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Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

The impact of China's demographic policy on its current GDP growth

Author: **Bc. Karina Rotar**

Supervisor: **Mgr. Michal Paulus**

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, July 31, 2017

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Abstract

The topic of this paper is relation between the current demographic policy of China and its GDP. A large number of papers have been already written on the subject; however, there is still a space for theoretical analysis and empirical estimation: use more recent data, find new variables and relations. In this thesis we have performed a research based on panel data on 31 Chinese provinces for the years 1995 – 2015. Based on Solow growth model, we chose gross regional product of each province as dependent variable; gross capital formation, foreign direct investment and joint variable of percentage of ethnic minorities multiplied by birth rate have been chosen as independent variables. As an estimation technique we use fixed effects model.

Empirical estimation led us to the following findings. Firstly, the impact of the one child policy on economic growth of China is negative. Secondly, the impact of the foreign direct investment on gross regional product is insignificant. Thirdly, high percentage of ethnic minorities in the population of the region negatively affects its economy.

We come to a conclusion that the government of People's Republic of China has to further adjust the demographic policy in order to secure further sustainable growth.

JEL Classification	C23, E00, J11, J13
Keywords	demography; one child policy; economic growth; panel data;

Author's e-mail	karinka-30-06@mail.ru
Supervisor's e-mail	michal.paulus@fsv.cz

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Acronyms

1CP One Child Policy

GCF Gross Capital Formation

GDP Gross Domestic Product

GRP Gross Regional Product

FDI Foreign Direct Investment

FE Fixed Effects

FGLS Feasible Generalized Least Squares

LSDV Least Squares Dummy Variable

RE Random Effects

Master's Thesis Proposal

Author:	**Bc. Karina Rotar**	Supervisor:	**Mgr. Michal Paulus**
E-mail:	karinka-30-06@mail.ru	E-mail:	michal.paulus@fsv.cuni.cz
Phone:	+420 775 526 710	Phone:	
Specialization:	Corporate Finance and Strategy	Defense Planned:	June 2016

Proposed Topic:

The impact of China's demographic policy on its current GDP growth

Motivation:

The rapid economic development of China in the last decades is a result of a multitude of different economic, political, social, and cultural factors, the unique place among which have demographic processes. According to official data only, the current population of China is over 1 billion 360 million people. For a long period population growth had been viewed by the Chinese authorities as a positive trend, a source of production growth. Nevertheless, by the middle of XX century it became evident that the speed of population growth exceeded the speed of economic development; the country faced the problem of lack of the resources. Since the year of 1973, family planning is included into China's 5-year plan. Moreover, it is written in the Constitution, that the government encourages planned childbearing. All these are the signs of a special attention, which Chinese authorities pay to demographic issue that proves its importance for the economy. The current demographic policy of China is known under the name of "One-child policy", and it includes measures for encouragement of families with one child and punishment of the families with two and more children. Even though the policy led to some positive results, it also had a number of negative consequences, such as: sex-based birth rate disparity, aging of population, and reduction of population in working age. These consequences had a significant impact on socio-economic situation in the country.
The aim of this paper is the discussion and analysis of the impact of China's demographic policy and its recent results on country's economic growth.

Hypotheses:

1. Hypothesis #1: The relation between the birth rate and GRP of Chinese provinces is negative.
2. Hypothesis #2: The relation between foreign direct investment into the region and GRP is positive.
3. Hypothesis #3: The impact of high percentage of ethnic minorities in population on GRP is negative.

Methodology:

The thesis will represent a study on relations between population growth and GDP growth in China. The analysis will be based on data, annually provided by the National Bureau of Statistics of China.
Following Qilei Fang and Chee Kian Leong, I will use the Solow Growth Model as a basis for macroeconomic analysis, as this model represents the effect of population growth on real income.
Based on the available data, I will perform panel data analysis on provincial level using fixed effects model. Taking GRP as the dependent variable, I have chosen the following independent variables: gross capital formation, foreign direct investment, birth rate, percentage of ethnic minorities.

Expected Contribution:

I will make a research of the influence of "One-Child-Policy" in China on current economic situation in the country. Based on existing papers, I will modify previously created models with new significant variables to obtain better results. Taking into account the information for several past decades, I will focus on currently available data and also try to make a short-term forecast for the GDP.

Outline:

1. Motivation: the specific role of demographic processes in economic development of China.
2. Studies on relation between demographic policy and economic growth of China: a brief overview of existing literature and my further research on the topic.
3. Data: description of the data and the way it will be collected.
4. Methods: I will explain the theoretical background and empirical approach.
5. Results: description of regressions, robustness check.
6. Conclusion: I will give a summary of my results and suggest their future implications.

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Author **Supervisor**

1 Introduction

Rapid economic development of People's Republic of China – a truly unique example in modern history – has drawn a special attention of scholars all over the world. A great leap from poverty, incredibly high illiteracy of the population, damaged economic structure, non-developed production to constantly and stably progressing middle income society, made by this country in less than 30 years is beyond impressive.

From non-developed country of the so-called "third echelon", China became one of the world's leading economies, with the second highest GDP after United States. The country has also become an important player not only on the international market, influencing prices and competition in other Asian, as well as European countries and America; but in international politics, as an emerging power. Apart form being unprecedentedly fast, economic growth of China has also been pretty sustainable, despite of a number of challenges that came with it. According to the World Bank, these are: "high inequality, rapid urbanization, challenges for the environment and external imbalances".

The impact of the one child policy on Chinese economic development is a contradictory topic. The main aim of this paper is to empirically estimate and theoretically analyze this impact to identify whether its relation with country's GDP is positive or negative. Based on Solow growth model, we perform the analysis using provincial panel data set for 31 Chinese provinces for the period of 1995 – 2015. As an estimation technique we have chosen fixed effects model.

Several factors are named most often as causes of China's "economic miracle", among which: new economic policy, implemented by Den Xiaoping, which led to the transition from planned to market-based economy; rich natural resources base; significant foreign direct investment inflow; and, of course, a huge source of cheap labor force.

On the other hand, it has long been a subject of dispute, whether its huge population is a benefit, or an obstacle for China's development, as it gives significant pressure on environment and minimizes incentives for technical progress. Realizing the importance of population factor, Chinese government has several times in recent history used measures for rather encouraging, or controlling birth rate, based on the state of economy and the country's needs. At the point when high birth rate and constant population growth started being a threat for China's steady progress, authorities reacted with a new, more detailed and strict demographic campaign: the one child policy. Once implemented, the policy has several times been modified, to include special cases and take into account regional specifics and ethnic structure.

Limiting the number of births per one Chinese couple to one was aimed to slow down population growth, and therefore, increase the quality of life of the population. The results of the new policy came quite fast: decrease in birth rate led to a short-term demographic dividend – increase in share of working age population in total population of the country, which has also in its turn contributed to economic growth. However, after a while showed another side of the medal: the draconic policy measures caused distortion of population structure: imbalance of sexes and population ageing, meaning big challenges for the country in the long run. In the end, in order to minimize the negative consequences of the latest demographic regulations, the government has once again adjusted the policy measures in the year of 2015, and allowed the birth of a second child for all Chinese families.

The text of the thesis is structured as following. Section 2 is presented as description of theoretical background and includes brief introduction to the topic; overview of China's demographic policy measures in resent history; description of regional specific; issues brought by the policy; short-term results of the new two-child policy; overview of existing literature. In Section 3, we describe the methodology applied and data used, provide the empirical results and analyze them. In Section 4 we summarize our findings and make a final conclusion. In Section 5, we point out the contribution made and name the possibilities for further research.

2 Literature Review

2.1 Introduction to the Topic

The People's Republic of China is a unique country from a demographic prospective, first of all, due to its enormous population, which affects different spheres of life of the Chinese society: ecological situation, food security, employment and labor supply, social and family relations, and many others. To put it another way, population growth in China will have a great influence on modernization and socioeconomic development of the country in the upcoming decades. Currently, the role of demographic factor in changing socioeconomic, political and ideological processes in the countries, taking advantage of the demographic dividend is highly significant, and China, with its population of more than 1.3 billion, is not an exception. Majority of Chinese scientists agree, that the main current demographic problem of the country lies in the pressure, which its growing population is giving on the production factors. This is exactly the reason why strict control over the population growth rate became the basis for the demographic policy, implemented by the Chinese government. Huge population has already made the People's Republic of China face various problems, such as: extreme lack of natural resources per capita, growing unemployment, increasing level of stress and social pressure among Chinese citizens and many more. Demographical problem has already been named a key factor, deterring further economic development of the country. Whether China will be able to successfully solve its demographical problems, including changes in the age structure and disparity of sexes, or not, will have a direct impact on the quality of life and standards of living of the Chinese population.

According to E. Bazhenova, after more than 30 years of its implementation, current demographic policy in China has shown some successful results. The birth rate has declined from 33 in 1970s to around 15 per thousand nowadays, coefficient of natural increase of population has declined from 26 to 9 per thousand, as for these characteristics, China has joined the group of countries with low birth rate. The average family size has declined from 4.8 people in 1971 to 3.44 people in 2000.

Around 300 million births have been eliminated since early 1970s, which significantly decreased government's social expenses, softened the population's pressure on natural resources and ecology, contributed to the economic development and increase in standards of living.

During the 16th congress of the Communist Party of China, the new goal of 4 times increase in GDP by 2020, in comparison to 2000, was stated; the GDP per capita target was set at 3000 USD. Those targets are supposed to be achieved by sustaining a relatively high growth rate of the economy, through active economic reforms in both rural and urban areas. In addition to this, one of the major conditions for Chinese economic development is the implementation of the birth control policy (Bazhenova, 2005).

The strictness of birth control measures was justified by the extremely negative impact, which population growth had on socio-economic development of the country. For this reason, Chinese scientists are now taking demographic theory as a priority, aiming to give a scientific proof for the creation and implementation of current demographic policy. According to them, demographic problems of the country can be solved through the gradual realization of specific measures, with changing priority goals of the policy at each stage. Currently, the stress is put on birth control, decreasing children's mortality rate, decreasing unemployment and increasing women's status in the society. Another important issue is the so-called "improvement of population", which includes regulation of age structure, sex ratio and urban-to-rural-citizens ratio. Next on the agenda is solving the problem of population ageing and development of social care system.

The key aspects of China's demographic policy are: changing traditional views and behavior in terms of fertility, birth control in rural areas and areas with high birth-rates, migration control, increase of the basic education level, improvement of technical education.

Chinese government also considers international migration as another effective way to solve demographic problems. It encourages export of goods and services, foreign investment and also supports the citizens, working abroad on legal terms, as the

export of labor force decreases the pressure, created by the population inside the country.

It is important to note, that the birth control measures vary significantly across different regions of China. For example, in Western provinces, with the highest density of national minorities in the country, they have a form of recommendations, rather than absolute rules. This partly explains the fact, that the birth rate is much higher in Western regions, than in other parts of the country – around 14.4 – 14.6 per thousand in Guangxi and Hainan; 15.2 – 15.8 in Qinghai, Ningxia and Xinjiang; and 17.4 in Tibet, while in North-Eastern China it is as low as 6 – 7 per thousand. Therefore, the coefficient of the population growth is higher in those regions as well: 8.3 – 8.7 per thousand in Guangxi and Hainan; 9.0 – 10.8 in Qinghai, Ningxia and Xinjiang; and 11.7 in Tibet, while in big cities, Central and Eastern provinces it is equal to 1.1 – 3.4 per thousand. (Bazhenova, 2009)

2.2 The history of population control policy in China

The one child policy was carried out as a fundamental national policy to keep the total population to 1.2 billion in the beginning of 21th century. Since 1971, Chinese government had called for “later marriage, longer spacing between children, and fewer children in total” in order to lower the population growth. The fertility rate decreased to 1.8%. Nevertheless, there were still around 8 to 10 million newly born babies under the base of 800 million total population which strengthen the burden on social capacity and obstruct the economic development. Therefore, in September 1980, the central government introduced the one child policy to further control the population growth rate. Under this policy, each couple could have only one child (Fang, Leong, 2014).

However, the roots of the policy can be found already in the 1950s. During the first few years of the post-1949 period, China’s leaders had a view that a large population was an asset, which was influenced by the traditional Chinese culture. But soon China started to become aware of the liabilities of a large and rapidly growing population. China’s first population census of 1953 showed that its population was already close to 600 million and was increasing at a rate of over 2% a year (Yu, 2008).

The first family-planning campaign in China started in 1956 – 1958. The government started intensive activity by organizing public lectures and meetings, spreading agitational broadsheets and leaflets, showing documentaries, explaining the need for birth control. A number of articles by famous Chinese scientists, pointing out the negative consequences of the rapid population growth for the country's economy was published in the newspapers (Nazarova, Serova, 2010).

For example, a wide public resonance was caused by the report of Ma Yinchu, one of the most well known and respected economists and demographers of that period, called 'New Population Theory' (1957). He proposed to the government a set of birth-control measures, among which, promotion of later marriages, and educating population on the use of contraception, as well as distribution of contraceptives. As mentioned in the article, published by Xu Mei, Ma Yinchu believed, that it was "very urgent to control the population, otherwise, the problem in the future will be more difficult to solve" (Xu, 2011). According to Howden and Zhou, in his report Ma Yinchu "systematically established that China's population was growing too quickly while its rate of capital accumulation was not high enough to maintain a sufficient quality of life. He recommended that China not only try to accumulate more capital, but also increase its rate of capital accumulation. This could be achieved in absolute terms by producing greater amounts of raw materials, promoting scientific research and limiting consumption among the population. In per capita terms, capital accumulation could be increased by simply reducing the rate of population growth" (Howden, Zhou, 2014).

However, the policy was interrupted shortly after by the Great Leap Forward, which brought the country to the early stages of the largest social reform ever undertaken. Country's leader, Mao Zedong, did not know whether the population should be higher or lower, but overstatements concerning food production during this period made him more favorable toward population growth. In the following years, Mao openly encouraged a larger population, which was named as one of the key factors, contributing to the economic growth (Howden, Zhou, 2015).

The failure of the Great Leap Forward and the following "3 years of hardship" caused a sharp decline in country's fertility rate and increase in mortality rate. In 1960 the overall population of China decreased in 10 million. However, since 1962,

the birth rate starts growing rapidly again. According to the second population census of 1964, country's population already exceeded 700 million, which was around 120 million more than in 1953 (Nazarova, Serova 2010).

During the early 1960s China started the second family-planning campaign with the emphasis on the virtues of the late marriage. As a consequence, the birth rate declined significantly by 1965. However, the second campaign, similarly to the first one, again came to an end soon, when the "Cultural Revolution" began in 1967. Nevertheless, during the Cultural Revolution many young people from urban areas were sent to the rural areas, as a result, many delayed their marriage and childbirth decision, which by itself had no connection with the birth-control policies (Yu, 2008).

From 1971, the third phase of China's demographic policy has started. The normalization of economic and social sphere required, among a number of other measures, normalization of demographic policy. Family planning was named as an important part of economic and social planning. In 1973 family planning was included into the 4th 5-year plan of economic development (Nazarova, Serova, 2010). The policy was now implemented under a slogan "later, longer, and fewer", which called for delayed marriage, greater spacing between babies (4 – 5 years), and fewer children in total. Between 1971 and 1979, the "later, longer, and fewer" campaign reduced the birth rate by 50% and the campaign was, therefore, viewed as very successful (Yu, 2008).

The fourth stage of the family-planning policy started after Mao Zedong's death, in 1976 – 1977. A major development of the scientific research on demographics was made. In December 1978, the new Constitution of People's Republic of China was approved, which, for the first time, included a paragraph on government's support of the family planning (Nazarova, Serova, 2010).

However, according to Zhihao Yu, the birth-control campaigns had not fundamentally affected the fertility rate in China. Although to some extent they reduced the fertility rate by delaying marriages and decisions on childbirth, the long-term effect was limited. For example, in the mid-70-s, a couple was still allowed to have two children in the cities, and three or even four in the country. Without

significantly reducing the number of children per married couple, the delaying strategies can work only in the short-run, being effective for maximum 10-15 years. In 1979 China was at the critical point where the previous delaying strategy on birth control ceased being as effective as it was before (Yu, 2008). Therefore, a new policy needed to be implemented.

According to the paper by Noemi Schramm, "introducing the one child policy together with other economic and societal reforms, the Chinese government was inspired by the work of the Club of Rome in the 1970s about the scarcity of resources and argumented with the Malthusian breakdown, which says that given limited resources, never ending population growth hampers economic growth" (Schramm, 2011).

When the policy was implemented, local government formalized the detailed regulations including special cases for second baby, benefits and penalties. Parents, who had only one child, with the certification from local government, could get some bonus from their working places, which varied according to different provincial conditions. In rural areas, the one-child families could pay lower tax and enjoy the priority to larger area of land or forests (Fang, Leong, 2014). In March 1979, local authorities of Sichuan province decided, as an experiment, to give a monthly reward of 5 RMB (which at that time was equal to 10% of a worker's salary per month) to the families, intended to have only one child. Those families had a right for a house as big as the family, consisting of 4 members would have. Moreover, the only child in a family would have benefits while applying for school and job. Similar measures were taken in Guangdong province: the only child could get free healthcare until the age of 14, free high school education, etc (Nazarova, Serova, 2010). On the other hand, those who have more than one baby would be punished for paying fines at the beginning of the policy implementation. Then in 2002 the regulations of "social support fee" were issued by the central government, which in majority of provinces and cities is equal to the amount of two to six times of the average income of local residents for one time and doubled amount for the second one. In some provinces the annual payment system exists, for example in Shanxi, family with extra child pay the fee for 7 years with 20% of family total income each year and both time and fee would be doubled for the second child. In addition to this, parents who violate the

policy will be demoted or even dismissed if they work in government sectors (Fang, Leong, 2014).

Since the beginning, the new population-control policy varied significantly throughout different regions of the country and different groups of population. There are several conditions for the second child, such as: the first child is disabled; in rural area where the first child is a girl; one of the parent has been working in a dangerous place for more than five years. The policy is strictly applied to Han Chinese (majority nationality), comparing with the ethnic minorities, especially in the ethnic minority autonomous regions of Xinjiang, Tibet, Inner Mongolia and Ningxia (Fang, Leong, 2014).

According to Howden and Zhou, as a result of numerous social pressures, including concerns about potential population decline in the upcoming period, further exceptions to the one child policy have been made, among which, a married couple was allowed to have two kids, in the case when both of the partners were only children themselves. By 2011, the policy had been relaxed in all administrative regions of the country. This was followed by a further loosening of the policy in November 2013, starting from that time, the families with only one parent being an only child, also received an official government's permission to give birth to two babies (Howden, Zhou, 2014). Finally, in October 2015, Chinese authorities officially announced the end of the one child policy era, from now on, every Chinese family is allowed to give birth to two children.

2.3 Regional differences in implementation of the one child policy

Although the one child policy is in force within the whole territory of China, the variation in its implementation in different parts of the country is quite significant.

The first Population and Family Planning Law, which has been decreed by the National People's Congress in September 2002, 'recommended' each Chinese couple to give birth to only one child; modifications to the state policy have been left to the local provincial authority (Gu, Wang, Guo, Zhang, 2007). As stated by Tu Ping in his article 'Trends and Regional Differentials in Fertility Transition', under the central

government's supervision, the local governments had been delegated the rights to create population plans in accordance with the specific socio-economic conditions of each administrative unit. In order to achieve the government's goal of reduction of the population growth rate, 'local resources have been mobilized and effective organizational arrangements, such as the family-planning-target responsibility system and the implementation of provincial family-planning regulations, have been made' (Tu, 2000). According to Avraham Ebenstein, starting from as early as 1984, the decisions regarding the policy issues, such as the exemptions from the one-child-per-couple rule or fines for the violation of the policy, are made on the provincial level (Ebenstein, 2007).

According to Gu Baochang et al, during 1990s, provincial regulations on the number of children per couple and the possible exemptions from the general rules, complying with the state policy, were drafted by the provincial Family Planning Commissions (local divisions of the China's State Family Planning Commission, later renamed the National Population and Family Planning Commission) and approved by the provincial People's Congresses (local divisions of the National People's Congress). After the adoption by those local legislative bodies, these regulations, comprised of more than 100 articles regarding the number of children allowed per couple and possible exemptions, were published in the local newspapers and, later, on official websites. Gu Baochang and his colleagues identify 22 unique exemptions, allowing a couple to have a second child and group them into four categories, ranging from the most general to the most specific:

1. Gender based/demographic: include the exemptions allowing rural couples with only one daughter and individuals who are only children themselves to have a second kid.

2. Economic: linked with excessive need for family labor or participation by the parents in risky occupations, such as mining, fishing, farming in mountains or poor areas. The creation of such exemptions was driven mainly by the rural/urban differences issue.

3. Political/ethnic/social: include the persons who belong to an ethnic minority population group, a case when a man is marrying into a woman's family with allowance for one son in the family only, Chinese returning from abroad, and those being a single child of a revolutionary martyr.

4. Entitlement/replacement: in case the first child has died or is physically disabled, the parents are allowed to give birth to a second baby. Another exemption in this category is a childbirth after adopting a kid, if one of the parents have been initially diagnosed as infertile (and the couple is able to provide a proof of required five-year observation after marriage and a medical certificate from an authorized hospital). A woman is also permitted a second childbirth in a remarriage. Another special case in this category is being the only fertile son in a family with several children (applies for a rural sector only) (Gu, Wang, Guo, Zhang, 2007).

Peng Xizhe in his article "Fertility transition in China: causes and trends" provides the following classification of local family planning regulations.

1. One child with few exemptions allowing the second childbirth: all citizens in 6 administrative units including 4 direct-control municipalities and Jiangsu and Sichuan provinces (around 35% of the country's population).

2. Two children if the first one is a girl: most couples in rural areas in 19 provinces (around 52% of population).

3. Two children with a 4-year interval: in rural areas in 5 provinces (around 9.6% of population).

4. Two or three children: ethnic minorities in the agricultural areas of minority autonomous regions.

5. No numerical regulation: rural Tibetan population (Peng, 2006).

Similarly, Gu Baochang and his colleagues developed the following two characteristics for the 31 administrative region of China with regard to the population control policy. The first one is the existing contrast between urban and rural areas: there is a number of exemptions from the policy for rural citizens, while for the residents of Chinese cities the one child policy is strict. The second groups the provincial level demographic policy for rural households into the following categories: 1) one child policy: in its strict form, is in force for the two central provinces – Jiangsu and Sichuan, plus four direct-controlled municipalities – Beijing, Tianjin, Shanghai, Chongqing; 2) "1.5 children" policy: couples with rural citizenship are allowed to give birth to a second child after a specified interval, if the first one is a girl, applies to 19 Chinese provinces; 3) two children policy: in 5 provinces – Hainan, Ningxia, Qinghai, Xinjiang and Yunnan – with lower standards of living and higher proportions of ethnic minorities, applies to all couples with rural residence.

The authors also note that in 26 provinces the policy allows a second childbirth in case both parents are only children themselves. What is more, in 5 among those 26 provinces, the couple is already allowed to have a second child with a certain interval after the first childbirth if at least one of the partners is a single child in the family.

The article highlights the existence of specific interval, which is equal to 4 years for majority of the provinces, between the first and the second child in those cases, when exemptions for a second childbirth apply. However, this restriction has been removed in some of the administrative regions, starting from Jilin, Shanghai and Hainan in 2002, following by Gansu and Xinjiang in 2005. The authors also point out an

interesting fact, that a lower number of exemptions in the province does not necessarily mean that the local policy is stricter. As an example, they use Shanxi province, where all the couples with rural residence are allowed to give birth to a second kid, if the first one is a daughter (Gu, Wang, Guo, Zhang, 2007).

According to Scharping, another important aspect of the one child policy in which the regional variations are observed is a comprehensive system of 'financial disincentives for excess fertility', comprised of 'reduction of land allotments, denial of public services, and fines for unauthorized births'. In 1980s, in most of the provinces, the fines were deducted from parents' wages on a regular basis (Scharping, 2003). For instance, as stated by Ebenstein, in Guangdong province, the fine for excessive childbirth was equal to 10% of income of each parent for 14 years. He continues that in 1990s, the form of the fines has changed into a share of annual income. For example, in Shanghai the amount of the fine was 10% of wage of both parents for 16 years in 1981, while since 1992 it has been raised to an immediate payment of 3 years of the family's income. More recently, the local governments have even greater authority when it comes to fertility fines. In Beijing fines have a form of 'social support fees' and vary from 5 to 50 thousand yuan. Overall, the fines vary by province and year, and also by individual, taking into account each person's registration and ethnicity (Ebenstein, 2007).

2.4 Negative consequences of the one child policy

Apart from achieving its main goal of reducing the population growth, the one child policy has also caused a number of unintended negative effects, which raise more and more concern of Chinese population and government.

As Wang Feng states in his article 'The Future of a Demographic Overachiever: Long-Term Implications of the Demographic Transition in China', China nowadays is dealing with a number of common issues of the global demographic transition, of which, one of the most highly debated is an aging population. He specifically highlights that "as a demographic overachiever, China's aging process will be faster then that of many other countries". Moreover, the one child policy was one of the main factors, attributing to the change in the sex ratio at birth in China, which has reached the level of 120 boys per 100 girls and even exceeded this level in the last

years. As a result, around 20 million Chinese men will not have a chance to find a partner and create a family. Furthermore, since the one child policy has been implemented, China has accumulated nearly 160 million single children aged from 0 to 30, which leads to "serious economic and social risks for Chinese families and society as a whole". Wang Feng uses the May 2008 earthquake in China's Sichuan province as an illustration of how a sudden death of thousands of people, which is already a tragedy itself, can lead to a huge number of personal tragedies of the parents, left alone, often without an opportunity to have another child due to their age or various other reasons. Although the mortality rate in China has declined significantly in recent decades, a large number of parents is still exposed to the risk of loosing their only children. According to the paper, for men, this likelihood is equal to 3 to 6 percent, for women, it fluctuates from 6 to 17 percent, as their life expectancy is in general longer than those of the men. The perspective of dying alone is especially painful for Chinese parents, as apart from emotional aspect, loosing a child for them, also means loosing financial support (Wang, 2011).

The first negative consequence of the birth control policy is population ageing. Population ageing grew fast with the rapid decline of fertility. Reduction of both in fertility and mortality rates have produced a fundamental change in the age structure of China's population, causing a negative impact on its social and economic sustainable prosperity, and also on its natural environment (Guo, Marinova, 2011). Howden and Zhou point out the significance of ageing trend in China, as the representatives of its baby boom generation are already in their late 40s, which is considered beyond the reproductive age. What is more, the percentage of this aging group in the whole population of the country is almost two times higher than the percentage of children under nine years old (Howden, Zhou, 2014). According to Chinese demographers, by the year of 2050, the population aged 60 years and older will reach 29.28%, meaning that 10 working aged people will have to support 53 elderly people (Nazarova, Serova, 2010). As the result of the one child policy, young generation in China is carrying a huge burden on their shoulders: a moral, as well as financial responsibility to directly support not only their elderly parents, but also their grandparents, both from the mother's and the father's side – the so called "4 + 2 + 1" situation. Financial burden, imposed on the society by population ageing is also reflected by pension gap, which, according to the Bank of China, was around

18.3 trillion yuan in 2013, and is forecasted as big as 68.2 yuan in 2033. The majority of both official and private researches conclude, that the Chinese pension fund is currently seriously underfunded, and the whole pension system is marked inefficient. Howden and Zhou claim that "despite high savings rates by Chinese workers (around 20 per cent of income), the lack of a new generation of working-age savers together with only a relatively new social security system will strengthen the sustainability problem" (Howden, Zhou, 2014). Furthermore, as the population ages, it will of course be necessary to devote more resources to the care and health of the elderly, state Banister, Bloom and Rosenberg. As in most of the developing countries, infectious diseases have long accounted for a high portion of deaths in China. However, as the elderly are increasingly subject to noncommunicable disease, the types of facilities and healthcare skills needed will change. It is unclear whether such changes will lead to higher or lower healthcare costs. What is more, it is possible that the aged will have a greater number of years of ill health (partly due to high level of consumption of tobacco and alcohol by people aged 60 and older in China). Therefore, the increased number of elderly in China has given rise to serious concern about their health and their financial well-being. Further concern centers around the basic care and companionship that these hundreds of millions of Chinese will need, and whether families, which have traditionally provided such care, will be able to do so, or will choose to, in the future (Banister, Bloom, Rosenberg, 2010).

In addition to this, according to Cai Fang and Wang Dewen, as the ageing population will continue to rise in the upcoming decades, Chinese government needs to establish a sustainable pension system to safeguard the society, as well as make some necessary policy adjustments. The policy adjustments, that could be undertaken are, for example, the transition from the pay-as-you-go system to a fully funded pension system and public education programs to make the society better informed and prepared for an ageing population. Improvement of labor market efficiency is one of the critical conditions for transformation of the pension system. Creating more work opportunities in the labor market and raising the retirement age should reduce the dependency of older people on social pensions, by prolonging the number of years in the workforce. Another way to enhance the total premium and financially support the transformation of the pension system could be including rural-to-urban migrant

workers in the pension system (Fang, Dewen, 2005). These measures will be discussed in more details below.

Banister, Bloom and Rosenberg in their paper, discuss some other measures, which could also be taken, that indirectly influence the problem of population ageing. For example, improving the education and skill levels of Chinese workers could make economy more productive and more able to compensate for the decline in the share of working-age people. In the short run, increasing the skills that the labor force brings to the production of goods and services is a major means for further raising productivity, which is the key factor for rising incomes. Strengthening education is the primary means of improving such skills (Banister, Bloom, Rosenberg, 2010).

Another important problem, resulting from the one child policy, and closely linked to the population ageing discussed above, is a labor shortage. The Chinese government has fully taken into account this threat and has implemented a number of new policy measures.

Nevertheless, it has been largely debated, whether the latest easing of the one child policy would indeed changed the situation significantly, as even the families, which were allowed to have two kids, still prefer to have only one child, if any at all. In Howden and Zhou's opinion, this is caused by the increasing cost of living and "perceived negative impact on [the parent's] quality of life, especially, at retirement age". They also note that, the mismatch between "current incomes and the expected future cost of living" has resulted in increasing popularity of a saving culture among young generation "as a method to ensure adequate means for retirement", while raising a child means spending a relatively big amount of financial resources, that could instead be used by the couple at retirement (Howden, Zhou, 2014). In this sense, one particular example is rather unique for the modern China: as a result of the disbalance of sexes, parents have to provide their son with a private accommodation, which is extremely costly, especially in the big cities, in order to make him competitive on the marriage market. What is more, a raising number of married couples in urban areas, usually those belonging to middle-class, refuse to have children at all. This phenomenon, which is new for China, is mostly common in big cities like Shanghai or Beijing, where around 10 per cent of couples in reproductive age are childless. According to statistics, the number of childless couples in the

country as whole, has already exceeded 600 thousands people. Apart from the one child policy, various other factors contributed to this phenomenon. Firstly, traditional values of parenthood were substituted by professional values, desire for wealth, etc. Secondly, change of values in society as a whole towards individualism and hedonism. The attitude towards childless families in modern China is contradictory. More frequently, decision to stay childless is taken by the most educated part of Chinese society, which has a negative impact on the overall educational level of country's population (Nazarova, Serova, 2010).

The second policy measure that has been proposed is to raise the retirement age. The current retirement age is 60 for men and 55 for women. According to Howden and Zhou, low pensions and lack of accumulated savings on the one hand, and increasing cost of leaving on the other hand, force many people to continue working, even after reaching official retirement age. Later retirement is common in the private sector, as well as in the state sector, despite the government personnel's retirement privileges. Therefore, the authors conclude, that delaying retirement could be a possible quick solution to a labor shortage problem, and could also help to make up for the shortfall in social security funding, as "there are insufficient numbers of young people to finance the retirees". Official media regularly reports the government's intention to "delay the age of retirement until 62 – 65 years of age", however this attracts widespread public opposition (Howden, Zhou, 2014). According to Global Times, a way to ease the tension, which has been chosen by Chinese authorities, is to raise the retirement age in progressive steps. The public will be notified a few years prior to the implementation, and early retirement will be strictly controlled by the government, which will create employment opportunities that fit the elderly and will not affect youth. The retirement age will not increase all of a sudden, but one or two month delay will be added each year. Such progressive way makes the policy more acceptable to the general public, as most people who oppose this policy are near retirement age (Zhang, 2013).

A third possible solution, proposed by Howden and Zhou in their paper, is to relax country's immigration policy. Under the existing law Chinese citizens are not allowed to have dual citizenship. Moreover, the policy also includes limits on the permitted number of immigrants, coming from certain regions, such as less

developed South East Asian countries, with cheaper labor resources, as it worsens the situation on country's labor market, increasing competition. At the same time, government uses several policy tools to encourage the part of progressive young Chinese population, which received education and had working experience abroad, to return back to China and use their knowledge and talent to contribute to their home country's economic development (Howden, Zhou, 2014). Considering the fact, that growing Chinese economy has a constant need of highly educated and experienced workers, the country is very welcoming to immigrants from Western countries. Chinese companies, on average, offer them higher salaries than those of Chinese employees at the same job positions, and a number of benefits, including health insurance and assistance with the accommodation. However, according to Howden and Zhou, the belief that "foreigners divert recourses away" from the locals, is still very widespread among Chinese population. Insisting that immigrants are only consuming resources and space, the locals ignore the fact that, the workforce coming from abroad, makes the division of labor more intensive and hence more productive, which results in higher wages for all workers, including the Chinese citizens themselves. The stereotyping of immigrants, not only from a foreign country, but also from one of the less developed Western regions in China, will obstruct the expansion of the workforce needed for sustainable growth of the country's economy (Howden, Zhou, 2014).

The third demographic challenge, faced by China is the disbalance of sexes. Traditionally, Chinese family has always given preferences to boys. There were two main reasons for this desire to have male descendants: first, to keep on the genealogical line; and second, to ensure financial support for the family in future. Under the one child policy this traditional preference for boys became even stronger (Nazarova, Serova, 2010). According to Shang-Jin Wei, during 1960s and 1970s, as well as early 1980s, the sex ration in China was normal or even slightly below normal (around 106 boys per 100 girls), but starting to grow steadily from mid-1980s to reach 124 boys for 100 girls in 2007. By 2005, there were already 30 million more men than women at the age below 25 (Shang-Jin Wei, 2011). Demographers usually point out three main reasons for a high predominance of boys in China, which is connected with some specific features of reproductive behavior of Chinese women, raised with traditional aim to give birth to a boy. The first reason is raising mortality

among the newborn girls due to the lack of necessary care. The second one is the fact of not registering the birth of girls or giving them for adoption to childless families. The third reason is increasing number of medically unnecessary abortions, in case when a woman finds out that she is pregnant with a girl. For this reason, Chinese government created a new law, according to which, the doctors cannot provide mothers with the information regarding the sex of their future children. Violation of this law is considered a crime. The increasing number of men has led to significant changes in Chinese society: nowadays, it's not men who choose wives, but women who choose their partners, which is a completely new phenomenon for this country, that has always kept its traditions (Nazarova, Serova, 2010).

Wei and Zhang in their article develop a hypothesis of the existing link between the raising savings rate in China and the problem of disbalance of sexes. The authors suggest that Chinese parents with a son are increasing their savings in order to make him more competitive on the marriage market, and that this factor can explain around 60% of the increase in the household savings rate in 1990 – 2007. Based on Chinese household and regional data, covering 122 rural counties and 70 cities, they find the significant variation across regions, with the savings of families with a son being larger in regions with higher local sex ratio, all other things being equal. At the same time, in the regions where the sex ratio is high, families with a daughter do not decrease their savings either, and Wei and Zhang explain this by the following: the parents do not want their daughter to lose the bargaining power in her future family, which is often correlated with the initial wealth level of husband and wife; there might be a spillover of savings from households with a son to other households. Nevertheless, the rising sex ration still has a greater effect on savings by households with a son, than those with a daughter. Moreover, the effect is more significant in urban than in rural areas, however is still observable in both. Another interesting fact, pointed out by the authors is that, a higher sex ratio results in higher demand for luxury apartments and higher housing prices in general, as a better house is an important advantage for men on the competitive marriage market. Again, the observed effect is slightly higher in urban regions with a 10 basis point increase in the local sex ratio implying a 7.4% higher housing cost, while in rural areas the same increase results in approximately 4% (Wei, Zhang, 2011).

All in all, even though, the population control policy was undoubtedly necessary in China, and its implementation has given some positive results, the unintended unfavorable consequences of the one child policy cannot be ignored. The negative socioeconomic effects of ageing population, labor shortage and disbalance of sexes are significantly high, and at some point might even exceed the policy's achievements. Therefore, majority of researchers agree that serious adjustments of the current birth control policies are needed.

2.5 Consequences of the policy's end

The Chinese government had stated the official reason for the change in demographic policy as being "intended to balance population development and address the challenge of an ageing population". However, there might be some serious economic motivations behind the end of one-child policy, as its abolition is supposed to lead to 0.5 percentage point boost in economic growth, says Xin En Lee in the article 'What Does the end of the One-Child Policy Mean for China?'

This point of view is supported by Lu Bei from the University of New South Wales's Centre of Excellence in Population Ageing Research. "The two-child policy is aimed at solving this fundamental population structure challenge, but it might take more than 50 years to take effect", she says, "Since fertility change will take a long time to alleviate the demographic structural pressure, I do not think the budget constraint caused by the ageing population is the main reason today for this policy". She also added that the new policy is "a strategic population policy for future fiscal balance" to "ensure sustainable economic growth".

Although, many researchers agree that the forecast for the economic growth, related to the policy's end might be too optimistic, the market is already reacting to the potential increase in consumption, claims Lee. According to the article, shares of Goodbaby – stroller and car seat maker – rose by 7.4% after the policy change has been announced; and those of milk powder producer Biostime increased by 5.5%. Chinese newspapers China Daily and the South China Morning Post reported an increase in demand for larger houses from less than 30% up to around 50% of all deals in real estate sector.

Jin Keyun, a professor from London School of economics, believes that the changes in China's demographic policy will result in consumption growth, supporting one of the key goals of country's economic policy for at least a decade – switching from export-based economic growth model, typical for developing countries, to the one, based on domestic consumption. To support her view, she refers to 2009 urban household survey, which compares families who had twins under the one-child policy, and those who had only one kid. The results of the survey show that families with only one child spent around 10.6% of their income on education and saved on average 21.3% of their income. At the same time, families who had twins, spent 17.3% of total income, and saved just around 12.8%. Therefore, she concludes, "as the number of households with two children increase, the two-child policy is likely to be the most effective way to increase consumption". The estimated consumption growth will be equal to 4-6% approximately. What is more, according to Jin, it is not only the sector of children's products that would be affected, but also other large sectors, for instance: housing, life insurance and pharmaceuticals.

On the other hand, professor from Saint Louis University in Madrid, David Howden, doubts whether the new policy will have a significant effect on savings and consumption in the short run, as more and more people in China cease to invest primarily in their children in order to get support from them in future; but prefer to invest in real estate and real assets to save for retirement.

While agreeing on the fact that adjustments to the one-child policy should have been made long time ago, many researches believe, the latest change will not have significant impact on economy of China, continues Lee. According to skeptics, increasing number of births will not be enough to stabilize existing imbalances in Chinese population.

Yong Cai, form University of North Carolina, in support of this view, says, that with approximately 16 million annual births in China during the recent years, around 10 million more children could be born in the upcoming 3-5 years. This means that there could be around 2 million births each year, bringing the yearly average to the number of 18 million approximately. Analyzing the demographic situation in China during the last decades, Cai claims that even with more than 20 million annual births during the 1990s, there was no significant impact on economic growth observed. This

means that 2-3 more million children being born, will not give a significant difference. “There will be a short-term economic impact, but I really doubt that any economist will say that it will boost GDP growth”, he concludes. “Economic growth is not so mechanical and is not entirely driven by the extra number of people.” (Xin En Lee, 2016)

2.6 Empirical papers written on the topic

Below chapter gives a brief review of the papers focused on the one child policy, models used by the authors, their empirical results, and conclusions. Papers covered in this section are: “Impact of Population Growth and One Child Policy on Economic Growth of China” (2014) by Fang and Leong; “Demographic Dynamics and Economic Take-Off – the Economic Impact of China’s Population-Control Policies” (2008) by Zhihao Yu; “ Demographic Dividends, Dependencies and Economic Growth in China and India” (2012) by Golley and Tyers; “Population Aging and Economic Growth in China” (2010) by Banister, Bloom and Rosenberg; “Demographic Transition, Demographic Dividend, and Lewis Turning Point in China” (2010) by Cai Fang; “The Future of a Demographic Overachiever: Long-Term Implications of the Demographic Transition in china” (2011) by Wang; “Demographic Transition: Implications for Growth” (2005) by Cai and Wang; “Can Augmented Solow Model Explain China’s Economic Growth? A Cross-country Panel Data Analysis” (2008) by Ding and Knight; “Solow or Lucas? Testing Growth Models Using panel Data from OECD Countries” (2007) by Arnold, Bassani and Scarpetta.

Qilei Fang and Chee Kian Leong (2014) use adapted Solow Growth Model, which considers labor growth to be one of the key factors for the economic development (Solow, 1956) to reveal the correlation between economic growth and population growth in China, considering the impact of one-child policy. They run an OLS regression based on national data, and also make a provincial panel data analysis, to compare the results, obtained on the aggregated level and the level of each province separately. They come to contradictive results, as the relationship between population growth and GDP growth is invariably positive at the national level, but negative at the provincial level since 1979 to 1995.

Zhihao Yu (2008), in contrast to standard econometric estimation, which captures "averaging effect" only and, for this reason, might underestimate the real economic impact of population-control policies in China, focuses on the relationship between demographic transition and economic "take-off effect", making a link between economic take-off and demographic structures. The significant effect of a dependency ratio (the ratio of non-working age to working-age population) on the economic growth is pointed out: increasing working-age population made an important contribution to economic miracle in China and East Asia in general. The author concludes, that China's population-control policies moved forward the timing of the country's economic take-off by a decade. Moreover, the economic impact of the one-child-policy, shown in the paper is much stronger than the one, revealed by the standard econometric estimation.

Golley and Tyers (2012), also take Solow Growth Model as a basis and show that, slower population growth not only reduces GDP growth, increasing per capita growth at the same time, but also raises the proportion of the working-aged population, giving rise to demographic dividend. They model different age, gender, and skill groups as separate households, which "differ in shares of regional disposable incomes, consumption preferences, saving rates, and labor supply behavior". The authors create a dynamic model of global economy, where the main endogenous drivers of economic growth are physical capital accumulation and the transformation of workers from unskilled to skilled. The model assumes endogenous saving rates and has multiregional structure. The paper concludes that population structure has a significant impact on per capita income growth. In contrast to majority of other researches, demographic dividend is projected to stay positive through to 2030.

Banister, Bloom, and Rosenberg (2010) focus on such a negative consequence of a one-child policy as population aging, showing that it may affect the output in two ways. Firstly, population aging means, that a larger number of people will stop being engaged in productive work, which will lead to the decline in total output per capita. Secondly, the saving rate varies by age and working-age people tend to save more, because they can do so, having a constant income source, and also, because they often save for the retirement. In contrast, elderly people, usually having low income,

have low or no ability to save. Therefore, in a country with a high share of elderly people, savings rate has a tendency to decline, leading to a decrease in investment, and, consequently, a decrease in economic growth. However, they also mention the behavioral responses that can smooth down the impact of aging on economic growth, such as: increased participation of women in the labor market, greater investment in children's health and education, and changes in savings behavior.

A number of scholars examine the relations between demography and economy through the effect of demographic transition. Cai Fang (2010) describes demographic transition and dual economy development, arguing that the two have a common starting point, similar characteristics of development stages, and overlapping processes, therefore the demographic window of opportunity is one of the stages of dual economy development. The author also gives theoretical and empirical reasoning about a diminishing demographic dividend and incoming Lewis turning point. The paper explores how demographic dividend is engendered and obtained: during the period in which population age structure is most productive, adequate supply of labor and high savings rate afford an extra source of economic growth and thus form demographic dividend. Once demographic transition exceeds this stage, demographic dividend gradually disappears. Demographic transition can be characterized by changes in total fertility rate (TFR). Using panel data from World Development Indicators, author describes the relationship between annual GDP growth rates and TFR among a number of countries in the period from 1960 to the recent years by regressing GDP growth rate on TFR and square term of TFR. The regression results show the reverse U shape relation between GDP growth and TFR by revealing the significantly positive sign of TFR coefficient and negative sign of squared term of TFR. Based on changing trends of age structure of population, the paper proves, that the development of the Chinese dual economy has reached its critical period of time, the Lewis turning point, when expansion of labor demand exceeds that of labor supply. Based on the obtained results and the experiences of foregoer economies, a number of policy implications is suggested as the potential sources of China's sustained economic growth in post-Lewis turning point period.

It is important to note, that Cai argues, that the one-child policy was not a decisive factor for the demographic transmission in China and was generated by other

independent factors. Similarly, Wang (2011), points out, that "not only did China's most significant fertility decline take place prior to the government's birth control policy, but in decade immediately following the announcement of the policy, the fertility level for the country as a whole hardly changed. It is Chinese population itself, not the government that contributed the most to the current fertility decline", he claims. Taking into consideration numerous exceptions and variations of the policy across different regions, the author also mentions that "in 4 largely rural areas with a combined population of more than 8 million that is largely exempt from the policy, studies show that fertility has dropped below replacement level and often to a level lower than in surrounding areas". Therefore, he concludes that "local economy and other factors, not policy, explain much of the fertility variations". In addition to this, according to the paper, demographic transition in China is similar in many ways to the processes in other countries across the globe.

Cai and Wang (2005), examine the implications of demographic transition for economic growth of China, based on conditional convergence model. Using provincial panel data set, they run OLS and FGLS regressions to show the impact of the Chinese demographic transition on the savings rate. A high savings rate is viewed as a key factor contributing to rapid economic growth. The main results can be summarized as follows, the demographic transition has a significant impact on savings rate. The decrease of child-dependence ratio reflects the reduction of both the economic burden on the working-age population and consumption expenditures for the national income, contributing to an increase in the savings rate. However, this effect is offset by the increase in the aged-dependence ratio as the population ages. The authors also study effects of demographic transition on growth. The paper concludes, that about one-quarter of the growth rate in per capita GDP in China can be attributed to the decline in total dependence ratio during the observed period.

Ding and Knight (2008), examine the role of the augmented Solow model in explaining China's post-reform economic growth rate, absolute and relative to other countries, using panel data on 146 countries over the period 1980 – 2000. The countries at similar levels of development are classified into 3 samples to control for the differences in technology and institutions. After estimating the textbook Solow model, augmented Solow model with human capital and augmented Solow model

with structural change using OLS, within-groups and system GMM estimation, the authors conclude, that the best-explaining model is the augmented Solow model, based on the dynamic panel data analysis using a robust and consistent system GMM estimator. One of the key findings of the paper is that physical capital accumulation, structural change, conditional convergence and population growth explain the majority of the difference in the growth rates of output per worker between China and other country groups. It is also important to mention, that according to the results, obtained by the authors, slower population growth rate in China contributes to its faster growth relative to other developing countries, therefore, the one-child policy has a positive impact on the economy.

In contrast to majority of studies, Arnold, Bassanini and Scarpetta, based on a sample of 21 OECD countries over the 1971 – 2004 period, prove that empirical evidence on the role of human capital accumulation for economic growth is better reflected by an endogenous growth Uzawa-Lucas model with constant returns to scale to both human and physical capital, than the human-capital augmented Solow model of exogenous growth. This distinction is important to understand the process of economic growth and the role of policies in influencing it. In Solow model, human capital enhancing policies would have a temporary effect on economic growth during the transition towards the new steady-state growth path of output, while in Uzawa-Lucas model the growth effect would be more persistent. The authors apply an econometric technique, the pooled mean group estimator (PMG), which allows for speed of convergence, short-term dynamics and variances to vary across countries; this approach is different from most panel-data approaches that impose homogeneity restrictions on all these parameters. To discriminate between two models, different non-linear restrictions on factor elasticities and speed of convergence implied by the augmented Solow and Uzawa-Lucas models are exploited. According to Arnold, Bassanini and Scarpetta, the estimated speed of convergence is too high to be consistent with the Solow model, but supports the Uzawa-Lucas model. This main finding is robust to several robustness tests. The research proves positive and significant impact of human capital accumulation to output per capita growth.

3 Methodology and Data

3.1 Theoretical approach

Following the paper by Qilei Fang and Chee Kian Leong "Impact of population growth and 1CP on economic growth of China", we will use Solow Growth Model as a basis theory:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta},$$

where Y_t, A_t, K_t and L_t stand for output, technological progress, capital and labor respectively. The authors adapt the model to take population as one variable. Therefore, they keep the original form of the equation instead of dividing L on both sides to use GDP per capita. Fang and Leong also replace working labor by overall population growth in their equation. Technological progress is endogenous in their model and represents total factor productivity. They do not cover the relationship between TFP and China's economy growth. The shares of capital and labor in total output are represented by α and β respectively. Gross domestic capital represents capital growth in the paper, not taking into account capital depreciation and foreign direct investment. The authors base their estimation on data obtained from World Bank (2013) and National Bureau of Statistics of China (2012). They run regressions both on country level and provincial level. Provincial data set includes observations for 31 provinces (not including data for Hong Kong, Macao and Taiwan) for the year 1965 – 1995.

We modify the model of Fang and Leong by using gross regional product (GRP) per capita instead of overall GDP, as a more representative and objective indicator of economic development, and, therefore exclude population from the regression. Moreover, we add variable for FDI, as well as variable for ethnic minorities (in percent of total population), multiplied by birth rate in each region, to capture the effect of the one child policy. We are going to estimate the model on provincial level only.

3.2 Dependent Variable

As the aim of this paper is to determine the impact of the one child policy on the economic development of China, and the analysis is performed on provincial level, in order to reflect the difference in development of Chinese provinces, the GRP has been chosen as the dependent variable. Taking into account the size of the country and its population, we are using GRP in per capita terms, so that the estimates of actual economic growth would be more accurate. Thus the dependent variable for all 31 provinces is the logarithm of GRP per capita, measured in Yuan; and the independent variables, which should determine the GRP growth, have been chosen, based on existing literature and availability of the data for the selected period and sample.

3.3 Independent Variables

The number of possible variables, affecting the country's economic growth is countless, thus, including them all into regression to get the most precise results is not feasible. In line with the previous literature, we focus on the effect of the following key regressors only:

- **Gross capital formation,** as physical capital is another key input to production according to basic Solow Model. Hence, we expect strong positive relation between GCF and GRP of each region. GCF is taken in 100 million Yuan.

- **Foreign direct investment**, as it is believed to be strongly positively correlated with development of international trade and international economic cooperation, and, therefore, growth of domestic economy as a whole. FDI into China sky-rocketed after the liberalization reform of 1978. In 1980 total FDI inflow hardly reached $200 million, while in 1997 it grew more than 225 times larger and has reached an amount over $44.9 billion, making China the largest recipient of FDI among developing countries and second largest in the world, conceding only to U.S.A (Coughlin and Segev, 1999). Coughlin and Segev highlight that, "these flows of FDI are playing, and will likely continue to play, a key role in the integration of China into the world economy", according to them, "the future of Chinese state-owned enterprises, as well as the country's economic development generally, is

closely related to FDI activity". The data for FDI is taken in million USD, and then calculated by author in 100 million Yuan, based on average exchange rate for each year, to comply with GRP and GCF measurements.

- **Ethnic minority** is not commonly a part of economic growth models, and is not included into regression in the related papers, however, we believe that in our case it is an important factor, which reflects the specifics of the country. There are officially 55 ethnic minorities in China, which are dispersed across the country, with the highest concentration in the 5 Ethnic Minorities Autonomous Regions: Inner Mongolia, Guangxi, Tibet, Xinjiang, and Ningxia. Those regions are the least developed parts of the country due to various factors, from environmental conditions, to historical and political reasons. Local population is involved mostly in agriculture or in low-productive traditional industries. We would like to estimate, whether the percentage of ethnic minorities itself has a significant impact on GRP of different regions of the country. The variable we are going to use in our model, is presented as (1 –percentage of ethnic minorities) which means, in the end, the percentage of ethnic majority in each region, as minor nationalities are exempted from the policy, and the major nationality – *han,* falls under the policy measures. As per description given above, we expect a positive correlation between this (1 – ethnic minorities) variable, representing percentage of han, and GRP. We make such an assumption, firstly, following basic Solow model, where labor factor and GDP are positively correlated; and secondly, due to country specific – in China, regions with higher percentage of han in population will, in general, have higher standards of living and more developed economy. We use the data in percent of ethnic minorities population to total population of the region.

- **Birth rate,** since it is infeasible to directly include the one child policy into regression, we use birth rate as a proxy variable. It is the birth rate that is affected by the policy straightaway, as diminishing of the birth rate is its primer goal. The indicator is measured in percent. Together with the decline in birthrate, and, as a consequence, reduction in population size in the long run, increase in quality of labor and decrease in burden, which the population puts on country's existing natural and

economic resources, are observed. For this reason, we expect the variable 'birth rate' to be negative and significant.

3.4 Data collection and sources

For the analysis we use the data for 31 provinces, not including Hong Kong, Macao and Taiwan[1], for the years 1995 – 2015 (data for Chongqing for the years 1995, 1996 is the same as for Sichuan, as it was a part of this province and became a separate administrative division in year 1997 only). Based on observations for each year, we calculate averages for 5 years for our model estimation.

Data is obtained mainly from various issues of China Statistical Yearbook (*Zhongguo tongji nianjian*), issued by National Bureau of Statistics of China on annual basis. It includes data on various macroeconomic indicators, population, industry, domestic and international trade, education, etc. As the large international databases, such as, for example, World Bank, contain the data on the country- or region-level (Eastern China, Western China, Central China, etc) only; Statistical Yearbooks are the major, if not the only, source of provincial data. Some of the issues are not available in English; therefore we used the Chinese versions.

Percentage of ethnic minorities in total population on provincial level is not included into Statistical Yearbooks, and was, thus, obtained from the data in China's Population Census, published every 5 years in Chinese.

For the data on FDI, apart from Statistical Yearbooks, we used the data published by Ministry of Commerce of China.

[1] Hong Kong has been included again into Chinese territory in 1997, and Macao, in 1999, being a British and Portuguese colony respectively, these administrative parts have been developing completely independently and differently, than the rest of China, in terms of economy, politics and culture, for many decades. Therefore, not taking these regions into account, we avoid including possible outliers.

We also exclude Taiwan from the regression, due to its complicated political status. Peoples Republic of China claims Taiwan to be part of its territory, however, Taiwan itself, after the Chinese Civil War, insists on its independence. Although, officially, only several small states recognize Taiwan as sovereign country, many other states maintain unofficial diplomatic relations with it.

Main issues of the dataset:

The major problem is availability of the data, especially on provincial level, which is quite fragmental, data for one variable often needs to be collected from several different sources for different years; and data for the same year needs to be collected from different sources for different provinces. Missing observations need to be calculated based on the information available.

The fact that provincial data can be found in Chinese databases and publications only, leads to the problem of reliability of sources. Statistical data in China is being gained and processed for a relatively short period so far, which is easy to notice form the incompleteness and disorder of statistical tables, until recent years; some of the indicators are measured differently for different years, which makes it hard to systematize the data.

Some indicators seem to mismatch with those, published by World Bank and international organizations: as Communist Party of China controls all the official publications, including statistical researches, some numbers, for instance, for GDP are overestimated for political reasons and propaganda.

Data on birth rate cannot be totally precise, as since the one child policy has been implemented, thousands of births in the country are not being registered.

Data on FDI can also be partly upward biased, according to Coughlin and Segev (1999), “because of the special privileges enjoyed by foreign investors in China, it is likely that incentives exist for exaggerating the size of investments and for “round-tripping” through Hong Kong or some other country. This would result in measures overstating the level of FDI in China, and in particular of FDI originating in Hong Kong”.

Nevertheless, provincial data should be less affected by this problem, as it is destined mostly for internal use. Moreover, general trends of development of the indicators, reflected by the sources, are anyway still in line with the real trends.

All in all, we are using relatively recent data, the quality of which is significantly higher than that of an older one, due to improvements in statistical methodologies in China, and is, therefore, more convenient to use for empirical analysis.

3.5 Assumptions and Hypotheses

Following the discussion in the literature review, one child policy is believed to have a significant impact on China's economic development, although the nature of this impact is a subject for a dispute. As stated in the hypothesis below, we expect a negative relation between the birth rate and China's GDP growth, and therefore, a positive impact of the one child policy on the economy of China.

Hypothesis 1: The relation between the birth rate and GRP of Chinese provinces is negative.

According to the article "Go forth and multiply a lot less", published by The Economist in October 2009, slowdown in population growth and lower birth rate in China, caused by the current population policy, in short run effected GDP (in the prospective of the whole country, and, hence, GRP in our case) in 3 different ways. First, decrease in fertility, means increase in labor, as, again, in the short run, share of working age population in society increases compared to the share of non-working age population, as the number of children is smaller, and share of ageing population is not too high either, so far. This means, that the dependency ratio is relatively low. It is important to highlight, that in the long run, effect of falling fertility is different, which is described in more details in other chapter of this research. Second, lower dependency level, in its turn, means that more money is left for savings, which can be later turn into investment. As per the article, "Chinese household savings reached almost 25% of GDP in 2008, helping to finance investment of 40% of GDP" ("Go forth and multiply a lot less", 2009). Third, by simple rule of numbers, lower birth rate, leading to smaller number of children, results in faster capital accumulation per capita.

In short, the slowdown of population growth resulted in higher economic growth. Therefore, we expect a negative sign for the coefficient of joint variable (1 – EM*BR): percentage of ethnic majority multiplied by birth rate.

According to the standard Solow Growth Model, increase in capital leads to higher GDP. Larger inflow of foreign direct investment is also known to support development of the domestic economy. For this reason, we expect positive signs of both GCF and FDI coefficients.

Hypothesis 2: The relation between foreign direct investment into the region and GRP is positive.

Hypothesis 3: Ethnic minorities autonomous regions are the least developed regions of China, we assume then, the negative impact of the high percentage of ethnic minorities in the population on GRP.

What is more, ethnic minorities are excluded from the one child policy, based on this, we decided to multiply the variable 'birth rate' – a proxy for the one child policy, by 1 minus the percentage of ethnic minorities in the population of each region, in order to get more precise results of the impact of this variable. As ethnic minorities are exempted from the one child policy, this joint variable will exclude outliers, and the observed effect will only include the population (major nationality – han), for which the policy is applied.

3.6 Model specification

Based on the hypotheses above, the estimation model is as follows:

GRP = f (gross capital formation, foreign direct investment, share of ethnic minorities, birth rate).

Transforming the equation into mathematical form using log-linear model gives:

$$GRP_{it} = \beta 1 GCF_{it} + \beta 2 FDI_{it} + \beta 4 (1 - EM)_{it} * BR_{it} + \alpha_i + \mu_{it}$$

where,

GRP_{it} – the log of gross regional product per capita for region *i* in year *t*

GCF_{it} – the log of gross capital formation for region *i* in year *t*

FDI_{it} – the log of Foreign Direct Investment, actually used for region *i* in year *t*

EM_{it} – percentage of ethnic minorities for region *i* in year *t*

BR_{it} – average Birth Rate[2] in percent for region *i* in year *t,* proxy for the one child policy

α_i – individual effect in province *i*

Variable	**Data Source**	**Symbol**	**Expected Sign**
Gross regional product (per capita)	China Statistical Yearbook	GRP	+
Gross capital formation (log)	China Statistical Yearbook	GCF	+
Foreign direct investment (log)	China Statistical Yearbook, Ministry of Commerce of China	FDI	+
1 - Ethnic minorities * birth rate (%)	China's Population Census, China Statistical Yearbook	EM*BR	+

Table 1: *Variables and expected signs*

[2] We use average birth rate in each region, in spite of the fact that using birth rate of han population would be more accurate, due to unavailability of the data.

3.7 Empirical approach

3.7.1 Panel data estimation techniques

We perform empirical analysis based on methods using panel data specification.

Panel data (or longitudinal data, or repeated measures) are "repeated observations on the same cross section, observed for several time periods, which means that it provides information on individual behavior both across time and across individuals" (Cameron and Triverdi, 2005). "Panel data allows pooling time-series observations across various cross-sectional units, such as countries, states, regions, firms, or randomly sampled individuals or households" (Baltagi, 2013).

According to Cameron and Triverdi, the main advantage of panel data is that it gives more accurate estimation, resulting from an increase in the number of observations due to pooling several time periods of data for each individual.

The second benefit of panel data, state the authors, is "the possibility of consistent estimation of the fixed effects model, which allows for unobserved individual heterogeneity that may be correlated with regressors".

The third advantage of panel data, as per Cameron and Triverdi, is "the possibility to learn more about the dynamics of individual behavior than from a single cross section" (Cameron and Triverdi, 2005).

As Baltagi points out, one of the limitations of panel data sets can be problems in the design, data collection and data management of panel surveys.

Another drawback of panel data sets, according to him, is the "distortions caused by measurement errors or incorrect sample selection" (Baltagi, 2013).

The basic regression model for panel data is the following:

$$y_{it} = x_{it}'\beta + z_i'\alpha + \varepsilon_{it}$$

$$= x_{it}'\beta + c_i + \varepsilon_{it}$$

X_{it} contains K regressors, not including constant term. The heterogeneity – individual effect – is captured by $z_i'\alpha$ where z_i includes constant term and a set of group specific variables, which can be observed (Greene, 2012).

Methods used for panel data are:

- Fixed Effects Method
- Random Effects Method
- Pooled OLS Method

The **pooled model** is "the most restrictive one; it specifies constant coefficients, the usual assumption for cross-section as following":

$$y_{it} = \alpha + x_{it}'\beta + u_{it}.$$

Fixed effects model: "if z_i is unobserved, but correlated with x_{it}**,** the LS estimator of β is biased and inconsistent as a consequence of an omitted variable. While the model

$$y_{it} = x_{it}'\beta + \alpha_i + \varepsilon_{it},$$

where $\alpha_i = z_i'\alpha$ represents all the observable effects and specifies estimable conditional mean. In the fixed effects model, α_i is a group-specific constant term".

Random effects model: "if the unobserved individual heterogeneity can be assumed to be uncorrelated with the included variables, then the model looks as following:

$$y_{it} = x_{it}'\beta + E[z_i'\alpha] + \{z_i'\alpha - E[z_i'\alpha]\} + \varepsilon_{it}$$

$$= x_{it}'\beta + \alpha + u_i + \varepsilon_{it}$$

In this model, u_i is group-special random element, similar to ε_{it}**,** the main difference is that for each group there is a single identical draw for each period".

Green highlights that "in panel data analysis, it is important to distinguish between balanced panel data set, when each individual in data set is observed the same

number of times; and unbalanced panel data set, when individuals may be observed different number of times" (Greene, 2012).

In our analysis, we will use balanced panel data, in order to get more precise results.

Some of the most commonly used panel data estimators of β are:

Pooled OLS estimator:

$$y_{it} = \alpha + x'_{it}\beta + u_{it}, \quad i = 1, \ldots, \mathrm{N}, \quad t = 1, \ldots, \mathrm{T}.$$

"The pooled OLS estimator is consistent if the pooled model is appropriate and regressors are uncorrelated with the error term; it is inconsistent if the fixed effects model is a better fitting one".

Between estimator: "to estimate β, unlike pooled OLS estimator, this estimator in short panels uses only cross-sectional variation.

$$\bar{y}_i = \alpha + \bar{x}'_i\beta + (\alpha_i - \alpha + \bar{\varepsilon}_i), \quad i = 1, \ldots, N,$$

where $\bar{y}_i = T^{-1}\sum_t y_{it}$, $\bar{\varepsilon}_i = T^{-1}\sum_t \varepsilon_{it}$, and $\bar{x}_i = T^{-1}\sum_t x_{it}$.

Between estimator is used for the constant-coefficients model and the random effects model estimation, as it is consistent if the regressors $\bar{x}_i$ are independent of the composite error $(\alpha_i - \alpha + \bar{\varepsilon}_i)$. Between estimator is inconsistent for the fixed effects model, as α_i in this case is assumed to be correlated with x_{it} and, therefore, $\bar{x}_i$".

Within (or fixed effects) estimator: "uses the variation in the data over time to measure in short panel the association between individual-specific deviations of regressors from their time-averaged values and individual-specific deviations of the dependent variable from its time-averaged value.

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)'\beta + (\varepsilon_{it} - \bar{\varepsilon}_i), \quad i = 1, \ldots, N, \quad t = 1, \ldots, T.$$

Within estimator gives consistent estimates of β in the fixed effects model, however, its important drawback is that it does not identify the coefficients of time-invariant regressors. Therefore, to capture the effect of time-invariant regressors, in many studies, pooled OLS or random effects estimators are used, however, those are

inconsistent when the fixed effects model is the correct model to use" (Cameron and Triverdi, 2005).

Another way to compute the within estimator is using **least squares dummy variable (LSDV). "**Given that y_i and X_i are the *T* observations for the *i*th unit, *i* is a $T \times 1$ column of ones, and ε_i is the associated $T \times 1$ vector of disturbances,

$$y_i = X_i + i\alpha_i + \varepsilon_i.$$

Collecting these terms yields

$$y = [X \;\; d_1 \;\; d_2, \dots, d_n] \begin{bmatrix} \beta \\ \alpha \end{bmatrix} + \varepsilon,$$

where d_i is a dummy variable indicating the *i*th unit. The $nT \times n$ matrix D = $[d_1, d_2, \dots, d_n]$. Then, generalizing all *nT* rows gives

$$y = X\beta + D\alpha + \varepsilon,$$

which is a general form of the LSDV model.

If *n* is small enough, then the model can be estimated by OLS with *K* regressors in **X** and *n* columns in **D**, as a multiple regression with $K + n$ parameters. If *N* is too large, the least squares estimator of β is written as:

$$b = [X' M_D X]^{-1} [X'^{M_D} y] = b^{within},$$

where $M_D = I - D(D'D)^{-1}D'$ "(Greene, 2012).

First-differences estimator: "in short panel measures the association between individual-specific one-period changes in regressors and individual-specific one-period changes in the dependent variable. The first-differences model is specified as:

$$y_{it} - y_{i,t-1} = \left(x_{it} - x_{i,t-1}\right)'\beta + \left(\varepsilon_{it} - \varepsilon_{i,t-1}\right), \qquad i = 1, \dots, N, \qquad t = 2, \dots, T.$$

The first-differences estimator, also gives consistent estimates of β in the fixed effects model, but does not identify time-invariant variables".

The feasible generalized least squares estimator (FGLS), or random effects estimator of the random effects model, "can be calculated from OLS estimation of the transformed model

$$y_{it} - \hat{\lambda}\bar{y}_i = (1 - \hat{\lambda})\mu + (x_{it} - \hat{\lambda}\bar{x}_i)'\beta + v_{it},$$

where $v_{it} = (1 - \hat{\lambda})\alpha_i + (\varepsilon_{it} - \hat{\lambda}\bar{\varepsilon}_i)$ is asymptotically iid, and $\hat{\lambda}$ is consistent for $\lambda = 1 - \frac{\sigma_\varepsilon}{\sqrt{\sigma_\varepsilon^2 + T\sigma_\alpha^2}}$.

The FGLS estimator is fully efficient under the random effects model, however, it is just slightly more efficient than pooled OLS. Furthermore, it is inconsistent, when the true model is the fixed effects model" (Cameron and Triverdi).

3.7.2 Tests used for panel data

To decide which of the panel data models is the correct one, three tests need to be performed: **Breusch-Pagan Lagrange multiplier (LM) test** for random effects; **Hausman test** for fixed effects, and **Wald test (also called F-test)**.

Breusch-Pagan test "helps to decide between the random effects model and simple OLS regression. The null hypothesis in this test is that variance across entities is zero, hence, no significant differences across units. If the null hypothesis is rejected, than the panel effect is present, and random effects model is preferred against OLS":

$$H_0 = \sigma_u^2 = 0$$

$$H_1 = \sigma_u^2 \neq 0$$

The test statistic is

$$LM = \frac{nT}{2(T-1)}\left[\frac{\sum_{i=1}^{n}(T\bar{e}_i)^2}{\sum_{i=1}^{n}\sum_{t=1}^{T}e_{it}^2} - 1\right]^2.$$

Hausman test "is used to decide between fixed and random effects models. The null hypothesis is that unique errors u_i are not correlated with the regressors, hence, the correct model is the random effects model. If the null hypothesis is rejected, fixed effects model is preferred to random effects model.

Test statistic is:

$$H' = \left(\hat{\beta}_{LSDV} - \hat{\beta}_{MEANS}\right)' \left[Asy.Var[\hat{\beta}_{LSDV}] + Asy.Var[\hat{\beta}_{MEANS}]\right]^{-1} \left(\hat{\beta}_{LSDV} - \hat{\beta}_{MEANS}\right),$$

where $\hat{\beta}_{MEANS}$ is the group means estimator" (Greene 2012).

Wald test is used for overall goodness-of-fit to test for fixed effects.

3.8 Model estimation and results

Firstly, as OLS is highly sensitive to outliers, we transform the data in logarithms.

Then we alternately perform pooled OLS, random effects and fixed effects specifications of panel data model. To estimate random effects model we use FGLS. For the fixed effects model we use within estimator as the most efficient and, as well, consistent one.

To identify the best fitting model specification, we apply F-test, Breusch-Pagan test for random effects, followed by Hausman test for fixed effects.

Possible econometric issues with panel data are heteroskedasticity and autocorrelation. Therefore, we apply Wald test for group-wise heteroskedasticity and Wooldridge test for autocorrelation.

Firstly, we apply F-test, based on its results, we reject the null hypothesis of no fixed effects.

F test that all u_i = 0:

F (30, 90) = 1.69

Prob > F = 0.0306

Secondly, we perform Breusch and Pagan Lagrangian multiplier test for random effects to choose between pooled OLS and RE model. The null hypothesis of the test is that the variance across entities is zero, meaning no panel effects. As, based on the results, we reject the null, we can conclude, that using OLS regression is not appropriate in our case.

	Var	**sd = sqrt (Var)**
grpperc-a	.7721385	.8787141
E	.5402113	.7349907

Table 2: *Breusch and Pagan Lagrangian multiplier test*
Source: author's computations

Test: Var (u) = 0

chibar2 (01) = 0.00

Prob > chibar2 = 1.0000

The last test we apply is Hausman test, to decide between RE model and FE model. The null hypothesis is that the unique errors (u_i) are uncorrelated with regressors, and hence, the preferred model is random effects. Based on the results of the test – Prob > chi2 lower than 0.05, we reject null hypothesis, and take fixed effects as the correct model specification.

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	Random	Difference	S.E.
Minusminor	.0042906	-.0001539	.0044445	(.0009455)
Fdi	.3503473	.2293511	.1209962	(.1220755)
Gcf	.0354458	.025513	.0099328	

Table 3: *Hausman test*

Source: author's computations

Note: robust standard errors in parentheses

b = consistent under H_0 and H_a; obtained from xtreg

B = inconsistent under H_a, efficient under H_0; obtained from xtreg

Test: H_0 **: difference in coefficients not systematic**

chi2 (3) = (b-B) ' [(V_b - V_B) ^ (- 1)] (b-B)

= 24.06

P-value = 0.0000

(V_b – V_B is not positive definite)

Following this, we also need to check whether heteroskedasticity or autocorrelation are present in our model.

The null hypothesis of Wald test is homoskedasticity – constant variance.

H_0**: sigma (i) ^ 2 = sigma ^ 2 for all i**

chi2 (31) = 7133.67

P-value = 0.0000

Based on the above results, we reject the null hypothesis, which means that we are facing the problem of heteroskedasticity in our model.

We then apply the test for serial correlation, as we use a macro panel in the analysis (data for more than 20 years). Testing for serial correlation is necessary, as when present, it leads to downward bias standard errors of the coefficients, and upward bias R-squared (Torres-Reyna).

H_0: no first-order autocorrelation

F (1, 30) = 492.566

Prob > F = 0.0000

Above we reject the null hypothesis of no autocorrelation in the model.

As a remedy for heteroskedasticity and autocorrelation in fixed effects regression, we use robust and clustered standard errors. In clustered data, we assume independence across clusters, but correlation within clusters, as some phenomena do not affect observations individually, but, instead, affect groups of observations uniformly within each group. Clustering is usually required, when the model includes aggregate variables. Clustered standard errors increase the confidence interval, allowing for correlation between observations. The higher is the clustering level, the larger are standard errors (Sarzosa, 2012). Panel-robust estimation solves the potential problem of underestimated standard errors and over-estimated t-statistics (Cameron and Triverdi).

Therefore, according to the results of all the tests applied, we run the fixed effects model again, adding the robust cluster errors command:

Grppercapita	Coefficients	Robust Std. Err.	t-ratio	P-value
Minusminor	.0042906	(.0013906)	3.09	0.004***
Fdi	.3503473	(.3000704)	1.17	0.252
Gcf	.0354458	(.0093945)	3.77	0.001***
Constant	9.092851	(1.214747)	7.49	0.000***

Table 4: *Pesaran CD test*
Source: author's computations
*Note: robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

To further test the model, we apply also Pesaran CD test for cross-sectional dependence and Levin-Lin-Chu unit-root test.

Pesaran's test of cross sectional independence = 35.001, Pr = 0.0000

Average absolute value of the off-diagonal elements = 0.860

We can now run the unit-root test, which assumes cross-sectional independence in panel, and our data meets this assumption, according to the results of CD test.

	Statistic	p-value
Unadjusted t	1.3261	
Adjusted t*	4.7e+14	1.000

Table 5: *unit-root test*
Source: author's computation

With p-value equal to 1, we reject the null hypothesis that panels contain unit roots.

Based on joint results of all tests performed, we conclude, that this is the final regression, which gives us proper results we are going to analyze. We can see that the Prob > F is lower than 0.05, meaning that all the coefficients in the model are different than zero. Intraclass correlation – *rho* shows that 87.9% of the variance is due to differences across panels. The overall R squared is equal to 0.12. All the coefficients have expected sings: they are positively correlated with the dependent variable. When *minusminor,* representing ethnic majority, multiplied by birth rate, increases by one unit, *grp per capita* increases by 0.004 units, holding all other things constant. When *fdi*, representing foreign direct investment, increases by one unit, Y increases by 0.35 units, ceteris paribus. When gross capital formation (*gcf*) increases by one unit, per capita GRP increases by 0.035 units, holding all other things constant. To see whether the independent variables we used in our model have significant influence on the dependent variable *grp per capita* we check the t-values and p-values. From the results we can see, that the only variable with the p-value higher than 0.05 is *fdi,* which means that this variable has no significant impact on Y on 95% confidence level (the possible reasons, caused these results will be analyzed in the following part). As for the other independent variables, we can see that the joint variable representing ethnic majority multiplied by birth rate is highly significant on 95% confidence interval. The same applies to gross capital formation. The analysis of the results of two-tail p-value test gives the same: the independent variables, excluding foreign direct investment are significant.

3.9 Analysis of the results

According to our regression, the joint variable *minusminor*, that stands for the birth rate in each province weighted by the percentage of ethnic majority, which falls under the regulations of the one child policy, is positively related to dependent variable GRP. In other words, the higher is the birth rate in a given province, the higher is its gross regional product. These results are totally in line with the statement, repeated by many sources: economic growth in China has for the long time been population- or labor force-driven. This would lead us to the conclusion that the one child policy, that is decreasing the birth rate, has a negative impact on GRP. The question is, whether such absolute statement is legitimate. Howden and

Zhou, come to similar conclusion, they claim that after 35 years of one child policy's implementation, China had to look for the solution of labor shortage problem in order to remain on its current path of steady economic development. 2012 was the first year in history of modern China, when the working-age population declined, and the measures of certain relaxation of the policy and planned increase of the retirement age, taken then by Chinese government were too weak to minimize the negative impact of the situation (Howden and Zhou, 2014). Golley and Tyers study both the impact of labor and capital increase on GDP of China. They indicate that higher birth rate affects economy through three main channels: through increase in labor force; through larger share of saving in income, caused by increase in the share of working age population in overall population of the country; and through the product composition of consumption, which more clearly indicates preferences of young people with the increase in population growth. "Changes in China's labor force alter the productivity of its capital and therefore the return on Chinese investment," – state the authors. Therefore, higher population growth leads to increase in other countries' savings into investment in China, resulting in more intensive growth of Chinese capital stock. This means that, increased birth rate impacts GDP of China positively, directly and indirectly through the supply of two of the main productivity factors: both labor and capital (Golley and Tyers, 2006). A number of scholars, among which, Peng and Mai, are operating the concept of demographic dividend, highlighting the fact that during the years of one child policy China has completed rapidly demographic transition from state of high fertility, low mortality and high population growth to a state of low fertility, low mortality and low population growth. Decrease in population growth rate resulted in a "demographic dividend", which contributed much to already fast economic development of China, initiated by economic reforms of Deng Xiaoping. It has been estimated that one fourth of country's economic growth since the beginning of economic reform results from demographic dividend. However, demographic changes brought by one child policy, in particular, distortion of age structure, will in the nearest future cause the closing of "demographic window", meaning that, "the demographic dividend will turn into a demographic deficit", which, in its turn will result in decrease in economic development (Peng, Mai, 2008). On the other hand, unlike the majority of researchers, Fang and Leong in their paper, after conducting the research both on

national and provincial level, come to the following results: on country level, “a 1% increase of population growth rate would facilitate a 1.7% increase in economic growth rate”, meaning that the impact of the one child policy, which brings down the birth rate, and hence, population growth, on China’s GDP is negative; while on provincial level, the relation between population growth and economic growth becomes negative after the demographic policy restrictions were implemented. According to the authors, “with every 1% increase in population growth, GDP decreases by 1.2%”. To put it another way, population control policy has significant positive impact on regional economies (Fang, Leong, 2014).

Based on regression results, we conclude that gross capital formation has a significant positive impact on GRP of Chinese provinces, and this is in line with the basic Solow growth model and majority of other economic theories and empirical researches. The contribution of GCF to GDP growth is especially very well seen in the developing countries. For instance, Shuaib and Dania in their paper “Capital formation: impact on the economic development of Nigeria 1960-2013”, highlight that capital accumulation is essential for economic development, as the increase in physical capital stock – machinery, buildings, infrastructure – provides opportunities for further increase in productivity and further employment opportunities in the first place; and also increases the overall standards of leaving, giving the opportunities for development of education, healthcare, technological progress. The authors note, that the roots of a number of obstacles for the economic development of emerging economies are coming from low level of accumulated capital (Shuaib and Dania, 2015). In context of China, Ding and Knight claim that in line with the augmented Solow model, capital formation plays a key role in economic development of China in recent decades, emphasizing the fact that the country’s economic growth is highly investment-driven. Although, the capital accumulation is usually “a subject to diminishing returns”, they claim that it is not the case for China, and name the following two reasons. First, investment leads to structural change, transferring large amount of labor force from low-productivity agricultural sector to high-productivity industrial sector. Second, the empirical research, conducted by them, indicates low rate of convergence in China, meaning that even with diminishing returns to investment, it will still take decades until capital accumulation will cease having a significant impact on China’s economic growth. Furthermore, the authors mention

existing difference in return on capital among Chinese provinces: it is significantly higher in southeastern regions, than in western and central parts of the country, although, variation has slightly decreased in the last years (Ding and Knight, 2008). Similarly, Wang in his research finds that during the 20 years from the beginning of the economic reform in China, additional value brought by capital stock growth into the economic growth rate was equal to 3.8 percentage points, the contribution of accelerated economic growth was equal to 1.3 percentage points. From these figures, only 0.3 percentage points come from increase in savings, same 0.3 percentage points are attributed to FDI and foreign debt, and 0.7 percentage point is a result of increase in investment. The author also notes that before the beginning of Den Xiaoping's reform, investment rate for significantly lower than the savings rate, equal to 12 and 30 per cent of China's GDP respectively. He brings forward an interesting fact that a big amount of investment funds was used for investment projects, and hence, did not contribute to capital stock formation. During the reform, the savings rate grew by 7 percentage points in comparison to the pre-reform period, however investment rate and rate of capital formation growth far exceeded growth in savings, which means that the use of savings in investment started to be more efficient. As per Wang's calculations "every hundred yuan of savings only formed 42 yuan capital stock in the pre-reform period, but 59 yuan in the reform period" (Wang, 1999).

All in all, the positive relation between GCF and GRP of Chinese provinces fits within the frame of macroeconomic theory and is also proved by a number of empirical researches.

The output of the regression showed that foreign direct investment has no significant influence on gross regional product per capita in China, which is against our initial assumptions. The reason for this can lie in the nature of the analyzed data – we made our research on provincial level, and according to a know fact, foreign direct investment is spread very unevenly across the country. Majority of FDI is concentrated in eastern provinces and costal area: at the initial stage of FDI inflow to China in 1980s, almost 90 per cent of foreign direct investment was made into this area, especially, four Special Economic Zones – Shantou, Shenzhen and Zhuhai in Guandong province and Xiamen in Fujian province, which had big incentives for

FDI. In 1990s FDI started to gradually spread from initial area of southeastern costal area to further eastern and partly inland provinces, the target areas of FDI became: the Yangzi River Delta, comprised of the provinces of Shanghai, Jiangsu, Zhejiang, and the Bohai Gilf, which includes provinces of Shandong, Hebei, Tianjin and Liaoning. Increase in FDI has been also recorded in this period in central provinces of Jilin, Heilongjiang, Jiangxi, Henan, Hubei and Hunan, as well as the most developed of western provinces – Sichuan and Shaanxi. Guangdong has been the leader among the other Chinese provinces attracting foreign investors, its accumulated FDI stock from 1983 to 2002 equaled to 28% of national total, leaving the other key FDI destinations – Jiangsu, Fujian and Shanghai – far behind. However, in recent years, Guandong has partly lost its positions, while the shares of the rest of the costal provinces, among which – Jiangsu, Fujian, Zhejiang, Shandong, Tianjin and Hebei – in China's FDI stock have raised. The share of central provinces is also rising, most significantly of Henan, Hubei and Hunan (Chen, 1997).

Therefore, evidentially, despite the program of development of western regions, known as "China's Western Development", initiated by Chinese government in 2002, which covers 6 provinces – Gansu, Guizhou, Qinghai, Shaanxi, Sichuan and Yunnan – and 5 autonomous regions – Guangxi, Inner Mongolia, Ningxia, Tibet and Xinjiang, aimed to encourage FDI in these least developed regions of the country, Western and Inner China remains unattractive for foreign capital.

According to Chen, there are several key factors, determining the direction of FDI in China, which can be summarized into: economical factors, such as market size of host province, level of economic development of the host province, economic growth rate, labor costs and productivity, openness of certain province to the outer world, level of accumulated FDI; infrastructure and energy supply factors, such as intensity of transport infrastructure, level of telecommunications, energy supply; human resource and labor quality factors; geographical location; policy factors.

Summarizing all things mentioned above, FDI had indeed supported economic growth in the certain areas of China. However, FDI inflow is more or less significant only in the provinces, with already existing preconditions for steady economic development. Southeastern costal area is historically more developed and prosperous region, rich in economic, natural and human resources, which enabled rapid

economic growth after Den Xiaoping's reform of 1979. On the other hand, poor, undeveloped western and inner provinces witnessed no significant FDI inflow. Therefore, the impact of FDI itself on the economy of Chinese provinces can not be neglected completely, however, should definitely not be overestimated.

4 Conclusion

In this master thesis we have analyzed the impact of the one child policy on economic development of China, using panel data from provincial level, covering the years from 1995 to 2015. We have made both empirical research and theoretical analysis of the topic.

The aim of this research was mainly to further examine the relation between the current demographic policy of China and its economic development, by analyzing the key macroeconomic indicators. Based on existing literature and econometric models, we tried to construct our own vision of the topic and fulfill the possible gaps left by previous studies.

From the prospective of macroeconomic theory, we have concluded that the Solow growth model can well explain China's economic growth, therefore, we have constructed a model, which combines the factors, traditionally known as economic growth determinants, such as gross capital formation and labor factor, although presented in a modified form; and other factors, influencing GDP, but not included into baseline models, such as foreign direct investment.

The main contribution of the paper can be seen in creating an own proxy for the one child policy – as it is difficult to measure the policy factor empirically – which is represented in a model by joint variable of the percentage of ethnic minorities in the region and birth rate. In other research papers, for example the one by Fang and Leong, the one child policy is included into the model as dummy variable. One of the drawbacks of this approach is a big size of a dataset, which needs to include as well at least several years before the policy implementation, and the availability of these data is quite low due to a poor level of Chinese statistics at that point in time. But the main weak point of such models, in our opinion, lies in ignoring the regional specific of different provinces, which, we believe, is crucial to more accurately capture and interpret the effect of the policy. Birth rate in different regions of the country differs significantly, and one of the important factors influencing birth rate is percentage of

ethnic minorities, which were from the very beginning excluded from the one child policy.

While studying various sources and existing theoretical and empirical papers, we have found out that there are two opposite opinions regarding the relation between China's demographic policy and its economic growth. According to one point of view, the impact of the one child policy on GDP of China is positive. Those authors, who come to this conclusion, bring forward the fact that policy's birth restriction created a demographic dividend, which initiated rapid economic growth in the country. They also point out that the standard of living of population; level of education and qualification of labor force has risen with the implementation of the policy, as the families are putting all the resources into raising the only child. The opponents of this point of view conclude that the demographic policy, limiting the number of births per family has a negative impact on China's economy. They highlight the fact that despite of capital accumulation, FDI inflow, technological progress economic growth of China has still been mostly labor-driven. The reduction of the population might have led to certain benefits, however, only in the short run. In spite of the fact that the demographic policy increased the quality of life of the population and eased the pressure put on the environment, the drawbacks still outweigh the positive points. Damages in demographic structure, in particular, disbalance of sexes and population aging are, in the long run, serious threats for the economy and country in general. After the literature review, we were more inclined to support the first opinion.

Empirical estimation we made based on selected data, disproved our initial assumption: according to the results obtained from fixed effects model, relation between the variable, representing population factor and GRP of Chinese provinces is *positive* and significant on 95% confidence level. Based on this, we rejected our *First Hypothesis*, and conclude that, as population growth remains one of the key factors positively influencing China's GDP growth, the impact of the one child policy on the country's economy is negative. Our main findings based on the other hypotheses we made are as follows.

In line with our *Second Hypothesis*, the relation between foreign direct investment into the region and its gross regional product is indeed positive. However, it is not significant, on 95% confidence level, meaning that FDI can not be named as one of the major factors affecting economic development of China.

As the joint variable representing percentage of ethnic majority in the region and birth rate is positively related to the region's GRP, we can conclude, that the percentage of ethnic minorities is, on the contrary, negatively impacting the economy, which proves our *Third Hypothesis* is correct.

The field for a further research might be the impact of the new policy measures. Will they be enough to minimize the negative consequences of the one child policy? How long will it take the population to get used to new policy, the birth rate to increase and economy to react to these changes? What would be the impact on other Asian and World economies? All these and a number of similar questions leave a significant space for forecasting

All in all, the one child policy, constructed for solving potential threats for further economic development of China, has in reality resulted in even bigger threats undermining the country's future prosperity. At the current point it is crucial for Chinese authorities to pay intensified attention to the demographic processes, and, most probably, design further modifications of the population policy and launch a new campaign, as even the latest two-child policy alone might not be enough to remedy the destructive impact of the measures taken in previous decades.

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Annex 1: Pooled OLS

Source	SS	df	MS	Number of obs =	124
				F(3, 120) =	9.98
Model	18.9696606	3	6.32322019	Prob > F =	0.0000
Residual	76.0033726	120	.633361438	R-squared =	0.1997
				Adj R-squared =	0.1797
Total	94.9730332	123	.772138481	Root MSE =	.79584

grppercapita	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
minusminor	-.0001539	.0002649	-0.58	0.562	-.0006784	.0003706
fdi	.2293511	.056743	4.04	0.000	.117004	.3416983
gcf	.025513	.027229	0.94	0.351	-.0283985	.0794245
_cons	8.563758	.3035879	28.21	0.000	7.962675	9.164841

Annex 2: Between Estimator

```
Between regression (regression on group means)  Number of obs      =       124
Group variable: a                               Number of groups   =        31

R-sq:  within  = 0.0000                         Obs per group: min =         4
       between = 0.5230                                        avg =       4.0
       overall = 0.0801                                        max =         4

                                                F(3,27)            =      9.87
sd(u_i + avg(e_i.))=  .3602611                  Prob > F           =    0.0001
```

grppercapita	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
minusminor	-.0002693	.0002718	-0.99	0.331	-.000827	.0002885
fdi	.2798957	.0700334	4.00	0.000	.1361991	.4235923
gcf	-.1236867	.1737032	-0.71	0.483	-.4800962	.2327228
_cons	9.286755	.9864077	9.41	0.000	7.262814	11.3107

Annex 3: FE model (within estimator) results

```
Fixed-effects (within) regression               Number of obs      =       124
Group variable: a                               Number of groups   =        31

R-sq:  within  = 0.2587                         Obs per group: min =         4
       between = 0.2604                                        avg =       4.0
       overall = 0.1234                                        max =         4

                                                F(3,90)            =     10.47
corr(u_i, Xb)  = -0.9626                        Prob > F           =    0.0000

------------------------------------------------------------------------------
grppercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  minusminor |   .0042906   .0009819     4.37   0.000     .0023398    .0062413
         fdi |   .3503473   .1346187     2.60   0.011     .0829037    .6177909
         gcf |   .0354458   .0256974     1.38   0.171    -.0156066    .0864983
       _cons |   9.092851   .5962706    15.25   0.000     7.908255    10.27745
-------------+----------------------------------------------------------------
     sigma_u |  1.9836904
     sigma_e |   .73499065
         rho |   .87928884   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(30, 90) =     1.69              Prob > F = 0.0306
```

Annex 4: RE model GLS estimator

```
Random-effects GLS regression                   Number of obs      =       124
Group variable: a                               Number of groups   =        31

R-sq:  within  = 0.0794                         Obs per group: min =         4
       between = 0.4987                                        avg =       4.0
       overall = 0.1997                                        max =         4

                                                Wald chi2(3)       =     29.95
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
theta          = 0
```

grppercapita	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
minusminor	-.0001539	.0002649	-0.58	0.561	-.0006731	.0003653
fdi	.2293511	.056743	4.04	0.000	.118137	.3405653
gcf	.025513	.027229	0.94	0.349	-.0278549	.0788809
_cons	8.563758	.3035879	28.21	0.000	7.968736	9.158779
sigma_u	0					
sigma_e	.73499065					
rho	0	(fraction of variance due to u_i)				

Annex 5: Hausman test

	Coefficients (b) fixed	(B) random	(b−B) Difference	sqrt(diag(V_b−V_B)) S.E.
minusminor	.0042906	−.0001539	.0044445	.0009455
fdi	.3503473	.2293511	.1209962	.1220755
gcf	.0354458	.025513	.0099328	.

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(3) = (b−B)'[(V_b−V_B)^(−1)](b−B)
= 24.06
Prob>chi2 = 0.0000
(V_b−V_B is not positive definite)

Annex 6: Breusch-Pagan test

```
Breusch and Pagan Lagrangian multiplier test for random effects

        grppercapita[a,t] = Xb + u[a] + e[a,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
               grpperc~a |    .7721385       .8787141
                       e |    .5402113       .7349907
                       u |          0              0

        Test:   Var(u) = 0
                                 chibar2(01) =     0.00
                              Prob > chibar2 =   1.0000
```

Annex 7: Wooldridge test

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      30) =    492.566
           Prob > F =      0.0000
```

Annex 8: Fixed effects regression with AR (1) disturbances

```
FE (within) regression with AR(1) disturbances  Number of obs      =        93
Group variable: a                               Number of groups   =        31

R-sq:  within  = 0.1397                         Obs per group: min =         3
       between = 0.2091                                        avg =       3.0
       overall = 0.0955                                        max =         3

                                                F(3,59)            =      3.19
corr(u_i, Xb)  = -0.9153                        Prob > F           =    0.0300

------------------------------------------------------------------------------
grppercapita |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  minusminor |  -.0019958   .0010556    -1.89   0.064    -.0041081    .0001165
         fdi |  -.0662141    .062043    -1.07   0.290    -.1903618    .0579336
         gcf |   .0133258    .007624     1.75   0.086    -.0019298    .0285813
       _cons |   10.92735   .1068031   102.31   0.000     10.71364    11.14106
-------------+----------------------------------------------------------------
      rho_ar |  .65931946
     sigma_u |  1.1175331
     sigma_e |   .3068936
     rho_fov |  .92987401   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(30,59) =     0.84                 Prob > F = 0.6985
```

Annex 9: Pesaran CD test for cross-sectional dependence

```
Pesaran's test of cross sectional independence =    35.001, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.860
```

Annex 10: Heteroscedasticity ModifiedWald test

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (31)  =    7133.67
Prob>chi2 =      0.0000
```

Annex 10: Unit root test

Levin-Lin-Chu unit-root test for **grppercapita**

Ho: Panels contain unit roots — Number of panels = **31**
Ha: Panels are stationary — Number of periods = **4**

AR parameter: **Common** — Asymptotics: **N/T -> 0**
Panel means: **Included**
Time trend: **Not included**

ADF regressions: **1** lag
LR variance: **Bartlett** kernel, **5.00** lags average (chosen by **LLC**)

	Statistic	p-value
Unadjusted t	**1.3261**	
Adjusted t*	**4.7e+14**	**1.0000**

Annex 11: Final model

```
Fixed-effects (within) regression               Number of obs      =       124
Group variable: a                               Number of groups   =        31

R-sq:  within  = 0.2587                         Obs per group: min =         4
       between = 0.2604                                        avg =       4.0
       overall = 0.1234                                        max =         4

                                                F(3,30)            =      8.83
corr(u_i, Xb)  = -0.9626                        Prob > F           =    0.0002

                                    (Std. Err. adjusted for 31 clusters in a)
```

grppercapita	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
minusminor	.0042906	.0013906	3.09	0.004	.0014505	.0071306
fdi	.3503473	.3000704	1.17	0.252	-.2624781	.9631727
gcf	.0354458	.0093945	3.77	0.001	.0162596	.054632
_cons	9.092851	1.214747	7.49	0.000	6.612007	11.5737
sigma_u	1.9836904					
sigma_e	.73499065					
rho	.87928884	(fraction of variance due to u_i)				