenzhen, a fast growing city in South. The Chinese securities market is composed of tradable and non-tradable shares, and differentiate three classes of shares outstanding: shares traded by domestic investors (A-shares), shares denominated in foreign currencies and set aside for foreign investors (B-shares), and shares of companies listed or cross-listed overseas (H-shares in Hong Kong) (Beltratti & Bortolotti, 2006; Campello, et al., 2010). The non-tradable shares were originally created to ensure that state-owned enterprises would not be acquired by private or foreign entities and were issued to the founders of a corporation, business partners or employees. Such suppression of capital reduced supply and pushed up the price of tradable shares. In 2006, as we can see in FIGURE 10, non-tradable shares accounted for 55% of total shares outstanding, most of them were represented by state-owned shares.

Outstanding Shares of Chinese Listed Companies by Class, 2006

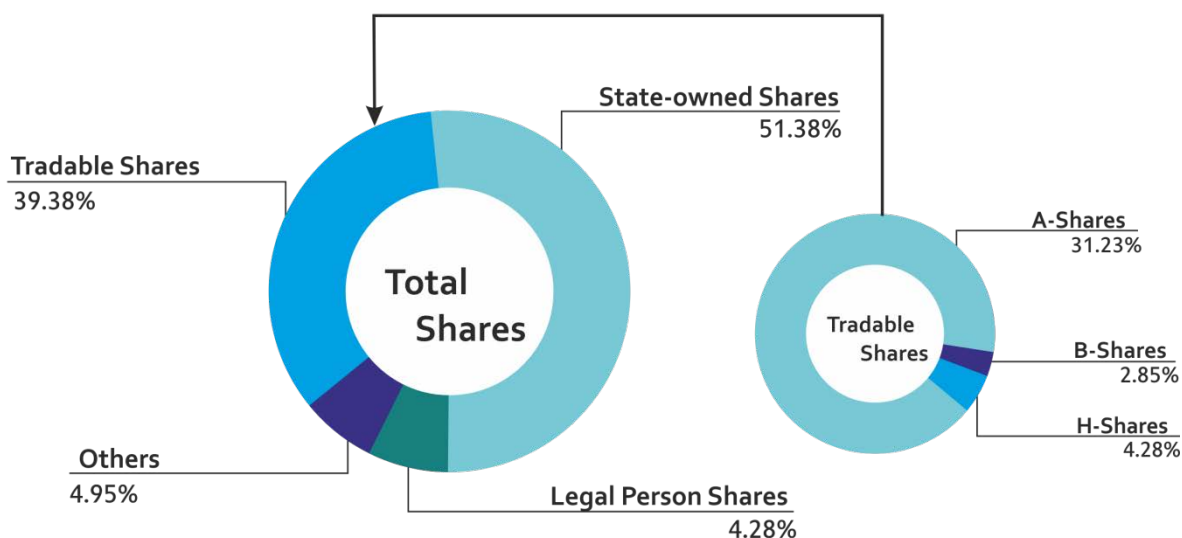


Figure 10 - own processing; data source: China Securities Regulatory Commission (2006)

However, the dominance of non-tradable shares soon proved to be causing problems. Tradable shares holders were usually minority shareholders with a limited power and limited free float on the domestic market led to volatility and insufficient liquidity, hence making the market prone to manipulation and insider trading. The inefficiency of the domestic market compelled many Chinese businesses to list overseas, most preferably in Hong Kong.

After few attempts to deal with this problem, in 2005 Chinese government initiated two pilot programs, inviting 4 at first and later 42 companies to transform non-tradable shares to tradable. Shareholders were compensated through bonus shares, cash, options and others. Chinese government further encouraged other companies to participate in the reform share project. In 2006, as a result, 769 listed companies had finished or at least started to turn non-tradable into tradable shares (Beltratti & Bortolotti, 2006). At the end of 2007, the capitalisation of the Shanghai and Shenzhen stock exchanges stood as 133% of GDP. However, the tradable market capitalisation accounted for only 37% of GDP.

After these changes, further development of financial markets followed instantly. Financial system slightly shifted from clear monopoly of central bank towards the free market.

According to (Yao & Wu, 2011), in 2009, ‘there were about 5,600 banking institutions, 4 asset management companies, 107 security companies, 100 security investment consultation agencies, 60 kinds of fund management companies and 162 future companies.’

Chinese banking system is highly regulated sector, and is not directly linked to other international financial markets as other open economies are. Powerful government control over the financial system has managed to tackle successfully the last financial crisis (2008 Global Financial Crisis), nonetheless, at the cost of suspended market liberalization. A famous Chinese financial constraint emphasizes that there is a significant delay between actions of the financial system and economic growth. Financial products are often blocked in the system and cannot support the real economy. On the other hand, one must admit that Chinese commercial banks (still state-owned) are considered as the world’s most profitable.

Moreover, China has preserved outstanding economic growth even during the post-financial crisis period. The economy has been seriously hit by a drop in exports, due to the negative shock of international demand. GDP growth, though, remained over 6%. Such performance would not be possible without Chinese government’s decision to stimulate domestic demand by 4 trillion RMB investments and to relax the restrictions on bank loans (Yao & Wu, 2011).

It may seem that China has successfully settled not only the global financial crisis in 2008, but one can get the same impression from Asian crisis in 1997. On the other hand, these costly measures and already mentioned discrepancy between the financial sector and the real economy are making the economy even more fragile. This approach is not sustainable cannot be repeated over and over. China should, therefore, continue the path of market liberalization and develop a flexible financial market. That might be the only way how to become world’s major player.

3.8 Concluding remarks

If we take into account the past GDP growth rates and the GDP PPP progression (see Figures 8 and 9), (Holz, 2005) suggests that the Chinese economy should surpass the USA in

purchasing power terms until 2015. In terms of per capita, the crossing point lays further in the future, twenty to thirty years from now. However, faster developing coastal areas may catch up a decade earlier.

These predictions are based on two relevant considerations. First, the development and reforms of China's economy, described above, fits the standard development pattern and trade theories. Providing that, this booming 'miracle' still has many years of economic growth to come. Secondly, as we have shown earlier, China's education in science and engineering is experiencing remarkable rise as well. If we assume that talent is randomly distributed in the world population and omit some unexpected events (e.g. natural disasters, wars), an increasing amount of high-skilled labourers will certainly support China's economic growth. Furthermore, the increasing amount of able workers might have a positive impact on rising competition and further innovation.

Despite all the positive forecasts, it is necessary to continue reforming the financial sector. China recognised the role of healthy financial system. Therefore, it is vital to further remove market imperfections – develop better credit allocation and improve access to financing private enterprises and SMEs (Holz, 2005).

4 QUANTITATIVE ANALYSIS

In the previous section, we tried to describe carefully the key drivers of rapid upswing of the Chinese economy in the recent decades. We have also strived to build up a theoretical concept of particular growth factors which stand behind this economical outburst. Moreover, we would like to dedicate following part to **support previous résumés and theoretical concepts by quantitative data analysis.**

In the area of Chinese growth, there have been made profound research before. We may mention (Yingyi, 2000) for the institutional, (Lin, et al., 2003) for comparative-advantage, (Young, 2003) and (Yanrui, 2004) for aggregate production based, dangerous (Gertz, 2000) or productivity (Samuelson, 2004) perspective. All in all, there already are many

macroeconomic estimations investigating GDP growth, using quite sophisticated econometric techniques far behind the scope of this work.

Therefore, we have decided to concentrate on the variables which have not been widely used yet. We suppose that there may have been other factors aside from mainstream macroeconomics and financial markets theory, and which could have had a significant impact on the economic growth of a particular country.

As it is quite common, such effort cannot be successfully defended without empirical evidence – which is strictly connected to data availability. We have managed to obtain an access to one of the world most thorough and comprehensive annual report on the country competitiveness published since 1989 (without interruption).

On the following pages, we would like to take advantage of such opportunity and perform quantitative econometric analysis of the findings presented in the previous section. Our main effort is to find and determine the most significant variables influencing the GDP growth.

TABLE 1 and TABLE 2 depict China's GDP and GDP per capita as a percentage of GDP of other large nations. Such a striking economic performance served us as a motivation for further research.

Table 1: China's GDP as percent of GDP for other large nations, 1978-2004

	1952	1978	1990	2000	2004
United states	9,5	13,6	27,9	51,7	64,0
Japan	783,5	38,5	70,5	165,9	219,2
Germany	n/a	50,8	113,3	244,8	322,1
India	63,9	78,0	122,2	190,6	203,1

source: [Loren & Rawski, 2008], p.2, data: Penn World Tables

Table 2: China's per capita GDP as a percent of figures for other nations, 1952-2005

	1952	1978	1990	2000	2005
United states	2,7	3,2	6,3	11,6	15,7
Japan	11,8	4,6	7,7	16,7	21,3
Korea	25,4	15,0	16,4	25,5	30,1
India	42,6	53,7	90,3	151,4	188,5

source: [Loren & Rawski, 2008], p.2, data: Penn World Tables

4.1 Data

The fundamental source of data is **WORLD COMPETITIVENESS YEARBOOK ONLINE (WCY)**, which analyse and rank the qualities of particular countries, in terms of competitiveness. This comparison extensively covers 59 countries within 300 criteria from business, international, institutional or academics area.

As a secondary source we used the reputable and often updated database – **PENN WORLD TABLE (PWT)** – which is the largest freely available database of basic macroeconomic data, covering 30 national account variables for 167 countries in the time period from 1950 to 2000. The majority of variables is purchasing power parity (PPP) adjusted. Hence, extracted dataset makes possible long-term comparison of the time series data for selected countries.

Finally, we have obtained basic dataset of 100 variables⁵ for 19 countries from 1995 through 2011, which is a truly exceptional source for creating a **strongly balanced panel data dataset**.

4.1.1 Modelling procedure

In this paper we would like to examine Chinese economy in two steps. Firstly, we want to build up an overall model and try to estimate GDP growth using different variables from areas mentioned in the SECTION 3. Secondly, we wish to analyse particular significant drivers of growth and find their estimates, using other independent variables.

⁵ Variable list is enclosed in the appendix, due to space limitation in the main body of the work,

To pursue this promoted course of our work, we would like to use various econometric techniques, regarding the character of the dataset, based on the analysis of panel data including pooled OLS regression, Fixed and Random Effects modelling, instrumental variable approach and 2SLS estimator.

The sample selection was fully submitted to the topic of our interest – the key drivers of GDP growth. Therefore, we have chosen to analyse the most developed countries in the world - the members of the G-20 major economies⁶. To present them in the alphabetical order: ARGENTINA, AUSTRALIA, BRAZIL, CANADA, CHINA MAINLAND, FRANCE, GERMANY, HONG KONG, INDIA, INDONESIA, ITALY, JAPAN, KOREA, MEXICO, RUSSIA, SOUTH AFRICA, TURKEY, UNITED KINGDOM AND USA.

From all the observations available for time period 1995-2011 the countries have been arranged into the classic panel data pattern. Subsequent estimation was performed using STATA: DATA ANALYSIS AND STATISTIC SOFTWARE.

4.1.2 Limitations

First two fundamental limitations come directly from the data selection and its form. Nevertheless, we do not consider taking observations from a limited group of countries (G-20) as a **violation of the Random sampling assumption**. In our case, there is a particular reason for restricting the dataset because the chosen variables are determining only for the developed countries. Moreover, after exploring the data, the differences between individual countries are still considerable.

The more complicated issue was the substantial number of missing values. In this particular case, the situation was more disturbing and, as a result, we were forced to remove the whole Saudi Arabia section and several more variables from the dataset.

The STATA software automatically treats the data using list-wise edition (deleting/omitting affected observations from regression). Even though, this is the simplest solution of missing values issue, it also substantially decreases the sample size. Nonetheless, under the assumption that the missing values are Missing Completely At Random (MCAR) the estimates stay

⁶ The only country missing is Saudi Arabia – due to unavailability of the data.

unbiased. Taking into consideration, that there is no numerical relationship between the variables and missing values are emerging without any pattern, we assume that this MCAR assumption holds. (The violation towards Missing Not At Random (MNAR) would still produce almost unbiased estimates. Thereby, we simply decided to delete all obviously non-performing variables and then consider this problem of second-rate importance further on.)

We also tried to use other and more rigorous approaches to the issue of missing values. The mean substitution seems to be inappropriate for Fixed Effect approach – even though it helps to increase the sample size, it also produces bias. Neither second - Multiple Imputation treatment - was working, as it sometimes produced unreal values (e.g. negative Urbanization). Hence, we checked for the probability of having MCAR values, and solved the problem as written above. Without omitted observations, FE estimator basically produces the same result as if it would deal with only balanced panel, not strongly balanced one.

4.2 Empirical evidence

As we have already mentioned, our first intention was to estimate OVERALL MODEL which would describe the GDP growth rate and which we regress on different sets of chosen independent variables from SECTION 3.

With respect to the properties of our dataset, we have decided to take advantage of using panel data estimation methods to find the significant factors influencing GDP growth. With such numerous possibilities for regression candidates, the estimating procedure has turned demanding and time consuming.

We have performed plenty of regressions with an intention to identify the significant variables and join them together to create models with both statistical and economic significance and reasoning. With this concept in mind, we developed 5 models. The final choice of variables can be found in TABLE 3, regression results in TABLE 4.

4.2.1 Methodology

Each model had been originally estimated with more variables. Some of them were then diagnosed as not significant and, therefore, dropped out of the model. Moreover, in accordance with classic panel data analysis we have developed both Fixed and Random Effects estimator and consequently controlled for the consistency of Random Effects (RE). As reported in TABLE 5, it is clear that the key assumption for RE to be consistent $Cov(x_{it}, \vartheta_i) = 0$ is obviously **violated** in all the 5 models. The null hypothesis of consistent RE can be **strongly rejected** on the 1% level of significance in all cases (p-value is always lower than 0.01).

Random Effect estimator produces **inconsistent** estimates and, therefore, Fixed Effects (FE) should be preferred. The FE estimates are unbiased and consistent even if they are no longer fully efficient. Moreover, since there are no time invariant variables in our dataset, using the RE has no further justification. Last but not least, it is crucial to be aware of Hausman test assumptions; if they do not hold, the whole inference could be wrong (though, for our p-values it is not very probable). Nevertheless, we had to check up for the verification of classical assumptions.

We used modified Wald test for the presence of group-wise heteroskedasticity in fixed effect regression model (`XTTEST3` STATA command (Baum, 2000)). As one can see in TABLE 5, null hypothesis of no group-wise heteroskedasticity can be strongly rejected in all five models. Heteroskedasticity itself cannot cause any bias of the regression coefficients. On the other hand, it affects the size of standard errors and consequently the inference of particular variables and model efficiency.

To test the presence of autocorrelation we used Wooldridge test for panel data (STATA command `XTSERIAL` (Roodman, 2004)), and found no evidence in models (1) and (2). However, strong first order autocorrelation is present in models (3), (4) and (5).

To achieve correct inference about the significance of particular variables, we corrected standard errors for heteroskedasticity and autocorrelation. Models (1) and (2) were adjusted by robust standard errors, models (3), (4) and (5) needed to produce statistics robust to both heteroskedasticity and first order autocorrelation. The only software solution to this problem

is to use another estimation method (STATA command `XTIVREG2` (Schaffer, 2005)). This method is primarily designed for instrumental variable estimation but is also able to control FE estimation for violation of this assumption; and produces Heteroskedasticity and Autorrelation Consistent (HAC) standard errors.

After treating data for violation of assumptions, we checked if the results of Hausman test are plausible even in this scenario. `XTOVERID` STATA command (Schaffer & Stillman, 2006) performs a test for overidentifying restrictions. FE versus RE dilemma can be seen even from this perspective. FE estimator is defined by the orthogonality conditions that the regressors are not correlated with the idiosyncratic error e_{it} : $E(X_{it} \cdot e_{it}) = 0$. On the other hand, RE estimator uses the additional orthogonality conditions that the regressors are uncorrelated with the group-specific error u_i : $E(X_{it} \cdot u_i) = 0$.⁷ Basically, this additional condition is responsible for higher efficiency of RE estimator, but only if it is satisfied. The null hypothesis states that the additional condition is valid. In our data (as TABLE 5 reports) we can strongly reject the null. Therefore, reported Sargan-Hansen statistic **confirms** previous Hausman suggestion to prefer FE estimator.

This methodology we apply on all following models, thereby, we will not further report on the assumption testing, just submit its results (except of the instrumental variable approach which will be used later on).

⁷ [XTOVERID STATA help file]

4.2.2 Overall model

In the following part, we would like to present the interpretation of regression coefficients for each particular model. For the overall model each interpretation will be followed by data restriction to “China only” and subsequent regression results effective only for Chinese economy.

Table 3: Overall model - list of variables

Code	Variable ^a
lGDP	log of Gross Domestic Product (GDP)
GDP_g	Real GDP growth
LG_g	Labor force growth
Prod_rg	Overall productivity - real growth
bussin_ease	Ease of doing business
GovB_r	Total general government debt (%)
Adapt	Adaptability of companies
ESS	Economic sectors / Services
Know	Knowledge transfer
U_r	Unemployment rate
EI	Employment by sector / Industry
Fund_tech	Funding for technological development
Exp_rnd_r	Total expenditure on R&D (%)
LF	Labor force
Labor_prod_PPP	Labor productivity (PPP)
COL	Cost-of-living index
EA	Employment by sector / Agriculture
Bribe	Bribing and corruption

^a - full description of variables can be found in the Appendix part

Table 4: Overall model - Summary of estimates

model	(1)	(2)	(3)	(4)	(5)
dep_var	GDP_g	GDP_g	GDP_g	GDP_g	LGDP
method	FE	FE	FE	FE	FE
SE	robust	robust	HAC	HAC	HAC
LG_g	0.514**	0.501*			
Prod_rg	0.820***	0.796***	0.735***	0.809***	
bussin_ease	0.272*				
GovB_r	0.230**	0.191***			
Adapt		0.627**			
ESS		-0.152**			
Know			0.936***		
U_r			-0.320**		
EI			0.368**		
Fund_tech				0.796***	
Exp_rnd_r				-2.031**	
LF					0.008***
Labor_prod_PPP					0.039***
COL					0.007***
EA					-0.064***
Bribe					-0.076***
Constant	0.252	7.637*	-9.045***	0.686	5.379***
r2	0.764	0.806	0.655	0.705	0.812
N	164	191	187	174	231

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Overall model - testing of assumptions

	Model	1	2	3	4	5
Heteroskedasticity	chi2 statist.	3026.72	1111.79	6.8e+33	51424.58	348.01
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000
	het. presented	YES	YES	YES	YES	YES
Autocorrelation	F-test statistic	0.451	1.073	12.156	5.282	38.199
	p-value	0.5105	0.3141	0.0030	0.0345	0.0000
	aut. presented	NO	NO	YES	YES	YES
Hausman	chi2 statistic	18.65	18.26	54.12	11.63	14.4
	p-value	0.0009	0.0026	0.0000	0.0088	0.0072
	FE vs. RE	FE	FE	FE	FE	FE
Hausman check	Sargan-Hansen			0.0000	0.0000	0.0000

MODEL (1):

VARIABLES SIGNIFICANT FOR CHINA: PROD_RG (0.71), BUSINESS EASE (0.31)

All the regressors are significant and interpretation of the coefficients is clear. An increase in labour force by one percentage point is expected to raise GDP growth by 0.5 percentage point (pp) while one percentage point rise in real growth of productivity is expected to raise GDP growth by more than 0.8 percentage point (pp).

Similarly, an upsurge in ease of doing business and government debt-on-GDP ratio increase expected GDP growth by a quarter of *pp*.

In the last decade, overall productivity of Chinese workers is rising on average (as depicted in the trend line of FIGURE 11). On the other hand, US productivity growth has been stagnating, thus proving productivity to play a key role in closing the gap between Chinese economy and the rest of the world.

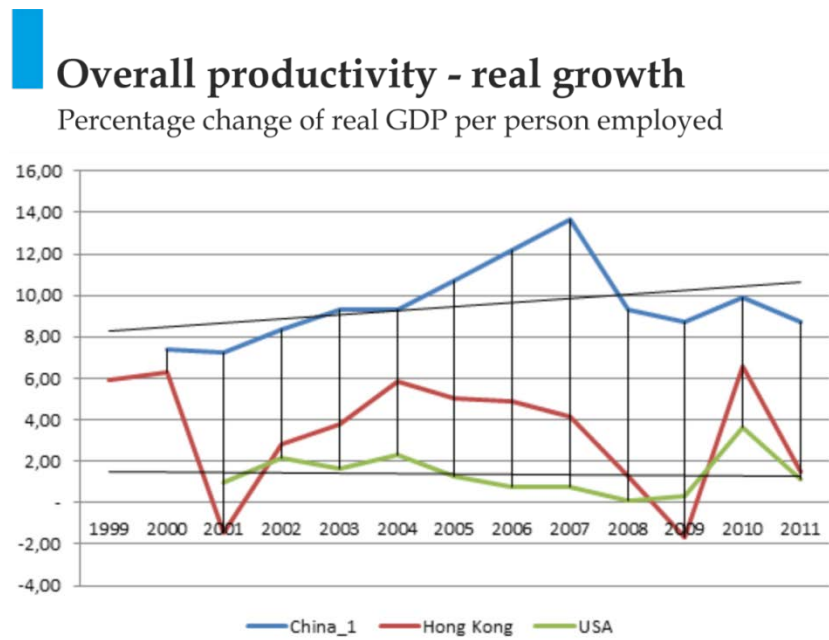


Figure 11 - own processing; data source: IMD World Competitiveness Yearbook Online

MODEL (2):

VARIABLES SIGNIFICANT FOR CHINA: PROD_RG (0.79), ADAPT (0.63), ESS (-0.15)

Productivity real growth and Government similarly debt-on-GDP rate coefficients are quite similar to those from the model (1), but still a bit lower. The adaptability of companies to market changes has proved to be a significant and strong predictor of GDP growth. One *pp* change is expected to influence it by 0.6 *pp*.

Surprisingly, in the relevant period, the *pp* increase in the share of Sector of Services on GDP had low, but still negative impact on GDP growth.

FIGURE 11 depicts the development of adaptability index in the last ten years. Adaptability index represents how the companies are able to adjust to market changes. As one can see, USA still surpass China, however, the gap is significantly closing from both sides.

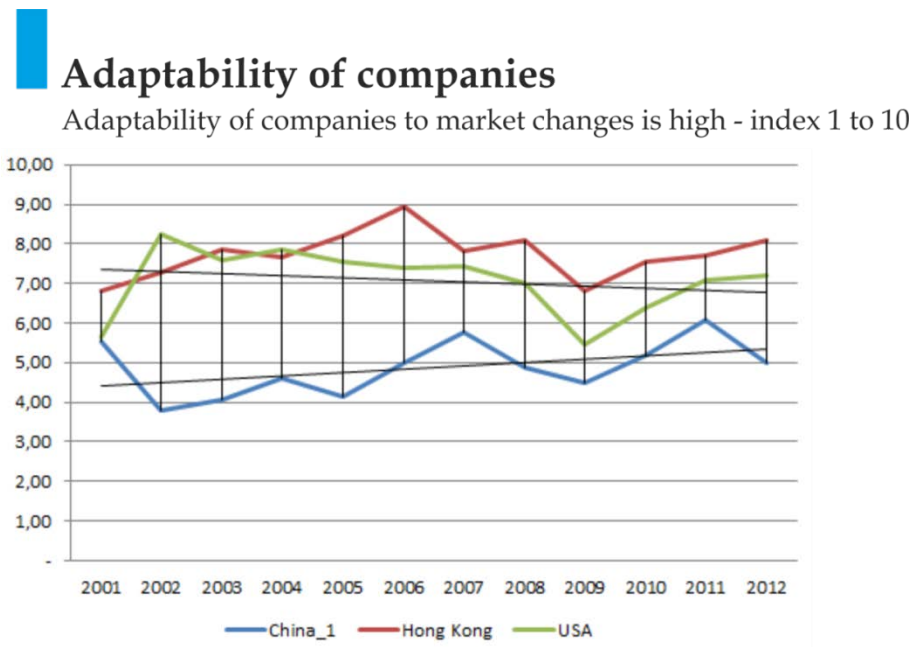


Figure 12 - own processing; data source: IMD World Competitiveness Yearbook Online

MODEL (3):

VARIABLES SIGNIFICANT FOR CHINA: PROD_RG (1.00), U_R (-0.37), EI (-0.51)

In the third model, the index of knowledge transfer (between highly developed companies and universities) has been shown as a key driver for GDP growth, the proportion of reciprocal change is almost equal to one. Not surprisingly, the unemployment growth has been shown as a negative factor for economy growth.

The regression coefficient suggests that the more people are employed in the industry, the higher growth in the economy is expected. The data for China, depicted in FIGURE 13, show a long-term increase of employment in industrial sector. After restricting data to China-only the coefficient has a negative value of -0.51, therefore, the tendency of industrial employment seems to be contradictory. These empirical findings might support the theory of passing the top of the Kuznets curve (mentioned in SECTION 3). Chinese economy was heavily industrialized for many decades. However, industrial sector may have been saturated, which could induce labour transfer to tertiary sector.

Employment by sector / Industry

Percentage of total employment

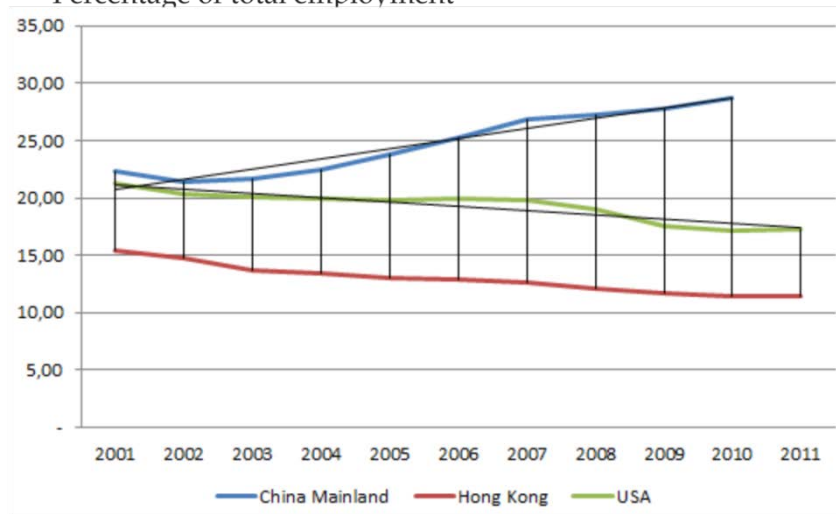


Figure 13 - own processing; data source: IMD World Competitiveness Yearbook Online

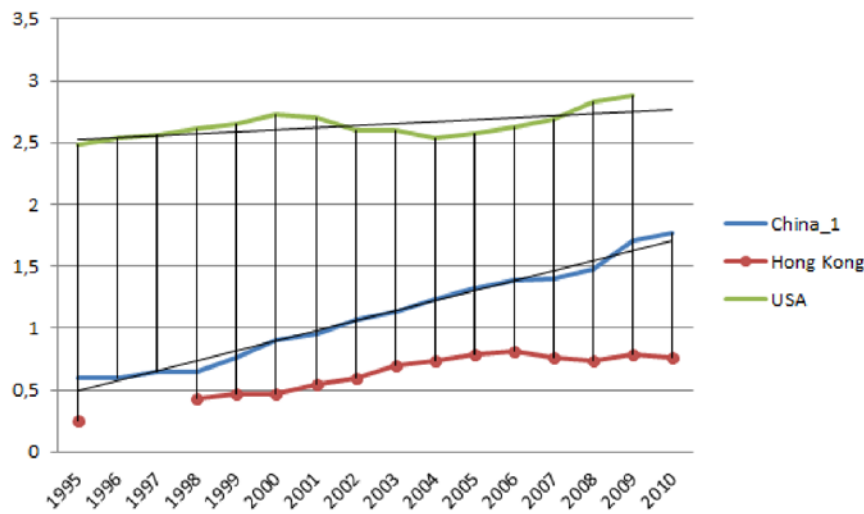
MODEL (4):

VARIABLES SIGNIFICANT FOR CHINA: PROD_RG (0.99), EXP_RND_R (-0.59)

This model showed, except from already mentioned productivity growth, a strong impact of fund availability for technological development (+0.8pp by 1pp increase). Simultaneously, it reported a totally unexpected 2pp decrease in GDP growth corresponding to the 1pp increase of expenditures share on R&D. This effect is unexpected as well, hence, we are going to cover it in the following modelling part.

Total expenditure on R&D (%)

Percentage of GDP



MODEL (5):

VARIABLES SIGNIFICANT FOR CHINA: EA (-0.55) – MARGINALLY SIGNIFICANT

Last model brings to discussion the variables with low but still highly significant influence on the performance of the economy ranging from 0.01 to 0.08. Positive effects are reported for: overall size of the labour force (LF), PPP productivity of this LF and also Cost-of-living index.

On the other hand, higher share of agriculture sector on employment and higher corruption in a particular country have indicated negative effect on GDP growth.

The long-term trend in China's agriculture sector is a decline of employment. From 1995 to 2010 the percentage of total employment fell from 52.2% to 36.7%. These empirical data may be an addition to supportive evidence of surpassing the peak of Kuznets curve, thus explaining the negative coefficient of EA variable for China.

4.2.3 R&D sector modelling

In the previous section, we have found a suspicious relationship between GDP growth and expenditures on research and development. Therefore, we decided to build up a model which could help to understand this relationship.

However, to be able to find the drivers of research and development growth, we need to use other variables from dataset. But as it was already mentioned in the methodology part, there is a need to cope with the missing values issue. There is no possibility to explain R&D development without having sufficient data source. We have to reduce our dataset to five year period between 2007 and 2011, due to missing values constraint, Nevertheless, following estimation results (derived by the same methodological process as described before) presented in TABLE 6 are accompanied by estimation of the same model on the original data (1995-2011) to a) control for reliability of results; b) to be able to distinguish between possible long/short-run differences. The estimation method has been chosen according to the nature of R&D variable which is not supposed to differ from one country to another. Hence, we made Between Effects estimation (based on group mean data) and presented a pooled OLS estimator. The real values are expected to range between these two estimates but most likely closer to the BE estimator, which is more efficient. Log(Exp_rnd) variable was renamed for demonstrative purpose to l_RnD and the model assumptions testing is enclosed in Appendix (TABLE 10).

Table 6: R&D sector - Summary of estimates - short vs. long perspective

model	(1) ^a		(2) ^a		(3) ^b	
dep_var	l.RnD		l.RnD		l.RnD	
method	BE		pooled OLS		FE	
SE	robust		robust		HAC	
	b	se	b	se		
Brain_d	1.321***	(0.264)	0.703***	(0.144)	-0.943	(0.059)
Int_exp	-1.450***	(0.234)	-0.570***	(0.140)		
IT_skill	-1.552**	(0.345)	-0.554**	(0.168)		
Fund_tech	1.728***	(0.305)	0.671***	(0.145)	0.199**	(0.067)
Tech_reg	-1.881**	(0.447)	-0.342	(0.197)	-0.162*	(0.066)
Tech_exp	0.000*	(0.000)	0.000**	(0.000)	0.000*	(0.000)
Bexp_rnd	-0.000	(0.000)	0.000*	(0.000)	0.000**	(0.000)
Adapt			-0.528***	(0.126)		
Comp_man	0.944**	(0.272)				
Constant	19.224***	(2.141)	14.809***	(1.127)	9.781***	(0.289)
r2	0.954		0.856		0.396	
N	61		61		96	

^a - variable estimates for period 2007 - 2011

^b - variable estimates for period 1995 - 2011

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

MODEL R&D SECTOR (SHORT-RUN):

A high brain drain index shows that competitiveness of economy is not hindered by outflow of talented people. Thus, the data for 19 developed countries report that, in the short run, the country's expenditure on R&D is not limited by outflow of skilled workers abroad.

As depicted in TABLE 6, the internationally experienced senior managers and easy availability of IT skills show a negative effect. Conclusion might be that an additional increase of these factors has not the desirable effect on further progression of R&D expenditures in developed countries, as they already possess such factors profusely. However, for developing or emerging countries it still provides an opportunity for growth. The technological regulation, supportive to business development and innovation, reports the same results as INT_exp and IT_skill. We may conclude that the argumentation is similar.

The data gives clear evidence that funding for technological development effects the expenditures on R&D in a positive way.

For the effect of availability of competent senior managers on the market, the causality may be reversed. The overall effort to continuously increase competitiveness, supported by elevating levels of R&D expenditures, raises a need for attracting competent people.

Other effects are too negligible for further analysis.

MODEL R&D SECTOR (LONG RUN):

In the long run, several variables became insignificant, meaning they are relevant for effective policy making only in the short-term horizon.

Only difference is in the change of brain drain effect. Despite the fact, that the economy is not affected by outflow of talented people in terms of becoming less competitive, it is not long-term efficient to increase investments on R&D, as they would vanished abroad. Total costs would be higher than benefits for the economy.

4.2.4 Effects of education

The interest in education sector is motivated by recent sharp increase of Chinese expenditures on education and consequently rising share of high-skilled labour force. Such efforts may result in overall competitiveness improvement as well as in progressive development of R&D sector.

Therefore, we decided to focus on variables connected to education sector (for the list of used variables and their definitions see Appendix TABLE 12) and their impact on GDP growth. Following regression coefficients depicted in TABLE 7 compare short-term and long-term perspective of partial effects. Testing of model assumptions is enclosed in Appendix (TABLE 11).

Table 7: Education sector - Summary of estimates - short vs. long perspective

model	(1) ^a		(2) ^a		(3) ^b	
dep_var	LGDP		LGDP		LGDP	
method	FE		FE		FE	
SE	robust		robust		HAC	
	b	se	b	se		
Exp_edu_p	0.000***	(0.000)	0.000***	(0.000)	0.000***	(0.000)
Bexp_rnd	0.000***	(0.000)	0.000***	(0.000)		
High_edu_ach	-0.019***	(0.002)	-0.017**	(0.005)	0.013*	(0.005)
Sec_enrol_r	0.032***	(0.006)	0.028**	(0.008)	0.028***	(0.005)
Know	0.067**	(0.022)	0.109**	(0.026)		
Pup_tea_sec	0.033	(0.026)	0.030	(0.030)	0.047*	(0.018)
Edu_sys	0.129***	(0.025)	0.088*	(0.037)	0.000***	(0.000)
Educ_uni	-0.315***	(0.050)	-0.248***	(0.054)		
Engin	0.073**	(0.017)			0.000***	(0.000)
Tech_exp_r			0.009*	(0.004)	0.000***	(0.000)
Constant	4.298***	(0.796)	4.501***	(0.971)	0.000***	(0.000)
r2	0.875		0.809		0.627	
N	40		40		154	

^a - variable estimates for period 2007 - 2011

^b - variable estimates for period 1995 - 2011

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

MODEL EDUCATION SECTOR:

The examined variables are mostly significant, though, they have little influence on the GDP growth. The exceptions are educational system and university education, both meeting the needs of a competitive economy. These two are, however, insignificant in the long run.

Worth mentioning is the secondary enrolment ratio, which is significant and has the same effect in both periods. It seems that a development in secondary educational system was the most effective, in terms of growth rate increase. In the case of China, secondary school enrolment rose from 70% in 1995 to 99% in 2009, thus might have contributed to the boom of Chinese economy. In this context, the development of neglected secondary education was prior (and more effective) to university education, hence the negative coefficient in the short-run.

It is interesting to point out that China's secondary school enrolment ratio in 2009 was one of the highest among relevant countries, leaving for example USA behind.

4.2.5 Instrumental variable approach

We have already reported the estimation results, discussed their interpretations and limitations. Before presenting the conclusion of this part, we would like to use our preceding findings from the OVERALL, R&D and EDUCATION model to evaluate the last one.

Our preceding enthusiasm about having plenty of useful variables from various areas at our disposal has been shown as slightly misleading. Two main problems arose instantly. Some of the variables (indexes especially) have been constructed in a way which makes their interpretation complicated or quite vague. The second challenging issue is the potential collinearity between variables as well as the presence of endogeneity. We have experienced both these limitations. There were coefficients difficult to interpret, or having similar meaning (high correlation) but with opposite signs of the regression coefficients. To deal with such issues, we suggest using the instrumental variable approach which is presented in the following part.

We have decided to treat both previously analyzed variables as potentially suffering from endogeneity. In TABLE 8, we present the initial model (1) and then we instrument firstly for *Exp_rnd_r*, and then in models (2) and (3) for *Exp_edu*.

Table 8: IV & 2SLS approach^a - Summary of estimates

model	(1)		(2)		(3)		(4)	
dep_var	LGDP		LGDP		LGDP		LGDP	
method	FE		2SLS		IV		IV	
SE	HAC		HAC		HAC		HAC	
instrumented var.			Exp_rnd_r		Exp_edu		Exp_edu	
instruments			<i>Fund_tech</i> <i>Tech_exp_r</i> <i>Bezp_rnd_r</i>		<i>High_edu_ach</i>		<i>GovB_r</i>	
	b	se	b	se	b	se	b	se
Exp_rnd_r	-0.587***	(0.148)	-0.623***	(0.130)				
Exp_rnd_p					0.001***	(0.000)	0.001**	(0.000)
Exp_edu	-0.048*	(0.024)	-0.043*	(0.023)	-0.223***	(0.067)	-0.193*	(0.089)
LF	0.038***	(0.005)	0.037***	(0.004)	0.043***	(0.007)	0.033***	(0.006)
Prod_PPP	0.000***	(0.000)	0.000***	(0.000)	0.000	(0.000)	0.000	(0.000)
r2	0.760		0.758		0.457		0.569	
N	50		48		40		50	

^a - variable estimates for period 2007 - 2011

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

MODEL IV APPROACH:

The theoretic intuition behind the instrumental variable approach is to include in regression a strictly exogenous variable which is strongly correlated with the potentially endogenous regressor. Thanks to the instrumental approach, such variable can then influence dependent variable via the endogenous regressor.

The key assumption to make this approach work is strict exogeneity of instrument, high correlation between instrument and instrumented variable. We test if these assumptions are satisfied in our models (2), (3) and (4). We use `XTIVREG2` (Schaffer, 2005) command, which automatically performs underidentification, overidentification and exogeneity tests – the results are presented in TABLE 9.

Firstly, the underidentification test reports Kleibergen-Paap LM statistic. In all three models, the null hypothesis is strongly rejected. Used instruments are obviously relevant (i.e. significantly correlated with the instrumented variable).

Secondly, the Hansen J statistics reports the results of the Sargan-Hansen overidentification test. The joint null hypothesis states that the instruments are properly chosen (i.e. uncorrelated with the error term, correlated with the instrumental variable). TABLE 9 shows that we can reject the null in models (3) and (4) but we fail to reject it in case of model (2). Hence, even if the first stage regression results of models (3) and (4) are outstanding in terms of regressor significance, we clearly cannot use `High_edu_ach` and `GovB_R` as proper instruments; and coefficients of models (3) and (4) are biased.

Therefore, we can concentrate on model (2) and perform the exogeneity test using `DMEXOGXT` (Baum & Stillman, 1999) command. This test is an analogy to Durbin-Wu-Hausman test for HAC standard errors and under the null hypothesis it tests the consistency of the OLS estimator applied on the same regression equation. Rejection of the null suggests that the endogenous regressors have significant impact on the regression results, and in such case, the instrumental variable approach can be justified.

The rejection of the null is obvious in the case of all three models but only the model (2) fulfills all the tests requirements. It is adjusted for heteroskedasticity and autocorrelation and can be accepted as extension of initial model (1). TABLE 8 shows that by using IV approach,

we managed to slightly adjust the FE estimates towards the real value and make them more efficient.⁸

Table 9: Instrumental variable approach - testing of assumptions

Model		(2)		(3)		(4)	
	Instrumental variable	b	p-value	b	p-value	b	p-value
First stage regression	<i>Fund_tech</i>	-.0590	0.000				
	<i>Bexp_rnd_r</i>	1.021	0.000				
	<i>Tech_exp_r</i>	0.010	0.003				
	<i>High_edu_ach</i>			0.077	0.003		
	<i>GovB_r</i>					-0.055	0.019
	<i>statistics</i>	test stats.	p-value	test stats.	p-value	test stats.	p-value
Underidentification	Kleibergen-Paap	11.639	0.0087	7.974	0.0047	4.049	0.044
Overidentification	Hansen J	1.912	0.3844		0.0000		0.000
Exogeneity	Davidson-MacKinnon	6.888	0.018	6.292	0.0196	5.422	0.027

4.3 Concluding remarks

In the previous section, we tried to determine and quantify growth factors of GDP. The findings were surprising. The most unexpected result was the size and the sign of expenditure on R&D effect, which persisted throughout different periods and estimation methods.

The last coefficient estimation from 2SLS model suggests that in period 2007 - 2011 *1pp* increase in R&D share on GDP will cause 0.623% decrease of GDP. FE estimate suggests a decrease of 0.59%, overall model even *2pp* decrease of real GDP growth in period 1995 - 2011.

The reason behind this phenomenon is that the expenditures on R&D are growing faster than GDP. In order to stay competitive on the global market, countries are thriving to innovate and more willing to invest on R&D, even at higher costs relative to their GDP. For example in post-2008 crises period, when GDP of many countries was stagnating the expenditures on R&D were still rising.

We have also considered the hypothesis of lagged R&D effect on GDP growth. Nonetheless, based on our dataset lagged variables of R&D have been insignificant. The only different result we have obtained was by applying advanced instrumental variable models (3SLS), which reported long-term positive effects of expenditures on R&D. We have not included

⁸R² decreased because of dropping 2 observation due to missing values issue, as explained above.

these results in our analysis because the system of equations suffered from over/identification issues. However, this gives an opportunity for further analysis.

Previous modelling part provided supportive evidence for confirmation of growth factors from SECTION 3. We were unable to instrument endogenous expenditures on education, even though its effect on GDP growth was considerably lower but still negative. On the other hand, we managed to demonstrate partial effects of relevant growth factors in the overall modelling part and highlight the unique features of China's case.

5 CONCLUSION

During the 20th century, China has come from simple agricultural land through heavy industrialization to current development of tertiary system. Decades of intensive reforms and remarkable changes have reshaped Chinese economy into a unique and still developing hybrid. This hybrid economy is increasingly responsive to market forces (even in international terms), yet it still reflects a legacy of planned system. We may call it a successful transformation so far as it is clear that these reforms released China's suppressed potential and started a new era of 'miraculous' growth. Without a doubt, China has become a noticeable player on the global market.

The new market attracted numerous profit-seeking investors mainly from the North America and Europe. The first motivation for FDI was to increase production and exports, whilst taking advantage of low-cost labour. That served as a trigger for expansion of R&D. Today, China is one of the biggest recipients of FDIs; and Chinese growing enthusiasm for innovation is undeniable.

China has been dealt with a strong hand of cards – being the most populous country in the world it disposes of an abundant source of human capital. In SECTION 3, we reported increasing significance of education for Chinese. The rational conclusion is to set such educational system that would attract talent and curb brain drain. Conclusively, from such unmatched labour endowment China should benefit immensely.

Despite the booming economy, China is facing grievous imbalances among regions and repercussions of the ageing population. That lays a particularly challenging task for Chinese government and elite to carry out. Above all, these major issues have to be addressed in a very short period of time.

However, this formerly developing country has undeniably earned a prominent place among economic giants; and with a promise of further development growth. The world has turned upside down.

BIBLIOGRAPHY

Accenture, 2007. *The Rise of the Multi-Polar World*.

Anon., n.d. *Office of the Historian - Milestones - 1942-1952*. [Online]
Available at: <http://history.state.gov/milestones/1945-1952/ChineseRev>
[Accessed 13 May 2013].

Baum, C. F., 2000. *Xttest3: Stata module to compute modified wald statistic for groupwise heteroskedasticity*. s.l.:Boston College Department of Economics.

Baum, C. F. & Stillman, S., 1999. *Dmexogxt: Stata module to test consistency of ols vs xt-iv estimates*. s.l.:Boston College Department of Economics.

Beltratti, A. & Bortolotti, B., 2006. *The Nontradable Share Reform in the Chinese Stock Market*.

Brandt, L. & Rawski, T. G., 2008. *China's Great Economic Transformation*. s.l.:Cambridge University Press.

Burzynska, K., 2009. Financial Development and Economic Growth: The Case of Chinese Banking Sector. September.

Cai, F. & Wang, M., 2012. Labour Market Changes, Labour Disputes and Social Cohesion in China. *Working Paper No. 307*.

Campello, M., Ribas, R. P. & Wang, A., 2010. *Is the Stock Market Just a Side-Show? Evidence from the Split-Share Reform in China*.

Chan, A. & Unger, J., 2009. A Chinese State Enterprise under the Reforms: What Model of Capitalism?. *The China Journal*, July, Issue 62, pp. 1-26.

Economic Census, 2004. *Zhongguo jingji pucha nianjian [Yearbook of China's 2004 Economic Census]*, 4 vols. Beijing: Zhongguo tongji chubanshe.

Gertz, B., 2000. *The China Threat: How the People's Republic Targets America*.

Holz, C. A., 2005. *China's Economic Growth 1978-2025: What We Know Today about China's Economic Growth Tomorrow*.

Jefferson, G. H. & Rawski, T. G., 1999. Ownership and Change in Chinese Industry. *Enterprise Reform in China: Ownership, Transition and Performance*.

Jiatao, L. & Jing, Z., 2003. Explaining the Growth of International R&D Alliances in China. *Manage. Decis. Econ.*, Issue 24, pp. 101-115.

- Khanna, T. & Palepu, K. G., 2006. *Emerging Giants: Building World-Class Companies in Developing Countries*. s.l.:Harvard Business School Publishing.
- Khanna, T., Palepu, K. G. & Sinha, J., 2005. *Strategies That Fit Emerging Markets*. s.l.:Harvard Business Scholl Publishing.
- Lardy, N. R., 1994. *China in the World Economy*.
- Laurenceson, J., 2013. *China tackles income inequality, but is silent on state corruption*
- Lewis, A., 1972. *Reflections on Unlimited Labour*. New York, NY.: Academic Press.
- Lin, J. Y., Cai, F. & Li, Z., 2003. Gold into Base Metals: Productivity Growth in the People's Republic of China during the Reform Period.
- Lundin, N., Sjöholm, F., He, P. & Qian, J., 2007. FDI, Market Structure and R&D Investments in China. *IMF Working Paper No. 708*.
- Morawetz, D., 1978. *Twenty-Five Years of Economic Development, 1950 to 1975*. Baltimore: Johns Hopkins University Press.
- National Center for Science and Engineering Statistics, 2012. *Science and Engineering Indicators 2012*. Arlington: National Science Foundation.
- Naughton, B., 1995. *Growing out of the Plan: Chinese Economic Reform, 1978-1993*. Cambridge and New York: Cambridge University Press.
- People's Daily, 2000. Insight on MNCs' establishing R&D centers in China. *People's Daily*, 21 September.
- Ranis, G. & Fei, J. C. H., 1961. A Theory of Economic Development. *American Economic Review*, 51(4), pp. 533-565.
- Ronstadt, R., 1977. Research and Development abroad by U.S. Multinationals.
- Roodman, D., 2004. *Abar: Stata module to perform arellano-bond test for autocorrelation..* s.l.:Boston College Department of Economics.
- Samuelson, P., 2004. Where Ricardo and Mill Rebut and Confirm Arguments of Mainstream Economists Supporting Globalization. *Journal of Economic Perspectives* 18, Issue 3, pp. 135-146.
- Schaffer, M. E., 2005. *Xtivre2: Stata module to perform extended iv/2sls, gmm and ac/hac, liml and k-class regression for panel data models..* s.l.:Boston College Department of Economics.

Schaffer, M. E. & Stillman, S., 2006. *Xtoverid: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2, xthtaylor*. s.l.:Boston College Department of Economics.

The Economist, 2009. The spend is nigh. *The Economist*, 30 July.

The Economist, 2010. The world turned upside down. *The Economist*, 15 April, Issue 17th April.

United Nations, 2009. The World Population Prospects: The 2008 Revision.

Voelker, R. & Stead, R., 1999. New technologies and international locational choice for research and development unit: Evidence from Europe.. *Technology Analysis & Strategic Management*, 11(2), pp. 161-172.

Wang, M., 2010. The Rise of Labor Cost and the Fall of Labor Input: Has China Reached Lewis Turning Point?. *China Economic Journal*, 3(2), pp. 139-155.

Xiaodong, Z., 2012. Understanding China's Growth: Past, Present, and Future. *Journal of Economic Perspectives*, Volume 26(4), pp. 103-124.

Xie, Y. & Wu, X., 2008. Danwei Profitability and Earnings Inequality in Urban China. *The China Quarterly*, September, Volume 195, pp. 558-581.

Yanrui, W., 2004. China's Economic Growth: A Miracle with Chinese Characteristics.

Yao, X. & Wu, X., 2011. Transition of China's Financial System after the Global Financial Crisis. *World Economy*, Issue 34, pp. 792-804.

Yingyi, Q., 2000. The Process of China's Market Transition (1978-1998): The Evolutionary, Historical, and Comparative Perspectives. *Journal of Institutional and Theoretical Economics* 156, March, Issue 1, pp. 151-171.

Young, A., 2003. Gold into Base Metals: Productivity Growth in the People's Republic of China during the Reform Period. *Journal of Political Economy* 111, December, Issue 6, pp. 1220-1261.

Zhang, J., 2008. China's Economic Growth.. *Trajectories and Evolving Instituion*, Issue Research Paper No. 2008/33.

Zhongguo Tongji Chubanshe, 2008. China Statistical Yearbook. *Zhongguo tongji nianjian*, pp. 496, 485.

APPENDIX

APPENDIX 1

Table 10: R&D sector model - testing of assumptions

		model	1	2	3
Heteroskedasticity	chi2 statist.		40193.16	0.70	10126.20
	p-value		0.0000	0.4032	0.0000
	Het. presented		YES	NO	YES
Autocorrelation	F-test statistic		11.503	0.0031	232.184
	p-value		0.0048	0.1764	0.0000
	Aut. presented		NO	NO	YES
Hausman	chi2 statistic				0.3586
	p-value				0.9122
	FE vs. RE				FE
Hausman check	Sargan-Hansen				0.0000

APPENDIX 2

Table 11: Education sector model - testing of assumptions

		model	1	2	3
Heteroskedasticity	chi2 statist.		7.3e+25	29608.97	9129.27
	p-value		0.0000	0.0000	0.0000
	Het. presented		YES	YES	YES
Autocorrelation	F-test statistic		1.867	2.116	57.486
	p-value		0.2017	0.1764	0.0030
	Aut. presented		NO	NO	YES
Hausman	chi2 statistic		2.66	8.28	5.49
	p-value		0.9538	0.4068	0.3586
	FE vs. RE		RE	RE	RE

APPENDIX 3

Table 12: List of variables

Code	Variable	Definition
GDP	Gross Domestic Product (GDP)	US\$ billions
GDP_PPP	GDP (PPP)	Estimates ; US\$ billions at purchasing power parity
ESA	Economic sectors / Agriculture	Breakdown as a percentage of GDP
ESI	Economic sectors / Industry	Breakdown as a percentage of GDP
ESS	Economic sectors / Services	Breakdown as a percentage of GDP
GDP-g	Real GDP growth	Percentage change, based on national currency in constant prices
GDP-g-p	Real GDP growth per capita	Estimates, US\$ per capita at purchasing power parity
GDP_PPP-p	GDP (PPP) per capita	Estimates, US\$ per capita at purchasing power parity
E	Employment	Total employment in millions
E_r	Employment (%)	Percentage of population
E-g	Employment - growth	Estimates: percentage change
EA	Employment by sector / Agriculture	Percentage of total employment
EI	Employment by sector / Industry	Percentage of total employment
ES	Employment by sector / Services	Percentage of total employment
EPS	Employment in the public sector (%)	Percentage of total employment
U_r	Unemployment rate	Percentage of labor force
CPI	Consumer price inflation	Average annual rate
COL	Cost-of-living index	Index of a basket of goods & services in major cities, including housing (New York City = 100)
GovB	Total general government debt (\$bn)	US\$ billions
GovB_r	Total general government debt (%)	Percentage of GDP
GovR-g	Total general government debt-real growth	Percentage change, based on national currency in constant prices
Gov_dom	Central government domestic debt (%)	Percentage of GDP
Gov_for	Central government foreign debt (%)	Percentage of GDP
Public	Public finances	Public finances are being efficiently managed (index from 0 to 10)
Pension	Pension funding	Pension funding is adequately addressed for the future (index from 0 to 10)
Gov_exp	General government expenditure (%)	Percentage of GDP
Transp	Transparency	Transparency of government policy is satisfactory (index from 0 to 10)
Bure	Bureaucracy	Bureaucracy does not hinder business activity (index from 0 to 10)
Bribe	Bribing and corruption	Bribing and corruption (index from 0 to 10)
Tariff	Tariff barriers	Tariffs on imports: Most favored nation simple average rate
Protect	Protectionism	Protectionism does not impair the conduct of your business (index from 0 to 10)
Inv_f	Foreign investors	Foreign investors are free to acquire control in domestic companies (index from 0 to 10)
compet	Competition legislation	Competition legislation is efficient in preventing unfair competition (index from 0 to 10)
bussin_ease	Ease of doing business	Ease of doing business is supported by regulations (index from 0 to 10)
Labor_reg	Labor regulations	Labor regulations do not hinder business activities (index from 0 to 10)
U_leg	Unemployment legislation	Unemployment legislation provides an incentive to look for work (index from 0 to 10)
Per_sec	Personal security and private property rights	Personal security and private property rights are adequately protected (index from 0 to 10)
Ageing	Ageing of society	Ageing of society is not a burden for economic development (index from 0 to 10)
Soc_coh	Social cohesion	Social cohesion is a priority for the government (index from 0 to 10)
Gini	Gini index	Equal distribution of income scale: 0 (absolute equality) to 100 (absolute inequality)
Inc_low	Income distribution - lowest 10%	Percentage of household incomes going to lowest 10% of households
Inc_high	Income distribution - highest 10%	Percentage of household incomes going to highest 10% of households
Prod_PPP	Overall productivity (PPP)	Estimates: GDP (PPP) per person employed, US\$
Prod	Overall productivity	GDP per person employed, US\$
Prod_rg	Overall productivity - real growth	Estimates: Percentage change of real GDP per person employed
Labor_prod_PPP	Labor productivity (PPP)	Estimates: GDP (PPP) per person employed per hour, US\$
Labor_prod_PPP-g	Labor productivity (PPP) growth	Percentage change of GDP (PPP) per person employed per hour
A_prod_PPP	Agricultural productivity (PPP)	Estimates: Related GDP (PPP) per person employed in agriculture, US\$
I_prod_PPP	Productivity in industry (PPP)	Estimates: Related GDP (PPP) per person employed in industry, US\$
S_prod_PPP	Productivity in services (PPP)	Estimates: Related GDP (PPP) per person employed in services, US\$

Code	Variable	Definition
Corp	Large corporations	Large corporations are efficient by international standards (index from 0 to 10)
SME	Small and medium-size enterprises	Small and medium-size enterprises are efficient (index from 0 to 10)
Prod_comp	Productivity of companies	Productivity of companies is supported by global strategies (index from 0 to 10)
ULCM	Unit labor costs in the manufacturing sector (%)	Percentage change
Work_h	Working hours	Average number of working hours per year
Work_m	Worker motivation	Worker motivation in companies is high (index from 0 to 10)
Emp_train	Employee training	Employee training is a high priority in companies (index from 0 to 10)
LF	Labor force	Employed and registered unemployed (millions)
LF_r	Labor force (%)	Percentage of population
LG_g	Labor force growth	Percentage change
Part-time	Part-time employment (%)	Percentage of total employment
Skill_lab	Skilled labor	Skilled labor is readily available (index from 0 to 10)
ART	Attracting and retaining talents	Attracting and retaining talents is a priority in companies (index from 0 to 10)
Brain_d	Brain drain	Brain drain (well-educated and skilled people) does not hinder competitiveness (index from 0 to 10)
For_skill	Foreign high-skilled people	Foreign high-skilled people are attracted to country's business environment (index from 0 to 10)
Int_exp	International experience	International experience of senior managers is generally significant (index from 0 to 10)
Comp_man	Competent senior managers	Competent senior managers are readily available (index from 0 to 10)
Adapt	Adaptability of companies	Adaptability of companies to market changes is high (index from 0 to 10)
Pop_market	Population - market size	Estimates in millions
Pop_15r	Population under 15 years (%)	Percentage of total population
IT_skill	Information technology skills	Information technology skills are readily available (index from 0 to 10)
Engin	Qualified engineers	Qualified engineers are available in your labor market (index from 0 to 10)
Fund_tech	Funding for technological development	Funding for technological development is readily available (index from 0 to 10)
Tech_reg	Technological regulation	Technological regulation supports business development and innovation (index from 0 to 10)
Tech_exp	High-tech exports	US\$ millions
Tech_exp_r	High-tech exports (%)	Percentage of manufactured exports
Exp_rnd	Total expenditure on R&D (\$)	US\$ millions
Exp_rnd_r	Total expenditure on R&D (%)	Percentage of GDP
Exp_rnd_p	Total expenditure on R&D per capita (\$)	US\$ per capita
Bexp_rnd	Business expenditure on R&D (\$)	US\$ millions
Bexp_rnd_r	Business expenditure on R&D (%)	Percentage of GDP
Science_deg	Science degrees	Percentage of total first university degrees in science and engineering
Know	Knowledge transfer	Knowledge transfer is highly developed between companies and universities (index from 0 to 10)
Urban	Urban population (%)	Percentage of total population
HDI	Human development index	Combines economic - social - educational indicators/ Source: Human Development Report
Sust	Sustainable development	Sustainable development is a priority in companies (index from 0 to 10)
Qual	Quality of life	Quality of life is high (index from 0 to 10)
Exp_edu	Total public expenditure on education (%)	Percentage of GDP
Exp_edu_p	Total public expenditure on education per capita	US\$ per capita
Pup_tea_prim	Pupil-teacher ratio (primary education)	Ratio of students to teaching staff
Pup_tea_sec	Pupil-teacher ratio (secondary education)	Ratio of students to teaching staff
Sec_enrol_r	Secondary school enrollment (%)	Percentage of relevant age group receiving full-time education
High_edu_ach	Higher education achievement (%)	Percentage of population that has attained at least tertiary education for persons 25-34
TOEFL	English proficiency - TOEFL	TOEFL scores
Edu_sys	Educational system	The educational system meets the needs of a competitive economy (index from 0 to 10)
Science	Science in schools	Science in schools is sufficiently emphasized (index from 0 to 10)
Educ_uni	University education	University education meets the needs of a competitive economy (index from 0 to 10)
Educ_man	Management education	Management education meets the needs of the business community (index from 0 to 10)
Illiteracy	Illiteracy (%)	Adult (over 15 years) illiteracy rate as a percentage of population
Language	Language skills	Language skills are meeting the needs of enterprises (index from 0 to 10)