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TOWARD A NEW SUSTAINABLE DEVELOPMENT FOR CHINA: AN ENVIRONMENTAL MULTISECTORAL MODEL USING A SOCIAL ACCOUNTING MATRIX

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Introduction

In most known definition, given by Brundtland report, sustainable development means integrating the economic, social and environmental objectives of society, in order to maximize human well-being in the present without compromising the ability of future generations to meet their needs (UN, 1987). This requires seeking mutually supportive approaches whenever possible, and making trade-offs where necessary. Sustainable development is not an activity that has to be left to the long term; rather, it constitutes a set of short, medium and long term actions, activities and practices that aim to deal with immediate concerns while at the same time address long-term issues. Achieving sustainable development requires far reaching policy and institutional reforms and the involvement of all sectors at all levels.

In recent years, sustainable development has been representing an important economic policy objective for World Countries as a consequence of the strong awareness for climate changes and the ensuing environmental damage. Environmental policies generally consist on a set of measures oriented to improve efficiency on energy consumption and reduce inefficient behaviours. The use of such instruments, aimed to reduce the amount of emissions and promote environmental conservation according to international agreements, in some cases is still discouraged by politicians and governments which interpret this measures as burdens to economies.

After years of difficult dialogue and strong debate with the Western Countries on issues related to environmental protection and reduction of CO_2 emissions, the environmental emergency has officially entered in the China's Government agenda. This is certainly a major step towards the achievement of a unique action against the climate change concern, however, the environmental issue in China must be faced and debated like a "cultural revolution" that engages all the actors of the economic system from production activities to Institutional Sectors. The incredible economic growth of China, over the past three decades, is mainly attributed to its impressive industrial growth. However, industrial based economic growth may inevitably lead to environmental degradation. China is rated as one of the largest contributors of carbondioxide (CO_2) (IEA, 2008).

The "Green growth" for China have to pass through promoting economic growth while reducing pollution and greenhouse gas emissions (GHG), minimizing waste and inefficient use of natural resources, and maintaining biodiversity. An important objective for the

Government is to transform the Chinese economy from a current economic structure based on high levels of energy consumption at high levels of environmental impact and low efficiency, to a more sustainable growth model. At least at the national level, the Chinese government has declared its intention to fight climate change. In line with the 13th five-year plan, the central Government implemented a series of measures on energy efficiency, energy saving and renewable energies and was able to reduce energy intensity of its economy by 20% in the past five year.The country also is the world's biggest producer of renewable energies, but despite these successes and still moderate per capita emissions, China's total energy consumption and emissions continue to rise rapidly (World Resource Institute, 2016) As outlined in the Eleventh Five-Year Plan (2006–2010) and reiterated in the Twelfth Five-Year Plan (2011–2015), Chinese leaders are challenged by the simultaneous needs to 'build a resource efficient and environmentally-friendly society' and to ensure that growth is more equitable, both of which are integral to "building a harmonious society" (NDRC, 2011). In line with these, the Thirteen Five-Year Plan (2016-2021) contains many proposed programs bear directly or indirectly on poverty reduction, environmental stewardship or both. They include rural land reform, cleaner industrial development, promotion of new energy vehicles, protection of forests, efficient water management, and an improved social insurance system aimed at lifting people out of poverty. Although the Chinese political goal of building a socialist harmonious society is not new, this still has not been achieved. Therefore, how can China rebalancing its economy to better address the related challenges of eradicating poverty, reducing inequality and protecting the environment?

Considering the following research question, the aim of this work is to study the impact of environmental policy for the reduction of CO2 emission taking in account the chinese distributional income analyses. In order to following the purpose of the research, one has to develop an appropriate methodological instrument. The framework chosen in order to follow this research's objective is the Social Accounting Matrix (SAM). SAM is widely used for the analysis of income distribution in a socio-economic system. It is related to the National Accounts, but typically incorporates whatever degree of detail is required for special interests. The principal goal in constructing a SAM is to integrate elements of the income distribution into a single coherent accounting framework.

For these reasons, a big effort has been made for building a Chinese Social Accounting Matrix (SAM) for 2011, that offers an analysis leading to a better understanding of the way the various agents in the real chinese economy interact.

Subsequently, the SAM for China has been integrated with environmental accounts for CO_2 emissions, with the purpose to include the link from the economy to the environment, exploring the relationship between production activities, pollution and income distribution.
The analysis applied will be an extended income–output loop (derived from a SAM), that can be quantitatively tested by sending a shock on a given macro variable and observing the effects on another macro variable within the loop. From the SAM approach a model of circular income flow which is more articulated than the usual one emerges: each macroeconomic flow variable, conveniently disaggregated, generates a second flow variable through the use of a structural matrix and progressively so on until the loop is closed. Final demand determines total output and value added by industry; the latter generates domestic income by factors which compose disposable income by institutional sector; this gives rise to the final demand closing the loop. Consequently, there will be an identification of the traditional multipliers and the related impact components of a multisectoral model based on SAM integrated with the environmental accounting.
Following the objectives of 13th Five Year Plan, the International Agreement of climate action and in accordance with the principles of sustainable development, the interventions designed by policy makers are required to aim at restructuring the final demand's composition so that it achieves a reduction of the CO_2 emissions. The implementation of such policies highlights a set of problems of the macro variable choice that makes up the control policy's final demand components, disposable income or other, of the determination of its amount, structure and balance (Ciaschini and all, 2011). For these reasons, in this work, it has been important to assess a new structure for the final demand which would be able to achieve a composite task: the economic sustainability and the environmental improvement.
This work consists of three parts: the first part (that is located in chapter one) where the research topic is outlined, related to the sustainable development of China, develops the analysis of the macroeconomic environmental framework of the country. In relation to this, in the second part (composed of chapters two and three), the functional tools for research's objective will be delineated. Finally, in chapter four, a paper developed within the Eureka project as integration of the work will be presented.
In particular, the first chapter introduce the new approaches to sustainable development in China. In accordance with the last International Climate agreement, it will discuss the China's policies strategies on order to reach a sustainable development considering the economic, social and environmental dimensions. After a brief introduction of the new China's

Government policies for sustainable development, in the first section it will be presented an analysis the most important problem in term of environmental issues and and the main measures taken by the Government in the last years.

The second chapter starts with an historical overview of the lines of research that contributed to lay the ground of modern multisectoral analysis, from the first estimates of national income in the seventeenth century to the most recent contributions to the SAM approach. It will outline the accounting scheme of SAM and some environmental accounting extensions. The second section describes the SAMs for China for the year 2011. This is an original contribution and it has been built by the author to serve as database for the model presented in Chapter 3. In particular, it will be outlined the key reasons that led to choose this framework, the main steps of construction and the crucial role of Chinese data-sources, in terms of availability and consistency. In fact, SAM was constructed using data from various sources including input-output table, national accounts, government budgets, balance of payments, labor employment and wage statistics and household expenditure surveys. This SAM is a detailed representation of China's economy in 2011; it covers thirtyfive industries, three types of primary factors and four institutional sector (of which two representative households, rural and urban groups), and four capital accounts (detailed by institutional sectors). The structural characteristics of China's economy well presented in this SAM would be helpful to better understand the economic linkages.

The third chapter presents the extended multisectoral models based to the SAM and the modelling for CO_2 emissions. In particular, it has been focused on the studydies that have analized the relationship between income distribution and environmental problems. The proposed multisectoral model is an extension of the Miyazawa approach (Miyazawa, 1970) through the integration of secondary income distribution (Pyatt, 2001). Considering the theoretical background mentioned in the previous section, a multisectoral model for China was constructed with the purpose of analysing certain policy measures and their impact on the environmental dimension of sustainable development. Sudsequently, it will be showed the mathematical formalization of the extended multisectoral model, from which it will get the final inverse matrix. This resulting inverse matrix will be used to identify which composition of the final demand (policy control variable) is consistent with the complex target of reducing the CO_2 emissions together with a positive variation of the aggregate total output (policy target variable).

Lastly, in chapter four a contribution will be presented which was developed during the three years in the context of the Eureka project, in collaboration with ICA Group company. In particular, the internationalization process in China for a family owned enterprise will be analyzed, producing green products in a traditional polluting sector (coatings). The prospect of analysis will be to outline how a focused strategy towards sustainable development in China today represents a fertile ground for the achievement of competitive advantages.

Chapter 1

GREEN GROW AND SUSTAINABLE DEVELOPMENT FOR CHINA: THE NEW CHALLENGES

China's double-digit economic growth rate of the past three decades has brought with it economic, social and environmental problems. In addition, to fostering a profound restructuring of the Chinese economy, these problems are at the core of the country's shift in domestic action against climate change. Arguably, they have also motivated, at least in part, China's uptake of a prominent role in international climate negotiations. This chapter will discuss the China's policies strategies on order to reach a sustainable development considering the economic, social and environmental dimensions. After a brief introduction of the new China's Government policies for sustainable development, in the first section it will be present an analysis the most important problem in term of environmental issues and and the main measures taken by the Government in the last years. In second section, it will present a focus on the evironmental programmes for promote the environmental sustainability and the strategy to reduce the carbon dependence.

1.1 China: the new approaches to sustainable development

China's environmentally sustainable development challenge is arguably the most complex and difficult that any country has ever tried to confront. Over the past 30 years, since the modern period of economic reform began, the two most defining features of the development agenda have been persistent, rapid, and relentless economic growth accompanied by equally significant, even radical, economic and social changes.

Nowadays, China is facing a profound transition, which is transforming it into an advanced economy, based on consumptions, services and innovation. The transformation path is crucial and it's no more possible to postpone, for reviving Chinese industrial structure, which cannot longer be based on low labor costs and State intervention. We therefore find ourselves in a phase called by the Chinese authorities themselves "New Normal" (Yao, 2014). The new course of the Chinese economy is due to the recognition that a double figures growth model that has characterized China since the 80s is no longer possible. When Chinese Government now sets its economic growth target, this is no longer an aspirational bottom line, it is the

ceiling. While a 8 percent GDP growth target was overshot consistently during the past, a 7.5 percent, perhaps 7 percent, should be seen as the higher end of an expected range going forward (The Oxford Institute for Energy Studies, 2015).

The “amounts” and “quantities” have to be substituted by the “quality”. For these reasons the New Normal is characterized by (Bin and Zhenyu, 2014):

- the reduced GDP growth rate: the objective of Thirteenth five-year plan is to keep an average growth rate of 6.5% until 2020;
- Quality Growth: a more sustainable growth and based on the most technologically advanced products;
- Less public investment: investments made by public, as a result of the economic crisis in 2008-2009, have generated a crisis overcapacity and fed the debt;
- Less exports: the decline in external demand and its volatility are forcing China to find sources more solid for the consumer demand;
- More domestic consumption: the development of domestic consumption will replace the decline in foreign demand;
- More services: China is expanding the share of services, which is representing, today, the main growth driver.

Another key aspect regards the demographic growth and the challenges that the country will face in the future. According to data published by the National Chinese statistics February, 2016, the total population reached just over 1.373 million at the end of 2015, an increase of about 6 million over the previous year (+ 0.41%) (NBS, 2016). Although China's population remains the largest in the world, China has to cope with a rapidly aging process, due to an improvement of people's living style, the availability of better health services, and level (artificially) low fertility.

Taking in account what mentioned above, by 2030, China will account for over a fourth of the world's elderly population. Population aging is significantly affecting on the entire system, with negative socio-economic implications and many tensions. The pension social system is under pressure from the beginning of the 2009, with some difficulties in meeting the citizens’ demands.

China, after the decision of the State Council, has accelerated the development of strategic emerging sectors of industries. In particular, in 2010, it was taken the decision to assist priority industrial sectors with a big level of knowledge, the so-called "Seven pillar industries". These are: energy savings; environmental protection; new generation information

technology; biotechnology; advanced machinery; alternative energy; environmentally friendly vehicles (Fondazione Italia-Cina, 2016). Considering this, for policy makers in China, the development of a green economy and technology presents opportunities and challenges not only for the central government, but also for provincial and city governments. The rationales behind the transition to a green economy are driven by environmental, economic, and social considerations. Rapid economic development, urbanization and industrialization has left the country with a heavy environmental toll, which includes deteriorated air quality due to coal burning and other industrial pollutions, surging greenhouse gas emissions from fossil fuel consumptions, degrading water quality and resources, worsening rural environments and land-based ecosystems. The concentration of both air and water pollutants are among the highest in the world, causing damage to human health and lost agricultural productivity. The Chinese government has increasingly recognized the transition towards a green economy as a long-term strategy, to boost its economic growth along a sustainable path and protect its environment from further deterioration (Pan et all, 2011). This industrial and energy transition is evidenced by China's adoption of energy and economic policies in recent years. As the largest developing country in the world, China has always placed development as the first priority.

A first draft of a National Sustainable Development strategy was included in the China's Agenda 21, completed in 1993, not long after United Nations Conference on the Environment and Development held in Rio de Janeiro (UNCED,1993). China's Agenda 21 contained development strategies and policies, divided in four main sections:

- Overall strategies for sustainable development;
- Aspects of the sustainable development society;
- Sustainable development of the economy;
- Protection of resources and the environment.

The 11th Five-Year Plan (2006-2010) specifically addressed energy efficiency and infrastructure improvements as key goals, while the 12th Five-Year Plan (2011-2015) addressed environmentally sustainable economic growth as an important aspect of development (Zhou, 2013). The 13th Five-Year Plan (2016-2020) was reviewed and approved by the Fourth Session of the 12th National People's Congress in March 2016, defining the development concept featuring innovative, coordinated, green, open, and shared development.

In the coming years, China will pursue innovative development and improve the quality and efficiency. The green development will be pursued by promoting a green and low-carbon development model and lifestyle, protecting the ecological system. Great efforts are needed to deepen opening-up, thus realizing win-win cooperation. Shared development will be facilitated to improve people's wellbeing (NATIONAL PEOPLE CONGRESS OF CHINA, 2016).

In September 2015, Xi Jinping, President of China, attended the United Nations Sustainable Development Summit and joined other leaders in endorsing the 2030 Agenda for Sustainable Development, providing guidance to national development of member states and international development cooperation in the next 15 years. (The World Bank 2013) China suggested that nine strategical areas should be prioritized in the implementation of the 2030 Agenda. These areas are (UN, 2015):

1. Eradicating poverty and hunger through targeted measures to alleviate and eliminate poverty and enhancing agricultural production capacities and food security;
2. Implementing innovation-driven development strategies and generating momentum for sustainable, healthy and stable economic growth;
3. Advancing industrialization to inject impetus to coordinated development between urban and rural areas and among the three dimensions of sustainable development;
4. Improving social security and social services to ensure equal access to basic public services;
5. Safeguarding equity and social justice to improve people's well-being and promoting all-around human development;
6. Protecting the environment and building protective barriers for eco-security;
7. Addressing climate change actively and integrating climate change response into national development strategies;
8. Promoting efficient utilization of resources and sustainable energy;
9. Improving national governance and ensuring economic and social development in line with the rule of law;

The exhaustion of China's old economic model based on investment and manufacturing has had, at least, one positive outcome: a 'new normal' development pathway that is less energy and emissions intensive. Although much remains to be done by China (and others) to set the world on a climate-bearable path, China's efforts are significant and its ratification of the Paris Agreement ahead of the G-20 (as explained in following 1.5 section)

1.2 The Chinese natural resources context and issues

China's economy has grown rapidly since the country entered the reform path in 1978 and, particularly, since the industrial expansion started in the mid-1980s. Over the last decade, a huge economic progress has been made, whereas various issues have been emerged. Two of the biggest issues among the other are the limited strategic resources and the environmental degradation.

The resources demand has been exponentially mounting, which has caused various environmental problems. China will experience further stresses on the resource availability and environmental sustainability unless a "sustainable" development mode is achieved.

In the recent decades, China is experiencing a rapid economic growth, industrialization and urbanization. Since 1978, China has witnessed an average annual economic growth rate of 9.7% (OEDC Economic Survey, 2015). Large progresses have been made in political, cultural and social reforms and remarkable achievements in its modernization. Meanwhile, rapid economic growth and social transformation have caused some challenges, for example, low efficient utilization of energy and resources, air pollution, water scarcity and pollution, severe ecological degradation, climate changes, as well as social fairness and rural development.

There is little doubt that China is committed to sustain economic growth. However, in the past decades, the rapid economic growth has been criticized as unsustainable as it does not fully take into account the social and environmental costs. In fact, it is well known that the rapid economic progress of the last thirty years has been combined with the deterioration of the environmental situation in China. This impact is already evident. According to the World Bank, China has 16 of the world's 20 most polluted cities, with four of the worst in the main coal producing province of Shanxi (The World Bank, 2007). In 2005, only 31% of Chinese cities met national air quality standards and more than 75% of water in rivers in China's urban areas cannot be used for drinking or fishing (Economy, 2007). The growing resources demand has been mounting, which has caused various environmental issues.

The conflicts between environment and development are becoming ever more prominent. Relative shortage of resources, a fragile ecological environment and insufficient environmental capacity are critical problems hindering the future development.

Considerable environmental effects have occurred owing to the major efforts on the issues of conservation and clean-up in recent years. The Chinese government attaches great

importance to environmental protection, which is believed to have a direct impact on the overall situation of the modernization and long-term sustainable development. Due to these efforts, although the amount of resource consumption and pollutants is increasing greatly, the trend toward aggravated environmental pollution and ecological destruction is gradually slowing down. However, the overall environmental improvements need more comprehensive and effective measures, such as public awareness, information transparency, enforcement of environmental laws, capacity building of civil institution and the balance between economic development and environmental protection.

1.2.1 Natural resources

Being a vast country, China first of all has rich land resources. National land resources have three main characteristics: variety in type cultivated land, forests, grasslands, deserts, and wetlands); (ii) a predominance of mountains and plateaus over flatlands and basins; and unbalanced distribution, with farmland mainly concentrated in the east, grasslands largely in the west and north, and forests mostly in the far northeast and southwest.

The country's farmland covers 122,400 sq. km, about 10% of its total land area, and is distributed mainly in plain areas in northeast China, north China, the middle and lower reaches of the Yangtze, the Sichuan Basin and the Pearl River Delta. Agriculture is highly developed in these areas, which are major producers of wheat, corn, rice and cash crops. The country has 67,500 sq. km of fresh water lakes, production bases for fish, shrimps and other aquatic products. The hydropower resource ranks first worldwide. It is one of the countries in the world having the most species of wild animals, and has almost all kinds of vegetation found in the Northern Hemisphere. The mineral resources are relatively abundant, with a great variety of minerals. Even so, the key challenge is the limited resources per capita compared with the World average, which probably is a stumbling block for the future development.

1.2.2 Forests

According to the findings of the 8th National Investigation on Forest Resources, the total forest area of the country was 208 milions of hectares, up by 12.23 milions of hectares, forest coverage at 21.63%. The findings of the investigation show that China’s forest resources have entered a stage at which its quantity and quality increased steadily. The most forested

area in the PRC is in the southern region, which accounts for 34% of the total, followed by the southwest and northeast regions, each of which has around 24% of the total. The north and northwest regions each have less than 10% of the total forested area.

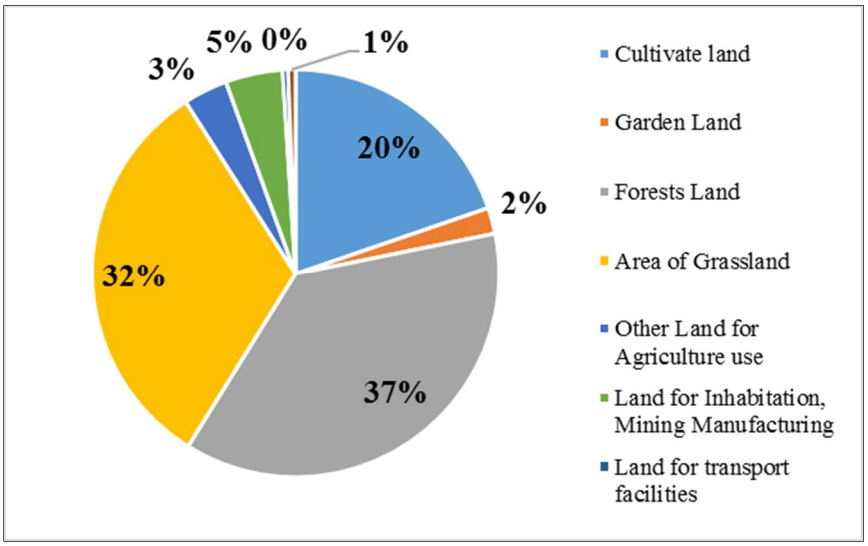
China increased its tree cover by 49 million hectares (121 million acres) over 20 years, from 1990 to 2010. Reforesting 50 to 100 million hectares over just 15 years is a serious undertaking that will require enhanced efforts at rural outreach. Additionally, to deliver sustainable results, it's important that China focuses on well planned reforestation efforts that improve rural livelihoods and ecosystem services, rather than on plantations and monocultures. The total biomass of forests in the country was 17.002 bn. tons, and total carbon reserve reached 8.427 billion tons. There was 580.709 bn. m3 for annual water conservation, 8.191 billion t for annual soil fixation, 430 million tons for annual conservation of nutrients, 38 million tons for annual adsorption of pollutants and 5.845 billion tons for annual dust retention.

In 2014, the authority launched special campaign to crack down on illegal encroachment of woodland, and initiated large-scale and national crackdown campaign of "2014 Net of Heaven Action" and "2014 Sharp Sword Action". The state council issued suggestions on strengthening the prevention and Control of Biological Hazards, which was effectively implemented by relevant departments and the ability of monitoring and early warning, quarantine, prevention and relief of disasters was significantly improved (Ministry of Environmental protection, The People Republic of China, 2014).

1.2.3 Land and degradation

With a total land area of around 9.6 million square kilometers, China is the largest country in Asia and the third largest in the world, next to Russia and Canada. Even so, the arable land amounted to 0.27 hectares per capita in 2005, less than 40% of the world per capita average, one-eighth the U.S. level, and one-half the Indian level. China is facing the challenge of increasing food production while dealing with the problems of desertification, conservation of ecological systems and reforestation.

Figure 1. Land Characteristic



Source: National Bureau of Statistics of China 2015
http://www.stats.gov.cn/tjsj/ndsj/2015/indexeh.htm

Soil erosion affects 19% of China's land area, one of the highest figures for any country. Erosion is especially devastating on the Loess Plateau on the middle stretch of the Yellow River, which is about 70% eroded, and increasingly on the Yangtze River, whose sediment discharge from erosion exceeds the combined discharges of the Nile and Amazon, the world's two longest rivers. By filling up rivers (as well as reservoirs and lakes), sediment has shortened China's navigable river channels by 56% between 1949 and 1990, and has restricted the size of ships that can use them.(Liu, Diamond, 2015).

According to the results of the land-use change survey in 2005, in comparison with 2004, the cultivated land declined by 0.30%, the garden land rose 2.31%, the forestland increased 0.30%, the pastureland dropped by 0.21%, the land for residential and industrial/mining sites went up 1.11%, the land for transport and communications grew up of 3.37% and the land for water conservancy facilities went up of 0.26%. Eight million hectares of farmland were lost over the past decade, and the area of cultivated land fell from around 130 million hectares in 1996 to 122 million hectares in 2005. One-fifth of its cropland has lost since 1949 (Day, 2005).

The MWR estimates that, in 2009, a total of 1.073 billion tons of soil was lost across the country due to water-related soil erosion. Although it is a widespread phenomenon across the country, 85.6% of total soil loss due to water erosion occurs in the Yangtze and Yellow river

watersheds, where the soil losses in 2009 were estimated to be 782 million tons and 137 million tons, respectively.

Several major factors contribute to the land loss. Half of the loss is due to the constructions growth. With accelerated industrialization and urbanization, China's arable land has continued the drop down trend. Furthermore, the central government has promoted a program of restoration of degraded or fragile ecosystems, lower-quality arable lands having been appropriated for forest or grassland replanting efforts. This has been the dominant driver of arable land loss in recent years, accounting for 84.5%, 88.2%, 91.6%, and 87.3% of the annual net losses of the past four years, respectively. Rapidly degrading land quality is exacerbating the arable land availability. About 12.3 million hectares, representing more than 10% of China's total arable land, is contaminated by polluted water, excessive fertilizer, heavy metals and solid wastes.

According to SEPA, every year about 12 million tons of crops are contaminated by heavy metal residues, causing direct economic losses for more than 20 billion RMB (US $2.5 billion). The extent of arable land also decreased - between 1957 and 1990 by an area equal to all the cropland in France, Germany, Denmark and the Netherlands combined. And, most important, arable land pollution is posing a severe threat for the food production (Huang and Rozelle, 1995).

1.3 Environmental issues and management

For the Chinese government, the problem of environmental pollution is one of the priorities in the twelfth five-year plan, in fact, in 2013, investments were made to 951.64 billion of RMB.

In China, pollution is the basic problem among all other environmental problems such as desertification, deforestation, declining water resources, acid rain, soil erosion, air and water pollution, and biodiversity loss and more. It comes directly from domestic sewage, chemical fertilizers and pesticides, motorized boat and cars oil, human and animal wastes, industrial smokes, domestic heaters and industrial batteries. In general, the pollutants are broadly divided into seven types, including contaminated water, polluted air, solid waste, radioactive substances, noise, soil pollution and others (Zhou, 2013). The pollution of air, water and soil, combined with drought and desertification, threaten the welfare of the people influencing the agricultural and industrial production.

Pollution problems have become a key factor probably affecting the national security and social stability. It's well known that many problems that have ever haunted the developed countries during industrialization have occurred in China in the last decades. Nowadays, the main environmental issues, are (MINISTRY OF ENVIROMENTAL PROTECTION, THE PEOPLE'S REPUBLIC OF CHINA, 2014):

- water pollution in several major rivers is serious, as well as the air quality and noise pollution, which have caused a high incidence of diseases;
- the carbon monoxide emissions are mounting rapidly, due to the abuse of fossil fuels, like coal, oil;
- both domestic and hazardous solid wastes are a new concern, directly connected to the economic development and the growth of the urban agglomerated[1].
- soil erosion, desertification and deforestation are strongly affecting the territory.

China's overall environmental pollution is serious and mounting, which has caused negative impacts on both economic growth and public health. A recent study by Greenpeace (Greenpeace, 2014), found widespread and dangerous levels of heavy-metal contamination of rice grown near mines and factories. A Chinese government report regarding the pollution of China's soil was recently released as a result of public pressure, having previously been classified as a state secret. It says that a fifth of China's agricultural land is polluted.

Regarding on this, during the last two winters, China is over once again in the spotlight for the air pollution level achieved in the country, particularly in the city of Beijing and Hebei area, with information considerably higher than the alarm threshold. For this, in the city of Beijing have been promoted plans for the reduction of industrial activity and the use of by government officials' cars, as well as measures to ensure the safety of children and the elderly population, limiting exposure to external environment.

As previously noted, the 12th Chinese FYP (Five-Year Plan) was the first in which the green development theme was introduced. New priorities have been included, making it completely different comparing to previous ones. Main objectives are a more quality development and a controlled growth, that has to be focused on internal consumptions. Sustainability is the key cross concept, on environmental, social, economical and political points of view. A point was made of the need to "construct a resource-conserving and environmentally friendly society". The plan explicitly said that, faced with ever-stronger environmental and resource

[1] Riferimento ad agglomerati urbani

constraints, China must increase its sense of urgency and establish concepts of green and low-carbon development. With a focus on energy-saving and emission-reduction, it must introduce incentives and disincentives to help promote resource conservation and green production and consumption. In particular, the plan is designed to rein in economic growth to some degree, make further efforts to restructure the economy, and pay prominent attention to the issues of the environment and climate change.

Some of the key macroeconomic objectives that will directly impinge on the environmental agenda include (NDRC, 2011):

- GDP growth: An average of 7% per annum;
- Increased service sector growth: Value-added of service sector to increase to 47% of GDP, a 4% increase over 2010;
- Urbanization: Urbanization rate to reach 51.5% by 2015, an increase of 4%.170 The main objectives with direct environmental consequence include:171
- Decrease SO_2 and chemical oxygen demand COD by 8% by 2015;172
- Commence regulating emissions of two new key pollutants (nitrogen oxide [NOx] in air and ammonia nitrogen [NH3–N] in water) and reduce emissions by 10% by 2015;
- Decrease energy intensity of the overall economy by 16% by 2015;
- Increase non-fossil energy as a proportion of primary energy (currently 8.9%) to 11.4%;
- Decrease water intensity of the overall economy by 30%; and • Increase forest coverage to 21.7% and forest stock by 600 million cubic meter (Mm3).

Refering to this, the following sections aims to give a brief overview of the main environmental challenges in China and initiatives of the Government aimed to the resolution of environmental issues.

1.3.1 Air pollution[2]

China's air pollution is regarded as one of the worst in the world, even if the overall air quality has been improving in the recent years. High levels of air pollution are an urgent social and public health challenge in China. Around 1 million premature deaths today can be

[2] Air pollution is an atmospheric phenomenon, mostly observed as haze, which occurs when the concentration of smoke, dust, sulfur compounds, nitrogen oxides and carbon dioxide reaches a level that is harmful to human health or the environment. (Liang, 2010) China uses an Air Quality Index (AQI) to measure air quality, and any reading above 100 is considered pollution.

attributed to outdoor pollution and household air pollution accounts for a further 1.2 million premature deaths. Average life expectancy in China is reduced by almost 25 months because of poor air quality[3]. As a consequence of air pollution, China's population suffers from a high incidence of respiratory diseases (lung cancers, pulmonary heart diseases, bronchitis). A United Nations report of 2015 said that 23,000 respiratory deaths, 13,000 fatal heart disease cases and 15 million cases of bronchitis in China were to be attributed to air pollution that year (UNDP, 2015).

In China, CO_2 emission increases via consumption growth have outweighed emission reduction from energy efficiency improvements since the 1980s. Increases in emissions were mainly driven by large capital investments and increased household expenditure until the early 2000s (Lin and Polenske, 1995; Peters et al., 2007, Zhang et al., 2009, Weber et al., 2008 and Guan et al., 2009) find that exports had become a main cause of the sharp rise in emissions between 2002 and 2005 and were responsible for over half of the increment in emission. Recently, Minx et al. 2011, have found that energy efficiency improvements have largely offset the effect of increased consumption between 2002 and 2007.

Country	Total CO_2 emissions from fuel combustion	Electricity and heat production	Other energy industry own use	Manuf. industries and construction	Transport	Other sectors
People's Rep. of China	**9 087,0**	**4 384,0**	**364,2**	**2 882,0**	**781,4**	**675,4**
Hong Kong, China	47,9	31,7	-	8,0	6,6	1,6
Total China	**9 134,9**	**4 415,7**	**364,2**	**2 890,0**	**787,9**	**677,0**

Table 1. CO2 emissions from fuel combustion by sector in 2014

Source: IEA Statistics,2015

By treating capital investments as an input to production, Minx et al. found that changes in the production structure emerged as a third major emission driver between 2002 and 2007. Structural change has mainly been the result of capital investment, which is responsible for over 60% of the emission growth between 2005 and 2007 (Zhang, 2014).

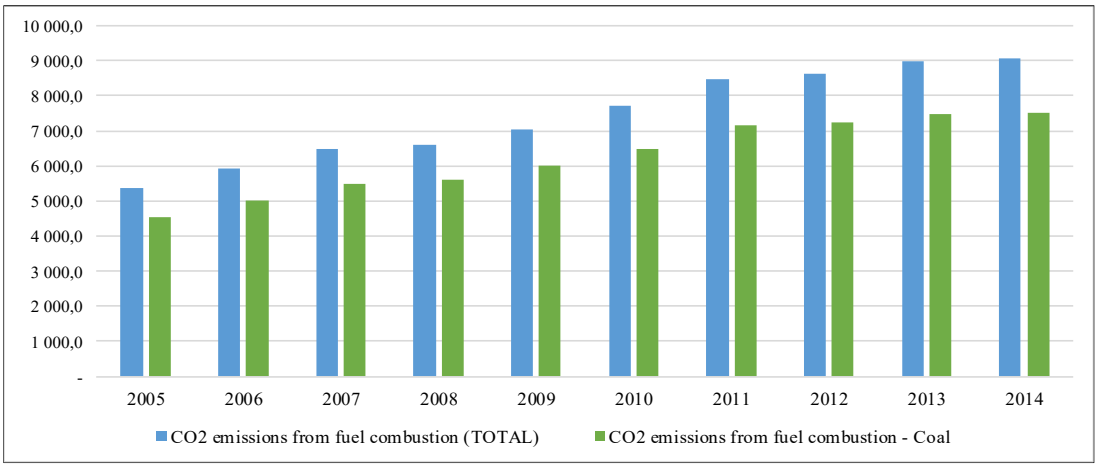
China's air quality has deteriorated rapidly since 2012 as evidenced by the surging number of haze days. There were 35.9 haze days on average in China during 2013, the highest level since 1961. In 2013, among 74 monitored cities, the number of days with very unhealthy or hazardous air quality totaled 677, making 2013 the worst year for air pollution in the past 50

[3] China Medical Association

years. In 2014, out of 161 monitored cities, only 16 reached the national standards of urban air quality, with a pass rate of 10% (4% in 2013).

In the figure 3, there are showed two trend of last ten years of CO_2 Emissions from fuel combustion (both total and the detail from coal)

Figure 2. CO_2 Emissions from fuel combustion -IEA (Mt of CO_2)



Source: IEA CO_2, Emissions from fuel combustion OECD/IEA, Paris 2016

http://www.iea.org/statistic

China's energy-related CO_2 emissions are estimated to have increased by about 150% since 2000 –from around 3300 $MtCO_2$ in 2000 to 8500 MtCO2 in 2013/14 from around 15% of the global total in 2000 to over 25% now (Enerdata, 2015).

According to the International Energy Agency, in 2015 the China's greenhouse gas emissions reduced by 1.5%, the largest decrease in volume in comparison to that of other countries, due especially the decrease in coal as an energy source. However, a newly released (April 2015) study of air pollution sources in nine major cities showed the major sources of pollution are motor vehicles, industrial production, coal, and dust, accounting for 85%-90% of particulate matter (PM) found in the air. (Greenpeace, 2015).

Motor vehicles represent the primary source of pollution in Beijing, Hangzhou, Guangzhou, and Shenzhen, while in Shijiazhuang and Nanjing it is coal, and in Tianjin, Shanghai and Ningbo the primary sources are dust, motor vehicles, and industrial production. China's investment-driven, energy- and resources-heavy growth model means the biggest pollution sources are electricity generation and the production of industrial materials (cement, steel, chemicals, metals and other resources). Power generation, building materials (mainly cement) and steel production are the top three emitters of several key pollutants, including

sulfur dioxide (SO2) as well as nitric oxide and nitrogen dioxide (NOx), and dust. (Smil, 1996).

The most pressing performance is a drastic increase of industrial-based SO_2 emission and soot a direct consequence of air pollution from SO_2 and NO_x is the occurence of acid rains, which remain very serious events in China. Over a half of the sulfur dioxide emissions comes from electric utilities (The World Bank, 2007). Figure 3 and figure 4 shows the anlysis by Chinese regions of these main pollutant emissions in waste gas for 2015 (NBS,2016).

The response of the Chinese government to the air pollution issue, has been intense and broad in scope. Alongside anticipated structural changes in the economy that lead China towards a less energy-intensive model for growth, the implementation of existing and planned air quality and energy policies in the new policies scenario leads to a significant reduction in emissions over the period to 2040: SO_2 emissions fall by almost 30% and NO_X and PM2.5 by around 40%. For SO_2 and PM 2.5, emissions reductions in the industry and transformation sector alone are almost as large as the total amount emitted by the entire energy sector of the United States today.

Efforts to combat air pollution are complemented by policies to reduce fossil fuel use in the energy sector, supporting China's ongoing transition towards a less energy-intensive model for economic growth. At COP21, the Chinese government pledged to increase low-carbon fuel use to 20% of the overall energy mix by 2030 (from around 10% today) and to reduce carbon intensity by 60-65% in 2030, relative to 2005. Finally, following the publication in May 2014 of the new emission standards for boilers coal, is the controls, both intensified industries within residential, doing growing demand for more efficient technologies.

The chances of achieving (or even over-achieving) these targets appear strong: for example, China is investing more in renewable energies than any other country in the world and has adopted stringent energy efficiency standards, in particular in the industry and transport sectors. According to preliminary data, coal use fell in 2015, so did energy-related carbon dioxide (CO_2) emissions, despite Chinese economy is continuing its expansion.

Figure -3 Sulfure Dioxide (SO_2) Emissions dy Region (2015)

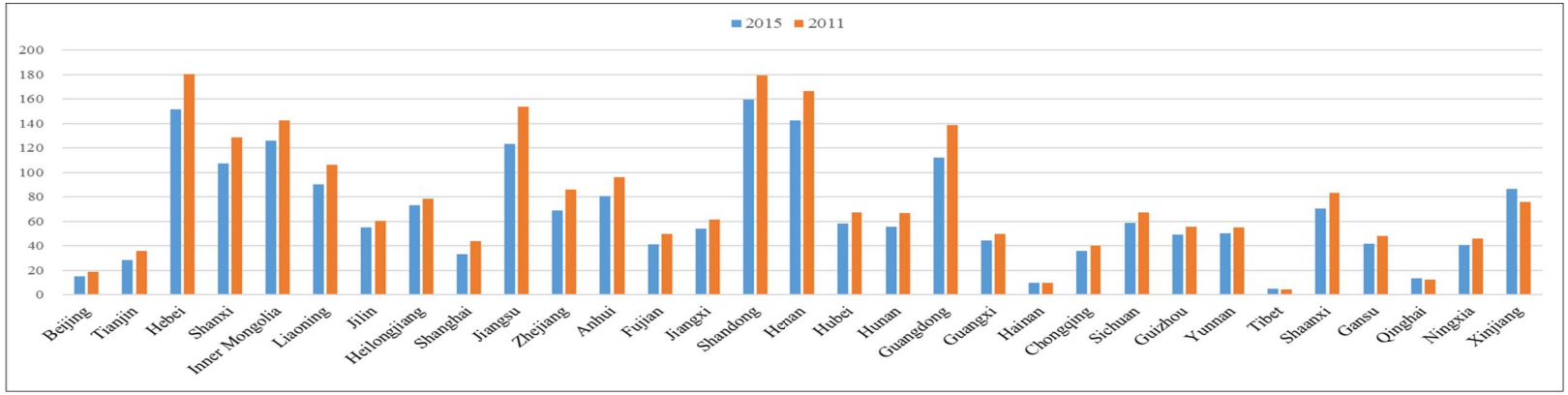
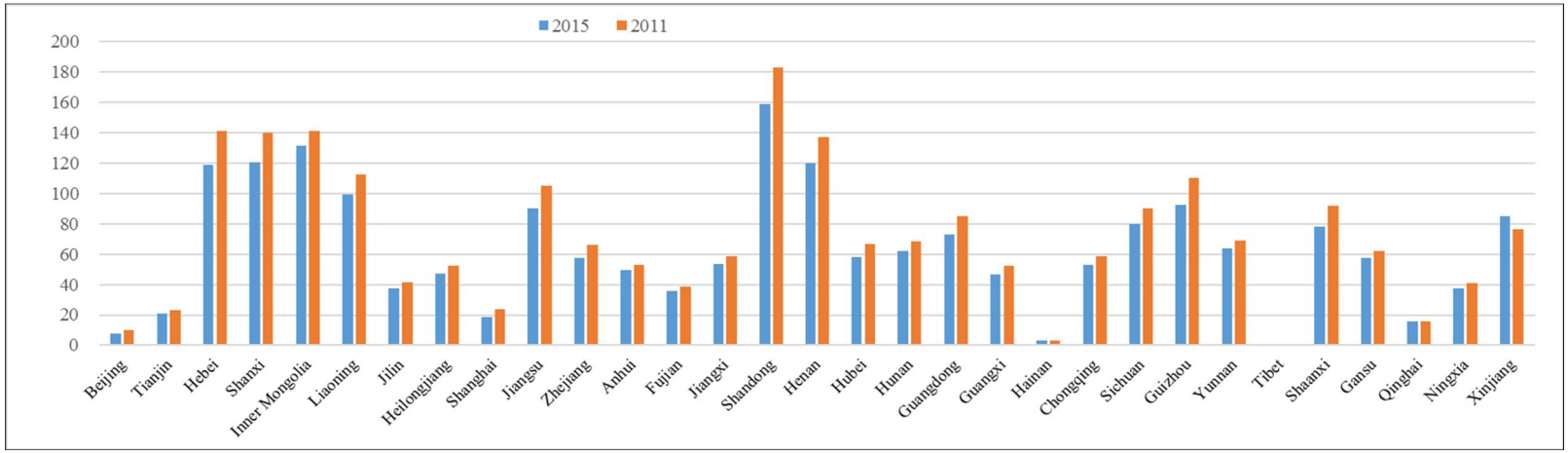


Figure 4 - Nitrogen Oxides (NO_X) Emissions by Region (2015)



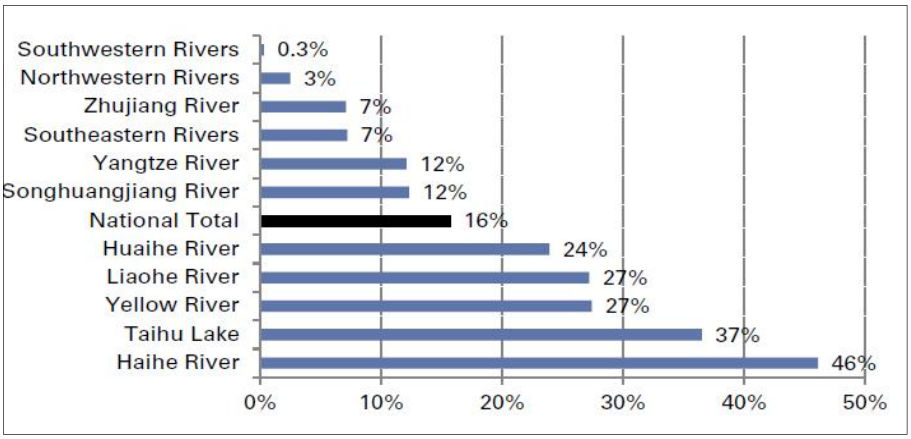
1.3.2 Water pollution

Water has gradually been one of the crucial natural resources to achieve sustainable development in the most populous country. With the rapid development of China's economy, water shortage has become a key factor limit in sustainable development of China's economy at present, but large amount of water has been polluted in China, so water pollution cannot be ignored. According to datat provided by the Ministry of Water Resources, water pollution is very serius in China, and the proportion of water superior to Level III increase from 80% in the 1980 to present (Lu, 2014).

Water samples are classified into one of six water quality grades depending on the concentration of the worst individual pollutant in the sample. The water quality grades defined in the Environmental Water Quality Standard GB3838-2002 are:

- Grade I: water suitable as a drinking water source (i.e., without treatment) and for national level nature reserves;
- Grade II: water suitable for use as a Class A water source for centralized drinking water supply, sanctuaries for rare species of fish, and spawning grounds for fish and crustaceans;
- Grade III: water suitable for use as a Class B water source for centralized drinking water supply, sanctuaries for common species of fish, and for swimming;
- Grade IV: water suitable for use as a general industrial water supply and for recreational use involving no direct human contact with the water; • Grade V—water only suitable for agricultural water supply and general landscaping use; and
- Grade V: water unsuitable for any use.

Figure 5. Chinese rivers by pollution level. % of evaluated length with worse than Grade V water



Source: China Statistical Yearbook on the Environment, 2014

Water classified as grade IV-V is considered unfit for human consumption. According to the MLR, 60% of groundwater in China exceeded level IV in 2014, and, more worryingly, this figure was up five percentage points from 2013.

As of 2014, 67% of the water resources in in China's key river basins was grade I-III and 15.7% was worse than grade V with the Haihe River Basin heavily polluted and the Yellow River, Huaihe River and Liaohe River basins moderately polluted. Eutrophication of lakes and reservoirs remains a serious problem. China began its "three rivers and three lakes" pollution control scheme in 1995 but after a 20-year effort these regions continue to suffer from severe water pollution.

As s result of the rapid deterioration in China's water quality, in recent years about half of China's major environmental pollution-related social protests and unrest have been related to water pollution and contamination. One of this, based on official statistics from a range of government agencies, said that 85% of the length of China's six biggest river systems consisted of water deemed undrinkable even after treatment. The proportion of groundwater that is polluted rose from 37% in 2000 to 60% in 2013. (The Economist, 2014)

Ministry of Environmental Protection (MEP), achieving the objectives set for control water pollution will require the purchase direct products and treatment services over 200 billion euro, and indirect investments for more than 71 billion. In 2014 it was operating 3,622 sewage treatment plants, for a capacity of 153 million meters' cubes/day. However, even in 2015 over 300 cities does not have facilities. Official figures state that 70% of water wastewater is treated before being discharged the environment. However, some experts argue that in the industrial sector the most realistic percentage is around 30%.

A 2014 report of the Ministry of Protection Environmental showed that among the 4,778 stations of the active groundwater monitoring, 43.9% pointed to the water level IV (polluted but usable for industrial purposes) and 15.7% to Level V (polluted, but can be used for irrigation). The same report indicated that the quality ofgroundwater is gradually deteriorated since 2011. The Chinese government has putted effort to tighten rules, limits and controls for the industrial sector, with the publication of "Action Plan for the Prevention of Water "(May 2015) and issuing specific standards for certain sectors, including the tanning, textile finishing and industries that produce batteries.

Local governments should implement the Plan of Action without further elaboration and distinctions of responsibility. Among the planned actions, it highlights the goal of completing the system for collecting waste water in all towns and modernization of wastewater treatment

plants, improving the quality of the main river basins and the implementation of policies for the reduction of water consumption. In addition, among the objectives, shows the will to intervene in the tariff system for the use of water resources and for the assignment of waste water, giving room for the intervention of private investors.

1.3.3 Solid Waste and pollution

Controlling environmental pollution resulting from solid waste (SW) and hazardous waste (HW) has become one of the most pressing tasks in the field of environmental engineering in China. With economic development, the quantity of solid waste is increasing rapidly.

China's soil pollution has been significantly underestimated despite its much broader and more complex impacts on daily life such as the safety of groundwater and heavy metal contamination of agricultural production. More importantly, air pollution can be reduced by simply cutting toxic emissions, while reducing soil pollution requires curbs on pollution as well as a treatment process, which takes more time and demands more investment. However, there is relatively lower awareness of soil pollution among policymakers and the public. For example, the 12th Five-Year Plan only set aside US$4.8 bn to address soil pollution, which is a fraction of the US$277 bn the State Council allocated to alleviate air pollution in 2013-17. Until 2014, China had no official data on the state of contamination of soils; in that year was published a study developed by the Ministry of Environmental Protection (MEP) and Ministry of Land and Resources (MLR) on data collected between 2005 and 2013, which showed that 16.1% of Chinese land is contaminated beyond acceptable levels, while 19.4% of the arable area is severely contaminated with heavy metals.

The Chinese government has determined that 90% of China's arable area is required for the maintenance food security of the country. The remaining contaminated soil, which cannot be used for food production, has been placed under the care of the Government so that measures can be taken for the functional restoration of this land.

Severe soil and water pollution have had a profound impact on China's food supply and safety. MEP estimates that heavy metal contamination affects 12mn tons of grain in China every year, which is enough to feed 24mn people, equal to the population of Australia. In 2013, the discovery of rice tainted with cadmium in Guangdong and Hunan triggered panic buying of Thai rice.

According to the report What a Waste, published in 2012 by the World Bank, China produced 70% of Urban Solid Waste in South-East Asia, with more than 180 million tons per year, as some analysts has grown to over 200 million tons for 2014, and is expected to exceed 230 million tons in 2020.

China's urban population produces 0.5 to 0.75 kg of municipal solid waste per day. The Urban Solid Refusal is primarily disposed of in landfills, which can be more or less operated and developed safely, while the industrial waste, according official data, is primarily reused, and only 25% would be disposed of in landfills. About a 17-18% of Urban Solid Waste is brought for incineration, of which, thanks to the Twelfth Five-Year Plan, a growing share also included an energy recovery Management and treatment of the huge amount of waste generation have enormous domestic and international implications. Inconsistent with the increasing waste production, solid waste treatment is less developed. Furthermore, China is struggling against an undercurrent of imported waste, especially the e-waste. The country, already laden with domestic pollution, is rapidly becoming the planet's largest garbage dump, facing a huge influx of foreign garbage. An informal estimate, cited in an official environmental research report, claims that of the 80% of the world's e-waste that pours into Asia every year, 90% is dumped in China. The mounting E-waste brings new challenges for both technological development and management in terms of Industrial Ecology (or Circular Economy).

1.3.4 Climate Change

The matter of climate change has become the focus of global attention. Climate change has developed in recent years into an area of the major international scientific, political and economic concerns. It is a matter involving both environment and development, but it is ultimately a concern of development. Climate change policy is related to national energy policy, industrial policy, environmental policy and nature conservation policy, and it is also an important component in the country's environmental diplomacy. It has been clearly indicated that most of the global warming observed over the past 50 years was likely induced by the increasing concentrations of greenhouse gases (GHGs), such as carbon dioxide, methane, and nitrous oxide, in consequence of human activities (International Panel on Climate Change IPCC, 2001). In the context of global warming, climate in China has also experienced noticeable changes over the past 100 years which causes precipitation

fluctuation, extreme weather events, sea level rising, mountain glacier retreating, etc. On account of the constraints of resource endowment, China's primary energy mix is dominated by coal CO2 emission intensity of the energy consumption is relatively high. China is already the world's second largest carbon emitter after the United States, and the emissions are increasing rapidly with economic growth and rising energy demand. Emissions have grown by about 80% in 1990- 2007[21], driven heavily by increased consumption of electricity from coal. But measured in per capita terms, China's carbon emissions are only one seventh the U.S. levels in 2004.

While seeking economic growth, China had been controlling energy consumption efficiency and greenhouse gas emissions in accordance with the country's sustainable development to fight climate change and improve the ecological environment. The Chinese government is taking climate change extremely serious though it is not covered in the Kyoto Protocol. On June 4, 2007, China released its first national climate change plan which was prepared by China's National Development and Reform Commission (NDRC,2011), saying it intends to tackle the problem but not at the expense of economic development. With the new climate change strategy and the establishment of a National Leading Group headed by Premier Wen Jiabao, it seems to recognize the critical importance of climate change to both China and other nations. The new strategy underscores the severe environmental and economic risks that China faces and outlines a broad array of government policies that are assisting to moderate the increase of the greenhouse gas emissions. These include restructuring the economy, promoting technology advancement, improving energy efficiency, developing renewable energy, and programs that reduce emissions from industry, agriculture, and forestry. China plans to achieve the objective of about 20% reduction of energy consumption per unit GDP by 2010, and consequently reduce CO2 emission[23].

1.4 Environmental protection-oriented Policies and Programs: an overview

The environmental degradation, in China, has serious natural and social consequences, because it is causing the damage of the Chinese economy, harming people's healt and escalating conflicts between the government and the people. If the Chinese government cannot appropriately handle the environmental issues, the negative consequences could not only damage the Chinese economy and social stability but also harm China's relations with the international community. For these reasons, for the policy makers in China, the green

economy development has presented opportunities and challenges not only for the central government, but also for provincial and City governments.

Over the years, the Chinese Environmental protection system has been strongly affected by the national multilayered governance system. Even so, the initiative launched by China (more intensively starting from the 11th five-year plan) to build a more virtuous environmental protection system in 2016 seems to be returning positive results, in the attempt to reform the entire apparatus on national governance.

China was among the firsts to formulate a national Agenda 21 entitled "China's Agenda 21 - White Paper on China's Population, Environment and Development in the 21st Century", in 1994, soon after the United Nations Conference on Environment and Development. It adopted a series of policies and measures taking into account its specific national circumstances and making a contribution to the mitigation of climate change. China is striving for both feasible policies and effective measures towards sustainable development. The 11th Five-Year Plan (2006-2010) for National Economic and Social Development was released in March 2006. It brings forwards a new development philosophy for China which was implicated by the following two guidelines:

- to build a harmonious society. One of the emphases of the future work is to balance regional development by facilitating development in west and northeast china and the rural regions, regulate income disparities and improve the living standards;
- to achieve steady sustainable development – more focus on "quality" rather than on "quantity" by developing a new development mode. The key points are to foster domestic demand, enforce environmental protection, enhance technology innovation capability and reduce energy and resource consumption.

Moreover, the 11th Five-Year Plan put forwards some environmental targets, such as energy consumption per unit GDP output decreased by 20%, total emission of main pollutants decreased by 10% and comprehensive utilization of industrial solid wastes increasing to 60%. To achieve these goals, both the policy and management strategies and practices were needed.

In fact, in the following Five-Year Plan, the Twelfth (2011 - 2015), the Chinese Government estimated that the green industry (that includes energy efficiency, environmental protection, new energy and clean vehicles) had an incidence of about 8% (around 740 billion euro) on the GDP, while the sector of environmental protection in the strict sense was affecting approximately the 2%, amounting at around 185 billion euro. The objective was to continue

to decrease the energy consumption by an additional 16% within the 2015. The Government has decided for the demolition of the old production plants with high environmental impact and strong energy consumption. It has also invested 1.200 billion of RMB in projects related to energy saving and pollution reduction. It has also forecasted an investment of 5.000 billion of RMB in supporting new energy sources, like hydroelectric, solar, Aeolian, biomass, together with others like nuclear, clean carbon, smart grid, shale gas and natural gas.

The objectives that China has settled, regarding environment, are still valid in the Thirteenth Five-Year Plan (2016-2020). They are really ambitious. The main goal is to obtain the 15% of the total energy need from non-fossil sources (including hydro and nuclear). During the writing of the new Five-Year Plan, the percentage of renewable sources is about the 10% of the total energy consumption.

However, the Chinese banking system has estimated that, during the Thirteenth Five Year Plan (2016 - 2020), the green industry will have a financial requirement of 2.900 billion RMB per year, reaching a total of 14.500 billion, equivalent to more than 2.000 billion the euro, in order to finance investments, including those for environmental protection. From this data, the Chinese government has estimated that will cater for not more than 15% of this financial commitment, and therefore it is necessary to engage and motivate private investment.

Even if the Central Government has put big efforts in environmental matters, the system has still to be properly implemented. First of all, where economic interests and environment are competitors, economic growth is still prevailing. Mainly, this is true where the environmental laws could bring advantages to the citizens, but these are often not applied, mostly because it could mean creating limitations to the industrial activities. There are often personal interests that can create obstacles, too. There are local administrators whose career are strongly related to parameters such as local GDP, FDIs, new jobs creation. They would have no interest in closing polluting factories, because it would mean deleting jobs.

However, for trying to overcome this conflict, Central Government has started to integrate their evaluation systems with environmental and energy efficiency goals, with the objective of calculating a sort of “Green GDP. In November 2007, the government introduced the evaluation mechanisms for government officials with respect to their capacity to contribute to energy efficiency. These criteria not only measure the whole performance of local administrators, but also aim to encourage the officers to achieve specific sub-goals that, when put together, can help to achieve the overall goal of the country. In relation to this, the local policies in China brought an increasingly important role in the reduction of pollution and

projects for the intensive energy use (examples of this can be represented by the petrochemical industry and the chemical pharmaceuticals). However, the environmental policy management system remains complex. Economic and environmental interests could be in conflict, and where economic and environmental interests are competing, economic growth still tends to prevail on the environment. This is especially true when referring to environmental regulations which could bring huge benefits to citizens, but that would involve limits to industrial activity.

If firms/entrepreneurs find themselves in a situation in which they could choose to switch from a profitable traditional business and move to a new but uncertain one, they may choose not to do so, unless the government would provide some sort of incentives that can help the entrepreneurs to reduce uncertainty in switching from traditional business to environmental one.

Starting from 2015, a series of new reforms have been designed and implemented, with the task of defining the conditions and development strategies of the environmental protection market. On one side, they have been defined limits and increasingly stringent environmental objectives, on the other they have been redefined rules for the involvement of private individuals. In January 2015, thus came into force a new review of environmental law of the 2011, in which there is the introduction of:

- new sanctions system on a continuative basis: before this review, the sanction for the companies was “una tantum”, and the amount was limited. After this review, the sanction is continuous, on a daily basis, without any limitations;
- evaluation of the environment impacts: evaluation of the impact on projects of every economical operator, but also on plans and policies realized by central and local authorities;
- the formalization of the right to solve the litigations of public interest: every association in charge of representing the civil society can sue during litigations related to environment protection.

This law shows how both the Central Government and the local authorities are trying to be stricter on their approach on environment protection. However, there are still some problems related to the application of this law. In fact, the local offices for environment protection are subordinated to local government authorities, and this can cause a conflict of interest, because the local authorities will tend to influence the environment protection offices. This can happen because of a not clear separation and the balance of powers (Monti, 2016).

More laws were introduced during 2015: in March 2015, the Action Plan for water pollution prevention, in June the reform of the Public Utility Concessions, in September the "Integrated Reform Plan for the Promotion of ecological progress", in December the drafts of the Thirteenth Five Year Plan and the national scheme for the issuance of Green Bonds, who put the accelerator on investments for environmental protection and for the development of circular economy according models, creating an unprecedented market space and projecting China at the helm of the world's green finance.

During the Twelfth Five-Year Plan, the Government tried to implement a new approach, under the form of incentive approach. This policy has been named "Carrot and Stick" (Haitiao et al, 2016).

The “Carrot” means that companies would receive positive incentives, for rewarding their effort in developing environmental industries. The “Stick” points to negative incentives, penalizing companies that hinge upon environmentally questionable industries. Both the policies related to positive and negative incentives could be applied on supply or demand side.

Main examples of positive incentives that could be given to virtuous industries could be subsidies given to environmental industries, to the ones that reach government purchasing requirements, to the ones that use the eco-labels. In particular, the purpose of the eco-label is to remove the information asymmetry between companies and consumers. The China Environment Labeling Product Certification Committee was formally established to implement an eco-label system, for giving authentication to procedures conducted in strict accordance with the international standards (for example ISO14020, ISO14021 and ISO 14024). The eco-label method has a great potential for firms, because if more and more consumers follow Eco-labels and choose to buy products that are good for the environment, incentives would be directly created by millions of buyers, consciously choosing products of environmentally friendly firms, and pushing the industries to strive for cleaner production or developing more environmentally friendly products.

On the other side, negative incentives to companies whose operations are harmful for the environment could create spaces or motivation for developing environmental industries. The main negative incentive applied by the Central Government (since the early 1980s) is the charging of a pollution fee. It has been applied, for instance, to fossil fuel power plants for discharging SO_2. In a case like this, there could be a double benefit for the environment:

giving renewable power generators a competitive advantage and stimulating the demand for desulfurization equipment and services.

In any case, in the 2003 a uniform standard for pollution fee was created, the "Regulations for Levy Standard on Pollution Discharge". It established that the governments at the level of county or above shall charge polluters for discharging waste water, waste gas, waste solid material and hazardous waste, or excessive noise, based on the pollution types and amounts. Then, in 2014, the Government decided to overhaul the regulation, better specifying the content and increasing the previous levels of the pollution fee, for enhancing a less tolerant attitude of government on environmental contamination. (Haitiao et al, 2016)

While the "Carrot and Stick" policy was a sort of cornerstone for the improvement of the environmental issues into the Twelfth five years Plan, President Xi Jinping's will have been to add a structural action to the already existent policies.

China is a unitary state, but local provinces and authorities have got ample autonomy, and they are allowed to implement plans that are different, uneven and unverifiable for the Central Government. All this autonomy, also for environmental matters, caused an escalation in infrastructure's construction, financed by bank loans, bringing several local administrations near to the default.

For this reason, in 2015, President Xi Jinping decided to make a complex of reforms of the local administrations. Without influencing their operative autonomy, the Central Government decided to put limits on the discretion capacity of local authorities and to establish a system of control, check and coordination with Central Government, citizens and potential investors. The Central Government directives are articulated in: national laws (set of general rules that dictate the conditions of maximum management environmental); Guobiao standards (define the technical parameters of environmental quality, the limits emission and the arrangements for monitoring); Action Plans (define the operational objectives to where local authorities should strive for). (Fondazione Italia-Cina, 2016)

1.4.1 The New Environmental Law

With the amendment of the Constitution of the People's Republic of China of 1978, the National People's Republic of China of 1978, the National People's Congress added the art 26 in which declares "The state protects and improves the living environment and the ecological environment and prevents and remedies pollution and the other public hazard". This principle, that represents the higher expressions of China's will to solve the

environmental issues, other than the real starting point and the legal basis for an environmental protection legal framework (Monti, 2016).

At the beginning of 2016 the Standing Committee of the National People's Congress, approved more than 30 laws about environmental protection, as well as further legal interventions in relevant laws and regulation which also provide new contents strictly linked to environmental protection. (Environmental Protection Law, PRC, 2014).

In January 2016, a revision of the Environmental law was made, introducing five key points:

- responsibilities' increases for subjects that pollute: higher fines, company closure who fail to adequate to law and commitment of publishing documents on Environmental Impacts;
- responsibilities' increases for public authorities and public subjects, that will be evaluated on the performances of the territories they are administrating, and could be punished for lacks of communication or surveillance omissions;
- increasing in communication to the public, mainly related to releasing more information to the public;
- legal actions for public interests;
- protection for people who advise about environmental violations.

For the first time, even with some limitations, the population is involved as an active subject for surveillance actions, both against public subjects and industries. It has also been established that, if a public official is violating the laws and the local public authority would not take actions, a public administration of a higher level could intervene and take measures. The Public administration could only waive the Guobiao standards by introducing more restrictive parameters, but only after communicating it to the Central Government.

The environmental law defines a more severe scenario compared to the previous one, both against public administration and industries, but at the same time it does not define the rules for the development of the environmental market. Also for this reason, the "Law Enforcement" action has been initially mild, waiting for the application of the successive reforms, but the prevision for throughout the 2016 is to assist to an even more severe scenario.

1.4.2 Public Utilities Reform

In June 2015, the Government reformed the concession of public utilities. (Fondazione Italia-Cina, 2016) This reform is the main instrument for moving direct investments from local

administration to private investors. Since the end of 2014, it was put a maximum limit to the amount of debts local administration could have. These could not incur any more debt for financing infrastructures, such as highways, purifying plants, treatment plants, etc. It was also prohibited to issue bonds, without the Central Government's approval. So if local administration would need to realize new infrastructures, they do have two options: have availability of financial liquidity, or they have to ask for a partnership with private subjects. Strategic sectors have been added, in this reform, to the ones in which a public/private partnership could be implemented. These are (Fondazione Italia-Cina, 2016):

- Energy;
- Transportation;
- Hydro resources;
- Environmental protection;
- Urban public works.

The reform allows foreign investors to make this partnership too, even if this foreign subjects have to create a local-based organization. Both for local and for foreign investors, there are the traditional partnership models available, such as Bot (Build-Operate-Transfer), Boot (Build-Own-Operate-Transfer), e Bto (Build-Transfer-Operate). There is also the possibility to make different proposals in terms of models and duration.

The local administration can impose rates to final users, and the Central Government gives a public capital in guarantee of the eventual lack of financial resources by the private counterpart. Other forms of funding are possible, like equity funds, obligations, guarantees and special loans.

1.4.3 Integrated reform plan for the promotion of the green progress

The 21st of September, 2015, the Central Committee of the Chinese Communist Party and the State Council published the "Integrated reform plan for the promotion of the green progress". This is a sort of directive document with the aim of a legislative reorganization and deepening, setting objectives that the administration, at every level, must reach within the year 2020. The main goal is to create a well-organized system, related to property rights, resource utilization, market mechanisms, assessment of environmental damages, identification of subjects responsible of it, rate definition for resources management and pollution.

What it's extremely important is that finally a national organic vision is set up. It means that there is the establishment of a unique system of territory management in terms of planning and fighting against local administration inefficiencies. (Fondazione Italia-Cina, 2016)

1.4.4 National method of issuing of the Green Bonds

Central Chinese Government has made a financial requirement estimation for the years 2016-2020 of 2 thousand Billion of Euro for addressing environmental issues and climate change. Public investment alone is not sufficient to meet this investment requirement, because public funds would give a maximum contribution of 10-15% of the required investment. For this reason, China is looking for financial capitals, and the private sector is expected to be the largest source of capital for this "green transition" (People's Bank of China, 2016). International investors could provide an important capital source, facilitated by the recent improved opening of the interbank market to foreign institutional investors.

Until 2015, bank loan was the main source for green projects, says the Association of China Banks. The 21 biggest banks gave loans, in 2014, for more than 6 billion of RMB for green projects, that is the 10% of the total amount of given loans. The Prime Lending Rate, that is the average interest rate of the three biggest Chinese banks, has gradually decreased from 6% to 4,35% (World Resource Institute, 2016). However, the Chinese Government has decided to look for cheaper financial funding than the bank loans, trying to involve private capital, national or international. Then, the Government has proposed the issuing of the "Green Bonds". These, (also known as Climate Bonds) are a new asset class that is receiving increasing attention over the past two years. It is often seen as a financial instrument that may help overcome the low-carbon investment challenge. At the end of December 2015, Bank of China and the Green Finance Committee of China Society of Finance and Banking have issued the guidelines for the Green Bonds, and a list of projects supported by these Green Bonds. Six main themes have been identified (Fondazione Italia-Cina, 2016):

- Energy efficiency;
- Prevention and control of the pollution;
- Conservation and recycling of resources;
- Clean transportations;
- Clean energy and ecological protection;
- Adjustment to the climate change.

The issuing rules are quite different from that from the Climate Bonds Initiative, because they also include projects about energy efficiency in using fossil fuels (coal and oil). This allow to extend the reference environment and to become more attractive for the international investors (Reichelt, 2010).

Labelled green bonds are increasingly considered an ideal vehicle for tapping into private sector capital. The proceeds of these bonds are used for green assets and projects and are labelled accordingly (mostly climate change mitigation and adaptation projects). Proceeds can be allocated to new projects or for refinancing existing green projects, or a mix of both. Green bond investors equally accept both. Globally, the green bond market has grown rapidly, from USD 11 billion (RMB 72.4 billion) of issuance in 2013, to USD 36.8 billion (RMB 242 billion) in 2014 and USD 41.8 billion (RMB 275 billion) in 2015. The growth in green bonds is expected to continue. SEB estimates that global green bond issuance will grow to USD 80 billion-USD 100 billion (RMB 362 billion-RMB 526 billion) in 2016. China is seen as a leading source of green bond market growth going forward (Climate Bond Initiative, IISD, 2016).

The Green Bond market unlocks a number of benefits by increasing the transparency of the information available to investors on underlying assets and companies. Green Bonds can help investors implement their long-term climate strategies and enable responsible investors to have alternatives to broaden their savings portfolios. In turn, Green Bonds can help bond issuers to communicate their sustainability strategies, reate internal synergies between financial and sustainability departments, and expand and improve relationships of borrowers with debt providers. Finally, green bonds can support the implementation of national climate policies – through improved awareness and more efficient capital allocation, especially in the perspective of redirecting capital towards low-carbon and climate resilient projects.

While these benefits alone may justify the existence of the green bond market, its tangible contribution to the low-carbon transition has so far been limited. Most notably, the green bond market does not appear to directly stimulate a net increase in green investments – or the financing and refinance of low-carbon projects – through a lower cost of capital. Moreover, the spontaneous bottom-up manner of the development of green bonds raises reputational and legal risks related to environmental integrity, which increasingly threaten the very survival of this nascent market. In order to realize its potential, the green bond market will therefore have to overcome two main challenges. First, it has to avoid implosion – due to the lack of investor confidence – by ensuring the environmental integrity of green bonds.

Second, the impact of green bonds needs to be enhanced by growing the pipeline of underlying low carbon projects and potentially bringing them tangible financial benefits (Baeumler, Ijjasz-Vasquez, Mehndiratta, 2012).

1.5 China's energy transition: pathways for low carbon development

"Low carbon" is mentioned explicitly in UNEP's definition of green economy, but not in the definitions of green growth by OECD or the World Bank. However, both the OECD and the World Bank reports recognize that climate change is a crucial part of environmental sustainability and that low-carbon development is part of the green growth agenda. Low carbon is featured much more prominently in the green growth reports by UNESCAP and KOICA (2012) and by ADB and ADBI (2013). These two reports use the term "low-carbon green growth" instead of green growth only. For example, ADB and ADBI state that "low-carbon green growth is an avenue toward development that decouples economic growth from carbon emissions, pollution, and resource use, and promotes growth through the creation of new environment-friendly products, industries, and business models that also improve quality of life.

China has made significant strides in decoupling energy use and emissions from economic growth—as of 2014 China was on track to exceed its 2015 energy and carbon intensity reduction targets. Three key trends have emerged (World Institute Resources, 2016):

- Rebalancing the Economy: China's leaders clearly intend to shift the impetus of the economy away from investment in heavy industry and toward consumer spending, services (such as retail businesses), innovation, and more innovative and efficient manufacturing. Under China's 12th Five-Year Plan, services moved from 43 percent of the economy in 2010 to 51 percent last year, replacing manufacturing (which went from 47 percent to 41 percent of the economy) as the largest contributor to China's GDP. Services continue to grow at a faster pace than manufacturing.
- Limiting Coal: After years of steep growth in coal consumption, regional coal and carbon limits and new-coal-plant bans have been followed by a leveling off of coal use in 2014 and reduced output in heavy industries like steel (down 2 percent last year) and cement (down 6 percent). A continued shift away from these energy-intensive industries would weaken a major driver of air pollution and greenhouse gas emissions.

- Non-Fossil Energy: China is the world leader in renewable energy, breaking records last year for installation of wind (32 gigawatts last year, 129 total) and solar power capacity (18 gigawatts last year, 43 total), and clean energy investment ($111 billion, nearly double U.S. investment).

China is the second largest energy consumer and the first electricity consumer in the world, and it is, in fact, rapidly improving its energy efficiency. (IEA,2016) Energy efficiency and demand-side management, doing more with less quantity, reducing energy consumption by substituting fuels and technologies and altering consumer behavior, is clearly the most environmentally benign way to address increases in demand for energy services. Energy efficiency can include practices as diverse as switching from conventional coal power plants to combined heat and power units, lowering thermostats, better maintaining industrial boilers, and walking or cycling instead of driving. These actions not only involve very little damage to the environment, they can be cost effective as long as they are strategically implemented to avoid the rebound effect.

The Chinese government has a variety of new plans that include targets for the energy sector. The most important ones for that matter are the Strategic Energy Action Plan (SEAP), the National 13th FYP and the Energy 13th FYP, the two-latter valid for the years 2016-2020. During the negotiations behind those plans it became clear that the Energy 13th FYP got stricter in terms of renewable energy expansion. Table 1 depicts the clean energy targets (renewables plus nuclear) of China for 2020 according to different planning regimes.

The industry and transformation sector is the largest energy consumer in China, with more than two-thirds of its energy demand based on coal and oil. This sector is also by some distance the largest contributor to the emissions of air pollutants. It emits more SO_2 and NO_X than any other sector, and is the second-largest contributor to PM2.5 emissions, after the buildings sector. Given the size of the sector, pollutant emissions from Chinese industry make up around 40% of SO_2 and about one-third of NO_X and PM2.5 emissions attributable to the industry and transformation sector worldwide. There is no shortage of regulation for the industry and transformation sector in China, but there are more than 70 million well-scattered small- and medium-size enterprises in the country, making enforcement challenging.

The 12th Five-Year Plan prioritized measures for industries that are highly energy and resource intensive, with the aim of eliminating outdated or inefficient production capacity in 21 key industries, including steel, cement, electrolytic aluminium and flat glass. The creation of new capacity in energy-intensive industries is strictly controlled, and where projects are

newly built, modified or expanded, a similar or higher amount of outdated or excess production capacity must generally be eliminated. In 2015, in a period of further slowdown economic development, energy consumption in China grew by only 0.5% (a slowdown, if compared to 2.2% in 2014 and 3.9% in 2013), while electricity consumption grew by 3.8% (growth halved, compared to 2013). The value added to the production of the utilities sector, which includes electricity, thermal power, gas and water grew 3.2% in 2014. Coal consumption has reduced by 2.9%, that of oil grew by 5.9%, that of natural gas 8.6%. The coal consumption represented two thirds of the production and the total energy consumption, while the clean energies (including natural gas and nuclear energy) accounted 16.9%. The service sector consumed 7.32% of electricity more than the previous year. The industrial sector saw a decline of 2.37%, while the agricultural sector recorded a growth 0.65% of consumption. (IEA, 2015)

These data further confirm the change in Chinese structure and economic difficulties the manufacturing sector. However, the Energy consumption continued its downward trend, a decrease compared to 2014 of 5.38%, indicating an acceleration of energy efficiency. At the end of the Twelfth Plan Five-Year, the reduction in the Energy consumption in China has exceeded the set target, thanks to a drop of 18.2% energy consumption, which has even reached 20% in the case of use of coal.

The year 2015 was a milestone for climate action, with the negotiation, at the 21st Conference of the Parties (COP21) in December, of the Paris Agreement on climate change. The Paris Agreement is the first international climate agreement extending obligations to all countries, both developed and developing ones. With the energy sector accounting for approximately two-thirds of global GHG emissions, taking action in the energy sector can make or break efforts to achieve global climate goals. Traditionally, industrialized countries have emitted the large majority of anthropogenic greenhouse gases (GHGs). More recently, shares of developing country emissions surpassed those of industrialized countries, and have kept rising very rapidly. To shift towards a low-carbon world, mitigation efforts must occur across all countries: decarbonizing the energy supplies of industrialized countries, and shifting developing countries onto a low-carbon development path. At COP21, the Chinese government pledged to increase low-carbon fuel use to 20% of the overall energy mix by 2030 (from around 10% today) and to reduce carbon intensity by 60-65% in 2030, relative to 2005. The chances of achieving (or even over-achieving) these targets appear strong: for example, China is investing more in renewable energies than any other country in the world

and has adopted stringent energy efficiency standards, in particular in the industry and transport sectors. According to preliminary data, coal use fell down in 2015, and so did energy-related carbon dioxide (CO2) emissions, despite the economic expansion is still continuing.

In line with the Twelfth Five-Year Plan, China is placing more emphasis on development renewable energy. The objectives were retouched up, and the current one – strongly ambitious, and far from easy to achieve - is that renewable sources should come to deliver up 18% of the total national demand by 2020. This is justified by the need the country have to meet a growing demand, driven by economic development and urbanization, as well as by the awareness of not to rely solely on fossil fuels (

CHAPTER 2

INTRODUCTION TO MULTISECTORAL ANALYSIS: THE CONSTRUCTION OF SOCIAL ACCOUNTING MATRIX FOR CHINA FOR THE YEAR 2011

This chapter reviews a number of studies in multisectoral analysis and presents the Social Accounting Matrix for China that will be used as empirical counterpart of the multisectoral model introduced in the subsequent chapter. After a short outline of the history of multisectoral analysis, it will propose a brief introduction about some extensions of environmental accounting. Consider this, it will be analyzed the main features of SAM and the key reasons that led to consider the choice of SAM construction. In particular, following the objective of this chapter is to present the data-set for the year 2011, it will show the various steps of construction of it and the crucial role of the Chinese data-sources. The main thread that connects the work presented in this chapter is the interpretation of the economic activity as a circular process, where it is described in a coherent manner the various channels through which production is linked with income distribution, consumption, savings, investment and foreign trade. The China's SAM for 2011 presented in this chapter is an original contribution prepared for this work.

2.1 From Input output table to Social Accounting Matrix

Half a century after King's estimate, Francois Quesnay, influenced by the work of Cantillon, developed a model of the interdependencies of the economic system. Although he started dealing with economics in 1756, when he was sixty-two, his main publication, the "Tableau Economique" (Quesnay, 1972) is considered one of the milestone of economic thought (Gilibert, 1977). The Tableau Economique describes the monetary transactions that take place in the economy when the income produced in agriculture (in Quesnay's thought net product arises only if agriculture is expended by the proprietary class and redistributed among the other social classes). It was a first attempt to systematically map the relationships among groups of economic agents. The key concept of the Tableau Economique is the idea that the economic activity is a circular process. Like Petty and King, Quesnay drew from its work political and fiscal conclusions concerning mainly reforms of taxation and protectionist trade distortions.

Leontief (1936) complained about the fact that, although the concept of general interdependencies had become popular, all the work done in the field was not different from the simplistic numerical examples adopted by Quesnay to reveal the functioning of the economic system. To overcome this shortcoming, he made “an attempt to construct, on the basis of available statistical materials, a Tableau Economique of the United States for the year 1919" (Leontief, 1936). The work of 1936 presents an accounting system that records in a table the monetary transactions associated to the flows of commodities and services occurred in the US in 1919.

To each industry is associated an account, whose revenues are recorded by row and costs by column. Given that the costs of an industry are the revenues of another, transactions are recorded only once, while preserving the characteristics of the double entry accounting practice. Furthermore, since the industry accounts are comprehensive of all the transactions occurring in the production sphere, the last columns of the table are assigned to final uses and the last rows of the table are assigned to factor costs, taxes and imports.

Input-output analysis describes the effects on industry output of changes in final demand and is based on the technical assumption that the production process of a given commodity requires a fixed amount of other commodities. Input output analysis views the economic activity as a circular process. Final demand can be satisfied only if a fixed amount of commodities is employed in its production process. In turn, these commodities require a fixed amount of other commodities to be produced. These are only the first two steps of a converging process of infinite length whose result, which yields total output at the industry level, is easily obtained with the input-output techniques (Miller and Blair, 2009). For every i and j, the "output multipliers" allow to quantify the effects of a change in the demand for the products of industry j on the output of industry i. Input-output analysis, in its traditional arrangement, is a theory of the industrial interdependencies. Final demand, completely exogenous, determines intermediate demand, and therefore total output.

Major events, such as the Great Depression of the 30s, the development of economic systems, the intensification of trade between countries, have given rise to the need for a common information system, based on a standardization of procedures for collecting, encoding and presentation of data. Given these requirements, in 1953 the UN published the System of National Accounts and supporting tables (SNA) adopted by the market-economy countries and the Material Product System (MPS) adopted by countries to collectivist economy.

Nonetheless, until the 1960s, input-output analysis and national accounting have been considered disciplines whose area of interest was different; according to Augusztinovics (1997) this may be due to the fact that national accounts are based on T-accounts instead of matrix notation (UN, 2009). However, the sequence of national accounts can be expressed in a unique matrix framework (Socci, 2004).

R. Stone and associates in Cambridge Department of Applied Economics (1962a) define Social Accounting Matrix (SAM) a "detailed, interconnected system of accounting statements for the whole economy" presented in matrix form, where "detailed" means that some accounts have been disaggregated. The input-output table can be included in this scheme as it represents the production account disaggregated on an industry basis. The aim was to form an economy-wide database, which not only included information about productive activities in the economy, but also incorporated other non-productive institutions and markets, such as factor markets, capital markets, households, government, and the rest of the world. It was proposed the method to convert the balance-sheet of flow of founds account into a square matrix.

Often the term social accounting matrix is utilized when the accounting scheme is enriched with supplementary information of social nature while the matrix representation of disaggregated national accounts is termed National Accounting Matrix (NAM).

The System of National Accounts[4] (SNA) of 1993 provides for the representation of national accounts in matrix form (National Accounting Matrix NAM). The NAM has a rigid structure, because it refers to a pure sequence of accounts and types of account holders, as provided for the accounts. The SAM is difference from the NAM for greater flexibility, as well as the possibility to choose which of the economic process stages highlight, in the opportunity to disaggregate the account holders using the most appropriate classification criteria distinguishing a case by case. SAM despite being a sequence of accounts, allows you to boost training, distribution and redistribution of income.

Social Accounting Matrix, calling SAM for short, is a comprehensive, economy-wide database, that presents a picture of the economy at hand (Löfgren and Robinson 2001). It is a particular representation of the economic accounts of a socio-economic system, which

[4] The SNA is the system used for reporting to international or supranational organisations economic accounts data that conform to standard, internationally-accepted concepts, definitions and classifications. The resulting data are widely used for international comparisons of the volumes of major aggregates, such as GDP or GDP per head, and also for comparisons of structural statistics, such as ratios of investment, taxes or government expenditures to GDP.

capture the transactions and transfers between all economic agents in the economic system (Pyatt and Round, 1985; Reinert and Roland-Holst, 1997). SAM is also flexible and disaggregated framework which elaborates and articulates the generation of income by activities of production and the distribution and redistribution of income between social and institutional groups (Round, 2003) A SAM is defined as the presentation of System of National Accounts (SNA) accounts in a matrix which elaborates the linkages between a supply and use table and institutional sector accounts. In many instances SAMs have been applied to an analysis of interrelationships between structural features of an economy and the distribution of income and expenditure among household groups. However, a SAM can be something more than an accounting scheme; when supported by a set of assumptions that put in causal relationship the economic variables considered, it can be the source of data for an economic model6. While input-output models describe the circularity in the production sphere, models built on SAMs can represent the circularity in the whole economic system. The assumptions on which an extended input-output model based on a SAM is founded are an extension of those adopted in the case of traditional demand driven input-output models. Revenues of any endogenous account are converted into outows that are allocated to the other accounts according to the proportions given in the SAM.

Several studies on the SAM have dealt with the realities of developing countries and have been driven by the need to create an information system capable of providing basic data on employment and income distribution, certainly in contrast with the traditional approach emphasis mail on the growth of the SAM the construction was conceived as the initial stage of a route to the understanding of the distribution of income as an integral part of the development process. The need to focus on employment and distribution, rather than on growth as such the objective of economic policies, has also been highlighted by the International Labour Office (ILO), World Employment Project (WEP). They remember about the SAM for Sri Lanka (1970), Swaziland (1971-1972) and Iran (1970).

However, SAMs can be used in the analysis of income distribution and poverty. This is the reason why they became popular in the 1970s. Indeed, SAMs are flexible tools that can combine economic data, such as input-output data and national accounts data, with additional socio-economic statistics. They can adapt to the social characteristics of the country analyzed. Also for these reasons, a large number of SAM-based multiplier studies have since followed, some of the earliest being for Sri Lanka (Pyatt and Round, 1979), Botswana (Hayden and

Round, 1982), Korea (Defourny and Thorbecke, 1984). Nowadays, the versatility of SAMs, has made them databases of preference for economic modelling.

2.2 The Social Accounting Matrix

SAMs have been presented as a suitable database where to look for a set of relationships connecting production process to final demand formation. Although they are accounting schemes and not models "they are clearly a stepping-stone in that direction"(Pyatt and Round, 1985a).

An elementary Social Accounting Matrix (SAM) can be seen as a matrix representation of national accounts on a disaggregated basis, that is an extension of an input-output table that takes into account all the steps of the income circular flow. It inserts more matrix that allow you to close the Leontief model taking into account the relations that are generally absent in the input-output model (such as factorial distribution, personal income distribution and composition of consumption expenditure) (Fossati and Lenti, 2004).

A SAM records all the transactions that take place among the economic agents in an accounting period, which usually corresponds to one year. Unlike an input-output table, it is a square table by construction; every revenues side of an account in a row has its costs side in a column and row totals must coincide with column totals. A simple SAM includes a number of accounts for the commodities, for the industries, for the value-added components, for the domestic institutional sectors, for the capital accounts and for the rest of the world. The entries made in the rows represent resources, incomes, receipts or changes in liabilities and net worth, whilst the entries made in columns represent uses, outlays, expenditures or changes in assets. Thus, each transaction, which is representative of the measurable part of a society's activity, is recorded only once, in a cell of its own.

In practical, in one SAM the j^{th} row total should equal the j^{th} column total, for example, for each account, the receipts should equal its expenditure or outlay. This feature of a SAM ensures compliance with the basic economic accounting principle. The basic structure of a general SAM considers:

- Goods and services: these accounts depict the origin of final goods available in the economic system (production activities and imports) and their destination (activities as intermediate inputs and institutions);

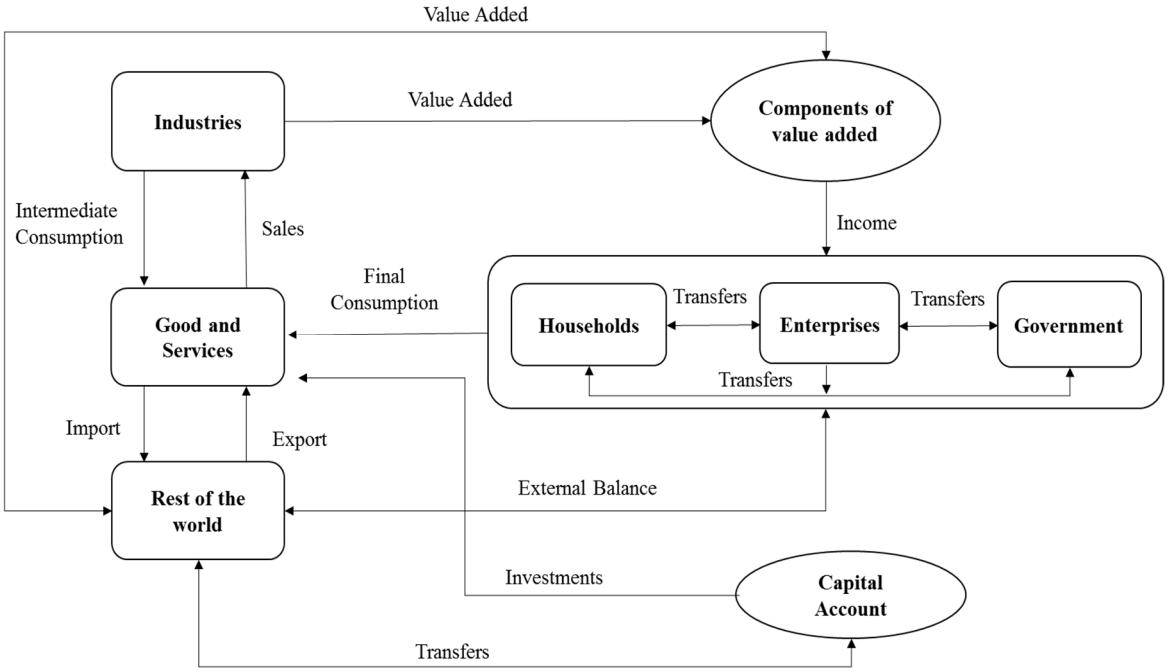
- Production activities: these are basically the production activities of the economy being analysed and generally refer to the defined sectors;
- Factors of production (or primary factors): these accounts depict receipts from productive activities, which pay for factor services, and payments to institutions, which provide those services. They are usually distinguished in labour and capital, but may refer also to natural resources, such as land and water;
- Institutional sectors (economic agents), normally comprising households, corporations and the government. These accounts record incomes of institutions along the rows and expenditure on the columns;
- The capital formation or saving-investment or accumulation account, which records allocation of resources for capital formation and use of these resources for the purchase of investment products and building up stocks of goods;
- The rest of the world account (ROW) or external account, in which the row records payments received by the rest of the world from the economic system and the column records the outlays of the rest of the world towards the economic system.

Each category is then normally split into several more detailed accounts which are shown in specific rows and columns. In particular, regarding the accounts for production activities, these are distinguished from the commodities that they produce. Therefore, the fundamental input-output tables come with two components, a matrix of 'uses' of commodities and a matrix of commodity 'supplies' (i.e. supply-use tables). Make and use tables are the starting point for the construction of modern symmetric input-output tables. Indeed, input-output analysis requires tables in which rows and columns are assigned both to industries or both to commodities. As pointed out by Stone (1961), input-output tables should also provide "an unambiguous and stable picture of industrial structure in such a way that it is possible to trace the implications in different lines of production of a change in the demand for any particular product". Symmetric input-output tables with the property of structural stability can be obtained in a framework in which industries produce different commodities only making assumptions on the production technology and on the sales structure". The different methods and the different assumptions, that can be used to obtain symmetric input-output tables from make and use tables are presented in Appendix 1.A. Since the purpose of this section is to present the basic structure of SAM, from now on it will be assumed that to each industry corresponds only one commodity and that to each commodity corresponds only one industry.

In this framework, symmetric industry by industry and commodity by commodity input-output tables coincide. Hence, it will show the structure of SAM following the industry by industry framework.

One way of depicting the economy is the circular flow diagram shown in Figure 6, which captures all transfers and real transactions between sectors and institutions. The aggregate structure of SAM connects the production activities with the distribution and redistribution of income (internal and national); in this way, it captures and shows the entire circular flow of income from its production to its distribution and its expenditure. The economic functions performed by representative's agents (institutional sectors and productive activities) determine flows of goods and transfer of income within an economy.

Figure 6. Economic circular flow



Source: adapted from Round (2003)

Productive activities purchase land, labor, and capital inputs from the factor markets, and intermediate inputs from commodity markets, and use these to produce goods and services (intermediate demand).

The industries receive payments from institutional sectors (for final consumption), from capital account (for investments) and from the rest of the world (for exports) and pays the

rest of the world (for imports). Primary factors (or components of value added), receive payments from industries and from the rest of the world and pay institutional sectors and the rest of the world. Institutional sectors receive payments from components of value added, transfers from institutional sectors themselves and transfers from the rest of the world; they make transfers to institutional sectors themselves and to the rest of the world, pay the commodity market (for final consumption) and save in capital formation. Capital formation receive savings from institutional sectors and from the rest of the world and allocate savings to the rest of the world and pay the commodity market (for investments). The rest of the world receives payments from industries (for imports), from value added components, transfers from the institutional sectors and savings from capital formation; it pays industries (for exports) and components of value added, makes transfers to institutional sectors and saves in capital formation. The final production hasn't other way out except in demand for consumption and investments: for this, the final product and the final expenditure are equivalent.

A SAM is also a representation of the economy. More specifically, it is an accounting framework that assigns numbers to the incomes and expenditures in the circular flow diagram. A SAM is laid out as a square matrix in which each row and column is called an "account." Figure 7 shows the SAM that corresponds to the circular flow diagram in Figure 6. Each of the boxes in the diagram is an account in the SAM. Each cell in the matrix represents, by convention, a flow of funds from a column account to a row account.

A general scheme of SAM is represented in figure 7. Each account is represented twice; once as a row (showing receipts) and once as a column (showing payments). The three main "forms" of economic activity are; production, consumption, accumulation and the transactions with the rest of the world.

Industries (or activities) If we read production activity accounts, by row, we can see that industries receive payments for: goods and services produced (output from domestic production activities), net of tax and product subsidies, export subsidies and exported goods and services. These elements make up the total production value. Industries, receive payments also for consumption by households, the government and investment (represented by changes in stock) and gross fixed capital formation (row 1). The column represents the account for domestic production activities. Industries pay: intermediate consumption to the goods and services accounts, labour and capital services to the factors accounts, indirect taxes

(VAT) to public administration, the value of imported products to the rest of the world account

Figure 7. Synthetic Scheme of SAM

		INDUSTRIES	COMPONENTS OF VALUE ADDED	HOUSEHOLD	CORPORATIONS	GOVERNMENT	CAPITAL FORMATION	ROW	Total
		1	2	3	4	5	6	7	
INDUSTRIES	1	Intermediate demand		Final Consumption Household		Final Consumption Government	Investments	Exports	T1
COMPONENTS OF VALUE ADDED	2	Value Added Generation						Factor income from ROW	T2
HOUSEHOLD	3		Factor income to Households	Inter-household Transfers	Corporation income distributed to households	Government Transfers to Household		Transfers to Household from ROW	T3
CORPORATIONS	4		Factor income to Corporations			Transfers to Corporations		Transfers to Corporations from ROW	T4
GOVERNMENT	5		Factor income to Government	Taxes on household income and property	Direct taxes on Corporations			Transfers to Government from ROW	T5
CAPITAL FORMATION	6			Household Savings	Corporations Savings	Government Savings		Balance of Payments	T6
ROW	7	Imports	Factor payment to ROW	Transfers to ROW	Transfers to ROW	Transfers to ROW			T7
Total		T1	T2	T3	T4	T5	T6	T7	

- Primary Factors (or component of value added): The receipts in factor of production accounts, such as capital and labour, are made up of payments from production activities which use factors of production. These receipts make up the total added value (row 2); Factors pay salaries to the household accounts and operating income to corporations. Additionally, they pay foreign labour and capital services to the ROW account (column 2).
- Households: receive payments from factor accounts for provision of labour services and transfers from the state, transfers between households, profits paid by corporations for services from entrepreneurs, capital services, and payments from workers abroad. Corporations receive gross operating income paid by the capital factor account (row 3). The households (column 3) records allocation of household revenue. They pay: purchase of end consumption goods and services to the goods and services accounts; intra-household transfers, including payments for services provided to households by other households, to other households, social contributions and direct taxes on income to public administration, savings from that period to the capital account; and transfers abroad to the ROW.

- Corporations: receive gross operating income and government transfers (row 4) The corporations column (4) records corporate payments of: shared profits to household accounts, taxes on profit to public administration accounts, corporate savings to the capital account, transfers abroad to the ROW.
- Government: records government revenue from indirect taxes on products, value-added tax (VAT) on activities, import tariffs and taxes on goods and services exports, social security contributions, taxes on profits, taxes on household revenue and capital account payments, when there is a public budget deficit (row 5). Government column (5) records payments to: goods and services accounts, for end consumption, activities accounts for subsidies to domestic production activity, household accounts, for transfers, such as pensions and consumption support, the capital account for savings from the central administration, when there is a public budget surplus; and payments to the ROW account, for servicing external debt.
- Capital formation: The capital formation receives payments of household, corporate and Government savings. It also records receipts due to net stock reductions of goods held in stock (negative changes in stock over the period being analysed). Furthermore, it records the capital transfers (namely, balance of the balance of payments) received from the rest of the world. This arises when the balance of payments is negative, in other words, there is a deficit (row 6) The capital formation pays: the industries for positive changes in stock (stock formation) and for investment goods (formation of physical capital stock); the ROW account when there is a balance of payments surplus, which is considered a foreign investment.
- The Rest of the World account (ROW): The rest of the world account receives payments from the country's imports of goods and services and transfers from the rest of the world. It must be noted that when the balance of payments is positive (balance of payments surplus), the rest of the world account is credited with the corresponding amount (row 6). The ROW account pays: the industries account for exports, the factors accounts, for labour services and capital returned by national actors abroad, the capital formation, when there is a balance of payments deficit (an outward net deficit position is offset by a transfer from outside the workings of the economy to the national economy).

We can conclude that the SAM is a picture of the economy, amounting to a numerical representation of the cycle: production, income and expenditure. However, beyond the

elaboration and detailed representation of the circular flow of income, the combination of data in a SAM permits a better analysis of the occurrence of poverty and inequality in living conditions, both as such and as factors hindering economic growth (Keuning and Ruuter, 1988).

2.3 Environmental accounting extensions framework

The successful search for an organic and, to the extent possible, complete statistical description of the interrelationships between the economic and environmental dimensions of development is one of the basic features of environmental accounting.

During the past years, the relationship between economic activity, the environment and the measures needed for preserving natural habitats had fueled debates. The Environmental deterioration had captured the attention of both economists and ecologists, who had discussed and integrated ideas and concepts. Frameworks for the accounting of economic environmental relationships date back to the late 60s and early 70s (Cumberland, 1966; Daly, 1968; Ayres and Kneese, 1969; Isard, 1972; Victor, 1972; Leontief, 1970; Leontief and Ford, 1972). These frameworks have resulted in a range of physical and environmental national accounts, some of which have been adopted in the System of Environmental and Economic Accounting (UN, 2003), where it appeared, for the first time, that the national system of accounts was extended to environmental accounting.

Accounting for sustainable development requires a broadening of scope of the conventional System of National Accounts (SNA; United Nations et al., 1993). This wider perspective is necessary to account for the priceless environmental and social externalities, which are important in a sustainable development context.

Many of the System of Environmental and Economic Accounting (SEEA) employ physical units: for example, economy-wide material flow accounts (MFA), the national accounting matrix with environmental accounts (NAMEA), physical supply and use tables (PSUT), physical IO tables (PIOTs), waste accounts and resource accounts. In addition, to the efforts of the United Nations to integrate economic and environmental accounts, studies on incorporating environmental impacts in the social accounting matrix (SAM) framework emerged in the 1990s.

Great support for implementing the SAM concept not only in developing ma also in developed country was given by the work done by Steven Keuning and his team at Statistics

Netherlands. They presented the concept and numerical example of a System and Economic and Social Accountig Matrix and Extensions (SESAME).

In particular, Keuning (1992, 1993, 1994) proposed the development of a national accounting matrix that would include environmental accounts. In this matrix, the economic variables would be expressed in monetary terms, and the environmental ones would be expressed in physical terms. Subsequently, Xie (1995) constructed an environmental SAM for China that took into account polluting emissions. The SAM analyzed payments to avoid emissions, taxes paid for emissions, subsidies for controlling emissions, and industrial environmental investment (waste treatment plants and control teams). These activities were differentiated according to production type, which resulted in a consistent database with which to initially calibrate a model with dejection activities. This SAM was therefore able to use real data on dejection costs to evaluate environmental policies.

De Haan and Keuning (1996) presented a national accounting matrix including environmental accounts (NAMEA) for the Netherlands that creates a link between the national accounts and environmental statistics. NAMEA shows the relationship between a number of important economic indicators (gross domestic product, balance of payments, etc.) and the environment. In particular, for NAMEA of Netherlands is extended with three accounts on the environment: a substances account, an account for global environmental themes and an account for national environmental themes. These accounts don't express the transaction in money terms but include the information in physical unit.

Keuning, Dalen and De Haan (1999) described an aggregated NAMEA which they used to compare the contribution of economic activities to economic indicators with the contribution of economic activities to environmental themes. They also described how economic activities contribute cumulatively to economic and environmental indicators (thus taking into account the relations between the production activities) and described a number of recent applications and extensions of the NAMEA in the Netherlands. Keuning and Steenge (1999) presented a description of the structure and methodology of construction of a NAMEA. A general structure of NAMEA is show in figure below.

Another important contribution is represented by Xie and Saltzman (2000) constructed a numerical version of the environmentally extended SAM using Chinese data from 1990. They applied multiplier and structural-path analyses to this database to assess the environmental impacts of pollution-related economic policies.

Figure 8. National Accounting Matrix and environmental accounts

		Commodities	Activities	Factors	Institutional Sectors	Capital Formation	Natural Resource
	n	1	2	3	4	5	6
Commodities	1		U		C_f+C_g	I_l+V_s	
Activities	2	M					W_1
Factors	3		Y^C				
Institutional Sectors	4	NT		Y^{is}	Tr+Id		
Capital Formation	5				S		
Natural Resource	6		W_2				

Source: Fiorillo and all (2007)

Xie (2000), then extended the SAM to capture the relationships among economic activities, pollution abatement activities, and pollution emissions. The results showed that an integrated economic- ecologic database can be a useful tool in environmental policy analysis.

The Environmentally extended Social Accounting Matrix (ESAM) is an extension of Social Accounting Matrix (SAM) which integrates economic and environmental activities in a single accounting framework. Since the ESAM follows same principle of SAM, the ESAM multiplier will also help us to understand the policy related to direct and indirect induced impact on the economy as well as on the environment. Typically economists use the SAM framework to understand the economic relationship between the agents of an economy. These ESAMs take into account environmental indicators in physical unit which are in a way generating from the economic activities and also absorbing by the economic activities on the other way.

The "substances account" of the ESAM provides flow data on the supply and use of a number of substances that affect in one way or the other the natural assets like air, water etc. and create pollution (Keuning, 1992). The term "substances" refers not only to the matter which is of damaging in nature (e.g. emissions of chemicals, wastes, etc.) but also includes valuable matter in the form of depletable natural resources. In case of damaging substances the columns of the substances account describe only the supply of these substances from different source and the rows describe the absorption of these substances into different sectors. But in case of depletable substances the column shows the renewal of the natural capital and this comes from the new discoveries of exhaustive natural assets like coal, crude oil etc. On the other hand the row of this depletable substances account shows the use of these substances in the form of intermediate input in the production process.

The environmental satellites are defined such as to cover the broadest range of environmental themes as reasonably achievable while maintaining a data quality that is well grounded in the empirical availability of primary data. In general terms, the variables cover: use of energy; emission of main greenhouse gases; emission of other main air pollutants; use of mineral and fossil resources; land use; water use.

Undoubtedly, environmental accounting frameworks are very useful for evaluating the environmental consequences of economic activity. In this way, there is an improve of SAM, that will allow the joint analysis of the circular income effects and the associated environmental loads.

2.4 Why SAM?

Sustainable development and sustainable development planning are complementary processes which should ultimately lead to increased well-being of the mankind. In order to better understand and implement the whole process, one should take into consideration their methodological basis, their preparation and implementation. However, for the purpose of understand the sustainable development concept, one has to develop an appropriate methodological instrument.

Given the on-going trend in globalization, we agree with Wiedmann et all (Wiedmann, Lenzen, Barrett and Turner 2007) that Social Accounting Matrix (SAM) database is useful for analyzing economic, social and environmental issues and policies, and take each of the following three aspects into account. The construction of a SAM helps to bring together data from many disparate sources that help to describe the structural characteristics of an economy.

SAMs are a very good way of representing information; the structural interdependence in an economy at both the macro and meso levels are shown in a SAM in a simple way. SAM can illustrate clearly the linkage between income distribution and economic structure; should provide information on how, and the degree to which, different groups in society interconnect and interact with the rest of the economic system. In particular, it connects the following aspects: the distributions of incomes available to institutions (in particular households), the private and public spending of these incomes on goods and services (which are part of the determination of individuals' living standards), transfer payments and savings by institutions; the production of goods and services, and the generation of factor incomes.

Lastly, SAM represents a useful analytical framework for modelling; that is, it could provide a direct input into a range of models, including fixed-price multiplier models and are also an

integral part of the benchmark data set required to calibrate computable general equilibrium (CGE) models. SAM can be used for macroeconomic planning in two ways: first, it can provide a framework for the organization of information related to economic and social structures of a country's economy. Secondly, a SAM can serve as a database for a model of the economy under consideration.

From the perspective of this study, SAM is a powerful tool in that it can include sufficient details to point out living conditions in households, in terms of income received, and expenditures incurred. In addition to the transparency of income distribution and the labour composition of production (as it emerges from the description of the productive structure of the economy), it allows one to examine the impact of different final demand by industry sector via simulations of policy intervention scenarios.

SAM, it will present as a suitable database where to look for a set of relationships connecting production process to final demand formation, moreover, the social accounting scheme is the empirical counterpart of models that combine keynesian features with multisectoral properties characteristic of the input-output analysis.

To address this progress in the design of a data base, which implies a meaningful sectorization of the major macroeconomic variables, flexible tools of analysis are needed, which provide a deeper insight into the propagation phenomena characterizing sectoral and industrial interactions (Round, 2003).

2.5. Assessment of China's Economic Data and literature review

In most industrialized countries, the management of the national and territorial economic accounts is entrusted to the national statistical offices and their organizational network, although in recent years have increased public and private research organizations that have started to make similar elaborations. The requirement of information, assigns to Institutions of data collection a crucial role in terms of efficiency and effectiveness, both in scientific research and in socio-economic planning. In most countries, national accounts are based on a mixture of statistical sources and administrative records. Statistical sources include censuses, regular sample surveys and ad hoc enquiries to fill specific data gaps. Administrative records include tax reports, corporate accounts, central bank records and data assembled by government ministries in carrying out various supervisory functions.

The data sources used for China's national accounts include statistics collected by the National Bureau of Statistics (NBS) and by other government agencies, financial statements

and other administrative records. The NBS uses both types of data. Because of the history of central planning, government ministries in China collect a particularly wide range of statistics and the NBS makes extensive use of this information (OEDC, 2000).

Statistics collected by the NBS include statistics on agriculture, forestry, animal husbandry and fishing; industry statistics, construction statistics; statistics on transport and post and telecommunications; statistics on wholesale, retail and catering services, statistics on real estate, statistics on other services, population statistics; statistics on employment and labour compensation, statistics on fixed assets, price statistics, sample surveys of urban and rural households. Statistics collected by other government agencies include statistics on government financing, statistics on tax revenues, statistics on state-owned assets, statistics on assets owned by urban collectives, statistics on assets owned by rural collectives, banking statistics, insurance statistics, social insurance statistics, statistics on transport and more.

Regarding the construction of SAM data based for China, we must take into account some questions about Chinese data quality and technical limitations. As previously said, when working with Chinese data, two commonly Chinese Official Statistics used are the China Premium Databased (https://www.ceicdata.com/China.htlm) and the National Bureau of Statistics' website (http:// www.stats.gov.cn).

However, it must be taken in account some issues of data availability in the context of doing research on China. In China, since the beginning of the economic reforms in 1978, economic transition, growth, and structural change have created severe challenges for the compilation of accurate statistics. In fact, economic transition in China had a severe impact on the compilation of statistical data. Traditional data collection methods were unable to capture the rapid growth in productive units outside the direct reporting system (Holz, 2004).

China's System of National Accounts (CSNA) was based on the Material Product System (MPS) that was devised and used by the former Soviet Union and its satellite states. These countries were characterized by their highly-centralized planning economies (CPEs). Following the reform and the opening up of the economy, China gradually introduced the United Nations System of National Accounts (SNA) used by countries that adopted the market economy system, while maintaining the conventional MPS. Along with the development of the socialist market economy, the SNA gradually replaced the MPS as the official accounting system in China. Hence, the evolution of CSNA can be divided into three stages: firstly, the establishment and development of the MPS, secondly, the transition from the MPS to the SNA, and thirdly the development of the SNA (XU, 2009).

The first official accounts for China were compiled in 1952 according to the Material Product System (MPS). The MPS was developed in the Soviet Union and has been used by most countries with centrally planned economies (Bosworth and Collins 2008). The main difference between the MPS and the System of National Accounts (SNA) which is used by countries with market economies, is that the MPS excludes "non-material services" from the production boundary. Starting in 1985, the second stage is characterized by the establishment of GDP accounting, as defined in the SNA, as a supplementary measure to national income in the MPS. The last stage, starting in 1993, is characterized by the abolishment of the MPS and the adoption of the SNA. Both the establishment of the MPS and the transition from the MPS to the SNA are of great historical importance. In 1992, the SNA was adopted as the official accounting system in China, replacing the MPS. Since then, the National Bureau of Statistics has concentrated on developing data sources and refining its estimation procedures to estimate directly national accounts according to the SNA.

During course of economic transition, it has been adopted new statistical concepts and variables, while some variables were redefined by other government departments (Holz, 2014). Incentives for data falsification, political prerogatives, and shifting interests of reporting units did nothing to facilitate the compilation of accurate statistics. Consequently, Chinese official data suffer from a large number of complications ranging from statistical breaks to various errors[5].

However, the suspicions on Chinese data are a relatively recent phenomenon, starting in the late 1990s. Since the mid 1990-s researchers have routinely explored the meaning of specific official Chinese Data. The large and growing body of literature covers every area of Chinese statistics. The most important reviews on China's Statistical System are: Holz Castern (2002, 2004b, 2005a) that has focused on the effects of the reforms on data collection, Xue Susan (2004), Chow Gregory (2006b), Xianchun Xu (2009) and Huang & Tong (2009) that has focused on the organizational structure of statistical system and the role of NBS.

However, the recent and ongoing innovations in data compilation methods suggest that the margin of error inherent in the nationwide aggregate data, short of outright, centralized data falsification, is shrinking[6].

2.6 Constructing of Social Accounting Matrix for China for the year 2011

The matrix structure of economic accounts represents the working basis for the development of SAM. The peculiarity of the requested information, determines an expansion of accounts of production and income accounting. For this reason, it was necessary a connection between the input output table and institutional sector accounts, and in the case where there weren't, it' necessary a balancing of differences.

The construction of one SAM becomes more complex when the greater the degree of detail that you want to provide and lower the available information set, no one can affect the representation of economic system. In fact, the detailed estimation and the data sets required for the construction, not form part of standard national accounting practice. In fact, social accounting framework is flexible enough to incorporate country-specific features and planning priorities, for international comparability is not the main issue (Keuning and Ruuter 1988). For this reason, the conventions laid down in the SNA usually are a frame of reference. Essentially, two approaches have been applied by practitioners to build a SAM, the top-down and the bottom-up approach. The top-down approach starts by building a highly-aggregated SAM, based on available information from the national statistics[7]. Then, the data in the aggregate SAM are used as control values when estimating the details of the separate SAM accounts. In contrast, the bottom-up approach estimates the separate SAM accounts at a disaggregated level and obtains the aggregate level of an account by simple consolidation (for instance summing up). Because 'control values' are absent in the bottom up approach, substantial discrepancies may arise between the aggregate level (obtained after consolidation) and the official national statistics.

In this work, it has been used the top-down approach. Essentially, for these main reasons:

- the availability of Chinese data: unfortunately, there is lack of information in the official chinese sources., Of course, if abundant information from survey data (e.g. for households, corporations or other institutions) is available, the bottom-up approach is preferred over the top-down approach;
- more consistency: the top-down approach yields a SAM that is (in its aggregated form) perfectly in line with the official statistics.

[7] In building their SAMs, Pyatt and Round (1984), Reinert and Roland-Holst (1992), and Roland-Holst and Sancho (1992) adopted the top-down approach, whereas Keuning and de Ruijter (1988) and Jabara et al. (1992) favored the bottom-up approach.

The construction of China's SAM with a significant degree of disaggregation of the principal accounts (activities, commodities, factors and households), had requested the availability of some key datasets. Table 3 shows the main data source that has been utilized for construction of China's SAM. Principally, in the table are included these followed type of data:

1- supply and use tables (input-output tables), or the necessary primary survey data to compile them;
2- national accounts;
3- household survey incorporating a population census (a multi-purpose, integrated household survey);
4- corporations survey;
5- government budget accounts, trade statistics and balance of payments statistics.

In the construction, China's SAM, it was important to identify the data's sources and determined a hierarchy, that it had to keep in mind always during the construction of the matrix. Once decided upon the hierarchy, it could determine what information was dominant and which it used as an alternative to derive a coefficient and share structure[8] (Socci, 2004). Regarding the data sources (that are showed below followed the hierarchy adopted for the construction), these are:

1- Input-Output table from WIOD[9];
2- Statistics collected by NBS;
3- Statistics of other Chinese government agencies;
4- Other supplementary data (World Bank, OECD data, etc).

It's important to underline that, in the compilation of China's SAM, it was dealed with a range of problems. Some of them, were conceptual, that concerned the Chinese economic system and its different operation (e.g. different laws and regulations) while others were practical; for example, different data sources and classifications, different definitions of accounts, different numeric quantity, etc.

[8] Matrix of the technical coefficients of production, the propensity to consume matrix, import coefficient matrix and others.

[9] WIOD – World Input-Output Database – is a project financed by the European Union's Seventh Framework Programme for research and technological development, aiming to develop database, accounting frameworks and models that enable to understand some of the worldwide trade-offs between socio-economic and environmental developments. http://www.wiod.org/new_site/home.htm

Table 2- Main Data sources for China's SAM construction

ITEM	*DATA SOURCES*	*DATA SET TYPE*	*NOTES*
Intermediate Demand	WIOD	I/O Table (2011)	
Value Added	WIOD	I/O Table (2011)	
Output	WIOD	I/O Table (2011)	Adjusted for balance
Sales Tax	China Statistical Yearbook (2012)	Income Approach Components of Gross Regional Product (2011)	Industry reconciliation
Imports	WIOD	I/O Table (2011)	
Factor Payments to Rural Households	China Statistical Yearbook (2012)	Per Capita Annual Net Income of Rural Households by Sources and Region Table (2011)	
Factor Payments to Urban Households	China Statistical Yearbook (2012)	Per Capita Annual Income of Urban Households by Sources and Region Table (2011)	
Factor Payments to Enterprises	China Statistical Yearbook (2012)	Income Approach Components of Gross Regional Product Table (2011)	Industry reconciliation
Factor Payments to Government	China Statistical Yearbook (2012)	Income Approach Components of Gross Regional Product Table (2011)	Industry reconciliation
Factor Payments to ROW	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	Residual calculation
Rural Household Current Consumption	Household survey of NBS	Household consumption (2011) Household consumption expenditure by region (2011)	
Urban Household Current Consumption	Household survey of NBS	Household consumption (2011) Household consumption expenditure by region (2011)	
Enterprise Current Consumption	China Statistical Yearbook (2012)	Main indicators of Industrial Enterprises by region (2011)	
Inter-household transfers	China Statistical Yearbook (2012)	Flow of Funds Account Table (Current transfers) (2011) Basic statistics of Welfare (2011)	Used as a residual to balance, however it is not included in SAM
HH income Tax	China Statistical Yearbook (2012)	Taxes Table (2011)	Not included in SAM
HH/Enterprise income Tax	China Statistical Yearbook (2012)	Taxes Table (2011)	Not included in SAM
Enterprise income Tax	China Statistical Yearbook (2012)	Taxes Table (2011)	Not included in SAM
Government Current Consumption	China Statistical Yearbook (2012)	National Government Expenditure (2011)	Share of Central and Local Government expenditure
Government Transfers to Households	China Statistical Yearbook (2012)	Basic statistics of Welfare (2011)	Not included in SAM
Government Savings	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
Government Payments to ROW	China Statistical Yearbook (2012)		
Rural Household Savings	China Statistical Yearbook (2012)	Saving Deposit of Rural and Urban Households (2011) Flow of Funds Account Table (2011)	
Urban Household Savings	China Statistical Yearbook (2012)	Saving Deposit of Rural and Urban Households (2011) Flow of Funds Account Table (2011)	
Rural Household Capital Formation	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
Urban Household Capital Formation	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
Enterprise Capital Formation	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
Government Capital Formation	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
Exports	WIOD	I/O Table (2011)	
ROW current transfers to HH/Enterprises	China Statistical Yearbook (2012)		Not included in SAM
ROW current transfers to Government	China Statistical Yearbook (2012)		Not included in SAM
ROW capital transfers to Rural Households	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
ROW capital transfers to Urban Households	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	
ROW capital transfers to Enterprises	China Statistical Yearbook (2012)	Flow of Funds Account Table (2011)	Adjusted for balance
ROW capital transfers to Government	China Statistical Yearbook (2012)	Balance of Payments (2011)	Adjusted for balance
CO2 Emissions by Industry	WIOD	Environmental Accounts CO2 Emissions Table (2011)	Used for calculating the polluted sectors intensity
Total CO2 Emission China	World Bank	World Development Indicators (Time series)	Used total value

Some of which came to light when the estimates from different sources were compared side by side. Has suggested Reinert and Roland-Holst (1997) the construction of a SAM should begin by recasting the macroeconomic accounts for the economy into a simple matrix tableau, a so-called Macro SAM. At the next stage the Macro SAM is followed by the construction of the detailed Micro SAM.

In particular, the process of building China's SAM has involved the following steps:

1. identification and preparation of appropriate data sources: this first step has included matching of several micro data to obtain the set of variables of interest, and has included also the complex task of harmonising the variables with the chinese national accounts;
2. combination of several data sets: this phase has been necessary for enabling the decomposition of the chinese national accounts into more detailed socio-economic variables (for example level of income for rural and urban households);
3. error detection: this step has been strategical for the presences of inconsistencies observed between estimates obtained by aggregation of micro-data and the national accounts presented after step 1 and 2;
4. balancing techniques: it has been used to obtain strict numerical consistency in the macro-data.

The China's SAM for the year 2011 is an original contribution compared to SAM for China for 2002 and 2007 presented in LI Jia in 2013 (LI, 2013). Both 2002 and 2007 SAM were 97×97 matrix, but they were aggregated into 42 activity and commodity categories into 8 each. So, each matrix contained 42 production activities, 42 commodities, 2 factors of production (labor and capital), 5 current accounts of institutions, 5 capital accounts of institutions, and one account of financial flows[10]. Another contribution, refers to Yumei Zhang and Xinshen Diao that presented the SAM for China for 2007[11] (ZHANG and DIAO 2013), That SAM, covered 61 production activities and commodity sectors, 4 types of factors (low skilled labor, skilled labor, capital, and land), and 2 representative household (rural and urban) groups. However, a

[10] LI (2008) used the same framework to build a 2002 Chinese SAM. Different from two SAMs built in this study, the SAM in LI (2008) has fewer production activities (7) and no separation of production activities and commodities.

critical point in that SAM, concerns the production of the block which is presented only on the diagonal of the matrix.

Instead, the 2011 SAM is 48×48 matrix. It represents the monetary transactions, that are expressed in millions of Yuan, that took place in China during the year 2011 among 35 industries, three factors of value added (compensation of employee, Taxes on production and imports, less subsidies, Operating Surplus), four currents accounts of institutions (urban, rural households, corporations, government), four capital formation (capital formation of rural household, urban household, corporations and Government) and Rest of the world (RoW).

The disaggregation of primary factors and the household classification were fundamental for the construction of China's SAM. For this reason, Pyatt and Thorbecke (1976) set out some clear principles and guidelines for choosing these primary factor and household classifications. Regarding the disaggregation of the primary factor, it has been chosen a classification which identified distinct factor markets (please see in Appendix the main criteria followed).

Knowledge of the functional income distribution constitutes only a first step towards assessing a country's distributional situation. More direct insights can be gained by tracing the flow of income from primary factors to households. Despite the great economic growth in China, this it has been accompanied by an enlarging income disparity, especially between urban and rural households. In doing so for China, we identify these two different types of households. Taking in account this aspect, the disaggregations of the household accounts was fundamental for construction China's SAM. Household classifications were split into categories (urban and rural households) in accordance with the purpose of analysis and with a support by the data (every year, NBS classifies the basic conditions of rural and urban households). In particular, with population of "Urban Households" it refers to members of households living and sharing economically together in the urban areas. All the income and expenditure of all the members of such households are included in the income and expenditure of the household.

With "Rural Households" it refers to usual resident households in rural areas. Resident households in rural areas are households residing on a long-term basis (for more than one year) in the areas under the administration of township governments (not including county towns), and in the areas under the administration of villages in county towns. Households

residing in the current addresses for over one year with their household registration in other places are still considered as resident households of the locality[12].

Corporation sector includes three categories: namely domestic-funded corporations, corporations with investment from Hong Kong, Macao and Taiwan, and corporations with foreign investment (according to the registration status of a corporation in industrial and commercial administration agencies). Domestic-funded corporations include State-owned corporations, collective-owned corporations, cooperative corporations, joint ownership corporations, limited liability corporations, share-holding corporations Ltd., private corporations and other corporations.

Figure 9 is a scheme of China SAM for the year 2011 and figure 10 is an aggregated picture of the SAM that gives an idea of the volume of the transactions occurred in China in the year 2011. The year 2011 has been chosen because it is the most recent year for which were available input - output table (from WIOD) and all the data necessary to compile a SAM. The National Bureau of Statistics of China (NBS) publishes input-output table every five years; however, it does not publish SAM database.

Special data of administrative regions as Hong Kong, Macao and Taiwan aren't included In China's SAM for 2011. As Hong Kong is a separate custom territory, trade between Hong Kong and the mainland of China needs customs declaration procedures.

Values in WIOD are expressed in millions of US dollars and market exchange rates were used for currency conversion. However, China's SAM is expresses in millions on yuan (so input-output table was totally converted in millions of yuan). This, because YUAN is the currency rate in which the table of NBS are expressed. For this reason, it has been used the table of Italian Central Bank for currency conversion for 2011 detailed by day. Then, it has been considered the yearly average exchange. (See in Appendix figure 1.E.1, 1.E.2)

The estimates of GDP derived from current SAMs are similar to the estimates from national accounts.

The construction of the SAM can be divided in steps corresponding to the different blocks and to the phases of the income circular flow. The SAM's blocks, identified in figure 9, are sub-matrices or sets of sub-matrices (as seen in the basic scheme of SAM (figure 7), with common characteristics.

[12] For households with their household registration in one place but all members of the households having moved away to make a living in another place for over one year, they will not be included in the rural households of the area where they are registered, irrespective of whether they still keep their contracted land.

Figure 9 - A scheme of China SAM for the year 2011

			COMPONENTS OF VALUE ADDED			INSTITUTIONAL SECTORS				CAPITAL FORMATION					
		INDUSTRIES	**Compensation of employee**	**Taxes on production**	**Operating Surplus**	**Rural Household**	**Urban Household**	**Corporations**	**Government**	**Rural Household**	**Urban Household**	**Corporations**	**Government**	**ROW**	**Total**
	INDUSTRIES	Intermediate Consumption (1)				Rural household Consumption (5)	Urban household Consumption (5)		Government Consumption (5)	Investments and var. stocks of Rural Household (7)	Investments nd var. stocks of Urban Household (7)	Investments nd var. stocks of Corporations (7)	Investments nd var. stocks of Government (7)	Exports (8)	T1
COMPONENTS OF VALUE ADDED	**Compensation of employee**	Value Added Generation (2)													T2
	Taxes on production	Value Added Generation (2)													T3
	Operating Surplus	Value Added Generation (2)													T4
INSTITUTIONAL SECTORS	**Rural Household**		Factor Income distributed to rural household (3)		Factor Income distributed to urban household (3)	**Transfers**	**Transfers**	**Transfers**	**Transfers**					**Transfers from RoW (12)**	T5
	Urban Household		Factor Income distributed to urban household (3)		Factor Income distributed to urban household (3)	**Transfers**	**Transfers**	**Transfers**	**Transfers**					**Transfers from RoW (12)**	T6
	Corporations				Factor Income distributed to (3)	**Transfers**	**Transfers**	**Transfers**	**Transfers**					**Transfers from RoW (12)**	T7
	Government			Factor income to Government, factor taxes (3)	Factor income to Government, factor taxes (3)	**Transfers**	**Transfers**	**Transfers**	**Transfers**					**Transfers from RoW (12)**	T8
CAPITAL FORMATION	**Capital Formation Rural Household**					Rural households Savings (6)									
	Capital Formation Urban Household						Urban Households Savings (6)								
	Capital Formation Corporations							Business Savings (6)							
	Capital Formation Government								Government Savings (6)						T9
	ROW	Imports (9)	Factor Income distributed abroad (11)			**Transfers to RoW (13)**	**Transfers to RoW (13)**	**Transfers to RoW (13)**	**Transfers to RoW (13)**	Net lending or borrowing of the national economy (14)	Net lending or borrowing of the national economy (14)	Net lending or borrowing of the national economy (14)	Net lending or borrowing of the national economy (14)		T10
	Total	T1	T2	T3	T4	T5	T6	T7	T8				T9	T10	

The specification of these blocks involves the identification of the transactions of the National Accounts, which are the sources of information used to construct the SAMs, and the method of calculation used.

Figure 10 - Aggregates from CHINA Sam for the year 2011

(100 milion of Yuan)		INDUSTRIES	COMPONENTS OF VALUE ADDED	INSTITUTIONAL SECTORS	CAPITAL FORMATION	ROW	Total
		1	2	3	4	5	6
INDUSTRIES	1	866.944	-	263.306	203.610	134.895	**1.468.756**
COMPONENTS OF VALUE ADDED	2	472.191	-	-	-	-	**472.191**
INSTITUTIONAL SECTORS	3	-	471.121		-		**471.121**
CAPITAL FORMATION	4	-	-	207.815	-	-	**207.815**
ROW	5	129.621	1.070		4.205	-	**134.895**
Total	6	**1.468.756**	**472.191**	**471.121**	**207.815**	**134.895**	

data not available

The block of the industries describes production activity and the generation of value added, the block of the components of value added describes the generation of income and allocation of primary income accounts of the institutions; the block of the institutional sectors describes secondary distribution of income and use of disposable income accounts of the institutions; the block of the capital accounts describe capital formation; the block of the rest of the world describes the relationships between China and the other countries. All details of SAM are represented in Appendix.

2.6.1 Input-Output table

The industry accounts of the SAM show transactions concerning production activity and its outcomes. Intermediate consumption (transaction P2 of the National Accounts), which consists of the value of the goods and services consumed as inputs by a process of production, excluding those fixed assets. The goods and services may be either transformed or used up by the production process.

The transactions are represented in the sub-matrices labelled with (1) and (2) in figure 9. In particular, for each industry, the entries in the revenues side of the account are domestic output by industries and those on the costs side are intermediate consumptions by industries

(1)[13], and payments to the value-added components (2). All block of intermediate consumption derives by input-output table.

As illustrated in Figure 9, sub-matrix from the Input-Output table used to construct the SAM was:

1. Domestic intermediate consumption matrix (35×35);
2. Foreign intermediate consumption matrix (imports) (35×35);
3. Value added by industries matrix (1×35);
4. Domestic final demand matrix (final consumption expenditure by households final consumption expenditure by non-profit organisations serving households, final consumption expenditure by government,) (3×35);
5. Foreign final demand matrix (3×35);
6. Capital formation matrix (gross fixed capital formation, changes in inventories and valuables) (2×35).

The database used in this study is the China's Input-Output table for the year 2011 with symmetrical structure Industry by Industry. The interindustry transactions are recorded in a single transactions matrix rather than the complementary pair of supply and use matrices of the SNA framework, divided into 35 production sectors. Data are obtain released by WIOD database in September 2012. In more detail, WIOD[14] input-output tables cover 35 industries for each of the 40 economies (27 EU countries and 13 major economies in other regions) plus the rest of the world (RoW) and the years from 1995 to 2011. For each country, tables are constructed that reflect how much of each of 59 products is produced and used by each of 35 industries (DIETZENBACHER and all, 2013).

For China and for other country as well, the WIOD classification list has 35 industries based on the CPA and NACE rev 1 (ISIC rev 2); each industry includes figures related to intermediate demand, final demand, value added and imports. The WIOD classification industries include agriculture, mining, construction, utilities, fourteen manufacturing industries, telecom, finance, business services, personal services, eight trade and transport services industries and three public services industries. However, the industry classification

[13] An industry-by-industry table is a symmetric input- output table with industries as the dimension of both rows and columns; as a result it shows which industry uses the output of which other industry.

[14] WIOD – World Input-Output Database – is a project financed by the European Union's Seventh Framework Programme for research and technological development, aiming to develop database, accounting frameworks and models that enable to understand some of the worldwide trade-offs between socio-economic and environmental developments. http://www.wiod.org/new_site/home.htm

adopted by NBS follows the “Industrial Classification for National Economic Activities" (GB/T4754-2002)[15]. The range of the industries included 80 groups and classes in the of which, manufacturing units involved 18 groups and classes, marketing units involved 17 classes, and services providing units involved 45 classes. In the table 3, the two different industry classifications are showed.

The I-O table can assume various structures, useful to highlight the links between the inter-industrial production processes activated in the economic system for the production of several types of goods (BULMER-THOMAS,1982). The table used for China’s SAM is of the industry by industry type[16]; it is assumed that each industry produces goods and services in exactly one product class (Miller and Blair 1985). That is, an important accounting identity, is the basic market-clearing condition stating that supply must equal use for each product, such that all flows in the economic system are accounted for. Products are supplied by domestic industries or imported, and are used as intermediates by domestic industries, for final use by domestic residents or exported. It is worth noting that the all transaction values are in basic prices reflecting all costs borne by the producer, which is the appropriate price concept for most applications[17]. International trade flows are accordingly expressed in “free on board” (fob) prices through estimation of international trade and transport margins. Total output is obtained from domestic intermediate consumption table, foreign intermediate consumption table and the value-added table.

The block of the payments to the component of value added labelled with (2) in figure 9, shows the components of value added by industry size. In particular, each entry shows the payments for the component of value added associated to the row by the industry associated to the column[18]. The estimation of value added for industries can be done by subtracting intermediate consumption from gross output or by adding up the components of value added:

[15] The new Industrial Classification of the National Economy (GB/T 4754-2011) is introduced starting from the compilation of 2012 annual statistics. The revision, based on the 2002 classification, was organized by the National Bureau of Statistics taking into consideration of the International Standards of the Industrial Classification of All Economic Activities (ISIC/Rev.4) of the United Nations. The new Classification was promulgated by the National Administration of Quality Supervision, Inspection and Quarantine and the Standardization Administration of the People's Republic of China on April 29, 2011. The revised version of the Industrial Classification of the National Economy (GB/T 4754-2012) is composed of 20 sections, 96 divisions, 432 groups and 1094 classes.

[16] An industry-by-industry table describes inter-industry relations. The intermadiate part of the table describes for each industry the use of products in productions.

[17]

[18] The figure includes also a further column for value added originated abroad.

compensation of employees, taxes on production, net (taxes minus subsidies on production), depreciation of fixed assets and operating surplus[19]. Both methods are used in China.

As said previously, an appropriate disaggregation of the factor accounts was crucial. For determine payments to the components of value added, it was necessary make a correspondence between the single sector fitting together the two different industry classifications (figure 1.D.3 in Appendix).

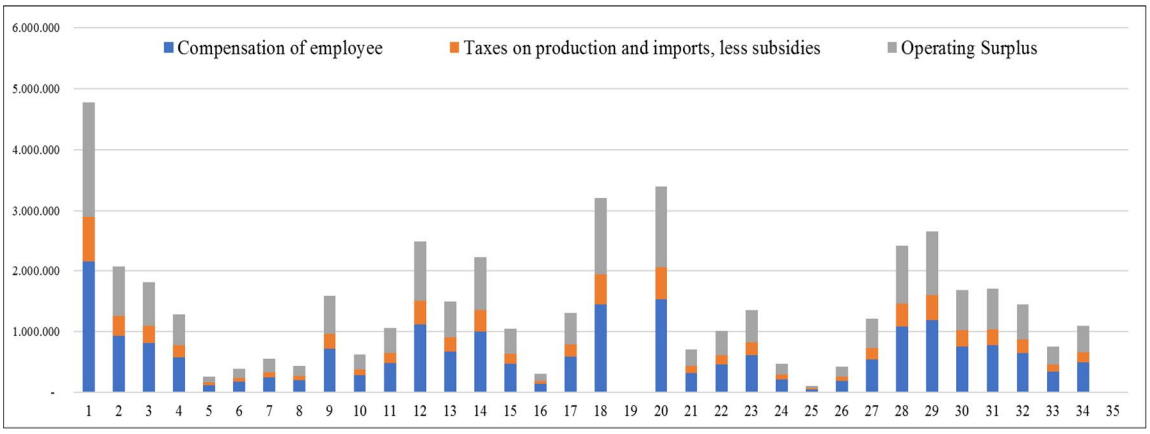
Regarding on this, data on the payments to the components of value added are obtained from the matching of WIOD and external accounting of NBS. Through the reconciliation of the two reclassifications and using the table of value added by sector (figure 1.G.6 in Appendix) and the table "- Income Approach Components of Gross Regional Product (figure 11 and figure 1.G.9 in Appendix) as a benchmark, it has been possible to derive the share of each individual component of the added value ascribed to every productive sector (figure 12).

Figure 11 - Income Approach Components of Gross Regional Product (2011)

	Gross Regional Product	Compensation of Employees	Net Taxes on Production	Operating Surplus
Total	100,0%	44,9%	15,6%	39,5%

Source: Our rielaboration from NBS (http://www.stats.gov.cn/tjsj/ndsj/2012/indexeh.htm)

Figure 12 - Components of value added for industry (milion of yuan)



[19] For more details, see section 1.I in Appendix.

Table 3- Industry classification (comparison)

1 Agriculture, Forestry, Animal Husbandry and Fishery	**1** Agriculture, Hunting, Forestry and Fishing
2 Mining	**2** Mining and Quarrying
3 Manufacturing	**3** Food, Beverages and Tobacco
4 Production and Supply of Electricity, Gas and Water	**4** Textiles and Textile Products
5 Construction	**5** Leather, Leather and Footwear
6 Transport, Storage and Post	**6** Wood and Products of Wood and Cork
7 Information Transmission, Computer Services and Software	**7** Pulp, Paper, Paper , Printing and Publishing
8 Wholesale and Retail Trades	**8** Coke, Refined Petroleum and Nuclear Fuel
9 Hotels and Catering Services	**9** Chemicals and Chemical Products
10 Financial Intermediation	**10** Rubber and Plastics
11 Real Estate	**11** Other Non-Metallic Mineral
12 Leasing and Business Services	**12** Basic Metals and Fabricated Metal
13 Scientific Research, Technical Services and Geologic Prospecting	**13** Machinery, Nec
14 Management of Water Conservancy, Environment and Public Facilities	**14** Electrical and Optical Equipment
15 Services to Households and Other Services	**15** Transport Equipment
16 Education	**16** Manufacturing, Nec; Recycling
17 Health, Social Security and Social Welfare	**17** Electricity, Gas and Water Supply
18 Culture, Sports and Entertainment	**18** Construction
19 Public Management and Social Organizations	**19** Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
	20 Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
	21 Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
	22 Hotels and Restaurants
	23 Inland Transport
	24 Water Transport
	25 Air Transport
	26 Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
	27 Post and Telecommunications
	28 Financial Intermediation
	29 Real Estate Activities
	30 Renting of M&Eq and Other Business Activities
	31 Public Admin and Defence; Compulsory Social Security
	32 Education
	33 Health and Social Work
	34 Other Community, Social and Personal Services
	35 Private Households with Employed Persons

In summary:

2011 SAM:

GDP: 47.219 bn RMB= 21.218 bn RMB Compensation of employees + 7.371 bn RMB Taxes on production and imports, less subsidies + 18.630 bn RMB Gross operating surplus.

2.6.2 Block of value added

The value-added block refers to the generation of value added and payment of primary factors of production to institutional sectors. This payment comprises salaries and capital payment (machines, buildings and other equipment). In general, the value added for each production activity is calculated by taking the difference between the value of total production shown in the total row and the value of intermediate consumption used. The value added is shown in the SAM by monetary flows from production activity accounts in columns to the labour and capital accounts in rows.

The transactions are associated with the block (2), (3), (10) and (11) in figure 9. On the revenues side of the accounts there is value added generated at the industry level in the production process (2), that is a cost of the industry accounts (already presented in the industry accounts). On the costs side, there are primary income distributed to the institutional sectors (block 3) and primary income distributed abroad (block 11). Considering four institutional sectors: Rural households, Urban households, Corporations, Government; there is also one further account for the Rest of the World (RoW).

As mentioned above, data on the payments to the components of value added are obtained from connection from WIOD table and Value added table from NBS. Taking in account the entries of production account, data on the distribution of primary income was obtained through several re-allocations.

The first step concerned the accounts of compensations of employee (wages and salaries, employers' social contributions. Compensation of employees (transaction D1 of SNA) is the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period. Compensation of employees is broken down into: wages and salaries (in cash or in kind) and employers' social contributions. Depending on this, total amount of compensation on employee was imputed to households that was split for rural households, urban households and Row.

To achieve this purpose, some steps were followed:

1. Firstly, it was determined the correct share of rural and urban population (using Table 3.5 Total Population by Urban and Rural Residence and Birth Rate, Death Rate, Natural Growth Rate by Region for 2011[20]). In 2011, the share of urban population was 51% instead the share of rural 49%. The distinction between urban and rural population differs more markedly when it goes to analyze the data for individual regions rather than on the total[21].
2. After that, it was considered the tables (from NBS) of "Per Capita Annual Income of Urban Households and Rural Households" detailed by region for 2011. In these, for every region, there are presented different sources of household's income: income from wages and salaries, income from properties, income from transfer, net income

[20] http://www.stats.gov.cn/tjsj/ndsj/2012/indexeh.htm

[21] The regions with the largest number of rural households are: Tibet, Guizhou, Yunnan and Gansu. For more details, see in the appendix the figure 1.D.

(only for rural household, income from operations[22]). In order to get the total values, in the table of rural households every component of income was multiplicated for the rural population and the same thing was repeated in the same way for urban households (for getting the total). This step was carried out to verify that there weren't sensible gaps in the aggregate data between external accounts and SAM.

3. Concerning the amount to ascribe to RoW, it was considered the table of "Flow of Funds Accounts" (from NBS). (In particular, it has been considered the values showed in the portion table in Appendix 1)

One that the RoW portion it has been define it was possible to calculate the percentage share and make reallocations (See the Appendix figure 2.5.2b).

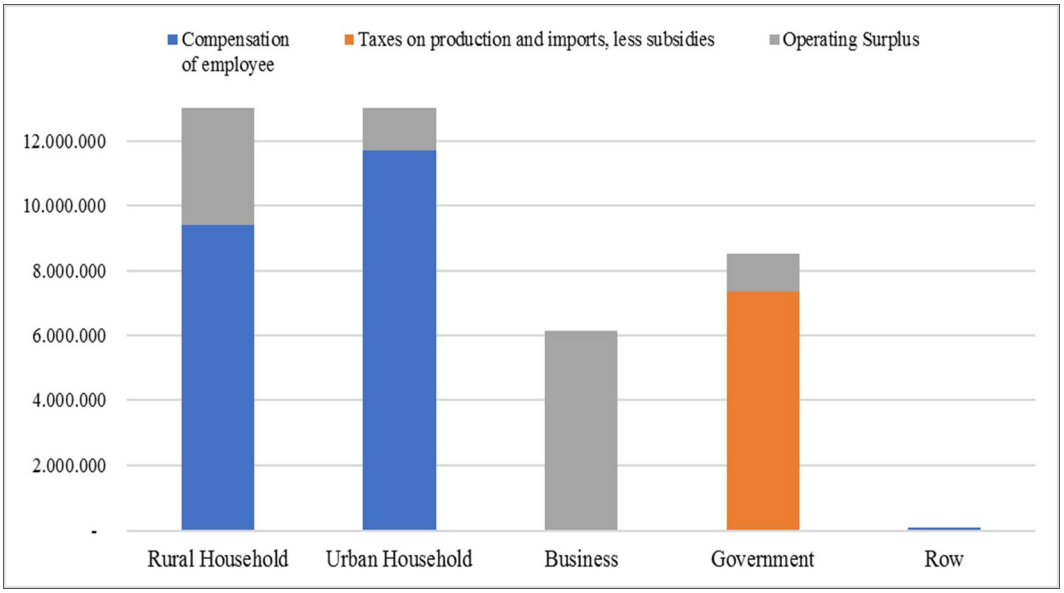
Taxes on production (transaction D29 of the SNA) minus the (other) subsidies on production (transaction D39 of SNA) consist of all taxes that corporations incur as a result of engaging in production, regardless of the quantity or value of the goods and services produced or sold, and that are paid to the government. Concerning this, taxes on production and imports less subsidies, it has been totally attributed to Government. It has been considered that units of the general government sector, except government administrative units, have to pay taxes on production. These taxes include turnover taxes, taxes for urban maintenance, taxes on buildings, stamp taxes, taxes on the use of urban land, taxes on the use of vehicles and ships and licensing taxes. The taxes on production, net paid by these units are estimated by using Taxes Statistical Yearbook, which provides data on taxes by branches and by categories of taxes.

For household sector, the gross operating surplus is calculated as the difference between the value added and compensation of employees plus taxes on production, net. This approach is consistent with the 1968 SNA but is not strictly in accordance with the 1993 SNA which introduced the concept of "mixed income" for households. Mixed income includes the return to the labour supplied by self-employed persons, as well as the operating surplus which is the return to capital and entrepreneurship. In the accounts for Government, the operating surplus, is equal to the depreciation of fixed assets owned by the units of the general government sector.

[22] Refers to income by the rural households as units of production and operation. Operations by rural households are classified according to their economic activities namely agriculture, forestry, animal husbandry, fishery, manufacturing, construction, transportation, post and telecommunications, wholesale, retail and catering, social service, culture, education, health, and other household operations. Source: http://www.stats.gov.cn/tjsj/ndsj/2013/indexeh.htm

Hence, for re-allocate operating surplus, it was necessary built a submatrix. After taking into account the amount to ascribe to corporations and to government (from the external accounting), for difference has defined the value to be allocated to households. Then, it was subsequently re-proportioned to the share of rural and urban households obtained previously. Figure 13 represents the final block matrix of primary distribution of income for institutional sectors.

Figure 13- Primary distribution of income for institutional sectors



2.6.3 Block of the institutional sectors

The accounts of the institutional sectors describe sources and uses of the national income of the institutional sectors. They combine the secondary income distribution and the use of the disposable income accounts. The first accounts show how the balance of primary incomes (national income) is transformed into disposable income through the receipt and payment of current transfers; the third account shows how gross disposable income is distributed between final consumption and saving.

On the revenues side of the accounts there are primary income (3), already presented as cost of the accounts of the components of value added, transfers from the institutional sectors (4) and from the rest of the world (12). On the costs side there are transfers to the institutional sectors (4), to the rest of the world (12) and the uses of the disposable income, which consist in final consumption (5) and gross savings (6) of the institutional sectors.

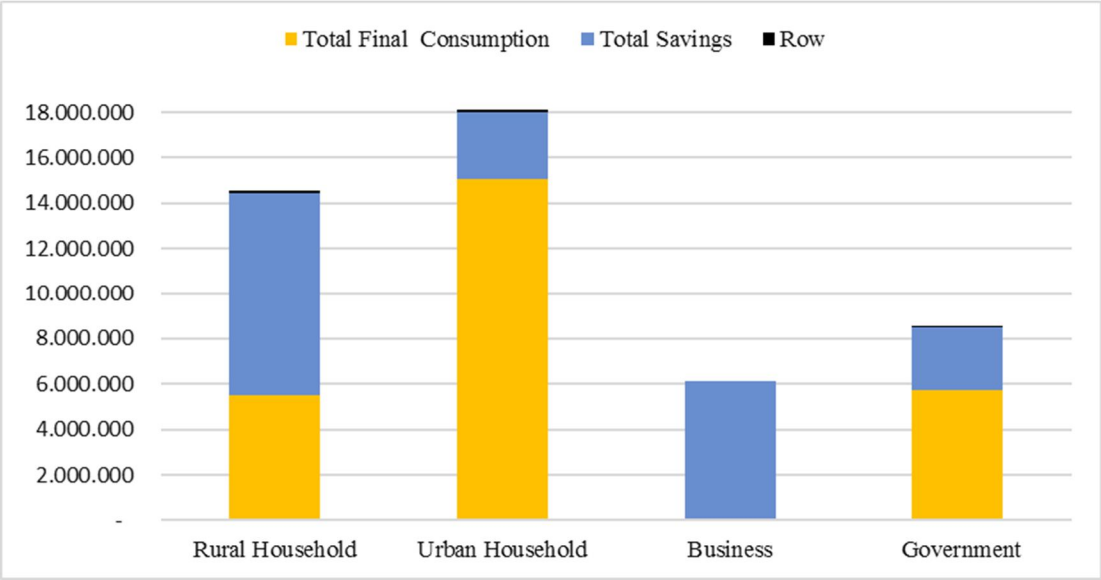
As mentioned above, data on the distribution of primary income to the institutional sectors are obtained through re-allocations. Regarding the block of current transfers[23] from institutional sectors, it is necessary to specify that for lack of details about some data, in this SAM there aren't some values of secondary distribution; in particular, regarding all transfers between the institutional sectors (rural households, urban households, and government). In fact, there is the presence of miscellaneous transfers where it is difficult to trace the institutional sectors involved (especially for: inter-household transfer, Transfer from Government to corporations, transfer from corporations to rural and urban household). However, during the construction of SAM, all the accounts of secondary distribution have been analyzed. In particular: current transfers of household sector (taxes on income, social contributions, social insurance of rural and urban households) current transfers of Government (Current taxes on income and wealth, Social contributions, Social insurance benefits, Social assistance benefits), Current transfers of Corporations (Corporations current transfer payments, Taxes on corporate income) (See in the Appendix the tables 1.G.12, 1.G.4) Final consumption, consists of expenditure incurred by resident institutional units on goods or services that are used for the direct satisfaction of individual needs or wants or the collective needs of members of the community. Final consumption expenditure may take place within the domestic territory or abroad. Data of final consumptions, are obtained from the final demand block of the input-output table (WIOD). In input-output table final consumption data are detailed in: Final consumption expenditure by households, Final consumption expenditure by non-profit organisations serving households (NPISH) and Final consumption expenditure by government.

For this reason, it was necessarily splitted the values for rural household consumption, urban household consumption, and government. For do this, it was take into account the external table of NBS. In particular, for splitted final consumption for rural and urban household it was utilized the table "Household Consumption" that detailed the use of income for rural an urban household. (see in the appendix figure 1.G.2). Instead, for Government, such as the block of production, it was made a reconciliation of value between WIOD and the table from

[23] They represent monetary flows which exist between the various institution accounts. Theses are payments between household accounts, payments from corporate accounts to household accounts, payments from the State account to household accounts and corporate accounts, payments from the Rest of the World account (emigrates) to household account and payments from household accounts to the rest of the world account.

NBS. It was considered the table ". Main Items of National Government Expenditure" (see in the appendix figure 1.G.3).

Figure 14- Composition of final consumption and gross savings for institutional sectors



2.6.4 Block of Capital formation

Capital account, describes, on the one hand, investment through gross capital formation and capital transfers, and, on the other hand, the funds available for such investments, resulting from gross saving and capital transfers, as well as from a balance corresponding either to financing requirements, depending on the respective sign.

This, refers to all payments made by the savings and investments account to the goods and services account. The transactions are associated with the sub-matrices labelled with (6), (7) and (14) in figure 9. As already specified, there are four institutional sectors: Rural Households, Urban Households, Corporations, Government.

On the revenues side of the accounts there are gross savings (6), that are cost of the accounts of the institutional sectors and measures the portion of the aggregate income that is not used for final consumption expenditure and current transfers to Chinese institutions or to the RoW; net lending to (-) or net borrowing from (+) the rest of the world (14), that represents the net resources that the total economy makes available to the rest of the world (if it is positive) or receives from the rest of the world (if it is negative). On the costs side, there are Investments and stock variations by industry (7), which records investment transactions and capital transfers for four institutional sectors.

Savings are accumulated in four capital accounts: capital account for Rural Households, capital account for Urban Households, capital account for Corporations, capital account for Government. Data of savings and net lending to (-) or net borrowing from (+) the rest of the world for each istitutional sector was obtained from the Flow of Funds Accounts from NBS (see the figure 1.G.4 in Appendix). Data on investment by industries are obtained from the final demand block of the input-output table released by WIOD reconciliated with the external table of NBS.

2.6.5 Block of the Rest of the World

The account of the rest of the world collects the transactions that take place between China and the other countries. The transactions are associated with the sub-matrices categorized with (8), (9), (11), (12), (13), (14) and (15) in figure 9.

On the revenues side of the account there are Imports (9), Primary Income distributed abroad (11), already presented as cost of the accounts of the components of value added), and net lending to (-) or net borrowing from (+) the rest of the world. On the costs side, there are Exports (8). Finally, for (14) “Net c net lending to (-) or net borrowing from (+) the rest of the world” was calculated through the Balance of payments table of 2011 by NBS. (see Appendix).

2.7 Balancing procedure

In an accounting matrix context, there are several problems that characterise matrices of balancing situations. One of these problems, more usual SAM is called "balancing problem” where, though account totals may themselves be unknown, there are accounting restrictions on corresponding row and column totals (Round,2003).

The information for China SAM construction comes from quite diverse sources; as a result, they often present discrepancies. For this reason, placing these data within the SAM framework has determined one inconsistency between the receipts and expenditures of each account. To assure agreement with the sum constraints, we apply the well-known iterative procedure of biproportional adjustment of the RAS technique. Stone (1962) and Stone & Brown (1962) developed this particular biproportional procedure that has become known as ‘RAS’, due, it seems, to the notation Stone used in a series of papers on the topic. While the A in the name ‘RAS’ clearly denoted the direct requirements matrix in a Leontief setting, one

could immediately surmise through observation that the matrices, which Stone used to pre- and post-multiply A in his papers, are labelled suspiciously similar to the author's initials (Lahr and De Mesnard, 2004).

RAS is a widely uses methodology to balance SAMs. It is used when new information on the matrix row and column sums becomes available and we want to update an existing matrix. The RAS procedure tends to preserve as much as possible the structure of the initial matrix, with the minimum amount of necessary changes to restore the row and column sums to the known values (Miller and Blair, 2009).

The problem is to generate a new nxn matrix A_1 from an existing matrix A_0 of the same dimension while respecting new given row and column totals, by apllying row and column multipliers, r and s respectively.

Define T as a matrix of SAM transactions, where t_{ij} is a cell value that satisfies the condition:

$$T_J = \sum_i t_{ij}$$

A SAM coefficient matrix is constructed from T by dividing the cell in each column of T by the column sum:

$$a_{ij} = \frac{t_{ij}}{t_j}$$

The classic approach to solve this problem is to generate a new matrix A_1 from the old matrix A_0 by means "biproportional" row and column operations:

$$a_{ij}^1 = r_i \, a_{ij}^0 \, s_j$$

In matrix annotation:

$$A^1 = \hat{R} \, A^0 \, \hat{S}$$

Where the annotation ($\widehat{\ }$) indicate a diagonal matrix f element r_i and elements s_j. RAS method is an iterative algorithm of biproportional adjustment. According to the literature, this should be surrounded either by a while-loop that stops when R and S are both sufficiently close to identity matrices or by a for-loop for a large enough number of cycles to ensure convergence (Stone, 1962)

2.8 Conclusion part I

This section has described the construction of a Social Accounting Matrix (SAM) for China for the year 2011.

The SAM displays a number of distributional features of the Chinese economy, of which the most important are:

- The industry sectors that mostly give their contribution to the Value-Added generation are “Agriculture, Hunting, Forestry and Fishing”, “Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles” and “Construction”.
- Considering the distribution of the population, the share of urban and rural population on total is almost equally distributed (Urban Households 52%, Rural households 48%). However, considering the single provinces, the distribution of rural and urban households change. In particular, Tibet, Guizhou and Yunnan are the provinces with higher percentage of rural households share, while Shanghai, Beijing and Tianjin have higher share of urban households. Geographically, urban areas are more concentrated along the coast, while the rural areas are mainly collocated in the interior.
- Considering the primary distribution of income, rural households have a lower level of income, compared to urban households. The income gap between coastal China and the interior is significant. In 1992, the average income in coastal provinces were 50 percent higher than in the interior. A main reason is that the coastal areas were in a better position to benefit from economic reforms and the open doors policy. Important factors were proximity to world markets, better infrastructure and more educated work force. (World Bank, 1997). Moreover, the consumption propensity of urban household is higher than rural. In particular, urban households expenditure is higher, between the others, in the “Education”, “Real Estate Activities”, “Agriculture, Hunting, Forestry and Fishing”, “Food, Beverage and Tobacco” sectors.
- Considering the savings, it is possible to see that the corporate institutional sector is characterized by a higher level of savings and investments. This aspect refers to the industrial structure of the country, where corporations include state-owned ones. Regarding the savings propensity, it is higher for the rural households (in any case, it is observed that the Chinese are used to save a significant portion of their income).

- By analysing the 2011 Chinese Balance of Payment, China has been presenting a positive balance of payment. The main reason of this result is due to Current Account section, where the Export is higher than the Import, particularly in the goods manufacturing sectors (like “Electrical and Optical Equipment”, “Textiles, Textile Products” and “Chemicals and Chemical Products”). For what concerns services related sectors, instead, the ones that affect more the positive balance of payment are “Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles” and “Real estate, renting and business activities”. Instead, in the section Capital and Finance Account, the extremely positive balance is due to the high level of FDI (Foreign Direct Investments) in China.

To arrive at a SAM that captures these distributional features in a consistent way, data from different sources – primarily the 2011 Input-Output table, the 2011 national accounts, and two household surveys for 2011 had to be reconciled. Moreover, various assumptions had to be made because at the given level of disaggregation not all the required information was available. The resulting data base is therefore in parts somewhat stylized, but it is a reasonable approximation of the structural characteristics prevailing in China, rendering it a useful starting point for further analysis.

Chapter 3
EXTENDED MULTISECTORAL MODEL FOR ENVIRONMENTAL CHINESE ISSUES

Taking carbon dioxide (CO2) as indicator of environmental degradation, this work addresses the following question: what is the impact of income distribution on CO2 emissions and on the CO2-income relationship? Consider this research's question, the aim of this chapter is to design economic policies for the reduction of CO_2 emissions in China consider the distributional analysis of Chinese economy. Important was made to assess a new structure for the final demand which would be able to achieve a composite task: the economic sustainability and the environmental improvement. The analytic framework chosen for addressing this purpose has been a multisectoral model that extended input-output analysis to income generation, distribution and final demand formation.

In the first part of this chapter, it will be present some studies that underline the role of income distribution in the environmental problems. the two approaches of multisectoral models in particular the Miyazawa contribution (Miyazawa, 1970) and Pyatt and Round contribution (1979). The Multisectoral model proposed is based on the Social Accounting Matrix (SAM) builted for 2011, that is the database on which the parameters of the model are calibrated. Besides, with the purpose to evaluate the compatibility between the environmental and economic objectives for the Chinese economy, in the second part of this chapter it will be show how SAM has been integrated with the environmental data set concerning CO_2 emissions by each industry provided by environmental accounts of WIOD. Policy design has been based on Leontief multipliers analysis that helped in showing the impact of the structure of macroeconomic variables.

3.1 The impact of income on environmental issues

Today, the argument that environmental degradation will reduce future benefits from economic activities is well accepted. Most countries consider improvement of environmental quality an integral part of their overall objectives (Lutz, 1993). However, for developing countries such China, strong economic growth and better income distribution are still the immediate goals. Literature concerning the relationship between environmental quality and

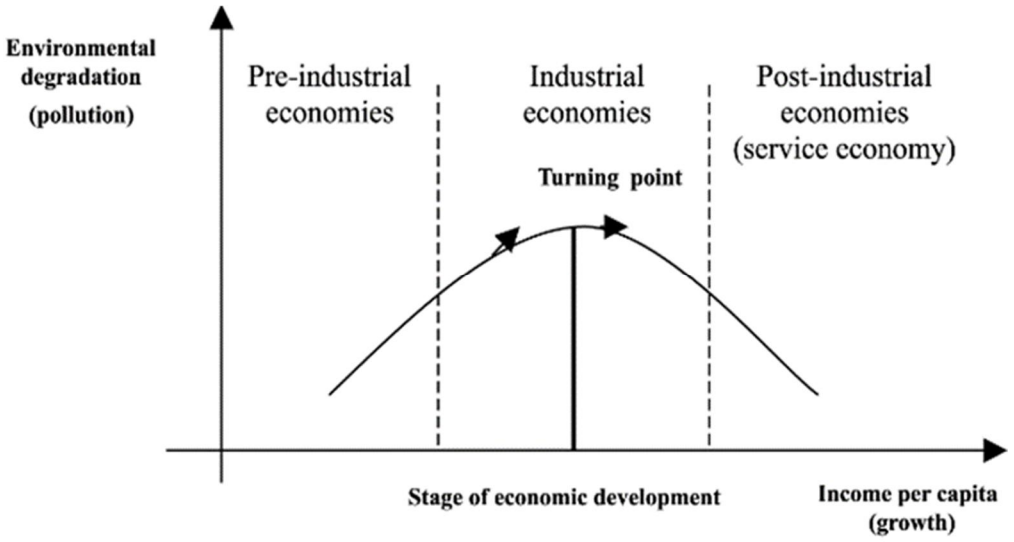
economic activities has been available since 1970. In that year, Leontief (1970) expanded an input-output table to include pollution generation and abatement.

Denison (1979) was also a pioneer in the subject of environmental quality and economic activities. He used a growth accounting model to analyze the impact of pollution abatement policies on US economic growth between 1929 and 1978. The relationship between environmental quality and economic activities has been empirically modeled through emissions–income relationship by many authors, in fact, this topic has remained a debated issue over the last ten years. Several studies, on the subject, have argued that level of environmental degradation and economic growth follows an inverted U-shaped relationship. The relationship between environmental quality and economic growth has been empirically modeled through emissions–income relationship by many authors, and the outcome of most of these studies has been formulated by the so called environmental Kuznets curve (EKC) hypothesis. The EKC hypothesis proposes that there is an inverted U-shape relation between environmental degradation and income per capita, or a U-type relationship between environmental quality and income per capita has also been reported (DeBruyn et al.,1998, Heil and Selden, 2001; Holtz-Eakin and Selden,1995; MoomawandUnruh,1997).

Moreover, the growth–environmental pollution nexus has been tested by many after Grossman and Krueger (1995) and Selden and Song (1995) provided the empirical evidence that the economic growth will lead to a gradual degradation of environment in its initial stages and then, after a certain level of growth, it leads to an improvement in the environmental conditions. Later, Panayotou (1993) [2] proposed the Environmental Kunzites Curve (EKC) to illustrate how environmental quality would be deteriorated in accordance with an increase in GDP Per Capita, and improved when income level rises to a certain degree. At present, there is a consensus in academia that EKC exists in the current economy, but the relative inflexion point, which is the bottom of the curve of EKC, will not appear spontaneously. This realization has led some researchers to investigate the underlying drivers and structural determinants of such a relentless growth.

At present, there is a consensus in academia that EKC exists in the current economy, but the relative inflexion point, which is the bottom of the curve of EKC, will not appear spontaneously. Therefore, it is valuable to discuss factors which can accelerate or slow the coming of the inflexion point of EKC, and income distribution is one of the most important factors which can affect the inflexion significantly.

Figura 15- Environmental Kuznets curve



Source: Panayotou (1993*)*

For these reasons, it has been analyzed the most importat literatures which consider that an imbalance in income distribution is detrimental to the improvement of environmental quality. Boyce (1994) was the first author to investigate how inequality affects environmental degradation from the theoretical viewpoint. In particular, he publishes the pioneering study in this scope and concludes that the rich would have always had more social power and prefer to consume more high-polluting goods but bear less responsibility for the corresponding always resulted from an unequal income distribution. Therefore, the greater the income distribution differential, the worse the environmental quality.

Scruggs (1998) has criticized the hypotheses set forth by Boyce. The author claims that there is no necessary causal link between inequality and environmental degradation and that the former may or may not increase the latter. Firstly, he considers that income distribution has nothing to do with environmental policy upon real democratic politics, but he also considers that based on the social paradigm propose d by Hofrichter and Reif (1990) the relation between income distribution and environment quality should be reversed when the income per capita reaches a certain level. Therefore, he concludes that there is an uncertain relationship between income distribution and environment quality which would be affected by factors such as different preferences regarding environmental quality, relative policy, etc. From the discussion on the relation between pollutant emissions and income distribution, Ravallion et all. (2000) believes that there is a reciprocal relationship between income distribution and environmental quality and the relation would be weaken over the long-term.

In particular, The authors argue that each individual has an implicit demand function for carbon emissions since the consumption of almost every good implies some emissions either directly (through consumption) or indirectly (through its production). They call “marginal propensity to emit” (MPE) the derivative of this demand function with respect to income. In general, the study has higlighted that the impact of inequality on emissions is ambiguous and depends on whether the MPE rises or falls as income grows, that is, on the second derivative of the CO2-income function. Heerink et al. (2001) makes an empirical study about the relation between individual income level and environmental quality and his conclusions contradict the arguments of Boyce (1994). In particular, the study suggests that the imbalance of income distribution would be inclined to improve the regional environmental quality.

Beyond these theoretical arguments, we can also find some other causal links between inequality and environmental degradation. Much of the theoretical environmental literature has stressed the need of cooperative solutions to environmental problems. In an unequal society, this is more difficult to achieve than in an equal society since there are generally more conflicts among the political agents (government agencies, lobbies etc.) on many social issues. In this sense, greater inequality can contribute to increase environmental degradation (Borghesi, 2006).

3.2 Principles of Multisectoral analysis: Miyazawa’s model

The extended input-output model differs with respect to both the traditional input output and the keynesian income multiplier models in a major aspect. In those models, any change in the internal composition of the autonomous final demand that leaves the total value of autonomous final demand unchanged has no effect on total value added generated. On the contrary, in the extended model, changes in the internal composition of the autonomous final demand give rise to different values of total value added generated in the production process. The closure of an input-output model with respect to households consumption introduces in the model a keynesian behaviour. Value added generated in the production activity stimulated by an exogenous change in final demand contributes to the formation of additional (endogenous) final demand, which in turns stimulates production activity. These are only the first steps of a converging process of infinite length. Total output is determined by a combination of the traditional output multipliers and the Keynesian income multiplier.

The solutions to the problems of income generation, distribution and final demand formation proposed by Miyazawa and Masegi (1963) have revolutionised the way in which input-output analysis was considered. This branch of research, which was initially relegated to the study of interindustry relationships of production, opened its frontiers to the wider sphere of the study of the income circular flow. In many ways, Miyazawa's work in linking income distribution impacts to input-output system may be seen as a parallel to Stone's work in the creation of social accounting system. In 1963 Miyazawa presented an extended model where different income groups have di different keynesian consumption functions (Miyazawa 1960, 1968). In two seminal pubblication, he traces the development of the income multiplier from the relatively simple Keynesian structure to the full interrelation income multiplier[24]. In particular, in Miyazawa main contribution of 1976 "Input-Output Analysis and the structure of Income Distribution" presented the linkage between Leontief and Keynesian effects in the generation of income distribution effects. He allowed the flexible inclusion of a certain number of more general categories of income, which could be distinguished by region or by income groups. In the model, it assumed only a single household type, no direct expenditure payments between households as labor income, and exogenous import.

Given n industries and r income-groups where n is the number of industries and r is the number of income groups, where A is the conventional $(n \times n)$ matrix of technical coefficients $(a_{ij} = x_{ij}/x_j)$, C is the $(n \times r)$ matrix of consumption expenditure for each sector out of unit household income earned by each household type, and household income $(c_{ik} = c_{ik}/Y_k)$, V is the $(r \times n)$ matrix of household income by household type per unit production for each industrial sector[25] $(v_{kj} = Y_{kj}/x_{j)}$, y is $(r \times 1)$ vector of household total income, f is the $(n \times 1)$ vector of exogenous final demand g is the $(r \times 1)$ vector of exogenous income injections, The Miyazawa model can be easily expressed by the following system of equations:

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} A & C \\ V & I \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} f \\ g \end{bmatrix} \tag{3.8}$$

[25] In other words, is the matrix of value added coefficients whose elements represent the share of value added allocated to the different income-groups by the diffeerent industries.

The model can be solved by inverting the extended matrix of coefficients. The equilibrium production can be solved by transforming Equation (1) as:

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} I - A & -C \\ -V & I \end{bmatrix}^{-1} + \begin{bmatrix} f \\ g \end{bmatrix} \tag{3.9}$$

We obtain the solution as:

$$X = (I - \bar{A})^{-1} f = \begin{bmatrix} B(I + CKVB) & BCK \\ KVB & K \end{bmatrix} \begin{bmatrix} f \\ g \end{bmatrix} \tag{3.10}$$

Where $B = (I - A)^{-1}$ is equal to the conventional inverse of Leontief, I is the identity matrix, $K = (I - VBC)^{-1}$. $B(I + CKVB)$ is the disaggregated version of the macro-multiplier shown.

Here, VBC, in Miyazawa's word shows the "interrelationship among income groups in the process of propagation resulting from each income group's consumption expenditure pattern[26]". In other words, consumption C is propagated through the Leontief'inverse B to generate change in industrial gross output as results of consumption. This is then converted by V to income. Miyazawa calls VBC the "matrix inter-come group coefficient".

Turning to income ad dependent variable, Miyazawa defines the relationship in the usual way:

$$Y = VX \tag{3.13}$$

Where Y is a column vector of incomes of order r. From equation (11) we obtain:

$$Y = VB(I + CKVB)f = (I + VBCK)VBf \tag{3.14}$$

Since $K = (I - VBC)^{-1}$, the following equation is also true:

$$(I - VBC)K = I \tag{3.15}$$

Hence:

26

$$K = I + VBCK \tag{3.16}$$

So, that:

$$Y = KVBf \tag{3.17}$$

Where KVB is the "multisector income multiplier in matrix form" and is the interrelational income multiplier K post multiplied by the coefficient matrix of induced income of VB. Therefore, Equation (3.17), yields the direct, indirect and induced income of each income group that result from the initial final demand.

Miyazawa's contribution here, from which an enormous literature has subsequently development, is to show and model different values that incomes take on as a results of different final demand structure. However, the description of the income circular flow put forward by Miyazawa and Masegi (1963) is not completely satisfactory. The mechanism of transmission that transforms income generated in production in final consumption is quite rough. The disposable income of the institutional sectors, on which depend consumption and saving behaviours, is something other than the components of value added that are remunerated in the production process. There are some missing relationships between value added generation and final demand formation.

3.2.1 SAM base model

Continuing the line of research focused on the development of multi-sectoral models, after Miyazawa's contribution, the latter models were based on SAM matrices.

In particular, SAM-based model describes a wider set of economic relationships than an input-output model and the circular process of production is extended to the income circular flow (Pyatt and Round, 1979). Revenues of any endogenous account are converted into outows that are allocated to the other accounts according to the proportions given in the SAM. The main result of the use of these assumptions is that models built on SAMs represent the circularity in the whole economic system as opposed to the input-output models that describe the circularity in the production sphere.

An exogenous shock in final demand activates an iterative process that, unlike in the input-output case, is not circumscribed to the production sphere. Value added is no more considered

as an open end of the model, which receives payments but doesn't stimulate further production activity. Moreover, value added generated in production is attributed to the institutional sectors, which in turn redistribute it among themselves and, by using it, stimulate further final demand.

The first question to address in a SAM-based framework is which accounts should be considered exogenous and which endogenous. The need for this, arises from the fact that there must be an entry into the system, for example some variables must be manipulated exogenously via injections in order to evaluate the consequences on the endogenous accounts. As a general guideline, accounts a priori specified as objectives or targets when the SAM was built should be made endogenous. On the other hand, the accounts intended to be used as policy instruments, or beyond the control of the domestic economy and institutions, should be made exogenous (ALARCON, 2000).

The representation of the SAM table in figure 3.3 lends itself to be used in economic modelling. The endogenous accounts have been grouped by class and placed in the first rows and columns and the exogenous accounts have been aggregated and are presented as the last account of the table. Matrix T_{ij} represents payments of the endogenous accounts of type j to the the endogenous accounts of type i, vector x_i represents payments of the aggregated exogenous account to endogenous accounts of type i, vector I_j represents payments of the endogenous account of type j to the aggregated exogenous account, r represents payments of the exogenous account to itself and vector y_i represents row/column totals of the accounts of type i.

Table 4 - Endogenous and exogenous accounts in a SAM.

		Endogenous accounts			Exogenous accounts (aggregate)	Total
		Production	Factors	Households		
Endogenous accounts	Production	T_{11}		T_{13}	X_1	Y_1
	Factors	T_{21}			X_2	Y_2
	Households		T_{32}	T_{33}	X_3	Y_3
Exogenous accounts (aggregate)		I_1	I_2	I_3	r	Y_4
Total		Y'_1	Y'_2	Y'_3	Y'_4	

Sources: Adapted from Cohen (1989)

Like an input-output model, the matrix of endogenous transactions, which are represented in summary form by the matrix T_{ij} , can be used to define a matrix A of column shares, by dividing
elements in each column of T by its column total:

$$T = Ay \tag{3.18}$$

Where T and A have, partitioned structure shown in Figure 3.3. The elements of matrix A_{ij} represent, depending on the indices i and j, technical coefficients (A_{11}) value added coefficients, primary income distribution coefficients (A_{32}), transfers coefficients $(A_{33})$and consumption coefficients (A_{13}), and the elements of vector $\hat{u}_{ij}$ represent the leakages of the model. Matrix A_{ij} is obtain by dividing the elements of matrix T_{ij} by the column totals of the accounts of type j, $A_{ij} = T_{ij}/\hat{y}_j$, vector $\hat{u}_j$ is obtain by dividing the elements of vector $\hat{u}_j$ by the column totals of the accounts of type j, $\hat{u}_{ij} = I_j/\hat{y}_j$.

In SAM-based models, like the one presented in Pyatt and Round (1979), the costs of the endogenous accounts are modelled in the same way of the payments of the industries accounts in input-output analysis. As intermediate demand and value added payments depend linearly on total output of the purchasing industry, value added allocated to the institutional sectors depends linearly on value added generated in production, and transfers, consumption and savings depend linearly on total revenues of the institutional sectors.

On the basis of this assumption the identity between total revenues of the exogenous accounts and the various sources of revenues can be expressed as:

$$\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix} \equiv \begin{bmatrix} A_{11} & 0 & A_{13} \\ A_{21} & 0 & 0 \\ 0 & A_{32} & A_{33} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \tag{3.19}$$

So that:

$$Y_4 = \hat{u}_1 y_1 + \hat{u}_2 y_2 + \hat{u}_3 y_3 + r \tag{3.20}$$

Equation (3.19) can be represented in a more compact notation:

$$y = A_n y + x \tag{3.21}$$

Where y is the vector of total revenues of all the endogenous accounts, x is the vector of payments of the aggregated exogenous account to all the endogenous accounts and A_n is the matrix that incorporates all the structural matrices A_{ij} .

SAM multipliers can be obtained by inverting the matrix derived by subtracting the matrix of coefficients A from the identity matrix

$$y = (I - A_n)^{-1}x = Mx \tag{3.22}$$

Where M is the SAM multiplier matrix More precisely, it is a matrix of 'accounting' multipliers "because it explains the results obtained in a SAM and not the process by which they are generated" (THORBECKE, 2000). Thus, from (3.22), endogenous incomes y (for example production activity incomes, Y_1, factor incomes, Y_2, and institution incomes, Y_3 as shown in Table 3.3) can be derived by premultiplying injection x by a multiplier matrix M.

Apart from the notation utilized, equation (3.22) is formally identical to equation (3.25) and the SAM inverse resembles the Leontief inverse. However, the variables considered in the SAM-based model of equation (3.21) are not only output levels, but also value added components and revenues of the endogenous current accounts, and the SAM multipliers in matrix M are generally larger than those in the Leontief inverse because the model takes into account all the steps of the income circular flow. For instance, the outcomes of an exogenous shock in final demand are amplified from the fact that value added generated in the production process is converted into primary income of the institutional sectors, which in turn redistribute it among themselves and, by consuming, give rise to additional final demand.

The most important feature of the matrix of multipliers in equation (3.22) is the possibility of decomposing it in economically meaningful ways, gaining extra insight into the economic processes described. As described in Pyatt and Round (1979), the first decomposition, is of multiplicative type; the matrix of multipliers can be expressed as:

$$M = M_3 M_2 M_1 \tag{3.23}$$

The three matrices represent different effects generated by an exogenous injection. M_1 accounts for the "intragroup" effects, that is those effects that "move around within the

subsystem "in which the injection originated"; in the case of production, the intragroup effects are described by the Leontief inverse matrix. M_2 accounts for the "intergroup" effects, that is those effects that move around the whole system and return to the subsystem "from which the injection originated". M_3 accounts for the "extragroup" effects, that is those effects that "move around and end up in one of the other subsystems (Stone, 1965).

The second variant, described in Stone (1985), is a decomposition of additive type. Therefore, the matrix of multipliers can be expressed as the rationship 3.24 that is as a function of the matrices just presented.

$$M = I + (M_1 - I) + (M_2 - I) + (M_3 - I)M_2M_1 \tag{3.24}$$

In summary, once the SAM is built with all the accounts in a consistent framework, this forms the transaction table providing the basis for the multiplier analysis to be undertaken. The framework can be used to measure the impact of changes in the exogenous accounts on the whole system. Although the multipliers obtained using the SAM as a linear model allow to capture the structural features of income distribution and the interrelations among various economic agents, the model rests on some critical assumptions. It assumes that there exists excess capacity that would allow relative prices to remain constant in the face of demand shocks; that expenditure propensities of endogenous accounts remain constant; and that production technology and resource endowments are given for a period.

A relevant feature of a SAM-based model is that, in general, any variable considered in the SAM can be the source of an exogenous shock and the effect of any given exogenous shock can be evaluated on any variable considered in the SAM. Therefore, a SAM-based model is more complete than a traditional input-output model where the only variables that are investigated are those related to the production sphere. Furthermore, the need to handle a specific set of variables in the model can lead the researcher to gather new data which are used to disaggregate some accounts of the SAM.

3.4 The extended multisectoral model

In traditional input-output analysis final demand, completely exogenous, determines total output through a multiplicative process channeled by interindustry technical relationships (Leontief, 1951). This kind of models completely lacks a keynesian mechanism connecting

income generation to consumption and thus an income multiplicative effect. On the contrary, in basic keynesian analysis production side is completely omitted; income is determined by the exogenous part of final demand through a multiplicative process channeled by the consumption function. However, recent developments in National Accounting have realized a substantial progress in the accounting system that integrates the Keynesian income expenditure model with the leontievian total output-intermediate comsumption framework (Lager 1988, Miyazawa 1970).

Thus, the emerging accounting scheme makes reference to an increased income circular flow: final demand generates outputs and value added at industry level, wich is distributed to factors and through these, to institutional sectors, in order to obtain after taxation disposable income by instituional sectors (Paytt, 2011).

The complerte model (Ciaschini and Socci, 2002) allows for the reconcialition of the income distribution loop by institutional sectors with the output generation loop by industries.

The closure of the model takes into account all the separate steps of the income circular flow as represented in a SAM. Through a complete set of operators, the structural matrices, the income circular flow process is described in all his separate steps. Considering Miyazawa approach, it is presented the linkage between Leontief and Keynesian effects in the generation of income distribution effects.

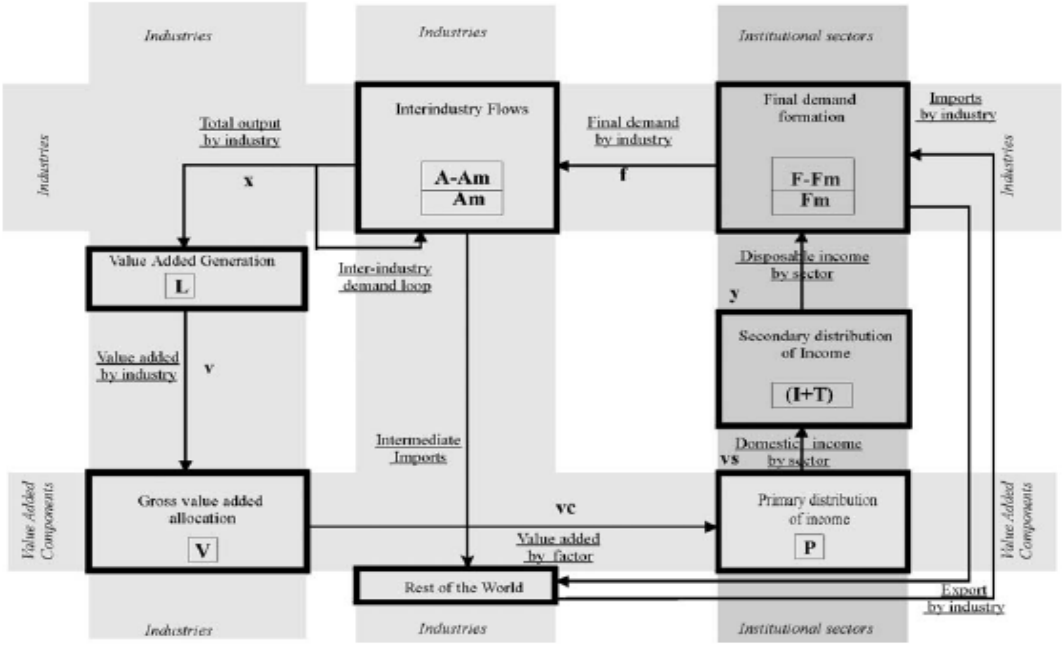
In particular, from the Social Accounting Matrix (SAM) there is an approach to the model of circular income flow that is more articulated: each macroeconomic flow variable, conveniently disaggregated, generates a second flow variable through the use of a structural matrix and progressively so on until the loop is closed. Final demands determine total outputs and value added by industry; the latter generates domestic incomes by factors which compose disposable incomes by institutional sectors; these give rise to final demands closing the loop (Ciaschini And Socci, 2006).

As shown in figure 16, the income distribution process creates a feedback loop between industry output and final demand. Each arrow identifies an expenditure flow while each box a matrix transformation of a flow variable into another.

In particular, the figure shows a diagram where the fundamental mechanism of production and distribution is shown in terms of interaction between industries and istitutions. The complete income circular flow, starts from the production process (that takes place at industry level), that generates total output and gross value added by the I-O industries, (Gross value

added generation). Secondly, value added by I-O industry is allocated to the value-added components, (Gross value added allocation). Value added by components is then allocated to the institutional sectors (primary distribution of income). Then, value added by institutional sectors is then redistributed among them through taxation to generate disposable incomes by the institutional sectors (secondary distribution of income). Finally disposable income will generate final demand by institutional sectors which will be transformed into final demand by I-O industries (final demand formation) (Ciaschini and Socci, 2004).

Figure 16- Rapresentation of extended output circular flow



SOURCE: Ciaschini and Socci, 2004

The characteristic of the model presented in this section is presented by the exactness of the structural relationships that connect the endogenous part of final demand to the industry activity level. Indeed, endogenous final demand is traced back to the production process going through all the steps of income generation and primary distribution.

The distinctive trait of the model presented in this section lies in the accuracy of the structural relationships that connect the endogenous part of final demand to the industry activity level. Indeed, endogenous final demand is traced back to the production process going through all the steps of (primary) income generation. Each step, transforming monetary ows one into the other, is represented by a matrix operator whose elements are derived from the SAM's blocks.

Moreover, due to lack of secondary distribution, in this model, there is a directly connection between the primary distribution of income and the generation of final demand. It assumes that an increase of the primary income of institutional sectors, generated through the formation of final demand for input-output sector, have an effect on total output.

A schematic representation of the extended income circular flow is depicted in figure 17; arrows represent monetary flows while boxes represent matrix operators that transform flow variables one into the other.

Following SAM based model, the following accounts of the SAM 2011 for China have been selected as endogenous accounts: industry accounts, primary factors account, current accounts, capital accounts. Therefore, the only exogenous accounts remain the rest of the world ones.

Consider a model with n industries, u value added components, s domestic institutional sectors, k domestic capital accounts and the "Rest of the World" sector. At the basis of the model there are some fundamental structural relationships: the assumptions of fixed prices, fixed technical coefficients, constant expenditure shares and unemployed productive capacity.

The extended I-O model starts from following fundamental equilibrium equation:

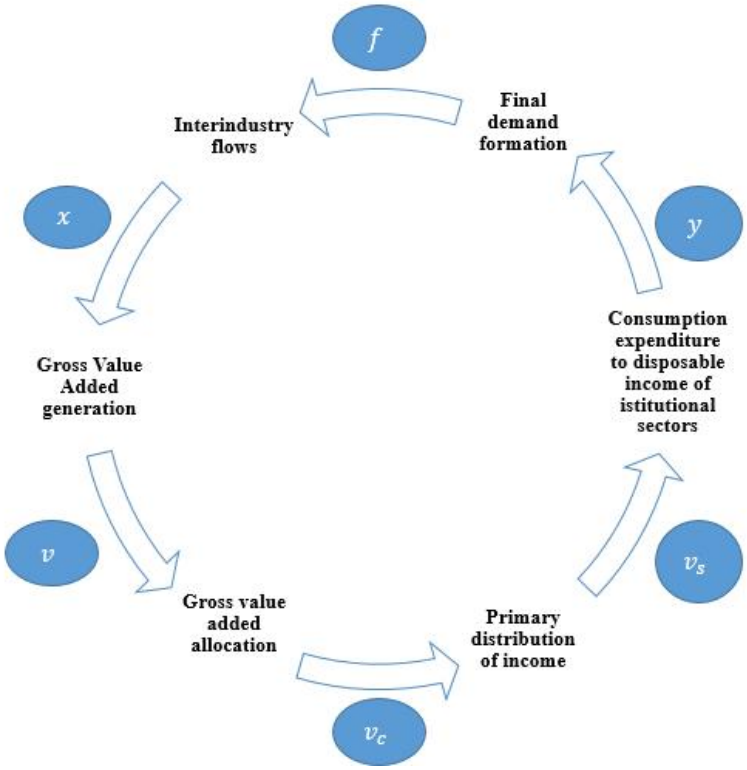
$$x + z = M \cdot i + f \tag{3.24}$$

Where x is $(m\times1)$ output vector by industry, M (nxn) is the matrix of the intermediate consumption flow, $i(nx1)$ is the vector row sum, z $(m\times1)$ is imports vector, f the $(m\times1)$ vector of final demand. (Miller and Blair,1985).

The direct and indirect output requirements for the final demand vector f is easly written in terms of the inverse:

$$x = [I - A]^{-1} \cdot f \tag{3.25}$$

Figure 17 - Income circular flow used into the multisectoral model



Where A (nxn) is the intermediate coefficient matrix which is usually determined as $M \cdot \hat{x}^{-1}$. Let denoted with R the inverse matrix, $(I - A)^{-1} = R$.

Not only intermediate demand, but also part of final demand has been endogenised. In the model presented in this chapter the only component of final demand that is left exogenous is export. Final demand at the commodity level can be expressed as:

$$f = f^{en} + f^{ex} \tag{3.26}$$

where f^{en} is the $(m \times 1)$ vector of endogenous final demand at the commodity level and f^{ex} is the $(m \times 1)$ vector of exogenous final demand at the industry level.

The first step analysed is the gross value added generation; given that the production process takes place at the industry level, gross value added is generated at the industry level and is a function of the industry output.

$$v = Lx \tag{3.27}$$

where, L is a $(n \times n)$ diagonal matrix whose elements are the ratios of value added, that is determined as the difference between the value of each industry output and its intermediate input requirements, to total output by industry. Value added is then allocated to the u value added components:

$$v^c = Mv \tag{3.28}$$

where M is a $(u \times n)$ matrix whose columns show, for each industry, the shares of value added that are attributed to the different value added components (compensation of employee, taxes on production and imports, less subsidies and operating surplus).
Following the steps of the extended income circular flow, value added by components is allocated to the (four) institutional sectors in the primary income distribution process:

$$v^s = Pv^c \tag{3.29}$$

where P is a $(s \times u)$ matrix whose columns show for each value added component, the shares that are attributed to the different institutional sectors.
As previously said, in this SAM there aren't the transaction refer to the secondary distribution of income. For this reason, there isn't represent the matrix T, that represents net income transfers among sub-sectors. Hence, the final disposable income is determined by primary distribution of income.

$$y = v^s \tag{3.30}$$

Where y represents disposable income of the institutional sector and in this application, will be considered as exogenous. Once disposable income is determined (in this case it refers to the primary distribution of income), the institutional sectors form their consumption plans on the basis of their disposable income. Hence, the final demand formation (by Input-Output industries) can be expressed as:

$$f(x) = C_0 \cdot y(x) + K \cdot y(x) + f^{ex} \tag{3.31}$$

Where C_0 provide the consumption demand structure by industry and is given by the product of two matrices:

$$C_0 = C_1 C \tag{3.32}$$

C is a (sxs) diagonal matrix whose elements represent the ratios of total consumption expenditure to disposable income of the different institutional sectors and C_1 is a $(nx\,p)$ matrix whose columns represent, for each institutional sector, the shares of consumption expenditure by commodity to total consumption expenditure. C_1 represents the consumption propensitie by institutional sector.

Instead, the investment operator K can be expressed as the product of three matrices:

$$K = K_1 \cdot \mathrm{s} \cdot (I - C) \tag{3.33}$$

where $(I - C)$ is a pxp diagonal matrix whose elements represent the ratios of total savings to disposable income of the different institutional sectors, s is a pxp diagonal matrix whose elements represent the ratios of "active savings", for example those savings that are converted into domestic investment, to total savings of the different institutional sectors and K_1 is a mxp matrix whose columns represent, for each institutional sector, the shares of investment by commodity to active saving.

Hence rewriting the equation 3.31 such as:

$$f^{en} = (C_0 + K)y \tag{3.34}$$

Substituting into the equations 3.26 then we get

$$f\,(x) = (C + K) \cdot P \cdot M \cdot L \cdot x + f^{ex} \tag{3.35}$$

It has begun with the deconstruction of final demand f into $f^{en} + f^{ex}$ the portion of istitutional sector consumption dependent of primary income within the observed time period, and f^{ex}, all other final demand components independent of income.

Let us rewrite the first part using the production as:

$$X = Ax + f = Ax + f^{en} + f^{ex}$$

$$= Ax + (C + K)PML + f^{ex} \quad (3.36)$$

The equilibrium production can be obtained by solving Equation (3.36) with respect to X as:

$$X = [I - (A + (C + K)PML)]^{-1} f^{ex}$$
$$= (I - A - (C + K)PML)x f^{ex}$$

So it finally get:

$$X = (I - A - (C + K)PML)^{-1} f^{ex} \quad (3.37)$$

The structural matrix in equation 3.37 shows the interaction among industries and sectors; each element shows the growth of the i^{th} output x_i, caused by a unit change income impulse y_j, in the j^{th} disposable income.

In the empirical analysis, central attention will be given to the effects of final demand shocks at the industry level on total output by industry and the reduced form of the model will be expresses as $x = R \cdot f$

3.5 Multiplier analysis

The original Input-Output (I-O) problem is to search the output vector consistent with final demand vector for I-O sectors, given structural interrelation among industry sector (Ciaschini, Socci, 2004). The Leontief multisectoral framework allows to search the level of total production of each process production for a given level of total demand relative to n commodities produced in the economy. It also assesses the impact of each single production caused by a shock in the final demand on the same production.

In order to allocate the policy problem in a multisectoral framework, in this work, it will refered to the Leontief Model (Leontief 1965). This is multisectoral model, gives an evaluation of the macro variables both in terms of sectoral composition and aggregate value. Through the approach of traditional multiplier, it can analyze the structural relationships and identify the composition of the policy variable able to pursue the objective set in terms of performance.

The inverse of the model matrix is defined as:

$$R = (I - A - (C + K)PML)^{-1} \tag{3.38}$$

and transform each final demand in a total production vector. A is the constant technical coefficients matrix, and generally exists, as in general the technology can be expected to be productive, i.e. the technology is such that a part of total output is still available for final uses, after the intermediate requirements have been satisfied. In this case, A satisfies the Hawkins-Simon conditions. R matrix is usually referred to as the Leontief multipliers matrix, where the element r_{ij} of the inverse matrix represents the direct, indirect and induced requirements of output of industry i per unit of final demand of the products of industry j (Leontief, 1965). The R matrix provides, in fact, a set of disaggregated multipliers that are recognized to be the most precise and sensitive for studies of detailed economic impacts. These multipliers recognize the evidence that total impact on output will vary depending on which industries are affected by changes in final demand.

The use of Leontief multiplier is based on the assumption of predertined and unit type (exogenous structure) of final demand structures. The sum of the inverse column R implies the use of final demand vectors with a composition of the type:

$$f^1 = \begin{bmatrix} 1 \\ 0 \\ . \\ 0 \end{bmatrix}; f^2 = \begin{bmatrix} 0 \\ 1 \\ . \\ 0 \end{bmatrix}; \ldots; f^m = \begin{bmatrix} 0 \\ 0 \\ . \\ 1 \end{bmatrix} \tag{3.39}$$

while the sum of row elements in equation 1 implies the consideration of a final demand structure of the type:

$$f = \begin{bmatrix} 1 \\ 1 \\ . \\ 1 \end{bmatrix} \tag{3.40}$$

The structure of final demand produces, on the level of total production, direct and indirect effects that may be significantly different (Ciaschini, 1989). These differences depend on the different composition that the final demand vector it can assume (composition effect). These considerations are particularly important when we are interested in evaluating the impact that the final demand determines the level of produzioneattraverso the use of the inverse matrix of the model, R. Given a set of nonzero final demand vectors, whose elements sum up to a

predetermined level, but with varying structures, we will have to expect that the corresponding level of total output will also vary considerably.

The resulting inverse matrix will be used to identify which composition of the final demand (policy control variable) is consistent with the complex target of reducing the CO_2 emissions together with a positive variation of the aggregate total output (policy target variable). The policy control, consisting in a vector of n elements according the number of sectors composing the macrovariable is then premultiplied by the reduced form of the model, that in the case of the Leontief model is an (nxn) matrix. (Ciaschini and all, 2011).

When focusing on these one-to-one multipliers it is implicitly assumed that the exogenous shock in final demand takes a predetermined structure where only the final demand of one industry at a time is stimulated. The similar approach can be used to performed multiplier analysis on extended I-O model which it is based on SAM framework. The development of a SAM database integrated with the environmental data, allows to evaluate how the policy on exogenous variable can produce effects on the strictly economic side and the environmental side.

3.6 Modelling CO_2 Emissions

With the purpose to evaluate the compatibility between the environmental and economic objectives for the Chinese economy, SAM has been integrated with the environmental data set concerning CO_2 emissions by each industry provided by environmental accounts of WIOD.

Wiebe et al. (2012) describes two forms of modeling of CO_2 emissions in such models. The first, suggested by Leontief (1970) uses the technique of adding a row in the matrix Leontief (pollution sector), providing pollution of all the other sections and having total pollution as the sum of the row (e.g. Lenzen, 1998; Lenzen Et Al., 2004; Miller and Blair, 2009; Carvalho Et Al., 2013). The second form of modeling, used by Peters and Hertwich and coauthors (Peters and Hertwich, 2004, 2006), it is to multiply the Leontief inverse by a matrix of coefficients pollution intensity.

Given that the objective of this study is to model CO_2 emissions in terms of sustainable policies for China, this paper uses the second method for modeling CO_2 emissions in the context of SAM. In such modeling, it is necessary to keep in mind that emissions from one sector refer to the amount of pollution in terms of CO_2 that a sector, in particular, emits to enable its production.

China does not officially publish annual estimates of CO_2 emissions. Hence, in order to expand the analytical potential of the dataset to wider range of research themes a set of socio-economic and enviromental satellite account are considered from WIOD (See in Appendix . In particular, air emission accounts include: CO_2 emissions (in 1000 tonnes) by sector and energy commodity; this matrix is obtained by applying CO_2 emission coefficients to emission relevant energy use and then adding process-based emissions. Such detailed data framework (as opposed to providing only aggregate CO_2 emissions per sector) is important if one wants to be able to simulate the environmental impact of energy mix changes, such as for instance of a substitution of gas for coal in the power sector). Regarding emissions, it has been distinguished energy-related air emissions from non-energy-related air emissions. Energy-related air emissions result directly from the use of energy through fuel combustion (Genty and all, 2012).

The first step is to associate the the CO_2 emission with the level of activity in that sector. Consider 33 sectors (that belongs to SAM), the generic sector is indicated by the subscript "i" where $i \in \{1,2,3,4,5,6 \ldots .33\}$. It has been assumed that the energy use of foddil fuels in any sector is proportional to the total output of that sector.

This, leads us to to define constants of proportionality relating total output to CO_2 emission:

$$CI_n = \frac{e_n}{X_n} \tag{3.41}$$

Where CI_n could be called "CO_2 emission coefficient" or "CO_2 intensity" that represent the intensity coefficient of use of CO_2 from industry i (Figure 18). The intensity coefficient of CO_2 uses corresponding to the ratio of CO_2 emission and the total output of sector i and it indicate show much CO_2 is generated per unit of total output in each sector. e_n is the CO_2 emissions of the sector i of country n, and X_n is the total output of industry i in the country n.

Therefore, the CI_n enables us to classify the sector as intensive or not with respect to CO_2 emissions. Furthermore, the CI_n is the weighting factor of the input-output matrix, where in order to better capture the dependency and CO_2 emissions in China.

The coefficients of intensity are calculated and the following algebraic operations are made:

$$\hat{E} = \begin{bmatrix} CI_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & CI_{33} \end{bmatrix} \tag{3.42}$$

Thus, the matrix $\hat{E}$ is used as follows:

$$R^* = R \cdot \hat{E} \tag{3.43}$$

where R^* represents the Leontief, inverse matrix weighted by the emission of CO_2. Therefore, the input-output model which uses the coefficient matrix of intensity of pollution (CO_2 emission) can be written in matrix form as follows:

$$\pi = \hat{E}X = \left[\hat{E}(I - A)^{-1}\right]Y \tag{3.44}$$

This equation shows the direct and indirect CO_2 emissions per unit of final demand: not only CO_2 emissions from direct final demand, but also from indirect intermediate products from other sectors. The CO_2 emissions are always associated with the final demand (directly or indirectly) for good and service. Substituting (3.35) into (3.36) we have:

$$\pi = R^*Y \tag{3.45}$$

where π is the matrix of pollution.

$$\pi = \hat{E}(I - A - (C + K)PML)^{-1} \cdot f^{ex} \tag{3.46}$$

The equantion (3.38) represent the pollution for each industry determined by final demand formation represented in figure 19.

Focus on the industrial sectors share of pollution of the most polluting industries in terms of CO_2 emissions in particular these are: 17 (Electricity, Gas and Water Supply), 12 (Basic Metals and Fabricated Metal). In table 5 are rapresented the top ten sector for production of emissions of CO_2 in 2011.

From an analysis of the Chinese these emissions are derived mostly from the combustion of fossil fuels (90%) and from cement production (10%). Energy production and manufacturing are the sectors that contribute most to carbon emissions (85%). (EIA, 2015)

The analysis first considers that carbon emissions are produced by either the manufacturing process or the power generation process, where the products and services that are to be exported are made.

Table 5 - Top ten sectors for CO_2 emission

Industries	Kt of CO2 Emissions
Electricity, Gas and Water Supply	2.484.523
Basic Metals and Fabricated Metal	1.098.593
Other Non-Metallic Mineral	414.224
Chemicals and Chemical Products	295.595
Agriculture, Hunting, Forestry and Fishing	170.084
Construction	156.117
Mining and Quarrying	130.145
Food, Beverages and Tobacco	80.343
Inland Transport	48.724
Textiles and Textile Products	47.398

From the consumption perspective, the emissions are “embodied” in the products and services, through this perspective the emissions can be reallocated from the producers to the final consumers and is referred to as “consumption-based emissions” or “carbon footprint”. Taking in account this aspect, the empirical application focuses on the government strategies for the energy sector of China that allocate and reallocate resources in order to reduce the demand for energy supply.

Figure 18- Iintensity coefficient of use of CO2 from industrial sector in 2011.

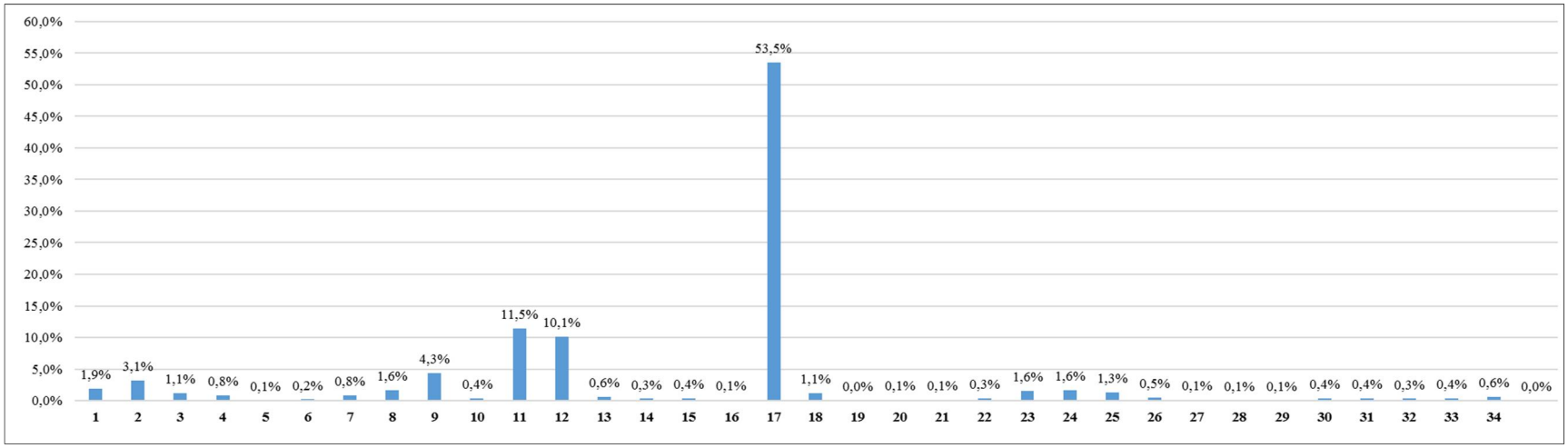
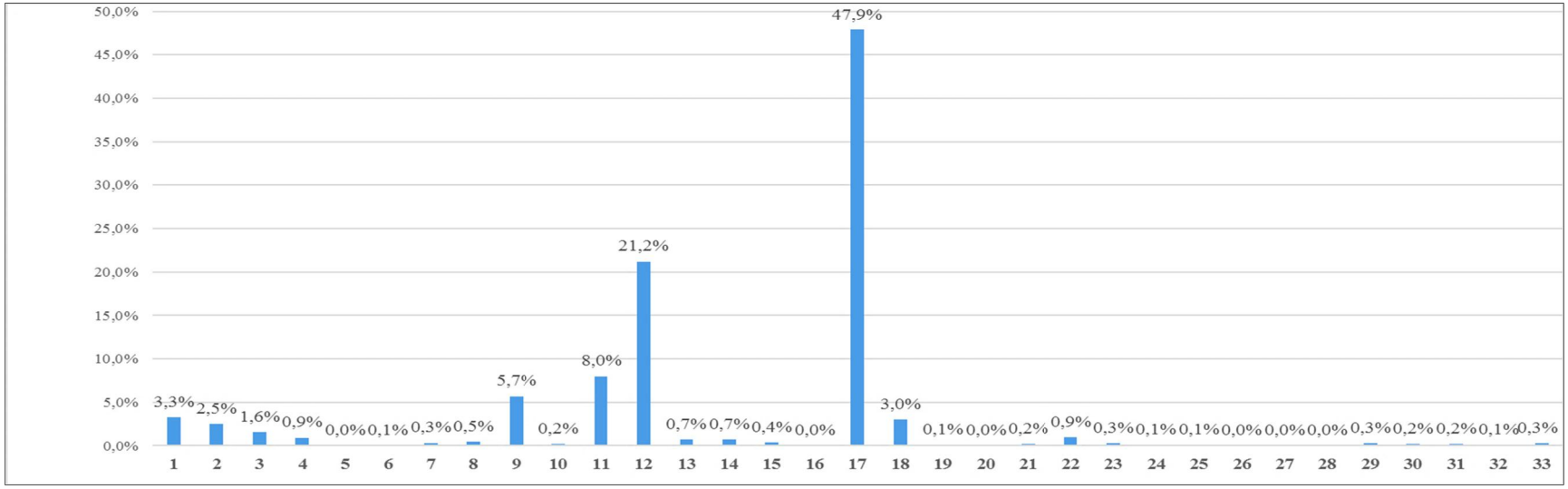


Figura 19- Share Pollution determined by final demand



3.7 Recent China's policies and plans on Energy and CO_2 emission

The first decade of the 2000s saw China's economy grow at a startling rate and consume increasing quantities of fossil fuels in doing so. Over the last two years, the nature of this growth has changed entirely; this has seen coal consumption flip from strong year-on-year growth to declines close to 4%, as seen in 2015 (Official Communiquè of PRC, 2016[27]). Consequently, China's energy-related CO_2 emissions declined by 1.5% in the same year (IEA,2016).

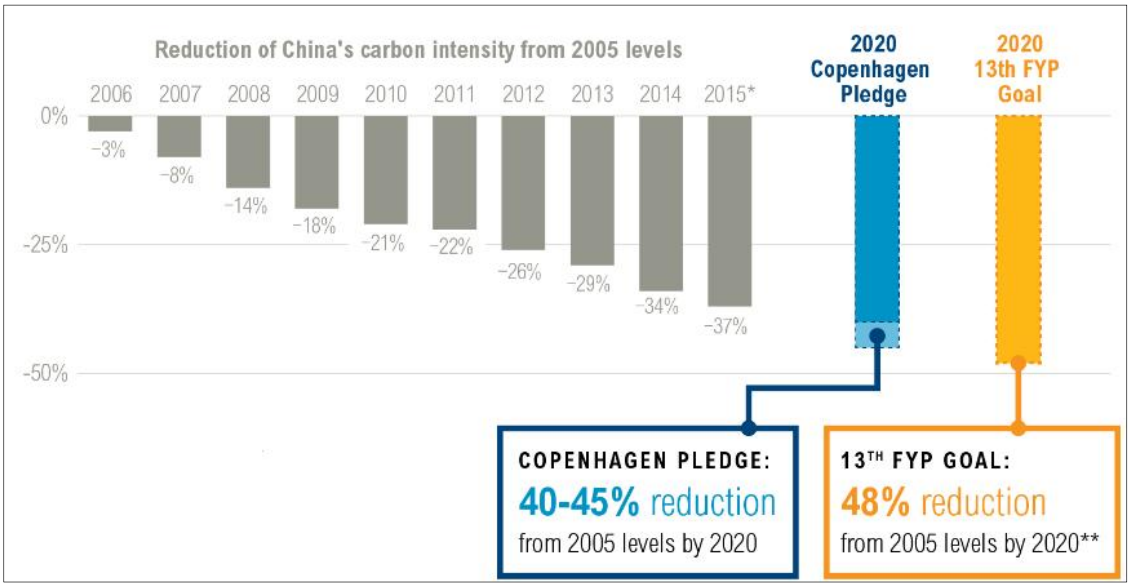
This March, China released a draft of its 13thFive Year Plan (FYP) for 2016-2020 – it sends signals that the Central Government intend to continue moving away from domestic and international coal consumption. China's 13th Five-Year Plan for energy (Energy 13FYP) might be one of the most anticipated official documents in the world and is one that will have far-reaching impacts on the carbon trajectory of the world's number one emitter. This represents the Chinese government's most significant commitment to addressing China's energy and environmental challenges to date. Of the 33 major targets listed in the document, 16 of them concern the environment and resource use. These cover a broad range of environmental issues, particularly air pollution, critical issues for Chinese people's health and livelihood, forest cover and water quantity and quality (Government report, "Zhengfu gongzuo baogao"[28]).

The Five-Year Plan delivers a comprehensive set of targets for controlling the growth of carbon emissions and ultimately peaking them. China has announced its 'contribution' to the UN climate talks set to conclude in Paris in 2015, pledging to "achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early*"* (NDRC, 2015). On 30 June 2015, China submitted its Intended Nationally Determined Contribution (INDC), including the target to peak CO_2 emissions by 2030 at the latest, lower the carbon intensity of GDP by 60% to 65% below 2005 levels by 2030, increase the share of non-fossil energy carriers of the total primary energy supply to around 20% by that time, and increase its forest stockr volume by 4.5 billion cubic metres, compared to 2005 levels (NDRC, 2015).

[27] STATISTICAL COMMUNIQUÉ OF THE PEOPLE'S REPUBLIC OF CHINA ON THE 2015 NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT (http://www.stats.gov.cn/english/PressRelease/201602/t20160229_1324019.html)

[28] People's Daily, 5 March 2016 (English version)

Figure 20- Reduction of China carbon intensity from 2005 levels



Source: World Resource Institute
http://www.wri.org/sites/default/files/uploads/China_Carbon_Intensity_v8-01.png

In this context, China has made great strides in controlling carbon emissions and has increasingly taken on a leadership role in tackling global climate change, while moving to a cleaner and more efficient low-carbon economy. The previous 12th Five-Year-Plan (FYP) period (2011–15) marked a new era in China's climate actions. The country incorporated binding energy- and carbon-intensity reduction targets, and non-fossil energy (nuclear, hydro, solar, wind, biomass, and geothermal) targets into China's top economic and social development plan, marking the institutionalization of domestically enforceable climate change policies. To achieve these targets, the government has developed and implemented a suite of plans and policy instruments, and is on track to beat its 2015 targets (Song er all 2015). By 2014, China had reduced its energy intensity and CO_2 emissions intensity by 29.9 percent and 33.8 percent respectively, compared to 2005 levels.

To help meet the 12th FYP efficiency goal, the Chinese government has two programs in place to engage industrial and transportation enterprises. Since 2005, China's industrial energy intensity has continued to decline significantly.

The 13th Five Year Plan's energy policy is to continue to increase energy efficiency (measured by energy intensity, energy consumed per unit GDP) and to increase the use of non-fossil energy. Energy efficiency improvements have been the major portion of China's reductions in carbon intensity to date. These have mainly focused on upgrading technology in heavy industry and the power sector. Because industry has been China's dominant energy

consumer, that strategy has been effective, and indeed, there continues to be room for efficiency gains here. China's vehicle efficiency standards are also comparable to those in the United States (He and Bandivadekar, 2013).

While heavy industry can benefit from efficiency improvements, the real gains in energy efficiency and greenhouse gas and pollution reduction in this sector will come from cutting overcapacity, in other words, not operating unnecessary plants. There are some indications that the Chinese government has become serious about overcapacity.

Slowing demand for electricity due to the economic downturn and slashing of energy intensive industries has caused widespread under-utilisation of existing power generation capacities, which are seeing their lowest utilisation hours since 1978. Yet the country is still seeing fast build-up of coal-fired power capacities as a result of inertia (many projects were approved in the heyday of the economic boom) and perverse incentives (dropping coal price and a government fixed electricity tariff is increasing the profit margin for coal power). The worsening overcapacity situation has prompted regulators to consider putting a two-year "freeze period" in the Energy 13FYP for the approval of any new coal-fired power projects

Chinese government has announced plans to cut capacity in both steel and coal, including a fund of RMB 100 billion (15.45 billion of dollars) for those made unemployed (Stanway Lian, 2016). In late March of 2016, the National Energy Administration also halted construction of power plants in 15 regions that were experiencing power oversupply (Diarmaid, 2016)

Looking to the future, fuel switching becomes a much more important part of the total effort to reduce carbon intensity and an important part of the pollution reduction story. The 13th Five Year Plan follows on the pattern in previous plans in encouraging development of all non-fossil sources. While much international attention has focused on solar and wind power, where indeed China is now the top producer and installations are growing at a prodigious rate, it is worth noting that hydropower continues to be the largest non-fossil source in China, and nuclear is growing rapidly.

3.8 Policy evalutation with traditional multiplier approach

Policy simulation consists in the evaluation of the short-term effects of sustainable policies expressed by shocks on final demand. The policy measure is usually evaluated in terms of its direct impact on the sector's performance, but it is crucial to asses both its indirect and induced effects on the production system as a whole (Ciaschini and all, 2011).

Through an approach that has designed policies for polluted industries, the sustainable policies will be designed according to the traditional multiplier approach, as it showed in 3.5 paragrapher.In the policy design, it has been considered that the objectives of the 13th five-year plan as well provide for a first phase in which the control of emissions focuses on the industrial and manufacturing sector, then move on to a phase of adjustment in the field of consumption and urban level (Chai and Xu, 2015).

First of all, it will be presented the results of the policies applied separately to assess their individual effects; then it will be shown the results as an aggregate (Table 6).

It has been used the multi-sector model in which the balance equation:

$$\Delta x = \hat{E} \cdot R \cdot \Delta f^{ex} \qquad (3.47)$$

Equation 3.47 summarizes the fundamental relationship between the change in final demand, Δf^{ex} (policy variable), and the variation of CO_2 emission consequently the variation on production, Δx (target variable).

Therefore, the objective of economic policy is oriented to the search for a settlement of the final demand vector that could ensure lower CO_2 emissions on the entire production and, in the alternative, that could guarantee an increase of goods and services production. The objective is pursued through the implementation of a policy that, in the first case, is based on a reduction in energy expenditure effected with a defined amount of resources. The intervention is then concentrated on final demand relative to energy and can be considered exogenous[29].

As shown above, the main policy objectives will be CO_2 intensity reduction of 18% by 2020, China will surpass its goal to slash the carbon emissions in a unit of GDP 40-45% on 2005 levels by 2020 by cutting its carbon intensity by 50% by the end of the decade. For this reason, consider a plan of five years, it has been contemplated a policy intervention economic where it is decided for the first year to reduce within a range of 1.5-2% ot total CO_2 for 2011. For achive this purpose, this measure requires an overall reduction of final demand for the most pollutant sector: Electricity, Gas and Water Supply.

[29]In this case are not investigated the reasons relating to reduction in final energy demand. This choice could be justified in the industrial restructuring caused by changes in ownership, the shutdown of small-scale power plants, and the introduction of policies to improve energy efficiency, the investment in renewable energy sectors.

The balance of the program for Electricity, Gas and Water Supply is 75.000 milions of RMB that constitutes 0.17% of the 2011 China GDP, and 13% of total expenditure for China electricity in 2011.

The reduction in final demand for Electricity, Gas and Water Supply, it is presented in Figure 24 and shows a greater reduction in the level of spending for electrical services provided by the central Government. Using the matrix R unbundled effect, direct and indirect, on the production of the vector is shown in Figure 24. In particular, this policy generates a negative change in the level of production of almost all kinds of activities. The productions that register a greater impact are the same electrical sector (sector 17) and those related to it. In particular: 12 (Basic Metals and Fabricated Metal), 2 (Mining and Quarrying), 9 (Chemicals and Chemical Products), 1 (Agriculture, Hunting, Forestry and Fishing), 11 (Other Non-Metallic Mineral), 3 (Food, Beverages and Tobacco), 8 (Coke, Refined Petroleum and Nuclear Fuel), 22 (Inland Transport) and 4 (Textiles and Textile Products).

The cut of energy expenditure made through the policy measure generates, in aggregate, a contraction of CO_2 emission generated (from to 2.485 to 2.418 Kilotonne). It corresponding to a change of -2.67% for Electricity, Gas and Water Supply, and a total change of -1.4% for total CO_2 emissions generate in 2011. In Figure 21 and 22 there are shown the main changes in terms of Kt CO2 emissions by industry and the main changes in the levels of ouput.

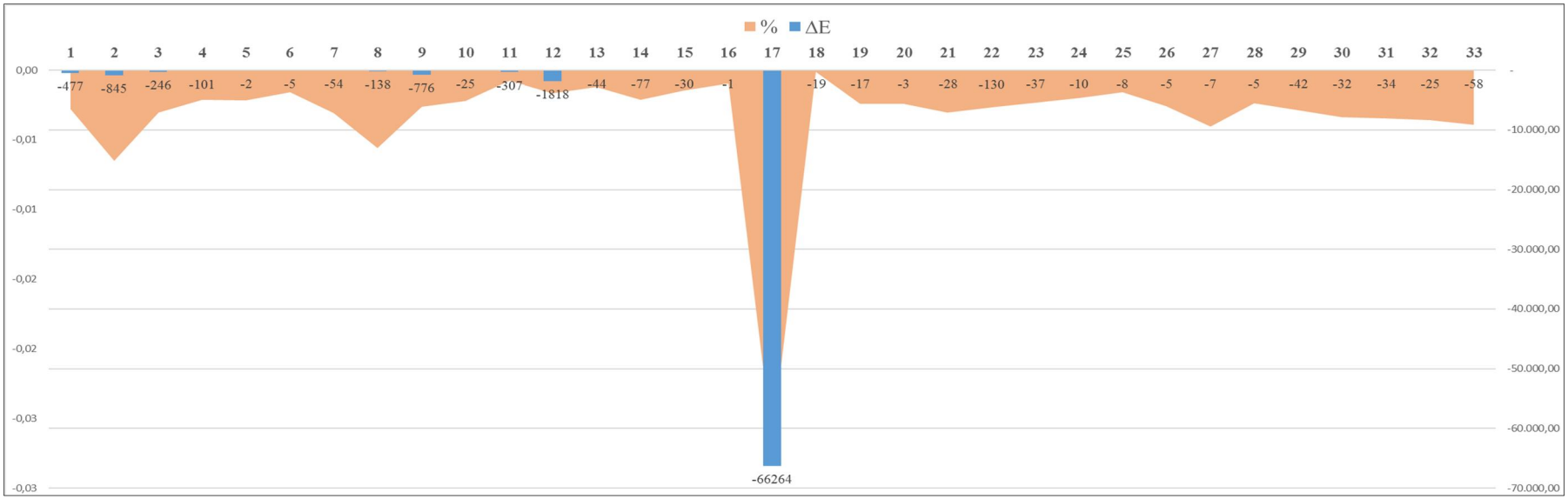
Since the emissions mainly result from consumption of fossil fuels, reducing energy consumption seems to be the direct way of handling the emissions problem. However, due to the negative impact on economic growth, the direct measure to reduce energy consumption is not viable in China. The scenario that synthesises the policy illustrated is such that final demand has decreased in all sectors according the amounts forecasted. On the other hand, in China pure development itself may not be a solution to environmental and ecological problem. Hence, other active policies and measures for resolve the trade-off between and economic growth and increase of CO_2 emissions could be implemented.

An alternative policy, by contrast, takes into account the ability to reallocate the amount of resources related to intervention for Health and Social Work[30] final demand.

Hence, it has been considered an intervention that give an impulse at the sector “Health and Social Work” of an amount of 40.000 milion of RMB. The balance of the program for Health

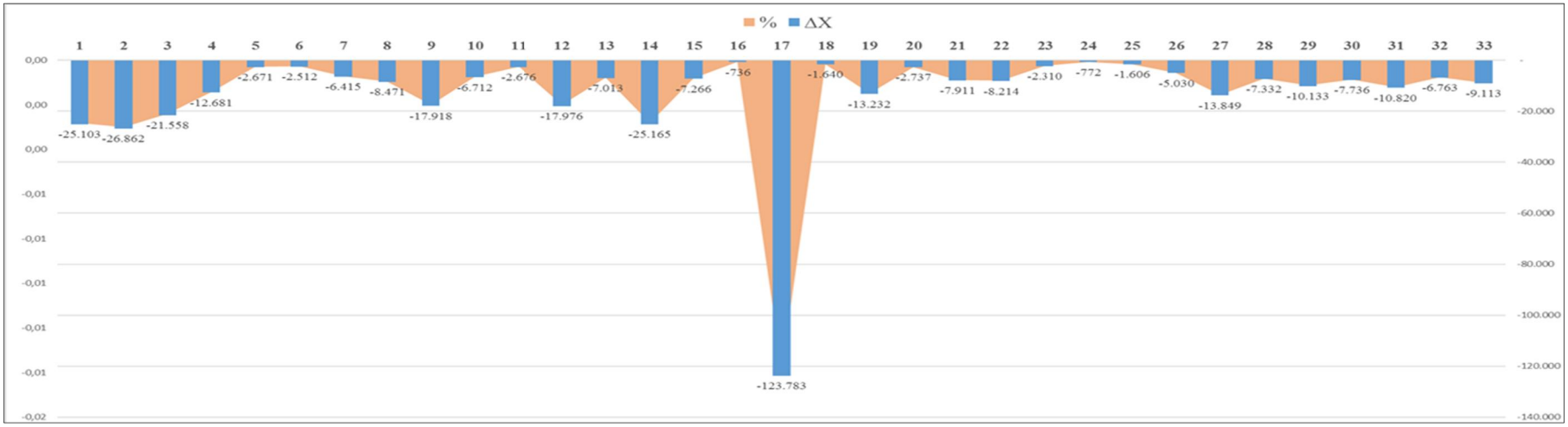
[30] This comprehend: Human health activities, Residential care activities Social work activities without accommodation

Figure 21- CO2 Kt emissions changes of the traditional policy for Electicity , Gas and water supply



and

Figure 12- Levels of Output changes of the traditional policies for Electicity, Gas and Water Supply



Social Work is 40.000 milions of RMB that constitutes 0.08% of the 2011 China GDP, and 4% of total expenditure for China electricity in 2011. The increase in final demand for Health and Social Work, it is presented in Figure 24 and shows a growth in the level of spending for health and social work services and in the industries, that are correlated to it. In particular: 9 (Chemicals and Chemical Products) 8 (Pulp, Paper, Paper, Printing and Publishing), 7 (Coke, Refined Petroleum and Nuclear Fuel).

However, the impulse on Health and Social Work expenditures for goods and services made through the policy measure generates, in aggregate, an expansion on total CO_2 emission generated in 2011 (from to 5.182 to 5190 Kilotonne) that corresponding to a total change of + 0.16 %. (Figure 23)

Therefore, it has been chosen the policy that combine first policy with a second, that is a decrease of the 75.000 RMB in the final demand for "Electricity, Gas and Water Supply" with an impulse on the activity of " Helth and Social Work " of an amount of 40.000 million of RMB.

Table-6 Main aggregate results through the Leontief Multiplier (milions of YUAN)

	Policy Control Balance	Effect on total output balance	Δ Total output	Effect on output 17	Δ Kg/tons emission	Δ Energy Intensity (E/GDP)
1	- 75.000	- 424.716	-0,32%	- 82.522	- 44.176	-1,38%
2	40.000	222.290	0,17%	1.596	7.239	0,16%
3	- 35.000	202.426	-0,15%	- 74.768	- 40.026	-1,22%

The key-structures policies are positive and negative thus, the policy control in some case increases and in other decrease the scale of total output and each industry output.

By figure 26, it can see, for almost industries, the policy generates negative changes in the level of output. If we focus on the output variable we can observe a minimal decrease of 0.15% for the total level of industrial output. This decrease of the industrial output, correspond to a decrease of the amount of CO_2 emissions emitted 63.395 Kt (-1.22%). The policy we analysed highlights a multiplier effect. In particular, the most relevant Kt of CO_2 emissions decrease regards the industry 17 (Electricity, Gas and Water Supply) with -61.521 Kt, 12 (Basic Metals and Fabricated Metal), 2 (Mining and Quarrying).

Figure 23 - CO2 Kt emissons changes of the traditional policies for Health and Social work

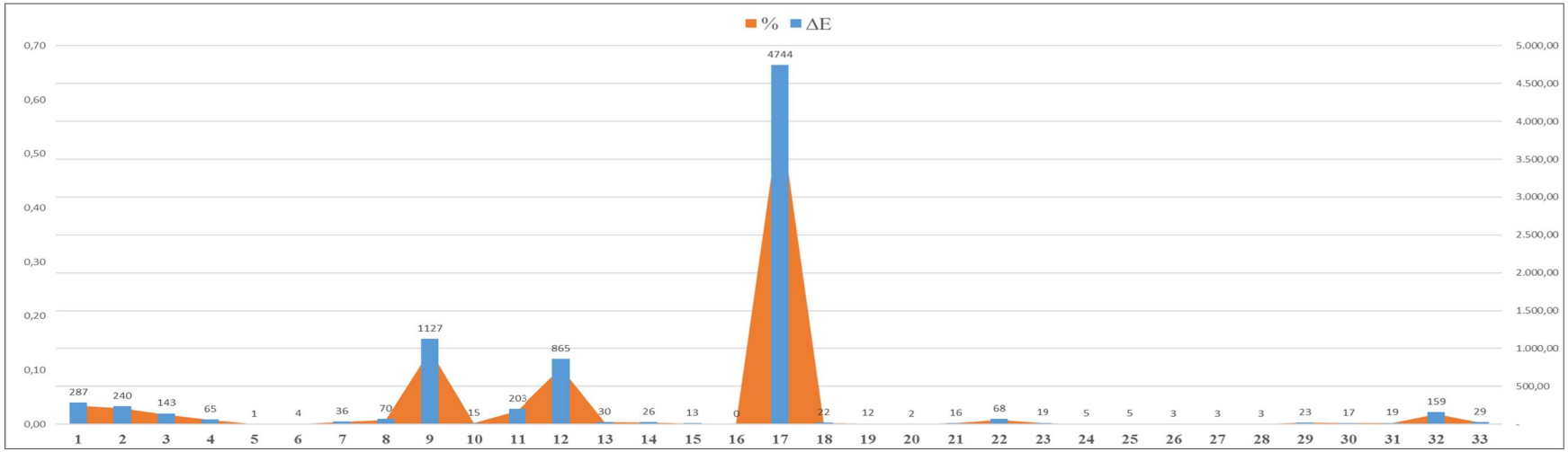


Figure 24- - Level of output chenges of the traditional policies for Health and Social

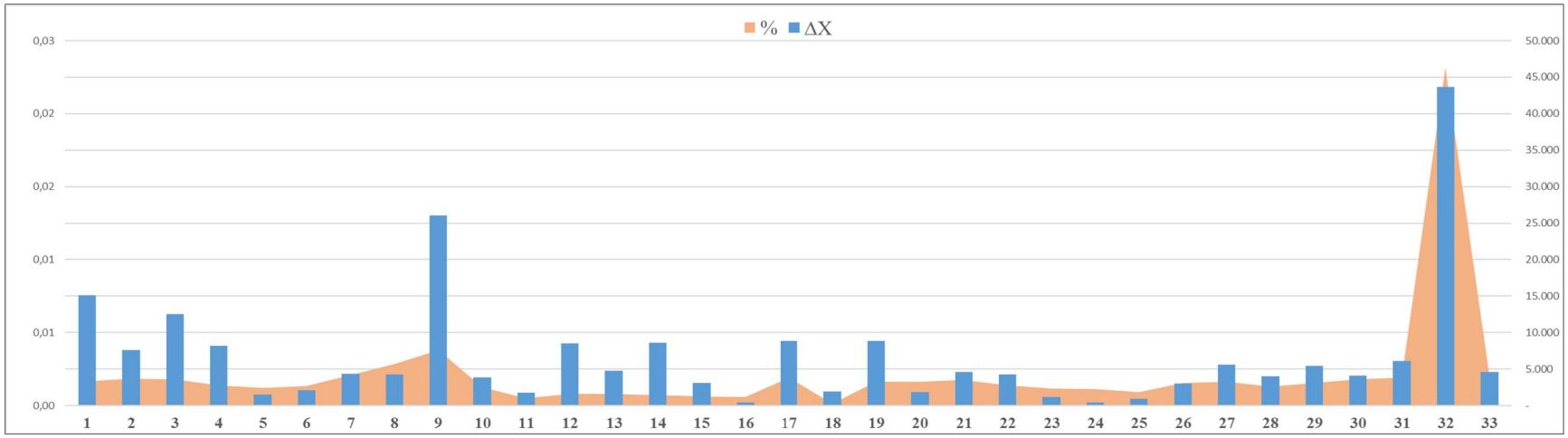


Figure 25 - CO2 Kt emissions changes of the combined policies

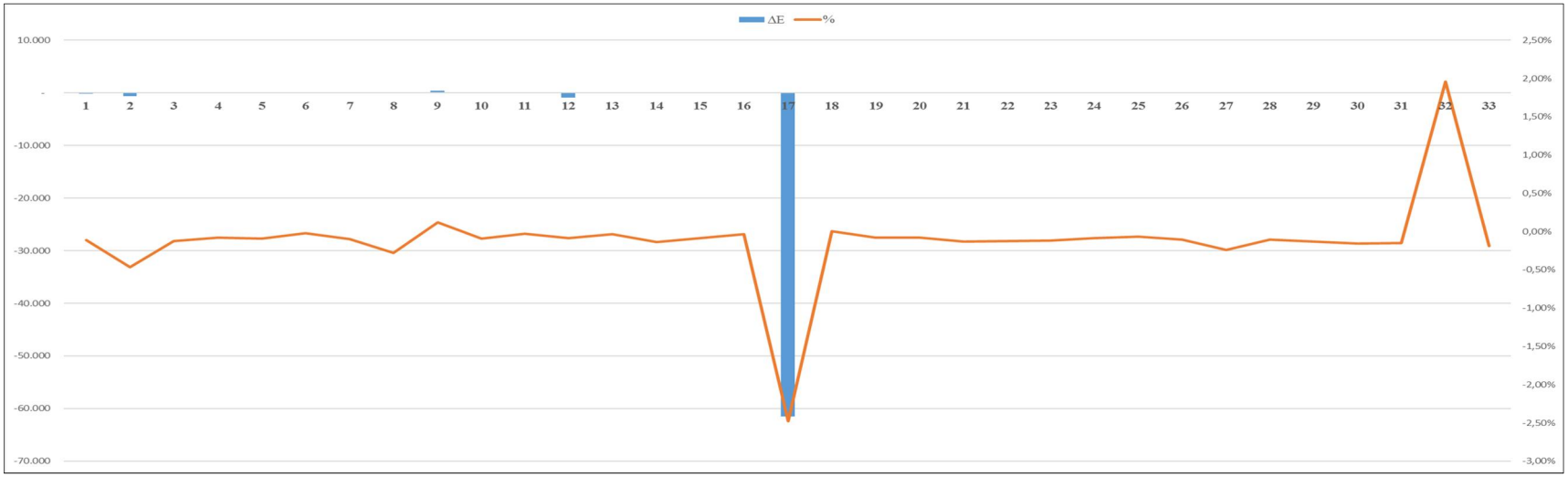
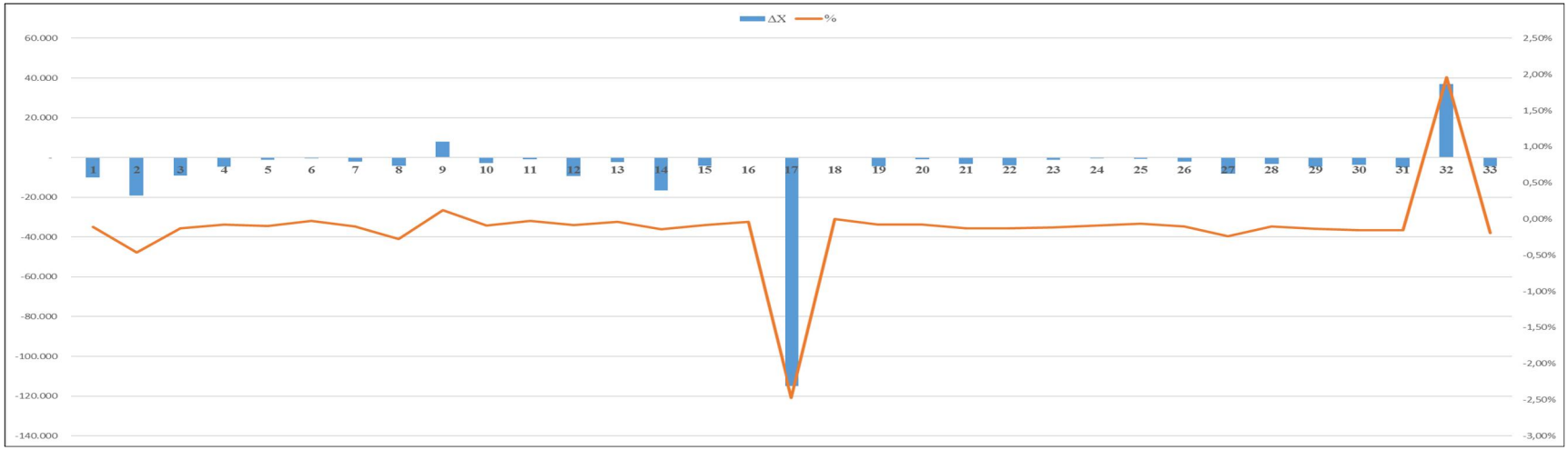


Figure 26- Levels of total output changes determined by the effect of combined



Industries whose output is most stimulated by this policy are in particular 32 (Health and Social Work), 9 (Chemicals and Chemical Products) and 18 (Construction). (Figure 25)
In terms, of economic circular flow, the institutional sector that receive the largest share of value added generated in the production process stimulated by the policies for "Helth and Social Work", spends a high share of its disposable income in helth and social work product and services. The case of "Chemicals and Chemical Products" which is among the industry most stimulated by the policy, can be used to illustrate the general characteristics of indirect and induced effects produced in the model. This two-steps link between "Helth and Social Work", and "Chemicals and Chemical Products," is an example of indirect effect which passes through the process of income generation and distribution, that is an example of induced effect.

3.9 Conclusion second section

China's remarkable economic growth was associate with an environmental degradation; the country is almost facing all major environmental problems during globalization. These problems have serious natural and social consequences, damaging the Chinese economy, harming people's health, and escalating conflicts between the government and the citiziens. Considering that China's environmental problems are derived not from a single source but from multiple sources, solving them is a comprehensive project. It is not realistic to expect to fundamentally improve China's environmental degradation in a short period of time. However, China is making significant progress in the fight against climate change, including a commitment to peak its carbon emissions around 2030. From ramping up its carbon intensity target to limiting coal use to implement an emissions trading scheme, recent signs show that the country is already beginning to shift toward a more environmentally and economically sustainable model of development.
In fact, in China, the process of "decoupling" has been supported by technical efficiency processes, rather than structural changes such as, for example, a shift from industry to services, although there are important signals: the growing demand for tourist activities, for services businesses, financial services, for those addressed to the person such as healthcare.
CO_2 emissions by industries have been considered in an extended multisectoral model, that is to say a model that extends input-output analysis to income distribution and final demand formation. The extended multisectoral modelling approach is a compromise between

unrestricted generalities of purely theoretical reasoning and the practical limitations of empirical fact finding (Leontief, 1951).

The SAM transactions are a comprehensive statistical description of Chinese economy for the year 2011 and give an empirical significance to the theoretical assumptions about the laws governing production interdependences, income generation, distribution of income and final demand formation. It has been considered the circular process that links production to income generation and distribution and final demand formation, hence accounting also for the induced effects generated by changes in the endogenous part of final demand (Ciaschini and Socci, 2006; Ciaschini and Socci, 2007; Ciaschini et al., 2013).

Moreover, extended multisectoral analysis is a suitable framework where to design and evaluate policies that foster the reduction of pollutant emissions in the system. Indeed, policies can be designed in such a way that only specific sectors of the economy are stimulated and output and GDP changes can be evaluated at a disaggregated level.

A SAM for China for the year 2011, prepared for this work, integrated with environmental data of CO_2 emissions, is the database on which the parameters of the model are calibrated. The research focuses on changes in income of the institutional sectors, on output changes at the industry level and on the decrease in the stock of energy consumption that originates the polluted emissions. Policy simulations consist in the evaluation of the short-term multiplier effects of environmental-oriented policies expressed by shocks on final demand at the industry level. A first approach to policy modelling, the traditional one, is based on the inspection of the single elements of the inverse matrix of the extended multisectoral model, in fact, a set of “one-to-one multipliers" that are of primary importance in the analysis of economic impacts. In this study, special attention has been given to policies that could support the aim of getting a reduction in energy expenditure.

The final purpose has been to choose a sustainable policy that takes into account the economic, social and environmental dimension of the economic system taking into account the trade-off between economic growth and reduction of CO_2 emissions.

The traditional policies for reducing CO_2 emissions determine inevitably negative changes of total output for almost sectors. In particular, the industries that higly contribute to the generation of CO_2 emission are connected to energy production and supply sector and metal sector. For this reason, these industries are very crucial for energy policies and it has been shown that higher shock in these sectors determine more interesting effects in terms of CO2 reduction.

Therefore, in order to maintain sustainable development goal that simultaneously keep in consideration economic growth with social and enviromental dimensions, it has been combined a further intervention. For this reason, it has been introduced a shock to the health and social work that in fact, increases the total of the produced CO2 emissions, but, if combined with the first policy, allows to keep the same output level of product CO_2 (approximately). The most stimulated industries in terms of output change by the policy types are: “Health and Social Work”, and “Chemicals and Chemical Products”. This application can demonstrate that it is possible to combine a policy oriented to the environmental protection with a policy that sustain corporation activities and households.

Thus, either ignorance of environmental problems or unrealistic expectations could damage the battle that China’s fighting against environmental degradation. The key for the government for solving the problems is to take decisive actions through policy making and implementation and investing all necessary funding in mobilizing national projects and helping local projects as well. To be sure, nurturing people’s consciousness of environment protection and changing people’s attitudes toward the environment are inseparable parts of the process of controlling environmental degradation. It is time for schools to make greater efforts toward environmental education. Mass media also has great power to influence people’s environmental awareness and behaviour, as well as government environmental policy implementation.

Chapter 4
THE CHEMICAL INDUSTRY AND NEW SUSTAINABLE OPPORTUNITIES: ICA GROUP GREEN STRATEGY IN CHINA

For small and medium enterprises (SMEs) the international context is a challenge to be faced by focusing on the mobilization and sharing of resources and competences of other actors. The aim of this chapter is to present a case study of a medium-sized company's internationalization strategy in China. In particular, the work analyzes the internationalization process in China of a family owned enterprise, producing green products in a traditional polluting sector (coatings). The case shows difficulties, choices and expectations of the company in the Chinese market for the wood coatings sector. Particular emphasis is given the creation of a joint venture and its importance to achieve a long term competitive advantage in that market.

4.1 Introduction

For a family owned Italian enterprise, emerging markets such as China, represent new opportunities in the of internationalization process. Along with Brazil, Russia and India (BRIC), China is increasingly seen as one of the target markets for companies and western economic systems. In additions, the global context puts companies to face new challenges for upgrading new business strategies (Sincoviks R. and Ghauri P.N., 2009).

The literature highlights that medium-sized firm play a leading role in the Italian industrial system, because of their performances and their international orientation (Resciniti R., Fortuna D., 2012) for their vitality and for the entity on performance, these are seen as pillar of the Italian economy.

In the wake of the initiatives undertaken since the mid-80s by some large domestic enterprises, many Italian SMEs have begun to set in motion initiatives opening to foreign markets, in the early 90s, primarily because of the production reallocation.

In Italy, especially in the Marche Region (where the ICA headquarters are situated), SME fulfil an important role in the long-term growth and development of the economy in the area.

Since the 50s of last century, the Marche Region are characterized by high business dynamism. The relevant industrial development that has characterized the region in the second half of the last century was the result of mobilization of entrepreneurial energies. These, were spread through which it has formed a development system made of small and very small enterprises, rooted in the territory and organized into productive systems locally specialized (Fondazione Aristide Merloni, 2014).

Starting in the 1960's (Fuà G., Zacchia C., 1983) the constant presence and increase of these important companies' clusters (districts) of companies have contributed to transform the Marche Region into one of the most innovative places in the national industrial context, arriving to the theorization of "Marche Region model (Balloni V., Jacobucci D., 1997)".

This model is founded on the presence of the SMEs and on their capacity to deeply integrate with the territory, taking advantage of all the opportunities present in that context. Typical of the district systems, this model is characterized by the following aspects (Fuà G., Zacchia C., 1983): ownership and family management; management founded on "auto-financing": in general, the initial capital is the savings of family owned; the system of internal reports to the supply chain.

Therefore, the development of the industrial system in Marche is no longer based on single sectors, but on the value chain, resulting from the division of labor and collaboration of different sectors. These are aiming to form a productive district, also called "homogeneous cluster companies", such as a set of companies, among them supplemented by a system of production, technology or service relationships that decide to work together to promote their own development (Alessandrini P., Canullo G., 1987).

This process has gradually led to the creation of leading organizations, capable of competing in international markets and of inspiring and even driving a widespread innovation at every level of the production chain (CCIAA Ancona, 2009).

Nowadays, the Marche region, has one of the largest presences of artisan companies and districts, with a strong development of SMEs (usually family owned SMEs). This is possible, respecting the pre-existent agricultural-artisan vocations and preserving the socioeconomic fabric of relationships, which are anchored in the territory.

The goal of the research is to encourage understanding of the qualitative approach, proposing a unique case study focused on the knowledge of best practice. With this case study, and

through fieldwork, the chance to explore how the SME's[31] organization and the individuals approach new cultures and markets, particularly in China will be illustrated. Regarding this aspect, the study focuses on the importance of internationalization drivers such as entrepreneurial values as well as on the relationship with the territory, to which the entrepreneurs and SMEs are deeply rooted.

In order to achieve the aim of the work, after outlining the research's methodology, the company profile and strategy adopted for Chinese market will be shown. The accent will be put on sector opportunities that the company has identified in the process of internationalization in China, and finally it will present the greatest difficulties in the approach to the Chinese wood coatings market.

4.2 Empirical Research: Methodology

The case study analysis has followed the typical qualitative approach of social sciences (Fattore G., 2005). The typology of the research that was used is explanatory (Ferraris Franceschi R., 1997) in the interpretative perspective.

The qualitative research methodology chosen to carry out the objectives which have been indicated above includes one case study, examining the phenomena within its broader socio-environmental context. It has been choosing the case study methods because is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt, K. M., 1989); it can involve either single or multiple cases, and numerous levels of analysis. Moreover, this methodology, could be useful when the aim of the research is to understand the phenomenon in depth, encompassing also the contextual conditions that are highly pertinent to your study (Yin, R. K., 2009) phenomenon.

Following Yin's methodology, for the research, the research questions "how" and "why" have been considered, that have significant explanatory power in case studies because "such questions deal with operational links needing to be traced over time, rather than mere frequencies or incidence (Yin, R. K., 2009)".

A case study design is the most appropriate methodology because of the explorative nature of our research questions. These are: identify processes of internationalization and internationality management "virtuous" that transpose the peculiarity of Italian companies.

[31] Small and Medium-size Enterprises (SMEs)

For the purpose of this chapter we conducted a qualitative analysis of this Italian company and its internationalization process. In particular, the hypothesis such as the motivation of global expansion of ICA Group in China and the model of entry choices will be examined.
Firstly, it has been conducted one within-case analysis including general information of ICA Group, the Chinese partner, the reason for choosing China, the FDI entry mode and the reason behind the entry mode choices. Moreover, because the phenomenon and context conditions are not always distinguishable in real-life situations, it is important to include other technical characteristics, such as data collection and data analysis strategies, in order to achieve the technical definition of a case study. Indeed, case studies typically combine data collection methods such as archives, interviews, questionnaires and observations.
Secondly, in order to assess the characteristics of strategic management systems and the implementation that have been adopted by the ICA Group, various data resources were used to collect information, such as time-lines, financial data analysis, short biographies, the company's business plan and international statistics.
In addition, business managers involved in the China project were interviewed, in order to "complete the picture" in the collection of information. Data collection was taking during 2015 in Italy at ICA head's quarter; instead, in October/November 2015 data collection was took in China. The table 7 shows the major steps followed during the preparation of the case study.

Table 7- Process of case study research

	Step	**Activity**
1	Start of the analysis	Definition of research questions
2	Selection of Case	Specified population constraints
3	Hypothesis formulation	Construction definition, validity and measurability
4	Creation of instruments and protocols	Multiple data collection methods
5	Enter the fields	Overlap data collection and analysis including context conditions
6	Analyzing data	Within case study
7	Comparison with literature and conclusions	Building an internal validity for the case study

4.3 ICA Group: The Company's History, Strategy and International Expansion

ICA Group is one of the leading producers of high performance industrial wood coatings in Italy and Europe (European Coatings Journal, 2009).

The product range includes: Water-based coatings for exteriors, Water-based coatings for interiors, Solvent-based UV coatings, Water-based UV coatings, Coatings for UV LED lamps, Polyurethane coatings, Polyester coatings, Acrylic coatings, Stains.

These products are particularly recommended such as solutions for: exterior frames and shutters, wooden houses and facings roof boards, match boarding, beams, garden furniture and street furniture, modern and period furniture, kitchens, doors, complementary furnishings, contract, marine interiors, traditional wooden flooring, pre-finished wooden flooring, flat glass and hollow glass (http://www.icaspa.com/eng).

The history of this Italian company, based in the Marche Region, is considered a successful example of reaction against economic stagnation (which has affected some of the mature European economies since the late 2000's), through an accelerated spin towards internationalization.

The company was founded in 1971 as a family firm, by Claudio Paniccia. The members of the Paniccia family remain a very active part of the business to this day, thereby ensuring continuity in the management, maintenance and pursuit of the corporate mission, with a specific, constant focus on quality and innovation.

In the early 1970s, ICA creates its first R&D laboratory, employing highly specialized technicians to ensure that the company's products remain aligned with the technological and production requirements of its clients.

Ica has been able through the last two decades to create, develop and commercialize advanced high-end R&D intensive products, placed on the technological frontier of the sector. One of the keys of success is the development of highly skilled human capital and an early development of green products. In the early 1980s, the company started to work in an ambitious study of Low-V.o.c.[32] coatings (water-borne products), which culminated in the

[32] Volatile organic compounds (VOCs) are organic chemicals that have a high vapor pressure at ordinary room temperature. Their high vapor pressure results from a low boiling point, which causes large numbers of molecules to evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air. https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality

acknowledgment of the EC LIFE Brand[33] in 1995. During the nineties, the company managed to develop several comparative advantages in the sector, expanding in the international context. The first phase was dedicated to strengthen its position in Europe then all over the world. A crucial step was realized with the acquisition in 2004 of the Salchi Wood coatings company from the German multinational BASF, which led the company to strengthen its position in the historically strong area of the Italian NEC (Center-North East of Italy) macro region and in Germany, where Salchi has a subsidiary. In 2012 ICA, incorporated Salchi Wood Coatings and established the Italian coatings division with the iCO34 brand. In 2009 the company created ICA IBERIA SAU in Benicarlò (Spain), in order to further strengthen its position in Spain and in Western Europe.

Another crucial decision was taken in 2013 with the founding of ICA China in Zhongshan (Guangdong Region), with the intention of penetrating the immense Chinese market.

In 2014, ICA Deutschland was created in the offices of the former SALCHI subsidiary in Heek (Germany), while further strategic decisions are expected in the first foreign market in terms of sales (Poland). After a sharp reduction in the group's sales in 2009 (-11%), due to the financial crisis which hit the still large and important internal market particularly strongly, the company recovered quickly in 2010 with turnover increasing by 5,70%, 2011 +3,42%, (106,5 Million of Euro). In 2012 the complicated Italian situation (internal recession) led to a decline of turnover (-2.55%). In 2013 turnover increased by only 0.19%, despite strong growth in some foreign key markets (104 million euros)[35]. See Figure 4.4.1.

With 378 employees (325 in 2009), the company always has been focused on innovation: in the period 2013-2015 the company invested 22.3 million Euros in process and product innovation (12,80 fixed assets - tangible and intangible) – 9,5 million euros R&D. In 2012 the percentage of R&D investments on total turnover was 2.86%, twice as high than the Italian R&D expenditure percentage of GDP (Figure 28).

[33] The LIFE programme is the EU's funding instrument for the environment. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value. LIFE began in 1992 and to date there have been four complete phases of the programme (LIFE I: 1992-1995, LIFE II: 1996-1999, LIFE III: 2000-2006 and LIFE+: 2007-2013). During this period, LIFE has co-financed some 3954 projects across the EU, contributing approximately €3.1 billion to the protection of the environment. http://ec.europa.eu/environment/life/

[34] Ico is an acronym of Italian Coatings.

[35] Ica Group data based

Figure 27 –ICA GROUP Turnover in EUR 1998-2013 Source: ICA data based

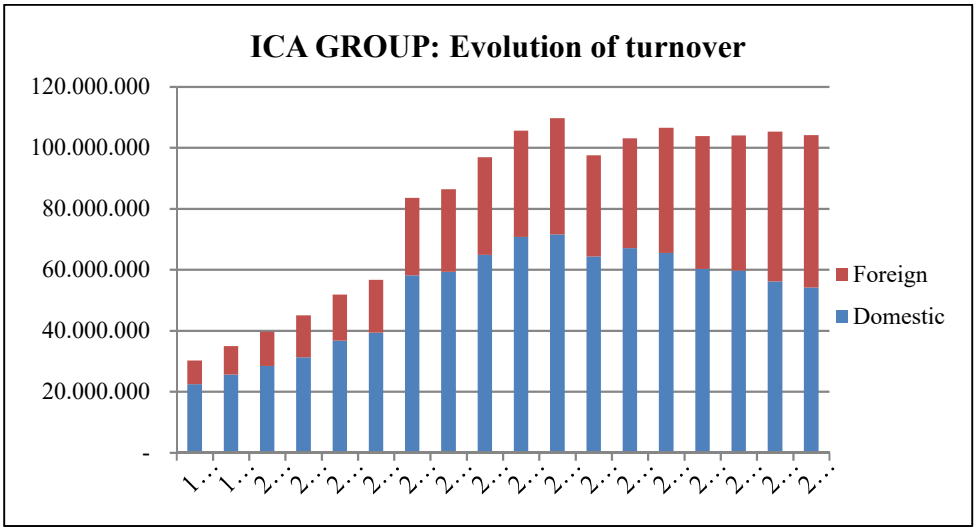
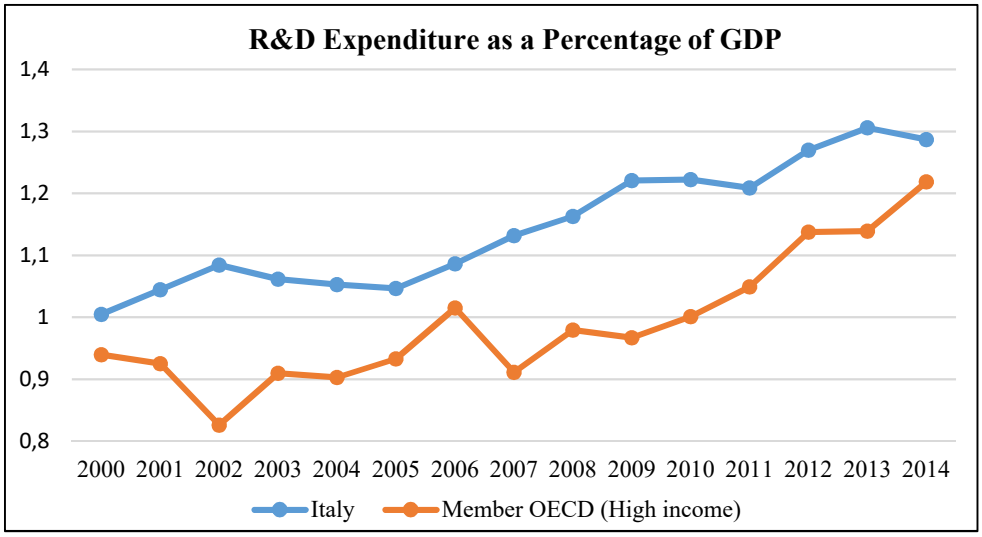


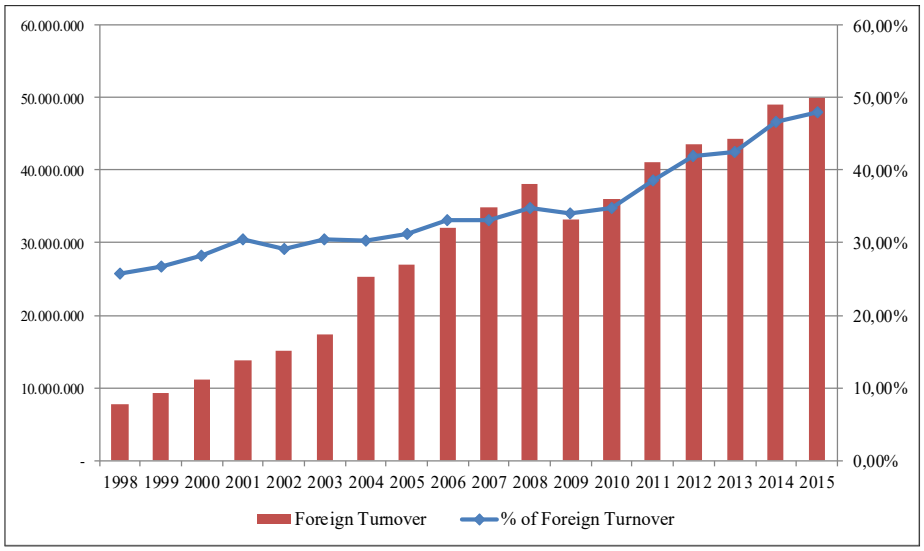
Figure 28 – R&D Expenditure on GDP Italy and OECD Source: http://data.uis.unesco.org/



Despite recent market difficulties, in the last few years ICA has triplicated its turnover from 1998 and the incidence of "foreign" components in the total turnover has steadily increased: foreign sales in 1998 represented 25.75% of the total, 35% in 2010, 42% at the end of 2013 (See Figure 29).

Higher penetration abroad managed to balance the prolonged stagnation/recession of the internal market.

Figure 29-- % of Overseas Turnover ICA GROUP

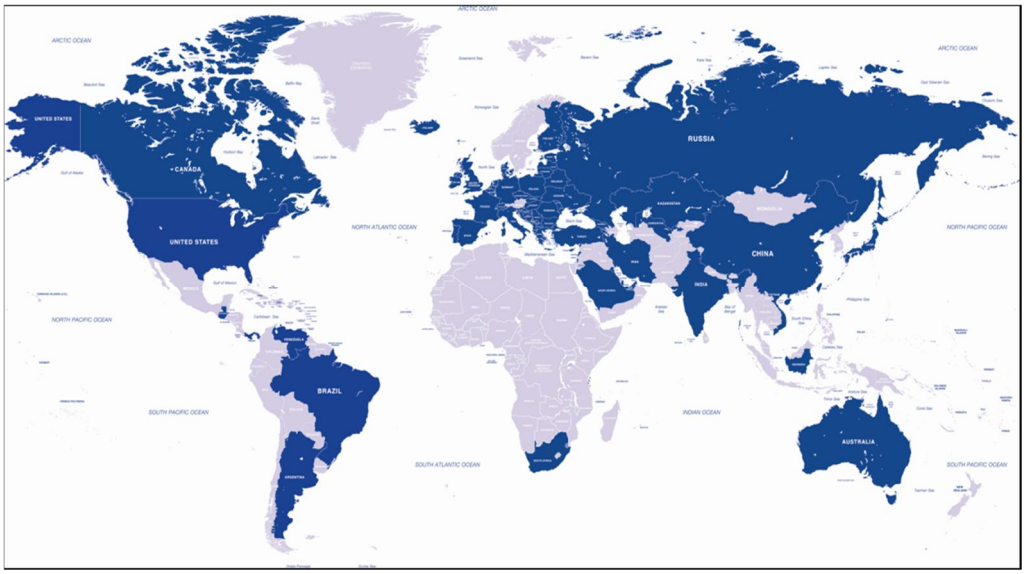


The future strategy of ICA GROUP will be to continue to push internationalization of sales, working more and more in synergy with local distributors and delivering strategic tools and knowledge also in the case of indirect presence.

One of the objectives is to enhance loyalty with foreign customers, creating higher standards in terms of fast delivery/proximity to customers and taking care more and more directly of the technical-commercial service.

Strategic options for the selected market will change based on the relatively different peculiarities of them and the company will evaluate between a sales office or distribution centers to support the activity of qualified local technicians, directly connected to ICA Group. Nowadays, some important markets for the company are still served by distributors, not with a direct presence (e.g. the Russian Federation and the Ukraine).

Figure 30 – Countries (in blue) where ICA Group sell.



Sources ICA Group sources

The main foreign markets are the Polish one (first in turnover as of 2015), the German one, and the Spanish and Russian ones. Strong sales growth accounted for some Asian and South American markets. The company is focusing on penetration with green products also in emerging markets. The new opportunities in emerging economies are represented by waterborne coatings, which account for an important share of sales in mature markets. Waterborne products represented roughly 30% of ICA turnover in 2013.

For the company, being "green" has multiple meanings: firstly, in production terms, to reduce the carbon footprint of products, materials and raw materials used, choosing suppliers that operate actively in reducing the use of carbon fuels in their products.

Secondly, focusing on production techniques that concentrate on reducing polluting components, continuing to extend the range of eco-friendly and at the same time high performance products. Thirdly, acting in the global context with the aim of selling also in the emerging markets the same advanced and environmental friendly products supplied in the developed world.

In particular, the environmental advantages of UV coatings (both UV products with 100% dry residue and waterborne) lie in the fact that they allow for drastic reductions in the levels of atmospheric solvent emissions. These types of products give coating specialists a technologically valid alternative that allows them to conform to the legal limits on emissions.

The side effects of an uncontrolled tumultuous development are already evident in countries like China and it is now generally accepted that these economies will try to develop more stringent environmental regulations in the short-medium term.
Speaking of which, the number of environmental policies is increasing in China (Spigarelli, F., Curran L., Arteconi A., 2016). As said in chapter 1, the central government has developed policies to promote energy saving, environmental cleanup and the use of renewable energies (China Greentech Initiave, 2013).

4.4 Why china is strategic for ICA: chemical sector and "green" developments

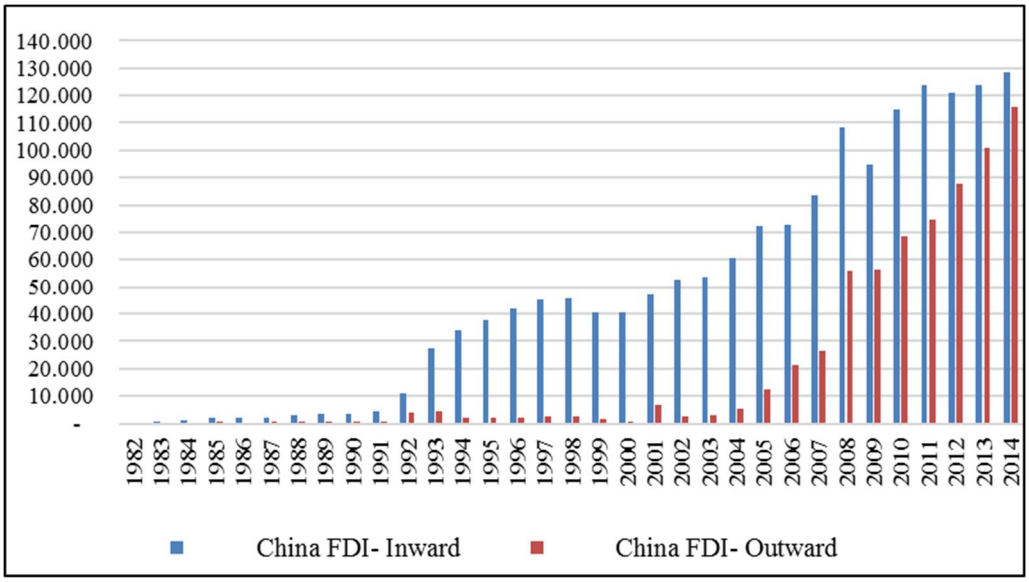
Recently, several countries such as China, have provided a renewed interest in the green economy approach. Featuring the implementation of state-of-the-art technology, China has reached a privileged position within the sector. In general, China considers the internationalization of Italian enterprises for several reasons: the high consideration of "Made in Italy", that has brought growing understanding of fine and high quality Italian products (Donata Vianelli P., De Luca P., Gegan G., 2012) the steady increase of urban consumers' spending power, the growing market potential in internal regions, the will to create new commercial opportunities with other foreign entities.
The chemical sector plays an important role in the twelfth "Five-year plan", since feeding almost all the country's industrial sectors. The economic recovery will be led by high-performance chemical products, including chemical niche products such as those intended treatment of pollution.
The main sectorial opportunities for the chemical sector in China are connected with these aspects:

- China is investing in green technology, products and practices (12th FYP put a great focus on green development; the biggest furniture market and wooden furniture market in the world in 2012 (US$154 Billion – Wood segment represents US$ 63 Billion); the world's largest construction market, accounting for 41 percent of the Asia Pacific total construction spent in 2012;
- Double digit growth expected until 2017 in all sectors connected to wood coatings (wood furniture, windows and doors industry, etc.)

Since initiating market reforms in 1978, China has shifted from a centrally planned to a market based economy and experienced rapid economic and social development. GDP growth averaging about 10 percent a year has lifted more than 500 million people out of poverty (The World Bank, 2012). Despite increasing competition from other investment destinations in recent years, China continues to be a favored destination for foreign direct investment (FDI). It remains the largest recipient of FDI among developing countries and FDI continues to play a disproportionately large role in promoting trade, investment and tax revenue generation (Davis K., 2013).

China was the first destination for international FDI flows both in 2012 and 2013, with an exponential growth in the period 1998-2012 (See Figure 31). In 2012, 253.4 Billion dollars were invested by international players in the People's Republic of China (Mainland), becoming the second country after the US also in terms of FDI flows.

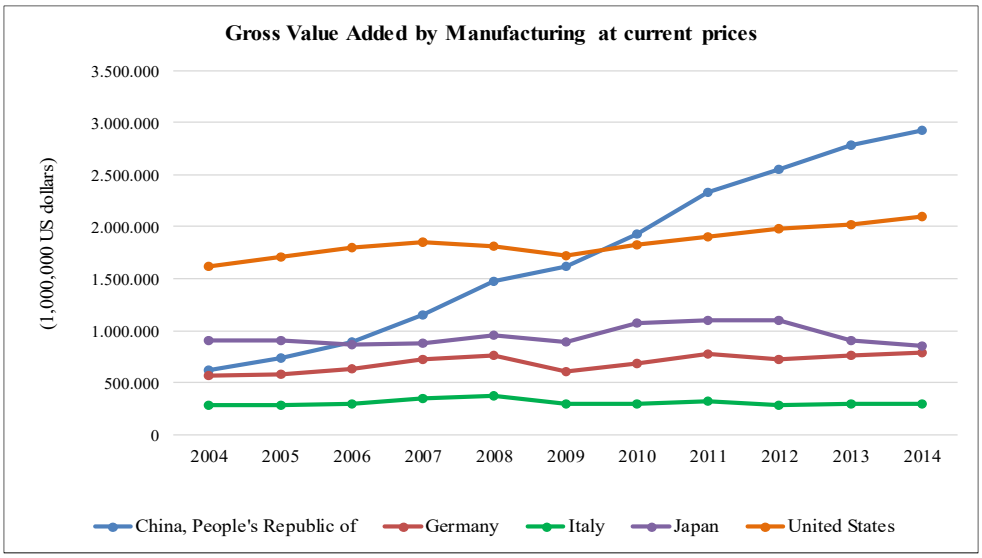
Figure 31: Chinese Inward and outward foreign direct investment flows



Source: own calculation on Unctad data
(http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx)

In the period 2005-2013, China climbed in terms of manufacturing share overshadowing the US in 2010 and became the first producer of goods in the world markets. (See Figure 32).

Figure 32 - Chinese leadership in manufacturing



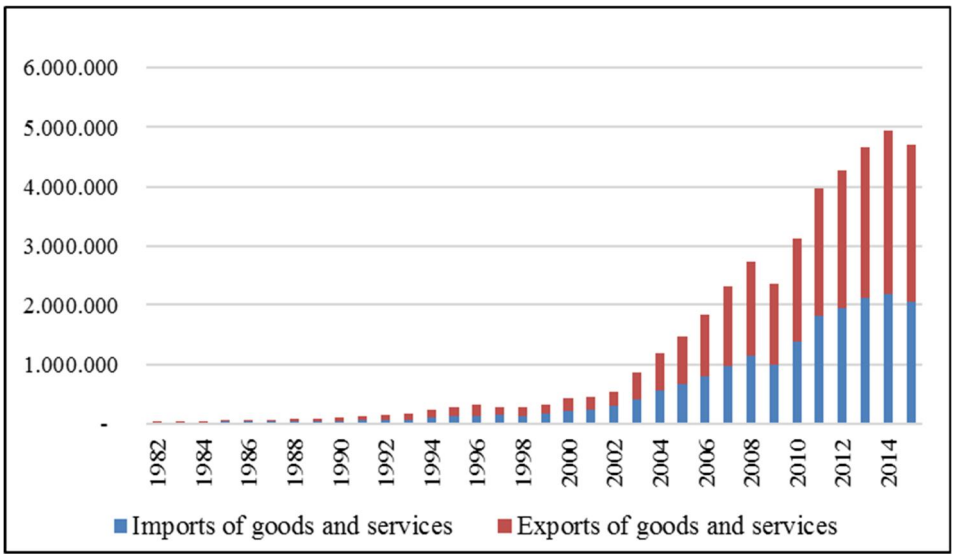
Source: UN

With a population of 1.3 billion, China recently became the second largest economy (in terms of GDP), and is increasingly playing an important and influential role in the global economy. The importance of the Chinese economy in the global context started to emerge in the last fifteen years as a result of an unprecedented growth of Chinese world trade (Figure 33).

In 2012, it became the biggest exporter (in absolute values) in the world and nowadays is the second biggest importer of goods and services. China nowadays, is still considered the biggest emerging market in the world, for this reason, ICA Group decided to open a sister company in China in order to deliver high-quality and technologically advanced coatings in a market where consumer choices are becoming more and more quality-oriented. Thanks to a joint venture with a local Chinese entrepreneur, the company took its first steps in 2013, investing in Zhongshan (Guangdong Province) in the rich south-east area of China.

The country is also starting to address the huge environmental issues, which are the result of an uncontrolled development for decades.

Figure 33 – Foreign direct investment: CHINA Inward and outward flows, annual 1982-2014 (milions of USD)



Source: World Bank http://databank.worldbank.org/data/reports.aspx?Code=NE.EXP.GNFS.ZS&id=af3ce82b&report_name=Popular_indicators&populartype=series&ispopular=y)

A recent study by Greenpeace[36], found widespread and dangerous levels of heavy-metal contamination of rice grown near mines and factories. A Chinese government report regarding the pollution of China's soil was recently released as a result of public pressure, having previously been classified as a state secret. It says that a fifth of China's agricultural land is polluted. Another recent report (The Economist, 2014), based on official statistics from a range of government agencies, said that 85% of the length of China's six biggest river systems consisted of water deemed undrinkable even after treatment. The proportion of groundwater that is polluted rose from 37% in 2000 to 60% in 2013. In China, the 12th FYP (Five-Year Plan) is the first in which the main theme will be green development.

A point will be made of the need to "construct a resource-conserving and environmentally friendly society". The plan will explicitly say that, faced with ever-stronger environmental and resource constraints, China must increase its sense of urgency and establish of green and low-carbon development concepts. With a focus on energy-saving and emission-reduction, it must introduce incentives and disincentives to help promote resource conservation and green production and consumption. Green development targets are also more apparent in the

[36] http://www.greenpeace.org/eastasia/publications/reports/toxics/2014/cadmium-rice-heavy-metal/

new FYP. Population goals aside, the number of resources and environmental targets account for 33.3% of the total, up from 27.2% in the 11th FYP. It also sets the key aims that will frame China's response to climate change. These include: reductions in carbon-dioxide intensity, reductions in carbon-dioxide emissions – by increasing the proportion of non-fossil fuels in energy structure – and the creation of new forest areas to boost forest coverage, timber reserves and carbon sinks. It highlights the development of services and measures to address environmental and social imbalances, setting targets to reduce pollution, to increase energy efficiency, to improve access to education and healthcare and to expand social protection.

In 2014 the nation's Environmental Protection Law was amended for the first time since it was approved in 1989. The new provisions, due to take effect in January 2015, will allow for higher fines for polluting companies, detention of negligent executives, protection for whistleblowers, and penalties for officials who fail to enforce laws.

ICA GROUP has always based is business model on the extensive research in eco-friendly wood paints and varnishes, which, in this context, could expand rapidly in China. End user segments for coatings are all booming in China: construction sector, wood and door industry, furniture industry, wood flooring industry.

Given the double-digit growth and the relative size of each of these markets, the potential for ICA coatings is huge. The wood and door industry, for instance, will reach the outstanding value of 97 Billion USD, with an average y-o-y growth (2012-2017) of 8,1%. In the previous period (2007-2012) the sector grew at an average yearly rate of 12.8%. In the next five years China, will surpass the US and will become the biggest producer of windows and doors in the world. In addition, the Chinese furniture industry is the biggest in the world (in terms of output) according to the CNFA (China National Furniture Association), the output value of China's furniture industry in 2011 was approximately US$154b (6-7 times the Italian Industry which is the 3rd biggest in the world) – up 25.28% year-on-year – and its export activity accounts for 35.3% of the total global furniture trade volume (The Freedonia Group, 2014).

Interestingly, in terms of consumers' behavior, Chinese consumers are evolving very quickly. Chinese consumers no longer only pay attention the appearance of wood furniture; instead, they are paying more attention to the materials. Many new products attract consumers by the original design and high-quality raw materials. In 2012, the output of China's wood furniture reached 239 million units. Most Chinese furniture is made in Shandong - 63,829,900 units

(accounting for 26.71% of China's total output). Other important provinces are: Guangdong, Zhejiang and Fujian, with the outputs accounting respectively for 19.85%, 9.79% and 8.81%. In 2011, the annual output value of China's wood furniture industry was USD 49 billion, increased by 24.93% compared with 36 billion USD in 2010; in 2012, the output value reached USD 62.8 billion, which is the historical extreme value. In general, China's wood furniture industry increased rapidly from 2007 to 2012, and the output value increased at the average growth rate of 28.24%. Forecasts show that the output value of China's wood furniture industry will reach USD 80,5 billion and USD 218 Billion in 2013 and 2017 respectively.

China is also the world's largest construction market, accounting for 41 percent of the Asia Pacific total construction spent in 2012 (AECOM, 2013). This makes it almost three times the size of the Japanese construction market. With a construction spending of US$1.25 trillion in 2012, the Chinese construction sector makes up 19 percent of the country's GDP. Furthermore, construction spending is forecasted to grow at 8 percent per annum over the next five years, which is well above the average for the region as a whole. China's construction industry has been a driving force behind the nation's rapid economic growth ever since the government deemed it one of the cornerstones of the national modernization agenda in the 1980s. Average expected growth of sector output in the period (2013-2015) is around 15% year-on-year. China's construction market is enormous. Despite the volatility of the real estate market, the sector still accounts for a large part of China's GDP and hence remains a cornerstone of the domestic economy.

4.6 The role of cultural distance and organizational differences: ICA's strategy

Most companies based in high income countries (especially in Western Europe) have experienced a situation of low growth/stagnation in domestic sales starting from the late nineties and thus began to push on sales globalization37. Accelerating a process of internationalization is becoming a sin-aqua-non-condition to survive in a changing international context, where usual western superpowers are gradually losing influence in favor of BRICS and other big emerging markets.

[37] FONDAMENTALE

Standardized strategies of penetration are indeed not optimal in approaching culturally distant markets, as the Chinese one for example (FONTE). It is generally accepted nowadays that a standardized strategy is not the best practice in approaching foreign and culturally distant markets, as the Chinese one.

The main problems encountered by Western companies in approaching the Chinese market regards the lack of specialized intermediaries, regulatory systems and contract-enforcing systems (Khanna T., Palepu K. G., Sinha J., 2005).

Cultural distances represent a great obstacle and are often connected to the institutional framework of a certain market. Cultural and psychic distance are strongly connected, and they refer to the degree of similarities or differences perceived by companies between home and host country and it refers also to the degree of familiarity of the company with the foreign environment (Vaccarini K., Spigarelli F., Tavoletti E., 2016).

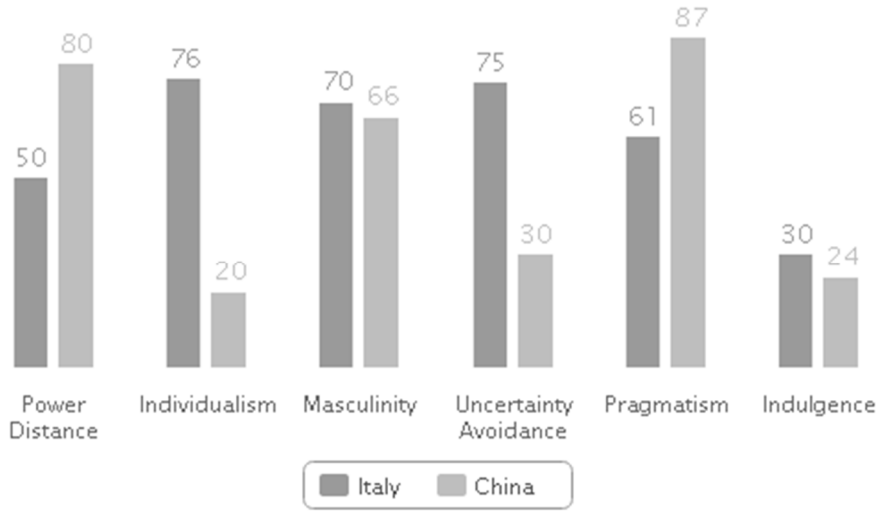
As it was for US multinationals in Japan during the seventies, the problem of different cultural dimensions and how to transfer the company's values are becoming more and more crucial for western multinationals and SME's who want to penetrate the fastest and largest growing market in the world (Donaldson T., 1996). Best practice in foreign markets are connected with interpretation and knowledge of local cultural dimensions.

Dutch psychologist and anthropologist Geert Hofstede defined six cultural dimensions with relative scores to identify cultural differences among countries: power distance Index (PDI), individualism versus Collectivism (IDV), masculinity versus femininity (MAS), Uncertainty Avoidance Index (UAI), Pragmatic versus Normative (PRA), Indulgence versus Restraint (IND). Taking into account the two cultural dimensions which are more correlated with business behaviors, the ones that show how people behave an organization (individualism and masculinity) (Hofstede G., Hofstede G. J., 2005), we can note that the scores in China are very different from the ones in Italy.

By figure 34 we can see that, with a score of 20, China is a highly collectivist culture where people act in the interests of the group and not necessarily of themselves. In-group considerations affect hiring and promotions with closer in-groups (such as family) are getting preferential treatment. Employee commitment to the organization (but not necessarily to the people in the organization) is low. Whereas relationships with colleagues are cooperative for in-groups, they are cold or even hostile to out-groups. Personal relationships prevail over task and company.

At 66 China is a masculine society, defined as success oriented and driven. The need to ensure success can be exemplified by the fact that many Chinese will sacrifice family and leisure priorities to work.

Figure 34 - Hofstede's cultural dimension - comparison



Source: http://geert-hofstede.com/

Service people (such as hairdressers) will provide services until very late at night. Leisure time is not so important. The migrated farmer workers will leave their families behind in places far away from cities in order to find better work and pay in the urban areas. Another example is that Chinese students care very much about their exam scores and ranking as this is the main criteria to achieve success or not.

Italian business culture tends to be masculine and individualist: personal achievement, as in China, prevail on everything else and the focus is on material success, women in business have still a modest role. As in other countries with high scores in IDV, Italy's favor is on job specialization, on a competitive entrepreneurial climate and individual performances orientated towards rewards. Individualism is also probably the cultural dimension most used in the field of cross-cultural management (Yan J., Hunt J. G. J., 2005). Italy also has a high internal variance with the north tending to be much more individualistic than the south (Hofstede G., Hofstede G. J., 2005). The culture pervades also all elements of the marketing

mix, which should be evaluated in the specific cultural context, both in B2B and in B2C markets (De Burca S., Fletcher R., Brown L., 2004).

Considering all these aspects, ICA Group developed a planned strategy to enter the Chinese Market, in order to follow right strategies and steps. For initial consultations, they opted for an Italian who has been living and working in China for more than 30 years.

The process involved preliminary cultural knowledge of Chinese culture and business environment, business plan realization, branding, acquisition of legal framework related to chemicals and basic regulations to safeguard intellectual property. Adapting and filtering company's values to Chinese cultural schemes seemed to be the best practice for entering the Chinese market.

The way to transfer the company's culture, values and ethics to foreign markets is crucial for commercial success and is a possible source of competitive advantages. When one company approaches the global marketplace with views inherent to western culture, it may find that business practices are not acceptable in some foreign countries. Cultural adaptation in the way you do business is essential for companies operating in foreign markets with cultures different from that of western world. Such adaptation efforts must take place in all major areas of company activity for them to be effective.

ICA Group chose a joint-venture strategy[38] of entrance with a local Chinese partner, considering all the cultural elements for a correct approach to the Chinese market. So, they took into account both the individual factors of the interlocutors, and the cultural dimensions of the specific company.

In conclusion, a good business relationship with Chinese entrepreneurs and the Italian counterpart is crucial to adapt Italian organizational culture to Chinese standards.

4.6 A Strategic Alliance for The Chinese Market

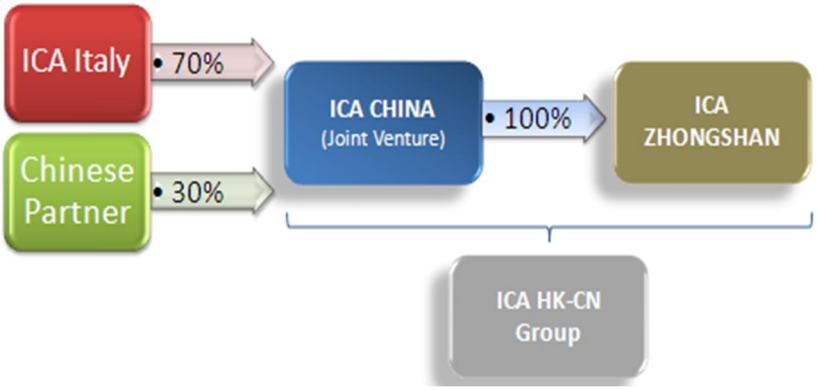
ICA GROUP considered the knowledge background of employees already present in the company as vital. Due to this was very important to investigate well on the know-how of potential Chinese partner.

Chinese partner was founded his company in 1981 as an international trading company based in Hong Kong. The company, is specializes in selling Chinese metals and chemicals; it has good network and strong tie with many Chinese corporation, smelters and producers.

[38] More details at chapter 4.6

Once the right way and agreement with the Chinese partner was defined, there was the creation of the joint venture39 between Ica and the Chinese partner which already had a production plant there. More specifically, the typology is Equity Joint Venture (EJV) like a society Liability Limited, which provides equity participation of foreign partners and local authorities.

Figure 35 – ICA structure in China Source: ICA Group sources



The reason why the company chose this solution was to improve the logistic flows China-Italy, to have help with regards to the red tape and to develop more easily intercultural relations.

The cooperative joint venture (CJV) is an agreement of cooperation between local and foreign partners that can give life to a society, where the responsibility and partners limited to the amount awarded, or be in the form of an agreement collaboration in which case the responsibility 'of the partners and' unlimited. The following schema shows the corporate organization that, as suggested, could be the base of ICA and the Chinese Company cooperation.

From the figure, can easily deduce that factually the flow has based on ICA Hong Kong buys goods from ICA Group and manages import from Hong Kong to China.

The purpose of setting up ICA CHINA is to consolidate ICA Group's business in greater China Region and to found Hong Kong as ICA Group Regional Headquarter in supporting the growing needs of developing companies in the region and to offer a comprehensive scope of Ica products and service.

[39] A business arrangement in which two or more parties agree to pool their resources for the purpose of accomplishing a specific task. This task can be a new project or any other business activity. In a joint venture (JV), each of the participants is responsible for profits, losses and costs associated with it. However, the venture is its own entity, separate and apart from the participants' other business interests.

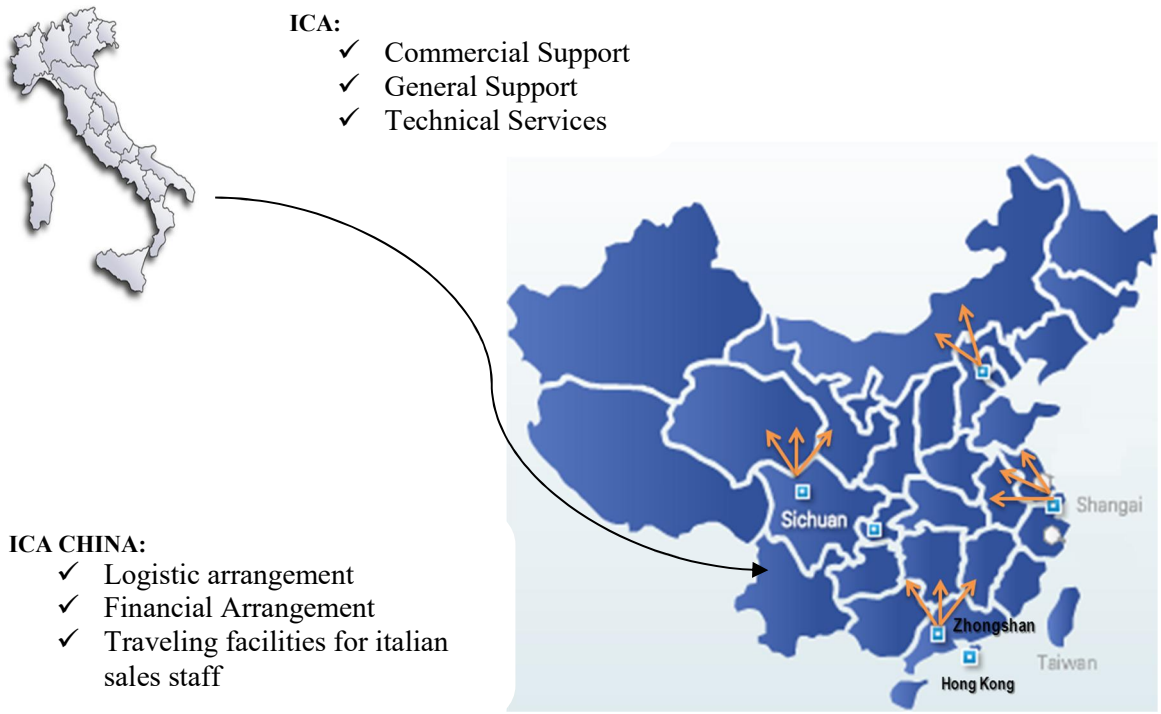
The joint venture ICA HONG KONG has been created for marketing and sales activities for the first three years, then for the partners, the next purpose it will be to organize together a new industrial plant to start some local production activities.

For the first period, the strategic alliance has achieved with the help by the Chinese partner to the new company JV with different services; especially for activities such as warehousing, administration, logistic. In particular, Ica China has incorporated a full range of Ica products and technical services to cover the demand of high performance and low environmental impact coating technology in the region. The Chinese company accepted orders and enquires, provides tolls necessary to smooth logistically transaction in China, develop a service laboratory for technical assistance to customers and develop regional service center around China to fulfill needs of customers coming from different regions. On the base of these strategic assumptions, the company decided to build his goals on the following points:

the products that will be sold won't be low value added; one the base of what we said before, communication strategy was crucial and has focused on brand communication and identification.

So in the first year, ICA has developed the commercial activities through agents and distributors, company staff that was already active in the market and easily has led to target right customers. Primarily, Ica Group has supported the sales organization with commercial and technical support and training courses with the purpose of selling in China high technology coatings made in Italy and therefore creating a sales and distribution network. In this way, selling local brand products made in China by the Chinese partner, Ica has helped the Chinese company supporting by the high-level Ica know-how in organization, production, formulation of wood coatings. Gradually, when partnership was more solid, Ica was able to help the local Chinese manufacture to improve the quality of the products and to make more productive the Chinese partner's production. After the first period, the parent company decided to built a warehouse in the Chinese territory with the intention to strengthen presence in the market.

Figure 36 – Representation ICA CHINA's market penetration strategy.



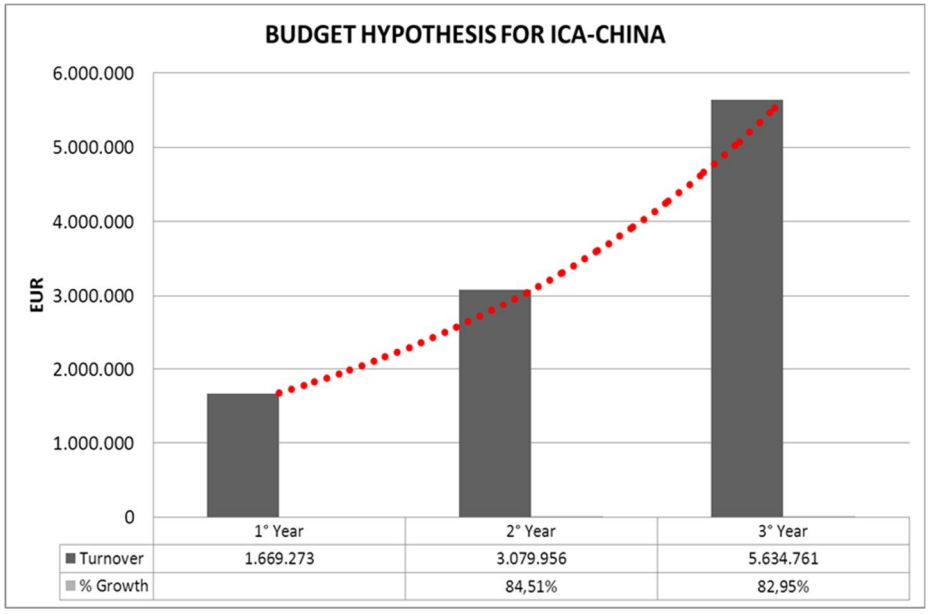
Source: ICA CHINA sources

Improving the knowledge of Ica brand in the Chinese market by commercial campaign to communicate Ica as a leader international brand for low environmental impact coatings. The new company Ica China have recognized by the Chinese customers as leader for high quality and low environmental impact coatings and excellent customer service (technical, delivery.) On the basis of what said before, since its foundation, Ica China has planned to achieve the key targets within three years. The consecutive figure shows the evolution of the sales in the following three years.

In particular, the initial target market was selling high performance coatings from ICA Italy to the end users that should have the advanced coating lines and/or to all of them that are eager to know and use such products. Keeping those high technology coatings in China warehouse as buffer stock for the above-mentioned customers as well as for the other users that works in wooden (furniture, window frames, doors, parquet) and glass industries that do not have the chance to import by themselves. Finally, selling to the customers that are looking for water-based products.

Speaking about the target geographic markets, sales efforts will be focused in Guangdong area at the beginning. After that, the sales will be extended throughout the other Chinese regions.

Figure 37 – ICA sales forecasts China Source: ICA Group data base



For key product targets, Ica China is making an analysis of its product portfolio to select which are the better products to be introduced to the Chinese market. Some products could be modified to suit to the local market when it will be necessary; for these reasons the company will aim for the sales of the following families of products: polyurethane water-based for interior and exterior; solvent and water-based UV; pigments, stains and special effects; water-based products for glass.

Finally, for what concerns the Marketing Plan, the company is creating an initial list for prospect customers that can be interested about technology and low environmental impact products. The next step will be to organize a plan meeting (both in the headquarters and in JV), with the potential customers to introduce the new company. For sure, marketing activities among which fairs, brochures, preparation of advertisement on specialized magazines, newsletters, brand strategy, will be focused also on communicating the imagine of the new company on the market and brand strategy. In particular, the main activities have been focused on:

web Site development for the China market; channel Realization (Alternative to YouTube) where the company videos are loaded; channel Implementation "WeChat" where customers can communicate with the Chinese company;

development of the APP into Chinese language: through the app customers and prospects can get in touch with ICA and see the color effects; distribution in the Android APP store; improved performance sites and APP speed, a CDN (Content Delivery Network) was

prepared to speed up the consultation of websites and apps from China; participation to the most important fair in Guangzhou; application Training laboratory.

4.7 The Difficulties that Ica Group Was Facing in China

When a company decides to invest in China, there could be several factors that might hinder a smooth approach to the Chinese market. Compared from the past, the Chinese market is becoming enormously complex and competitive. Production costs has increased, especially in the more developed areas of the country and, in the meantime, the local competition has become more dreadful (Barbatelli C., Cavalieri R., 2015). In fact, Chinese local enterprises on the one hand have become more efficient and competitive and at the same time continue to enjoy the support of the administrative and judicial authorities. Although there are many success stories of Italian enterprises in China, accessing the Chinese market remains particularly difficult for Italian companies, either for small business size and for the insufficient ability to systematizing cooperation.

In particular, the main internal business factors that could obstruct the foreign investments are:

- the difficulty or impossibility of obtaining licenses and permissions;
- disloyal or unreliable partners;
- uncontrollable distributors;
- lack of brand-awareness;
- misinterpretation of laws and regulations;
- difficult transportation (for supply or distribution);
- cultural gap;
- difficult communication;
- trademark or patent violations.

Considering these aspects, Ica headquarter has recognized several difficulties that the Group has got to face, going into the Chinese market. First of all, when they decided to invest in China, there were several very strong local competitors. Usually, the Chinese government tends to encourage and favor the local companies. This, because there is a high level of bureaucracy in China, several duty and sales taxes, and most of all, there are more government controls for foreign companies. Protectionism is also manifested in access to credit, with state-owned companies that benefit privileged access in terms of requirements

and economical conditions. This aspect is closely linked to the strategic importance of chemical sector, which is one of the main sectors subjected to protectionist measures (in particular for licenses).

There were difficulties related to price levels, too. The price for commodities products is quite low in China, and there is a high sensitivity of the customers on price levels.

One of the main difficulties, connecting with coating sector, is that the market is still not so receptive with the respect of quality and environmental issues connected with coatings. The company, in fact, wants to drive the market towards more advanced products and train potential customers to work with them. For these reasons, promoting ICA products in China will inevitably encounter difficulties in their cognition of the price and value of the products. Therefore, it has to lead the market to accept ICA intrinsic value to rationalize the price level.

In addition, another crucial aspect is the know-how "transfer" (human capital, management and technical skills); it is hard to create a qualified team in China that can actively assist a potential customer, delivering useful information on how to use at the best a selected product.

There is also the fact that Ica brand is not well known in China. Obviously, there are also risk factors like the real capacity to gain budgeted results, the risk of non-integration or very low level of integration with the local environment, cultural aspects, the difficulties in finding good local human resources and to be able to keep them from leaving the company after being trained, the difficulties in integrating the new structure with the original ones and to fine tuning the new organizational structure. Eventually, there is also the risk of loose focus on the company mission, due to turbulence factors.

4.8 Conclusions third section

This chapter aimed at exploring the case of one Italian company investing in China in the polluting sector with an environmental connotation.

ICA Group is still in a start-up phase in China. In fact, as of today, ICA China is still building and developing solid bases for a long-term collaboration in China. However, this case study could be useful for small and medium enterprises with lack of international experiences, that decide to follow a process of internationalization and strategic alliances in China.

In general, the detailed examination of a single case study on a class of phenomena cannot provide reliable information about the broader class, but it may be useful in the preliminary stages of an investigation since it provides hypotheses, which may be tested systematically with a larger number of cases. Because of the qualitative nature of case study, the conclusions

of this work are quite specific rather than generalizable; however, it was possible deduce some synthetic considerations useful for understanding the adoption of business models in Chinese market.

It has been conducted a descriptive within-case analysis by covering the following information: general

When we talk about the internationalization process of family owned enterprise, we should consider that it is very difficult to exactly replicate the Italian business model in China; the entrepreneur must know that he has to starts from “the beginning”. Therefore, it’s important to establish this alliance and watch the internal business model to be able to replicate the best: analyze the market, suppliers, customers and competitors. "Whatever new company in China is small (Barbatelli C., Cavalieri R., 2015)”. One new Italian company in China at the moment of the constitution, for its nature, is small and necessarily must give up the old family management system for geographic restrictions. For this reason, there is the need to acquire new managerial skills on the Chinese market, to implement the process of human resource loyalty using the know-how transmission. This aspect, should be successfully transmitted to internal resources as key factor for internationalization process.

Furthermore, the contribution of this work highlights the centrality of typical small or medium enterprise in Marche Region, capable to be competitive in the international context on intangible assets (social, human and relational capital), based on strong ties and values of the Region. These elements are also useful to approach internationalization processes in other countries, respecting peculiarities and values of the strategic partner.

Undoubtedly China is a new market with its own unique features, which make it an extraordinary case study and learning opportunity for enterprises; calling into a question the classic entry strategies of the management literature.

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APPENDIX

Figure 1.A

1.000.000 Yuan	Agriculture, Hunting, Forestry and Fishing	Mining and Quarrying	Food, Beverages and Tobacco	Textiles and Textile Products	Leather, Leather and Footwear	Wood and Products of Wood and Cork	Pulp, Paper, Paper , Printing and Publishing	Coke, Refined Petroleum and Nuclear Fuel	Chemicals and Chemical Products	Rubber and Plastics	Other Non-Metallic Mineral	Basic Metals and Fabricated Metal
	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN
Agriculture, Hunting, Forestry and Fishing	1.072.652	8.969	2.598.627	562.731	118.847	186.226	95.941	30	209.319	60.668	1.408	1.004
Mining and Quarrying	8.306	287.942	24.845	27.807	2.961	11.745	17.647	781.015	512.199	17.694	496.594	1.080.965
Food, Beverages and Tobacco	810.509	13.005	1.426.163	40.733	149.556	9.676	16.204	10.839	171.854	16.273	18.121	55.299
Textiles and Textile Products	5.085	27.934	16.716	2.722.156	104.882	6.660	33.276	1.638	54.599	80.521	25.359	56.164
Leather, Leather and Footwear	3.243	760	590	140.928	373.439	1.904	3.421	40	5.432	9.272	895	828
Wood and Products of Wood and Cork	5.977	25.131	7.953	8.040	2.074	629.580	51.495	693	13.555	8.488	39.815	81.333
Pulp, Paper, Paper , Printing and Publishing	8.143	10.550	130.515	56.442	12.827	20.732	705.429	4.477	105.746	42.537	85.608	41.344
Coke, Refined Petroleum and Nuclear Fuel	44.513	98.721	15.312	21.968	5.553	7.154	11.369	56.819	431.025	40.467	78.072	303.890
Chemicals and Chemical Products	423.642	109.107	55.698	385.513	45.354	101.024	172.984	25.873	1.989.597	952.215	210.488	189.264
Rubber and Plastics	40.250	54.341	145.149	54.766	44.493	6.350	57.139	4.936	216.858	728.119	56.007	72.909
Other Non-Metallic Mineral	9.040	48.309	35.375	9.448	1.528	2.457	3.234	5.612	54.478	8.599	516.073	154.094
Basic Metals and Fabricated Metal	23.707	210.056	36.127	25.354	9.633	27.332	23.045	8.605	127.748	69.368	186.364	4.141.348
Machinery, Nec	37.897	209.355	18.834	45.981	7.504	15.793	24.866	20.138	94.834	39.422	88.079	359.785
Electrical and Optical Equipment	6.769	91.057	16.665	23.067	3.414	6.284	15.813	4.807	51.799	19.752	27.878	96.933
Transport Equipment	23.878	41.658	8.748	11.120	1.707	6.813	17.518	4.560	22.997	14.853	21.779	86.943
Manufacturing, Nec; Recycling	2.027	4.743	2.903	4.068	644	1.793	19.705	285	6.134	6.059	10.278	62.524
Electricity, Gas and Water Supply	62.318	324.778	69.013	90.805	5.354	32.805	57.444	50.527	397.983	77.261	226.772	570.631
Construction	2.060	4.900	2.025	1.456	297	374	582	1.068	3.630	587	1.379	4.032
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	-	-	-	-	-	-	-	-	-	-	-	-
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	142.964	64.434	204.850	98.981	25.442	39.014	60.134	30.029	164.910	65.966	105.870	275.272
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	29.576	13.330	42.379	20.477	5.263	8.071	12.440	6.212	34.116	13.647	21.902	56.947
Hotels and Restaurants	21.502	53.737	38.717	24.374	5.374	6.948	11.580	3.666	47.033	12.220	28.301	67.823
Inland Transport	66.163	112.761	99.342	50.876	9.676	23.979	29.435	26.662	116.219	37.579	89.494	132.303
Water Transport	13.056	42.662	43.954	21.776	3.317	10.837	12.331	7.880	42.301	14.250	39.319	88.852
Air Transport	2.299	3.720	4.769	3.584	824	861	1.129	179	6.562	1.892	2.404	3.572
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	22.906	8.002	11.488	13.071	1.724	2.884	4.649	2.109	14.948	5.905	10.655	21.662
Post and Telecommunications	34.276	11.532	14.480	20.748	4.930	3.599	5.225	7.099	37.935	6.333	8.866	108.582
Financial Intermediation	68.484	72.673	68.501	76.012	10.215	20.676	31.958	12.766	119.080	35.224	99.648	163.678
Real Estate Activities	2.144	5.474	14.990	34.528	10.101	3.164	12.676	426	14.311	15.978	11.013	17.897
Renting of M&Eq and Other Business Activities	103.909	81.466	135.839	80.417	10.083	10.262	28.334	14.725	186.152	30.860	38.928	88.701
Public Admin and Defence; Compulsory Social Security	3.181	1.503	1.220	827	159	221	381	121	1.158	444	736	1.599
Education	10.773	10.429	3.552	2.099	388	746	1.043	322	4.233	1.125	2.037	3.949
Health and Social Work	10.216	14.190	7.164	4.113	3.157	3.120	4.833	1.079	11.047	1.028	12.623	28.040
Other Community, Social and Personal Services	37.633	43.921	20.914	15.932	5.514	4.353	8.707	3.220	34.514	9.617	23.222	48.951
Private Households with Employed Persons	-	-	-	-	-	-	-	-	-	-	-	-
Compensation of employee	2.145.936	927.346	811.574	572.737	115.156	170.599	245.197	196.048	712.093	279.749	472.813	1.115.017
Taxes on production and imports, less subsidies	745.497	322.160	281.940	198.969	40.005	59.266	85.181	68.107	247.381	97.185	164.255	387.356
Operating Surplus	1.884.197	814.239	712.587	502.881	101.110	149.791	215.291	172.136	625.240	245.628	415.144	979.019
Rural Household	-	-	-	-	-	-	-	-	-	-	-	-
Urban Household	-	-	-	-	-	-	-	-	-	-	-	-
Business	-	-	-	-	-	-	-	-	-	-	-	-
Government	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Rural Households	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Urban Households	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Entreprise	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Government	-	-	-	-	-	-	-	-	-	-	-	-
Row												
Output at basic prices	7.934.731	4.174.895	7.129.519	5.974.784	1.242.505	1.593.094	2.097.638	1.534.747	6.889.018	3.066.784	3.638.199	10.948.510

1.000.000 Yuan	Machinery, Nec	Electrical and Optical Equipment	Transport Equipment	Manufacturing, Nec; Recycling	Electricity, Gas and Water Supply	Construction	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	Hotels and Restaurants	Inland Transport	Water Transport
	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN	CHN
Agriculture, Hunting, Forestry and Fishing	494	75	189	35.426	75	54.127	-	1.377	285	290.571	191	48
Mining and Quarrying	56.168	29.882	16.697	3.991	579.062	230.282	-	2.733	565	7.024	26.625	6.449
Food, Beverages and Tobacco	26.788	58.737	19.837	5.817	19.139	72.790	-	39.581	8.188	782.889	15.809	13.465
Textiles and Textile Products	30.094	46.389	26.263	42.962	27.264	84.227	-	75.676	15.655	25.838	18.397	12.749
Leather, Leather and Footwear	1.448	10.063	52.446	17.561	368	2.739	-	292	60	184	303	141
Wood and Products of Wood and Cork	32.415	41.660	20.285	102.674	2.215	384.741	-	1.896	392	2.748	3.490	1.503
Pulp, Paper, Paper , Printing and Publishing	26.943	118.212	18.020	14.767	12.334	23.716	-	79.715	16.491	9.357	15.313	5.446
Coke, Refined Petroleum and Nuclear Fuel	44.445	43.535	18.379	3.188	109.381	185.873	-	14.385	2.976	8.951	229.788	169.310
Chemicals and Chemical Products	79.715	398.816	88.172	32.891	32.537	370.792	-	30.868	6.386	16.419	23.337	18.543
Rubber and Plastics	152.673	567.960	195.151	32.169	14.071	160.415	-	24.132	4.992	8.119	39.118	6.314
Other Non-Metallic Mineral	35.816	197.512	30.168	8.461	8.834	2.428.548	-	1.691	350	3.382	7.098	748
Basic Metals and Fabricated Metal	1.433.354	1.802.167	591.989	61.267	37.561	2.377.649	-	6.890	1.425	4.790	15.065	5.877
Machinery, Nec	1.081.896	283.874	395.517	5.591	36.189	335.739	-	13.544	2.802	3.594	23.541	24.265
Electrical and Optical Equipment	473.348	4.269.034	259.009	11.213	252.414	621.935	-	68.139	14.096	19.551	13.256	4.039
Transport Equipment	102.458	52.368	1.562.958	5.378	49.792	68.436	-	74.108	15.331	9.360	167.646	64.564
Manufacturing, Nec; Recycling	17.512	16.564	8.492	6.701	2.143	10.493	-	4.794	992	892	947	311
Electricity, Gas and Water Supply	146.290	144.450	59.169	9.989	1.348.632	192.053	-	70.674	14.621	62.881	51.090	3.517
Construction	2.333	2.966	1.686	151	1.846	163.666	-	18.805	3.890	6.956	15.352	147
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	-	-	-	-	-	-	-	-	-	-	-	-
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	199.401	453.088	198.534	15.793	44.283	436.203	-	42.505	8.793	83.639	31.830	19.144
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	41.251	93.733	41.072	3.267	9.161	90.240	-	8.793	1.819	17.303	6.585	3.960
Hotels and Restaurants	47.546	63.985	20.866	3.760	13.412	139.111	-	130.499	26.997	20.725	37.135	3.986
Inland Transport	88.763	122.036	49.085	8.456	30.215	379.374	-	231.974	47.990	9.731	101.452	1.223
Water Transport	32.246	43.860	19.446	3.450	12.938	37.924	-	99.608	20.607	4.866	2.068	81.898
Air Transport	7.561	13.344	3.371	525	1.810	7.744	-	19.518	4.038	3.012	1.161	628
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	10.511	16.878	7.820	1.065	3.102	509.864	-	52.278	10.815	8.728	21.409	29.176
Post and Telecommunications	25.689	88.915	10.762	3.475	27.548	239.082	-	65.056	13.459	14.016	15.199	30.607
Financial Intermediation	63.941	235.885	37.960	7.770	177.466	139.156	-	220.133	45.540	46.037	188.069	19.726
Real Estate Activities	22.989	44.610	8.897	5.104	2.667	10.983	-	165.015	34.138	43.224	11.442	311
Renting of M&Eq and Other Business Activities	111.280	315.433	134.406	8.816	70.868	248.381	-	408.132	84.432	42.283	17.871	5.176
Public Admin and Defence; Compulsory Social Security	1.109	1.647	750	95	825	2.383	-	2.196	454	630	989	371
Education	7.840	5.666	3.075	343	3.155	7.049	-	15.996	3.309	3.010	6.965	593
Health and Social Work	32.784	26.412	18.228	569	10.862	8.332	-	1.794	371	982	3.238	840
Other Community, Social and Personal Services	22.075	27.836	13.777	1.811	62.559	54.104	-	123.311	25.510	49.021	69.326	6.152
Private Households with Employed Persons	-	-	-	-	-	-	-	-	-	-	-	-
Compensation of employee	671.455	999.955	469.480	136.606	585.538	1.440.152	-	1.527.658	316.035	452.784	607.853	211.032
Taxes on production and imports, less subsidies	233.263	347.384	163.097	47.457	203.416	500.308	-	530.707	109.790	157.297	211.168	73.313
Operating Surplus	589.558	877.991	412.218	119.944	514.120	1.264.497	-	1.341.330	277.488	397.559	533.714	185.293
Rural Household	-	-	-	-	-	-	-	-	-	-	-	-
Urban Household	-	-	-	-	-	-	-	-	-	-	-	-
Business	-	-	-	-	-	-	-	-	-	-	-	-
Government	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Rural Households	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Urban Households	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Entreprise	-	-	-	-	-	-	-	-	-	-	-	-
Capital Account Government	-	-	-	-	-	-	-	-	-	-	-	-
Row												
Output at basic prices	**5.953.453**	**11.862.920**	**4.977.268**	**768.505**	**4.307.802**	**13.283.108**	**-**	**5.515.805**	**1.141.085**	**2.618.353**	**2.533.841**	**1.010.863**

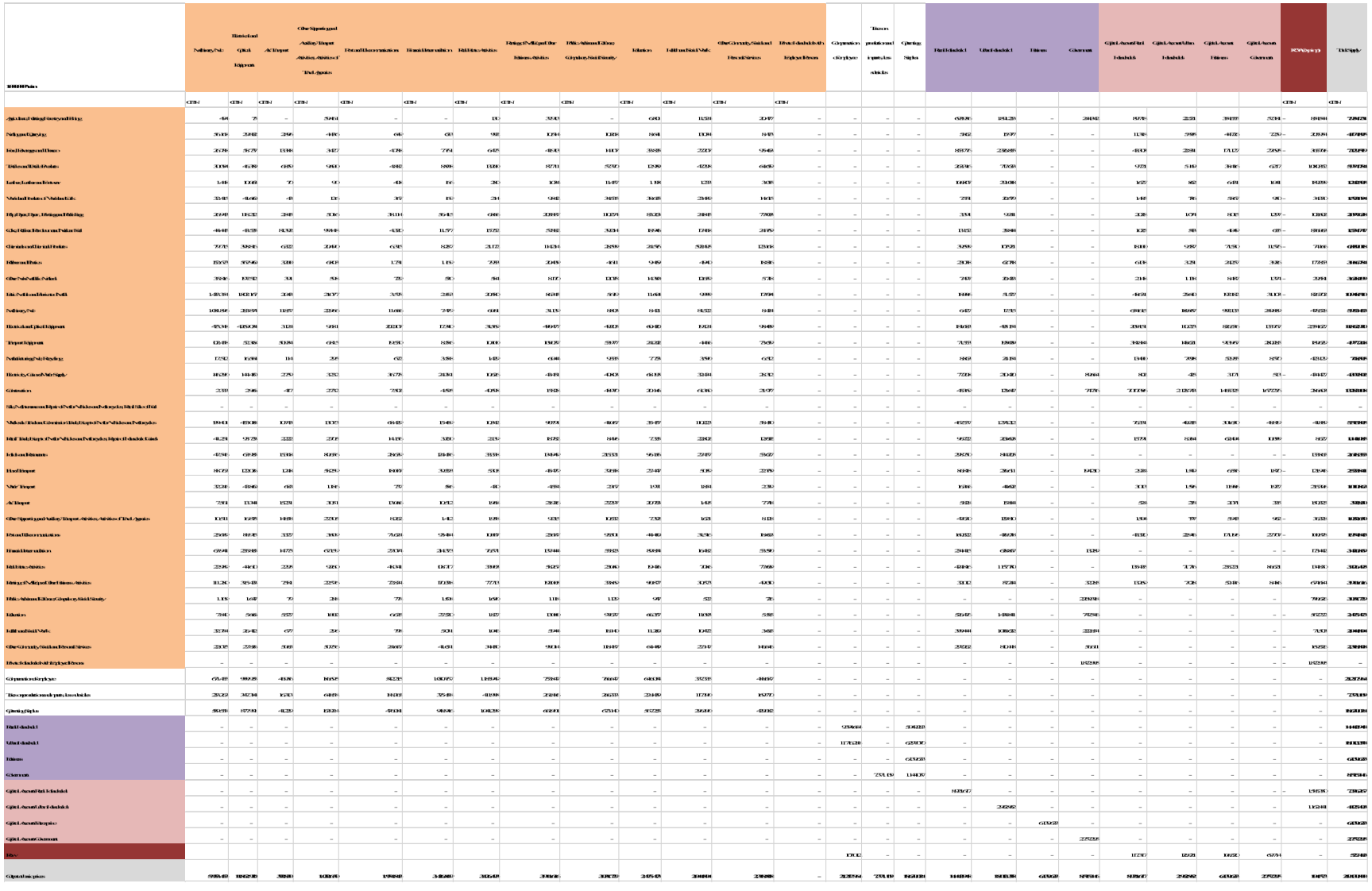

Figure 1.B From make and use to symmetric input-output tables

UN (2009) and EUROSTAT (2008) distinguish three kinds of secondary products: subsidiary, by-products and joint products. Subsidiary products input structure is uncorrelated with that of the primary product. By-products are produced together with the primary product but are also primary products of another industry. Joint products are produced together with the primary product but are not primary products of any other industry.

Two different kinds of symmetric input-output tables can be obtained starting from make and use tables, the industry by industry and the commodity by commodity input-output tables (UN, 2009; EUROSTAT, 2008). In order to obtain industry by industry tables, part of the inputs of the use table must be reallocated from row to row, while in order to obtain commodity by commodity tables part of the inputs of the use table must be reallocated from column to column. Unless one knows in detail the inputs employed by each industry in the secondary lines of activity, the process of input reallocation must be accomplished making assumptions on the production technology of the secondary products and on the sales structure.

Four main transformations of make and use tables in symmetric input-output tables are found in the literature (UN, 2009, EUROSTAT, 2008), two transformations that yield industry by industry tables and two that yield commodity by commodity tables. Two of the four transformations are based on technological assumptions, product technology assumption and industry technology assumption, and are used to obtain commodity by commodity tables; the other two transformations are based on assumptions on fixed sales structure, fixed industry sales structure and fixed product sales structure, and are used to obtain industry by industry tables.

In this section the transformations will be applied directly to the matrices of absorption coefficients. Some critiques of the interpretation of these transformations are reported at the end of this section.

Under the Commodity Technology Assumption (CTA) every commodity has its own production recipe, regardless of the industry where it is produced. The commodity technology assumption is appropriate in the case in which secondary products are of subsidiary type. This assumption is used to move inputs for the production of a given commodity from the industries where the commodity is secondary to the industry where it is primary. After completing this procedure, the columns of the table do not refer any more to

industries but to commodities. Let **U** be the commodity by industry block of the use table and **x** the vector of output by industry. Matrix $B = U\hat{}x\ 1$, where $\hat{}x$ is a diagonal matrix whose entries are the elements of x, consists of the industries absorption coefficients. Under the commodity technology assumption, the absorption coefficients are weighted averages of the elements of the unknown commodity by commodity matrix of technical coefficients $ACTAcxc$. The weights are the industry product mix coefficients obtained by normalizing the make table, M, by output by industry, x. Matrix B can be expressed as:

$$B = ACTAcxc\ C$$

where C is the product mix matrix obtained by transposing and normalizing the make table by output by industry, $C = M0\hat{}x\ 1$. Under the commodity technology assumption the matrix of absorption coefficients B has no technological meaning; information about technology is embodied in the commodity matrix of technical coefficients

$$ACTAcxc = BC^{-1}$$

Matrices B and C do not need to be constant; what it is assumed to be constant is their product, $ACTA\ cxc$. A drawback of the commodity technology assumption is that negative elements can be found in the commodity by commodity matrix of technical coefficients.

Under the Industry Technology Assumption (ITA) every industry has its own production recipe, de_ned in the respective column of matrix B, regardless of the mix of commodities produced. The industry technology assumption is appropriate in the case in which secondary products are by-products or joint products. This assumption is used to move inputs for the production of a given commodity from the industries where the commodity is secondary to the industry where it is primary. After completing this procedure, the columns of the table do not refer any more to industries but to commodities. The elements of the commodity by commodity matrix of coefficients $AITAcxc$ are obtained as weighted averages of the elements of matrix B. The weights are the market shares obtained by normalizing the make table, M, by output by commodity, q. Matrix $AITAcxc$ can be expressed as

$$AITAcxc = BD \qquad (1.18)$$

where D is the market shares matrix obtained by normalizing the make table by output by commodity, $D = M\hat{}q\ 1$: Under the industry technology assumption the commodity by commodity matrix of coefficients $AITAcxc$ has no technological meaning; the coefficients

relating to the input structure of a commodity are the superimposition of the input structures of the different industries producing that commodity. Information about technology is embodied in the coefficients of the absorption matrix B. Since in input-output analysis the commodity by commodity matrix of coefficients, $AITAcxc$, must be constant, and since under the industry technology assumption matrix B is assumed to be constant, from equation (1.18) also the matrix of market shares, D, must be constant.

While the industry technology assumption entails the additional assumption of fixed market shares, it doesn't su_er the drawback of the commodity technology assumption, that is the presence of negative elements in the commodity by commodity matrix of coefficients. Under the Fixed Industry Sales Structure (FISS) assumption, industries “supply all their products in the same proportions to their users" (EUROSTAT, 2008), regardless of the mix of commodities produced. The fixed industry sales structure assumption is appropriate in the case in which secondary products are sold together with primary product. This assumption is used to move sales of a commodity from a row to another; after completing this procedure the rows of the table do not refer any more to commodities but to industries. Under the fixed industry sales structure assumption, the absorption coefficients of matrix B are weighted averages of the elements of the unknown industry

by industry matrix of coefficients, $AFISSixi$. The weights are the industry product mix coefficients in matrix C. Matrix B can be expressed as

$$B = CA^{FISS}ixi \tag{1.19}$$

Every row in matrix C refers to a different commodity and contains, for each industry, the share of the given commodity in the product mix. Every column of $AFISSixi$ refers to a different industry and contains the absorption coefficients from the other industries. The product of a row of C and a column of $AFISSixi$ yields the coefficient of B which refers to the absorption of the commodity identified by the row in C by the industry identified by the column of $AFISSixi$; indeed, it has been assumed that secondary products are sold in the same proportions of primary product. From (1.19), the industry by industry matrix of coefficients can be expressed as

$$AFISSixi = C^{-1}B \tag{1.20}$$

Under the fixed industry sales structure assumption neither matrix $AFISSixi$ nor matrix B have technological meaning. Matrices B and C do not need to be constant, what it is assumed to be constant is their product, $AFISSixi$. A drawback of the fixed industry sales structure assumption is that negative elements can be found in the industry by industry matrix $AFISSixi$. Under the Fixed Product Sales Structure (FPSS) assumption every commodity has its own sales structure, that is every commodity is sold in the same proportions to its users, regardless the industry in which it has been produced. This assumption is used to move sales of a commodity from a row to another; after completing this procedure the rows of the table do not refer any more to commodities but to industries. The elements of the industry by industry matrix of coefficients $AFPSSixi$ are obtained as weighted averages of the elements of matrix B. The weights are the market shares in matrix D. Matrix $AFPSSixi$ can be expressed as

$$AFPSSixi = DB \tag{1.21}$$

Every row in matrix D refers to a different industry and contains the market shares for each commodity. Every column of B refers to a different industry and contains the absorption coefficients from the different commodities. The product of a row of D and a column of B yields the coefficient of $AFPSSixi$, which refers to the absorption from the industry identified by the row in D by the industry identified by the column of B; indeed, it has been assumed that every commodity is sold in the same proportions to its users, regardless the industry in which it has been produced. Under the fixed product sales structure assumption neither matrix B nor matrix $AFPSSixi$ have technological meaning. Matrices D and B do not need to be constant; what it is assumed to be constant is their product, $AFPSSixi$. The fixed products sales structure assumption doesn't suffer of the drawback of the fixed industry sales structure assumption, that is the presence of negative elements in the industry by industry matrix of coefficients. Summarizing, it can be said that while product by product matrices of absorption coefficients are based on technical assumptions on the production processes, industry by industry matrices are based on sales structure relationships. However, alternative classification schemes exist for the assumptions used in producing industry by industry input-output matrices of coefficients. The other major classification scheme is the one presented in Miller and Blair (2009), p.197. The idea is that also industry by industry matrices of coefficients are produced making assumptions on the technology of production. Avonds (2007) maintains that the “argument that the calculation of industry by industry tables is

solely based on sales structure assumptions is absolutely right but irrelevant when considering input-output analysis" because using “the coefficients of the industry by industry tables in industry by industry input-output analysis amounts to combining the fixed product sales structure with the industry technology assumption". This is not completely true: as observed in equations (1.20) and (1.21), matrices B, C and D do not need to be constant separately and there is no need for some input structures to be constant. However, in carrying out input-output analysis, the constancy of the technical coefficients must be based on an economic rationale. Therefore, the use of technology assumption seems to be necessary also in the industry by industry cases.

Figure 1.C Sectoring criteria

- the households sector: that consists of all resident households. These include institutional households made up of persons staying in hospitals, retirement homes, convents, prisons, etc. for long periods of time[40].
- the general government sector: it consists mainly of central, state and local government units together with social security funds imposed and controlled by those units. It includes non-profit institutions engaged in non-market production that are controlled and mainly financed by government units or social security funds;
- the financial corporations sector: it includes all resident corporations and quasi-corporations whose principal activity is financial intermediation or facilitating financial intermediation. It includes non-profit institutions engaged in market production of a financial nature (e.g., insurance), including those financed by subscriptions from financial enterprises whose role is to promote and serve the interests of those enterprises;
- non-financial corporations sector: it includes non-profit institutions engaged in the market production of goods and non-financial services (e.g., hospitals, schools or colleges), that charge fees that enable them to recover their current production costs, or trade associations financed by subscriptions from non-financial corporate or unincorporated enterprises whose role is to promote and serve the interests of those enterprises

[40] An unincorporated enterprise owned by a household is treated as an integral part of the latter and not as a separate institutional unit, except when the enterprise qualifies as a quasi-corporation.

Figure 1.D.1

GB/T 4754-2002			
Section	Division	Group	Class
A Agriculture, forestry, livestock, fishery	5	18	38
B Mining	6	15	33
C Manufacturing	30	169	482
D Production and distribution of electricity, gas and water	3	7	10
E Construction	4	7	11
F Transport, storage and post	9	24	37
G Information transmission, computer services and software	3	10	14
H Wholesale and retail trade	2	18	93
I Accommodation and catering	2	7	7
J Financial intermediation	4	16	16
K Real estate	1	4	4
L Leasing and business services	2	11	27
M Scientific research, technical service and geologic prospecting	4	19	23
N Management of water conservancy, environment and public facilities	3	8	18
O Services to households and other services	2	12	16
P Education	1	5	13
Q Health, social security and social welfare	3	11	17
R Culture, sports and entertainment	5	22	29
S Public administration and social organization	5	12	24
T International organizations	1	1	1
(Total) 20	95	396	913

Figure 1.D.2

Industry classification of China'S SAM 2011 (from WIOD)

ISIC rev.3 code	*Industry name*
AtB	Agriculture, hunting, forestry and fishing
C	Mining and quarrying
15t16	Food, beverages and tobacco
17t18	Textiles and textile products
19	Leather, leather products and footwear
20	Wood and products of wood and cork
21t22	Pulp, paper, printing and publishing
23	Coke, refined petroleum and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastics
26	Other non-metallic mineral
27t28	Basic metals and fabricated metal
29	Machinery, not elsewhere classified
30t33	Electrical and optical equipment
34t35	Transport equipment
36t37	Manufacturing, not elsewhere classified; recycling
E	Electricity, gas and water supply
F	Construction
50	Sale and repair of motor vehicles and motorcycles; retail sale of fuel
51	Wholesale trade, except of motor vehicles and motorcycles
52	Retail trade and repair, except of motor vehicles and motorcycles;
H	Hotels and restaurants
60	Inland transport
61	Water transport
62	Air transport
63	Other supporting transport activities
64	Post and telecommunications
J	Financial intermediation
70	Real estate activities
71t74	Renting of machinery & equipment and other business activities
L	Public administration and defence; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal services
P	Private households with employed persons

Figure 1.D.3

Bridging table between the two different industry classifications. For each sector in the NBS it was found an equivalent industry in WIOD (pink column).

	NBS		WIOD	Corr
1	Agriculture, Forestry, Animal Husbandry and Fishery	1	Agriculture, Hunting, Forestry and Fishing	1
2	Mining	2	Mining and Quarrying	2
3	Manufacturing	3	Food, Beverages and Tobacco	3
4	Production and Supply of Electricity, Gas and Water	4	Textiles and Textile Products	3
5	Construction	5	Leather, Leather and Footwear	3
6	Transport, Storage and Post	6	Wood and Products of Wood and Cork	3
7	*Information Transmission, Computer Services and Software*	7	Pulp, Paper, Paper , Printing and Publishing	3
8	Wholesale and Retail Trades	8	Coke, Refined Petroleum and Nuclear Fuel	3
9	Hotels and Catering Services	9	Chemicals and Chemical Products	3
10	Financial Intermediation	10	Rubber and Plastics	3
11	Real Estate	11	Other Non-Metallic Mineral	3
12	Leasing and Business Services	12	Basic Metals and Fabricated Metal	3
13	*Scientific Research, Technical Services and Geologic Prospecting*	13	Machinery, Nec	3
14	Management of Water Conservancy, Environment and Public Facilities	14	Electrical and Optical Equipment	3
15	Services to Households and Other Services	15	Transport Equipment	3
16	Education	16	Manufacturing, Nec; Recycling	3
17	Health, Social Security and Social Welfare	17	Electricity, Gas and Water Supply	4
18	*Culture, Sports and Entertainment*	18	Construction	5
19	Public Management and Social Organizations	19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	8
		20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	8
		21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	8
		22	Hotels and Restaurants	9
		23	Inland Transport	6
		24	Water Transport	6
		25	Air Transport	6
		26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	6
		27	Post and Telecommunications	6
		28	Financial Intermediation	10
		29	Real Estate Activities	11
		30	Renting of M&Eq and Other Business Activities	7,12,13
		31	Public Admin and Defence; Compulsory Social Security	14
		32	Education	16
		33	Health and Social Work	17
		34	Other Community, Social and Personal Services	18,19
		35	Private Households with Employed Persons	15

Figure 1.E.1 Foreign daily exchange rates EUR/USD

Day	Exchange rate	Day	Exchange rate	Day	Exchange rate	Day	Exchange rate
03/01/2011	1,33	01/04/2011	1,41	05/07/2011	1,45	05/10/2011	1,33
04/01/2011	1,34	04/04/2011	1,42	06/07/2011	1,43	06/10/2011	1,33
05/01/2011	1,32	05/04/2011	1,42	07/07/2011	1,42	07/10/2011	1,34
06/01/2011	1,31	06/04/2011	1,43	08/07/2011	1,42	10/10/2011	1,36
07/01/2011	1,30	07/04/2011	1,43	11/07/2011	1,41	11/10/2011	1,36
10/01/2011	1,29	08/04/2011	1,44	12/07/2011	1,40	12/10/2011	1,38
11/01/2011	1,29	11/04/2011	1,44	13/07/2011	1,41	13/10/2011	1,37
12/01/2011	1,30	12/04/2011	1,45	14/07/2011	1,42	14/10/2011	1,38
13/01/2011	1,32	13/04/2011	1,45	15/07/2011	1,41	17/10/2011	1,38
14/01/2011	1,33	14/04/2011	1,44	18/07/2011	1,40	18/10/2011	1,37
17/01/2011	1,33	15/04/2011	1,45	19/07/2011	1,42	19/10/2011	1,38
18/01/2011	1,34	18/04/2011	1,43	20/07/2011	1,42	20/10/2011	1,38
19/01/2011	1,35	19/04/2011	1,43	21/07/2011	1,42	21/10/2011	1,38
20/01/2011	1,35	20/04/2011	1,45	22/07/2011	1,44	24/10/2011	1,39
21/01/2011	1,35	21/04/2011	1,46	25/07/2011	1,44	25/10/2011	1,39
24/01/2011	1,36	26/04/2011	1,46	26/07/2011	1,45	26/10/2011	1,39
25/01/2011	1,36	27/04/2011	1,47	27/07/2011	1,44	27/10/2011	1,40
26/01/2011	1,37	28/04/2011	1,48	28/07/2011	1,43	28/10/2011	1,42
27/01/2011	1,37	29/04/2011	1,49	29/07/2011	1,43	31/10/2011	1,40
28/01/2011	1,37	02/05/2011	1,48	01/08/2011	1,44	01/11/2011	1,36
31/01/2011	1,37	03/05/2011	1,48	02/08/2011	1,42	02/11/2011	1,38
01/02/2011	1,38	04/05/2011	1,49	03/08/2011	1,43	03/11/2011	1,38
02/02/2011	1,38	05/05/2011	1,48	04/08/2011	1,42	04/11/2011	1,38
03/02/2011	1,37	06/05/2011	1,45	05/08/2011	1,42	07/11/2011	1,37
04/02/2011	1,36	09/05/2011	1,44	08/08/2011	1,42	08/11/2011	1,38
07/02/2011	1,36	10/05/2011	1,44	09/08/2011	1,43	09/11/2011	1,36
08/02/2011	1,36	11/05/2011	1,44	10/08/2011	1,44	10/11/2011	1,36
09/02/2011	1,36	12/05/2011	1,42	11/08/2011	1,41	11/11/2011	1,37
10/02/2011	1,36	13/05/2011	1,43	12/08/2011	1,43	14/11/2011	1,37
11/02/2011	1,35	16/05/2011	1,41	15/08/2011	1,43	15/11/2011	1,35
14/02/2011	1,34	17/05/2011	1,42	16/08/2011	1,44	16/11/2011	1,35
15/02/2011	1,35	18/05/2011	1,42	17/08/2011	1,45	17/11/2011	1,35
16/02/2011	1,35	19/05/2011	1,43	18/08/2011	1,44	18/11/2011	1,36
17/02/2011	1,36	20/05/2011	1,42	19/08/2011	1,44	21/11/2011	1,35
18/02/2011	1,36	23/05/2011	1,40	22/08/2011	1,44	22/11/2011	1,35
21/02/2011	1,37	24/05/2011	1,41	23/08/2011	1,45	23/11/2011	1,34
22/02/2011	1,37	25/05/2011	1,41	24/08/2011	1,44	24/11/2011	1,34
23/02/2011	1,37	26/05/2011	1,42	25/08/2011	1,44	25/11/2011	1,32
24/02/2011	1,38	27/05/2011	1,43	26/08/2011	1,44	28/11/2011	1,33
25/02/2011	1,38	30/05/2011	1,43	29/08/2011	1,45	29/11/2011	1,33
28/02/2011	1,38	31/05/2011	1,44	30/08/2011	1,44	30/11/2011	1,34
01/03/2011	1,38	01/06/2011	1,44	31/08/2011	1,45	01/12/2011	1,35
02/03/2011	1,38	02/06/2011	1,45	01/09/2011	1,43	02/12/2011	1,35
03/03/2011	1,39	03/06/2011	1,45	02/09/2011	1,43	05/12/2011	1,34
04/03/2011	1,40	06/06/2011	1,46	05/09/2011	1,41	06/12/2011	1,34
07/03/2011	1,40	07/06/2011	1,47	06/09/2011	1,41	07/12/2011	1,34
08/03/2011	1,39	08/06/2011	1,46	07/09/2011	1,40	08/12/2011	1,34
09/03/2011	1,39	09/06/2011	1,46	08/09/2011	1,40	09/12/2011	1,34
10/03/2011	1,38	10/06/2011	1,45	09/09/2011	1,38	12/12/2011	1,33
11/03/2011	1,38	13/06/2011	1,44	12/09/2011	1,37	13/12/2011	1,32
14/03/2011	1,39	14/06/2011	1,44	13/09/2011	1,36	14/12/2011	1,30
15/03/2011	1,39	15/06/2011	1,43	14/09/2011	1,37	15/12/2011	1,30
16/03/2011	1,40	16/06/2011	1,41	15/09/2011	1,38	16/12/2011	1,31
17/03/2011	1,40	17/06/2011	1,43	16/09/2011	1,38	19/12/2011	1,30
18/03/2011	1,41	20/06/2011	1,42	19/09/2011	1,36	20/12/2011	1,31
21/03/2011	1,42	21/06/2011	1,44	20/09/2011	1,37	21/12/2011	1,31
22/03/2011	1,42	22/06/2011	1,44	21/09/2011	1,36	22/12/2011	1,30
23/03/2011	1,41	23/06/2011	1,42	22/09/2011	1,34	23/12/2011	1,31
24/03/2011	1,41	24/06/2011	1,42	23/09/2011	1,34	27/12/2011	1,31
25/03/2011	1,41	27/06/2011	1,42	26/09/2011	1,35	28/12/2011	1,31
28/03/2011	1,40	28/06/2011	1,43	27/09/2011	1,36	29/12/2011	1,29
29/03/2011	1,41	29/06/2011	1,44	28/09/2011	1,36	30/12/2011	1,29
30/03/2011	1,41	30/06/2011	1,45	29/09/2011	1,36	**Averange**	**1,3680**
31/03/2011	1,42	01/07/2011	1,45	30/09/2011	1,35		
		04/07/2011	1,45	03/10/2011	1,33		
				04/10/2011	1,32		

Figure 1.E.2 Foreign daily exchange rates EUR/RMN

Day	Exchange rate	Day	Exchange rate	Day	Exchange rate	Day	Exchange rate
03/01/2011	8,7959	31/03/2011	9,3036	05/07/2011	9,3528	07/10/2011	8,5413
04/01/2011	8,8697	01/04/2011	9,2592	06/07/2011	9,2592	10/10/2011	8,6297
05/01/2011	8,7457	04/04/2011	9,3094	07/07/2011	9,2118	11/10/2011	8,6758
06/01/2011	8,6748	05/04/2011	9,2654	08/07/2011	9,2072	12/10/2011	8,7534
07/01/2011	8,5906	06/04/2011	9,3579	11/07/2011	9,0903	13/10/2011	8,758
10/01/2011	8,5646	07/04/2011	9,3442	12/07/2011	9,03	14/10/2011	8,8178
11/01/2011	8,5716	08/04/2011	9,4115	13/07/2011	9,1026	17/10/2011	8,7746
12/01/2011	8,5671	11/04/2011	9,4374	14/07/2011	9,1788	18/10/2011	8,7262
13/01/2011	8,7174	12/04/2011	9,4638	15/07/2011	9,1426	19/10/2011	8,8203
14/01/2011	8,797	13/04/2011	9,4687	18/07/2011	9,0853	20/10/2011	8,8147
17/01/2011	8,7759	14/04/2011	9,4075	19/07/2011	9,1539	21/10/2011	8,812
18/01/2011	8,802	15/04/2011	9,4389	20/07/2011	9,1762	24/10/2011	8,8343
19/01/2011	8,8902	18/04/2011	9,3199	21/07/2011	9,1817	25/10/2011	8,8528
20/01/2011	8,8719	19/04/2011	9,3399	22/07/2011	9,2777	26/10/2011	8,8492
21/01/2011	8,9013	20/04/2011	9,4716	25/07/2011	9,2679	27/10/2011	8,9284
24/01/2011	8,9315	21/04/2011	9,4708	26/07/2011	9,3237	28/10/2011	9,0058
25/01/2011	8,9498	26/04/2011	9,5418	27/07/2011	9,308	31/10/2011	8,9
26/01/2011	9,0062	27/04/2011	9,5508	28/07/2011	9,1874	01/11/2011	8,6613
27/01/2011	9,0279	28/04/2011	9,6161	29/07/2011	9,1793	02/11/2011	8,7785
28/01/2011	9,0431	29/04/2011	9,6456	01/08/2011	9,2746	03/11/2011	8,7544
31/01/2011	9,0299	02/05/2011	9,6218	02/08/2011	9,1228	04/11/2011	8,7321
01/02/2011	9,0604	03/05/2011	9,6024	03/08/2011	9,2008	07/11/2011	8,7275
02/02/2011	9,089	04/05/2011	9,6636	04/08/2011	9,1621	08/11/2011	8,7506
03/02/2011	9,0511	05/05/2011	9,6198	05/08/2011	9,1164	09/11/2011	8,6323
04/02/2011	8,976	06/05/2011	9,4158	08/08/2011	9,1552	10/11/2011	8,643
07/02/2011	8,9247	09/05/2011	9,3496	09/08/2011	9,1745	11/11/2011	8,6571
08/02/2011	8,9786	10/05/2011	9,3218	10/08/2011	9,215	14/11/2011	8,6813
09/02/2011	8,993	11/05/2011	9,322	11/08/2011	9,0437	15/11/2011	8,5842
10/02/2011	8,9605	12/05/2011	9,1978	12/08/2011	9,1129	16/11/2011	8,5636
11/02/2011	8,9164	13/05/2011	9,2794	15/08/2011	9,144	17/11/2011	8,5669
14/02/2011	8,8662	16/05/2011	9,2053	16/08/2011	9,1657	18/11/2011	8,6273
15/02/2011	8,902	17/05/2011	9,2195	17/08/2011	9,2466	21/11/2011	8,5613
16/02/2011	8,8963	18/05/2011	9,2542	18/08/2011	9,1785	22/11/2011	8,6022
17/02/2011	8,9225	19/05/2011	9,2784	19/08/2011	9,2006	23/11/2011	8,5121
18/02/2011	8,9529	20/05/2011	9,2429	22/08/2011	9,2232	24/11/2011	8,5159
21/02/2011	8,976	23/05/2011	9,1186	23/08/2011	9,2513	25/11/2011	8,4307
22/02/2011	8,9929	24/05/2011	9,1543	24/08/2011	9,2205	28/11/2011	8,5215
23/02/2011	9,0272	25/05/2011	9,1357	25/08/2011	9,2169	29/11/2011	8,4778
24/02/2011	9,0551	26/05/2011	9,1972	26/08/2011	9,1988	30/11/2011	8,5567
25/02/2011	9,0513	27/05/2011	9,2621	29/08/2011	9,2442	01/12/2011	8,589
28/02/2011	9,0912	30/05/2011	9,2528	30/08/2011	9,1892	02/12/2011	8,5702
01/03/2011	9,0816	31/05/2011	9,3199	31/08/2011	9,2133	05/12/2011	8,531
02/03/2011	9,076	01/06/2011	9,3336	01/09/2011	9,1138	06/12/2011	8,4847
03/03/2011	9,0995	02/06/2011	9,3741	02/09/2011	9,0977	07/12/2011	8,4905
04/03/2011	9,1673	03/06/2011	9,3876	05/09/2011	9,0202	08/12/2011	8,5313
07/03/2011	9,1975	06/06/2011	9,4499	06/09/2011	9,01	09/12/2011	8,482
08/03/2011	9,1292	07/06/2011	9,4963	07/09/2011	8,976	12/12/2011	8,4284
09/03/2011	9,1539	08/06/2011	9,4597	08/09/2011	8,9629	13/12/2011	8,3877
10/03/2011	9,0845	09/06/2011	9,4639	09/09/2011	8,8266	14/12/2011	8,2659
11/03/2011	9,0551	10/06/2011	9,3872	12/09/2011	8,7443	15/12/2011	8,2587
14/03/2011	9,1603	13/06/2011	9,3056	13/09/2011	8,7316	16/12/2011	8,2698
15/03/2011	9,1255	14/06/2011	9,3609	14/09/2011	8,7818	19/12/2011	8,2558
16/03/2011	9,1676	15/06/2011	9,2644	15/09/2011	8,8136	20/12/2011	8,2914
17/03/2011	9,2076	16/06/2011	9,1211	16/09/2011	8,7836	21/12/2011	8,2734
18/03/2011	9,2823	17/06/2011	9,2363	19/09/2011	8,7125	22/12/2011	8,2705
21/03/2011	9,3184	20/06/2011	9,2216	20/09/2011	8,7529	23/12/2011	8,2742
22/03/2011	9,3039	21/06/2011	9,2926	21/09/2011	8,6991	27/12/2011	8,2631
23/03/2011	9,2633	22/06/2011	9,3054	22/09/2011	8,604	28/12/2011	8,2607
24/03/2011	9,2634	23/06/2011	9,192	23/09/2011	8,5803	29/12/2011	8,1461
25/03/2011	9,2594	24/06/2011	9,2059	26/09/2011	8,6418	30/12/2011	8,1588
28/03/2011	9,2089	27/06/2011	9,2038	27/09/2011	8,6878	**Averange**	**8,998075**
29/03/2011	9,228	28/06/2011	9,2272	28/09/2011	8,7154		
30/03/2011	9,2381	29/06/2011	9,3235	29/09/2011	8,7103		
		30/06/2011	9,3416	30/09/2011	8,6207		
		01/07/2011	9,3663	03/10/2011	8,4973		
		04/07/2011	9,3714	04/10/2011	8,3858		
				05/10/2011	8,5037		
				06/10/2011	8,465		

Figure 1.F Reallocation Tables

Table (section) a – Reallocation for primary factors

(milion of Yuan)	Value
Compensation of employees	21.217.964
Taxes on production and imports, less subsidies	7.371.109
Gross operating surplus	18.630.024
Value Added	**47.219.097**

Table (section) b – Reallocation Detail for Rural and Urban Households of compensation of employees account

Compensation of employees	Value
Rural Households	9.394.664
Urban Households	11.716.288
Row	107.012

Table (section) c – Our reallocation for institutional sectors of operating surplus account

1.000.000 Yuan	Value
Total Gross operating surplus	**18.630.024**
Rural Households	5.049.283
Urban Households	6.297.070
Business	6.139.633
Government	1.144.037

Figure 1.G List of tables from NBS

Figure 1.G.1 Rural and Urban Population

Region	Total Population (year-end) (10 000 persons)	Urban Population			Rural Population			Birth Rate (‰)	Death Rate (‰)	Natural Growth Rate (‰)
		Population		Proportion	Population		Proportion			
National Total	**134735**	**69079**	**690.790.000**	**51.27**	**65656**	**656.560.000**	**48.73**	**11.93**	**7.14**	**4.79**
Beijing	2019	1740	**17.400.000**	86.20	279	**2.790.000**	13.80	8.29	4.27	4.02
Tianjin	1355	1091	**10.910.000**	80.50	264	**2.640.000**	19.50	8.58	6.08	2.50
Hebei	7241	3302	**33.020.000**	45.60	3939	**39.390.000**	54.40	13.02	6.52	6.50
Shanxi	3593	1785	**17.850.000**	49.68	1808	**18.080.000**	50.32	10.47	5.61	4.86
Inner Mongolia	2482	1405	**14.050.000**	56.62	1077	**10.770.000**	43.38	8.94	5.43	3.51
			-			-				
Liaoning	4383	2807	**28.070.000**	64.05	1576	**15.760.000**	35.95	5.71	6.05	-0.34
Jilin	2749	1468	**14.680.000**	53.40	1281	**12.810.000**	46.60	6.53	5.51	1.02
Heilongjiang	3834	2166	**21.660.000**	56.50	1668	**16.680.000**	43.50	6.99	5.92	1.07
			-			-				
Shanghai	2347	2096	**20.960.000**	89.30	251	**2.510.000**	10.70	6.97	5.10	1.87
Jiangsu	7899	4889	**48.890.000**	61.90	3010	**30.100.000**	38.10	9.59	6.98	2.61
Zhejiang	5463	3403	**34.030.000**	62.30	2060	**20.600.000**	37.70	9.47	5.40	4.07
Anhui	5968	2674	**26.740.000**	44.80	3294	**32.940.000**	55.20	12.23	5.91	6.32
Fujian	3720	2161	**21.610.000**	58.10	1559	**15.590.000**	41.90	11.41	5.20	6.21
Jiangxi	4488	2051	**20.510.000**	45.70	2437	**24.370.000**	54.30	13.48	5.98	7.50
Shandong	9637	4910	**49.100.000**	50.95	4727	**47.270.000**	49.05	11.50	6.40	5.10
			-			-				
Henan	9388	3809	**38.090.000**	40.57	5579	**55.790.000**	59.43	11.56	6.62	4.94
Hubei	5758	2984	**29.840.000**	51.83	2774	**27.740.000**	48.17	10.39	6.01	4.38
Hunan	6596	2975	**29.750.000**	45.10	3621	**36.210.000**	54.90	13.35	6.80	6.55
Guangdong	10505	6986	**69.860.000**	66.50	3519	**35.190.000**	33.50	10.45	4.35	6.10
Guangxi	4645	1942	**19.420.000**	41.80	2703	**27.030.000**	58.20	13.71	6.04	7.67
Hainan	877	443	**4.430.000**	50.50	434	**4.340.000**	49.50	14.72	5.75	8.97
			-			-				
Chongqing	2919	1606	**16.060.000**	55.02	1313	**13.130.000**	44.98	9.88	6.71	3.17
Sichuan	8050	3367	**33.670.000**	41.83	4683	**46.830.000**	58.17	9.79	6.81	2.98
Guizhou	3469	1213	**12.130.000**	34.96	2256	**22.560.000**	65.04	13.31	6.93	6.38
Yunnan	4631	1704	**17.040.000**	36.80	2927	**29.270.000**	63.20	12.71	6.36	6.35
Tibet	303	69	**690.000**	22.71	234	**2.340.000**	77.29	15.39	5.13	10.26
			-			-				
Shaanxi	3743	1770	**17.700.000**	47.30	1973	**19.730.000**	52.70	9.75	6.06	3.69
Gansu	2564	953	**9.530.000**	37.15	1611	**16.110.000**	62.85	12.08	6.03	6.05
Qinghai	568	263	**2.630.000**	46.22	305	**3.050.000**	53.78	14.43	6.12	8.31
Ningxia	639	318	**3.180.000**	49.82	321	**3.210.000**	50.18	13.65	4.68	8.97
Xinjiang	2209	962	**9.620.000**	43.54	1247	**12.470.000**	56.46	14.99	4.42	10.57

Figure 1.G.2 Household consumption

(100 million yuan)				
Item	2008	2009	2010	2011
Total	**111.670,4**	**123.584,6**	**140.758,6**	**164.945,2**
Rural Household	**27.677,3**	**29.005,3**	**31.974,6**	**37.394,6**
Food	11.342,7	11.397,8	12.249,1	13.989,2
Clothing	1.502,7	1.619,8	1.796,1	2.265,7
Residence	5.005,5	4.850,9	5.042,2	5.792,3
Household Facilities, Articles and Services	1.277,9	1.589,8	1.980,2	2.504,4
Health Care and Personal Articles	2.478,9	3.030,7	3.643,9	4.609,9
Transportation and Communications	2.609,2	2.806,9	3.136,6	3.631,2
Recreation, Education and Culture Articles	2.231,5	2.372,9	2.494,6	2.631,5
Financial Service	505,4	474,9	751,7	879,1
Insurance Service	179,3	275,7	240,6	281,4
Others	544,2	585,9	639,6	809,9
Urban Household	**83.993,1**	**94.579,3**	**108.784,0**	**127.550,6**
Food	26.205,4	28.419,4	31.588,6	37.458,5
Clothing	7.172,4	8.149,2	9.495,8	11.392,7
Residence	14.187,0	15.888,6	19.168,1	21.596,2
Household Facilities, Articles and Services	4.255,8	4.993,5	6.119,7	7.135,0
Health Care and Personal Articles	7.418,4	8.773,8	10.049,5	12.590,7
Transportation and Communications	8.717,7	10.677,4	13.041,8	14.624,1
Recreation, Education and Culture Articles	8.356,0	9.346,0	10.700,9	12.596,8
Financial Service	2.132,9	1.995,8	3.172,4	3.686,1
Insurance Service	1.536,2	1.589,8	2.165,4	2.516,0
Others	4.011,3	4.745,9	3.281,7	3.954,5

Figure 1.G.3 Main items of National Government Expenditure

(100 million yuan)

Item	National Government Expenditure	Central Government	Local Governments
National Government Expenditure	**109.248**	**16.514**	**92.734**
Expenditure for General Public Services	10.988	903	10.085
Expenditure for Foreign Affairs	310	307	3
Expenditure for External Assistance	159	159	0
Expenditure for National Defense	6.028	5.830	198
Expenditure for Public Security	6.304	1.037	5.267
Expenditure for Armed Police	1.082	790	292
Expenditure for Education	16.497	999	15.498
Expenditure for Science and Technology	3.828	1.942	1.886
Expenditure for Culture, Sport and Media	1.893	189	1.705
Expenditure for Social Safety Net and Employment Effort	11.109	502	10.607
Expenditure for Medical and Health Care	6.430	71	6.358
Expenditure for Environment Protection	2.641	74	2.567
Expenditure for Urban and Rural Community Affairs	7.621	12	7.609
Expenditure for Agriculture, Forestry and Water Conservancy	9.938	417	9.521
Expenditure for Transportation	7.498	331	7.167
Expenditure for Purchasing Vehicles	2.315	73	2.241
Expenditure for Affairs of Exploration, Power and Information	4.011	464	3.547
Expenditure for Affairs of Commerce and Services	1.422	27	1.395
Expenditure for Affairs of Financial Supervision	649	414	235
Expenditure for Post-earthquake Recovery and Reconstruction	174		174
Expenditure for Affairs of Land and Weather	1.521	232	1.290
Expenditure for Affairs of Housing Security	3.821	329	3.492
Expenditure for Affairs of Management of Grain & Oil Reserves	1.270	540	729
Interest payment for domestic and foreign debts	2.384	1.820	564
Other Expenditure	2.911	75	2.836

Figure 1.G.4 Flow of Funds Accounts

Sectors / Items	Non-financial Corporations		Financial Institutions		General Governments		Households		All Domestic Sectors		The Rest of the World		Total	
	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources	Uses	Sources
2011														
Net Exports												- 12.163,30		- 12.163,30
Value Added		**274.841,15**		**24.958,29**		**40.363,25**		**132.941,36**		**473.104,05**				**473.104,05**
Compensation of Employees	98.610,21		8.062,53		34.400,02		80.385,47	222.423,84	221.458,24	222.423,84	1.070,12	104,51	222.528,35	222.528,35
Wages and Salaries														
Employers' Social Contributions														
Taxes on Production, Net	57.843,21		2.906,30		300,84	62.270,81	1.220,45		62.270,81	62.270,81			62.270,81	62.270,81
Taxes on Products														
Subsidies on Production														
Income from Properties	**44.709,34**	**21.175,55**	**40.060,04**	**43.429,17**	**6.788,89**	**10.922,63**	**8.329,57**	**18.853,23**	**98.930,21**	**93.422,93**	**8.247,84**	**13.755,11**	**107.178,04**	**107.178,04**
Interest	23.905,59	19.571,90	37.656,29	42.808,74	6.156,00	4.135,38	8.287,25	15.913,56	76.005,14	82.429,58	6.706,11	281,67	82.711,25	82.711,25
Distributed Income of Corporations	16.449,82	1.541,73	1.145,82	620,44		2.391,01		1.110,76	16.638,00	4.706,28	1.541,73	13.473,44	18.179,73	18.179,73
Rent on Land, Natural Resources, and Subsoil Assets	3.033,21					3.075,52	42,32		3.075,52	3.075,52			3.075,52	3.075,52
Others	1.320,72	61,92	1.257,93		632,89	1.320,72		1.828,91	3.211,55	3.211,55			3.211,55	3.211,55
Total Income from Primary Distribution		94.853,93		17.358,58		72.066,93		284.282,94		468.562,38				
Current Transfer	**16.933,22**	**1.069,76**	**5.490,52**	**3.311,12**	**34.189,55**	**52.325,84**	**31.817,90**	**33.307,54**	**88.431,20**	**90.014,26**	**3.589,14**	**2.006,07**	**44.438,86**	**44.438,86**
Taxes on Income	13.367,05		3.402,59			22.823,75	6.054,11		22.823,75	22.823,75			22.823,75	22.823,75
Payment to Social Security					5.416,38	27.217,58	21.801,20		27.217,58	27.217,58				
Social Security Welfare					20.363,89			20.363,89	20.363,89	20.363,89				
Allowances	144,67				7.444,18			7.588,85	7.588,85	7.588,85			7.588,85	7.588,85
Others	3.421,51	1.069,76	2.087,93	3.311,12	965,11	2.284,50	3.962,58	5.354,81	10.437,13	12.020,19	3.589,14	2.006,07	14.026,27	14.026,27
Total Disposable Income		**78.990,47**		15.179,18		90.203,21		285.772,58		470.145,44				470.145,44
Final Consumption Expenditure					63.154,90		168.956,60		232.111,50				232.111,50	
Household Consumption							168.956,60		168.956,60				168.956,60	
Government Consumption					63.154,90				63.154,90				63.154,90	
Savings		78.990,47		15.179,18		27.048,31		116.815,98		238.033,94		- 9.204,70		228.829,25
Capital Transfers	**2.005,32**	**6.219,44**			**6.230,70**	**2.425,63**	**57,29**		**8.293,31**	**8.645,07**	**363,02**	**11,25**	**8.656,33**	**8.656,33**
Investment Allowances		6.219,44			6.219,44				6.219,44	6.219,44			6.219,44	6.219,44
Other	2.005,32				11,25	2.425,63	57,29		2.073,86	2.425,63	363,02	11,25	2.436,88	2.436,88
Gross Capital Formation	**147.080,40**		**400,09**	**65%**	**23.868,36**	**10%**	**56.995,32**	**25%**	**228.344,30**				**228.344,30**	
Gross Fixed Capital Formation	137.961,00		400,09		23.433,57		53.887,33		215.682,00				215.682,00	
Changes in Inventories	9.119,40				434,79		3.107,99		12.662,30				12.662,30	
Acquisitions Less Disposals of Other Non-financial Assets	23.626,19			-	9.033,19	-	14.593,00							
Net Financial Investment	- 87.501,99		14.779,09		8.408,07		74.356,37		10.041,41	-	9.556,46		484,95	

Figure 1.G.5 Balance of Payment

(USD 10 000)

Type of Transaction	Balance	Credit	Debit
Current Account	**20.171.419**	**228.683.653**	**208.512.234**
Goods and Services	**18.832.077**	**208.666.007**	**189.833.929**
Goods	**24.354.893**	**190.382.059**	**166.027.165**
Services	**- 5.522.816**	**18.283.948**	**23.806.764**
Transportation	- 4.487.481	3.556.990	8.044.471
Travel	- 2.412.105	4.846.400	7.258.505
Communication Service	53.580	172.638	119.057
Construction Service	1.099.591	1.472.434	372.844
Insurance Service	- 1.672.006	301.772	1.973.778
Financial Service	10.253	84.936	74.683
Computer and Information Service	833.792	1.218.206	384.414
Fees for Patent or Royalty	- 1.396.281	74.330	1.470.611
Consultation	980.988	2.839.142	1.858.154
Advertisement and Publicity	124.466	401.794	277.328
Movies and Audio-video Products	- 27.679	12.278	39.956
Other Commercial Service	1.401.263	3.227.752	1.826.489
Government Service not Elsewhere Classified	- 31.196	75.277	106.473
Income and Profit	**- 1.186.776**	**14.460.635**	**15.647.411**
Compensation of Staff and Workers	1.495.022	1.656.837	161.815
Profit from Investment	- 2.681.798	12.803.798	15.485.596
Current Transfers	**2.526.118**	**5.557.012**	**3.030.894**
Governments	- 258.698	1.582	260.280
Other Departments	2.784.815	5.555.429	2.770.614
		139.824.126	
Capital and Finance Account	**22.105.603**	**139.824.126**	**117.718.523**
Capital Account	**544.629**	**562.053**	**17.425**
Financial Account	**21.560.974**	**139.262.072**	**117.701.098**
Direct Investments	**17.044.869**	**27.166.278**	**10.121.409**
Chinese Direct Investments Abroad	- 4.969.460	1.740.745	6.710.204
Foreign Direct Investments in China	22.014.329	25.425.533	3.411.205
Securities	**1.963.915**	**5.194.699**	**3.230.785**
Assets	624.769	2.549.388	1.924.620
Capital Stock	110.412	1.122.894	1.012.482
Liability Stock	514.357	1.426.495	912.138
(Metaphase) Long-term Bonds	499.139	1.374.150	875.010
Money Market Tools	15.217	52.345	37.128
Liabilities	1.339.146	2.645.311	1.306.165
Capital Stock	530.843	1.519.554	988.711
Liability Stock	808.303	1.125.757	317.454
(Metaphase) Long-term Bonds	297.509	614.963	317.454
Money Market Tools	510.795	510.795	
		106.901.095	
Other Investments	**2.552.191**	**106.901.095**	**104.348.905**
Assets	- 16.681.563	10.877.499	27.559.062
Trade Credits	- 7.095.781		7.095.781
Long Term	- 141.916		141.916
Short Term	- 6.953.865		6.953.865
Loans	- 4.527.504	607.117	5.134.622
Long Term	- 4.332.049	76.727	4.408.775
Short Term	- 195.456	530.391	725.847
Currencies and Deposits	- 9.874.279	5.011.546	14.885.825
Other Assets	4.816.002	5.258.836	442.834
Long Term			
Short Term	4.816.002	5.258.836	442.834
Liabilities	19.233.753	96.023.596	76.789.843
Trade Credit	3.802.691	4.542.691	740.000
Long Term	64.565	77.515	12.950
Short Term	3.738.126	4.465.176	727.050
Loans	10.506.106	73.430.894	62.924.788
Long Term	1.302.105	5.384.661	4.082.556
Short Term	9.204.001	68.046.233	58.842.232
Currencies and Deposits	4.828.310	17.194.554	12.366.245
Other Liabilities	96.646	855.456	758.810
Long Term	- 147.585	243.376	390.961
Short Term	244.231	612.080	367.849
Reserve Assets	**- 38.780.145**	**101.644**	**38.881.789**
Gold Reserves			
SDR (Special Drawing Rights)	46.518	46.518	
China's Position in IMF (International Monetary Fund)	- 344.905	55.126	400.031
Foreign Currencies	- 38.481.758		38.481.758
Other Creditor's rights			
Net Error and Omission	**- 3.496.877**		**3.496.877**
saldo totale	**2.552.191**		

Figure 1.G.6 Value Added by Sector

(100 million yuan)

Sector	2008	2009	2010	2011
Total	**314.045**	**340.903**	**401.513**	**473.104**
Primary Industry	**33.702**	**35.226**	**40.534**	**47.486**
Agriculture, Forestry, Animal Husbandry and Fishery	33.702	35.226	40.534	47.486
Secondary Industry	**149.003**	**157.639**	**187.383**	**220.413**
Industry	130.260	135.240	160.722	188.470
Mining	19.629	16.726	20.937	27.226
Manufacturing	102.539	110.118	130.325	150.597
Production and Supply of Electricity, Gas and Water	8.091	8.395	9.461	10.647
Construction	18.743	22.399	26.661	31.943
Tertiary Industry	**131.340**	**148.038**	**173.596**	**205.205**
Transport, Storage and Post	16.363	16.727	19.132	22.433
Information Transmission, Computer Services and Software	7.860	8.164	8.882	9.780
Wholesale and Retail Trades	26.182	28.984	35.746	43.445
Hotels and Catering Services	6.616	7.118	8.068	9.173
Financial Intermediation	14.863	17.768	20.981	24.958
Real Estate	14.739	18.655	22.782	26.784
Leasing and Business Services	5.608	6.191	7.785	9.407
Scientific Research, Technical Services and Geologic Prospecting	3.993	4.722	5.637	6.966
Management of Water Conservancy, Environment and Public Facilities	1.266	1.480	1.752	2.040
Services to Households and Other Services	4.628	5.271	6.102	7.281
Education	8.887	10.482	12.042	14.429
Health, Social Security and Social Welfare	4.629	5.083	5.981	7.496
Culture, Sports and Entertainment	1.922	2.231	2.496	3.007
Public Management and Social Organizations	13.784	15.162	16.210	18.006

Figure 1.G.7 Gross Domestic Product (GDP)

(100 million yuan)

Year	Gross National Income	Gross Domestic Product	Primary Industry	Secondary Industry			Tertiary Industry	Per Capita GDP (yuan)
					Industry	Construction		
1978	3645,2	3645,2	1027,5	1745,2	1607,0	138,2	872,5	381
1979	4062,6	4062,6	1270,2	1913,5	1769,7	143,8	878,9	419
1980	4545,6	4545,6	1371,6	2192,0	1996,5	195,5	982,0	463
1981	4889,5	4891,6	1559,5	2255,5	2048,4	207,1	1076,6	492
1982	5330,5	5323,4	1777,4	2383,0	2162,3	220,7	1163,0	528
1983	5985,6	5962,7	1978,4	2646,2	2375,6	270,6	1338,1	583
1984	7243,8	7208,1	2316,1	3105,7	2789,0	316,7	1786,3	695
1985	9040,7	9016,0	2564,4	3866,6	3448,7	417,9	2585,0	858
1986	10274,4	10275,2	2788,7	4492,7	3967,0	525,7	2993,8	963
1987	12050,6	12058,6	3233,0	5251,6	4585,8	665,8	3574,0	1112
1988	15036,8	15042,8	3865,4	6587,2	5777,2	810,0	4590,3	1366
1989	17000,9	16992,3	4265,9	7278,0	6484,0	794,0	5448,4	1519
1990	18718,3	18667,8	5062,0	7717,4	6858,0	859,4	5888,4	1644
1991	21826,2	21781,5	5342,2	9102,2	8087,1	1015,1	7337,1	1893
1992	26937,3	26923,5	5866,6	11699,5	10284,5	1415,0	9357,4	2311
1993	35260,0	35333,9	6963,8	16454,4	14188,0	2266,5	11915,7	2998
1994	48108,5	48197,9	9572,7	22445,4	19480,7	2964,7	16179,8	4044
1995	59810,5	60793,7	12135,8	28679,5	24950,6	3728,8	19978,5	5046
1996	70142,5	71176,6	14015,4	33835,0	29447,6	4387,4	23326,2	5846
1997	78060,9	78973,0	14441,9	37543,0	32921,4	4621,6	26988,1	6420
1998	83024,3	84402,3	14817,6	39004,2	34018,4	4985,8	30580,5	6796
1999	88479,2	89677,1	14770,0	41033,6	35861,5	5172,1	33873,4	7159
2000	98000,5	99214,6	14944,7	45555,9	40033,6	5522,3	38714,0	7858
2001	108068,2	109655,2	15781,3	49512,3	43580,6	5931,7	44361,6	8622
2002	119095,7	120332,7	16537,0	53896,8	47431,3	6465,5	49898,9	9398
2003	134977,0	135822,8	17381,7	62436,3	54945,5	7490,8	56004,7	10542
2004	159453,6	159878,3	21412,7	73904,3	65210,0	8694,3	64561,3	12336
2005	183617,4	184937,4	22420,0	87598,1	77230,8	10367,3	74919,3	14185
2006	215904,4	216314,4	24040,0	103719,5	91310,9	12408,6	88554,9	16500
2007	266422,0	265810,3	28627,0	125831,4	110534,9	15296,5	111351,9	20169
2008	316030,3	314045,4	33702,0	149003,4	130260,2	18743,2	131340,0	23708
2009	340320,0	340902,8	35226,0	157638,8	135239,9	22398,8	148038,0	25608
2010	399759,5	401512,8	40533,6	187383,2	160722,2	26661,0	173596,0	30015
2011	468562,4	473104,0	47486,2	220412,8	188470,2	31942,7	205205,0	35198
2012	516282,1	518942,1	52373,6	235162,0	199670,7	35491,3	231406,5	38420

Figure 1.G.8 Total Value of Import and Export

Year	100 million Yuan				USD 100 million			
	Total Imports & Exports	Total Exports	Total Imports	Balance	Total Imports & Exports	Total Exports	Total Imports	Balance
1978	355,0	167,6	187,4	- 19,8	206,4	97,5	108,9	- 11,4
1980	570,0	271,2	298,8	- 27,6	381,4	181,2	200,2	- 19,0
1985	2.066,7	808,9	1.257,8	- 448,9	696,0	273,5	422,5	- 149,0
1990	5.560,1	2.985,8	2.574,3	411,5	1.154,4	620,9	533,5	87,4
1991	7.225,8	3.827,1	3.398,7	428,4	1.357,0	719,1	637,9	81,2
1992	9.119,6	4.676,3	4.443,3	233,0	1.655,3	849,4	805,9	43,5
1993	11.271,0	5.284,8	5.986,2	- 701,4	1.957,0	917,4	1.039,6	- 122,2
1994	20.381,9	10.421,8	9.960,1	461,7	2.366,2	1.210,1	1.156,1	54,0
1995	23.499,9	12.451,8	11.048,1	1.403,7	2.808,6	1.487,8	1.320,8	167,0
1996	24.133,8	12.576,4	11.557,4	1.019,0	2.898,8	1.510,5	1.388,3	122,2
1997	26.967,2	15.160,7	11.806,5	3.354,2	3.251,6	1.827,9	1.423,7	404,2
1998	26.849,7	15.223,6	11.626,1	3.597,5	3.239,5	1.837,1	1.402,4	434,7
1999	29.896,2	16.159,8	13.736,4	2.423,4	3.606,3	1.949,3	1.657,0	292,3
2000	39.273,2	20.634,4	18.638,8	1.995,6	4.742,9	2.492,0	2.250,9	241,1
2001	42.183,6	22.024,4	20.159,2	1.865,2	5.096,5	2.661,0	2.435,5	225,5
2002	51.378,2	26.947,9	24.430,3	2.517,6	6.207,7	3.256,0	2.951,7	304,3
2003	70.483,5	36.287,9	34.195,6	2.092,3	8.509,9	4.382,3	4.127,6	254,7
2004	95.539,1	49.103,3	46.435,8	2.667,5	11.545,5	5.933,3	5.612,3	320,9
2005	116.921,8	62.648,1	54.273,7	8.374,4	14.219,1	7.619,5	6.599,5	1.020,0
2006	140.974,0	77.597,2	63.376,9	14.220,3	17.604,4	9.689,8	7.914,6	1.775,2
2007	166.863,7	93.563,6	73.300,1	20.263,5	21.765,7	12.204,6	9.561,2	2.643,4
2008	179.921,5	100.394,9	79.526,5	20.868,4	25.632,6	14.306,9	11.325,7	2.981,2
2009	150.648,1	82.029,7	68.618,4	13.411,3	22.075,4	12.016,1	10.059,2	1.956,9
2010	201.722,1	107.022,8	94.699,3	12.323,5	29.740,0	15.777,5	13.962,4	1.815,1
2011	236.402,0	123.240,6	113.161,4	10.079,2	36.418,6	18.983,8	17.434,8	1.549,0

Figure 1.G.9 Income Approach Components of Gross Regional Product (2011)

(100 million yuan)

Region	Gross Regional Product	45% Compensation of Employees	Net Taxes on Production	Depreciation of Fixed Assets	Operating Surplus
Total	**521.441**	**234.310**	**81.399**	**67.345**	**138.387**
Beijing	16.252	7.992	2.566	2.156	3.538
Tianjin	11.307	4.378	1.772	1.416	3.741
Hebei	24.516	12.497	2.951	3.131	5.937
Shanxi	11.238	4.675	1.833	1.794	2.935
Inner Mongolia	14.360	6.240	2.083	1.591	4.445
Liaoning	22.227	10.269	4.143	3.042	4.773
Jilin	10.569	4.086	1.638	1.825	3.020
Heilongjiang	12.582	4.616	2.117	1.410	4.439
Shanghai	19.196	7.710	3.713	2.298	5.474
Jiangsu	49.110	20.523	7.272	6.588	14.727
Zhejiang	32.319	13.186	5.248	3.909	9.977
Anhui	15.301	7.435	2.076	1.881	3.908
Fujian	17.560	8.742	2.288	1.834	4.697
Jiangxi	11.703	5.144	1.965	1.607	2.986
Shandong	45.362	17.444	7.606	6.510	13.802
Henan	26.931	13.439	3.358	3.179	6.954
Hubei	19.632	9.433	2.676	2.485	5.038
Hunan	19.670	9.802	3.241	2.134	4.492
Guangdong	53.210	24.288	8.567	6.986	13.369
Guangxi	11.721	6.806	1.485	1.660	1.770
Hainan	2.523	1.273	438	378	433
Chongqing	10.011	4.930	1.486	1.069	2.526
Sichuan	21.027	9.382	3.242	2.683	5.720
Guizhou	5.702	2.982	947	795	978
Yunnan	8.893	4.271	1.822	1.100	1.699
Tibet	606	384	49	89	83
Shaanxi	12.512	4.912	2.273	1.465	3.863
Gansu	5.020	2.307	910	855	948
Qinghai	1.670	756	292	271	351
Ningxia	2.102	1.062	257	317	466
Xinjiang	6.610	3.345	1.084	885	1.296

Figure 1.G.10 Per Capita Annual Net Income of Rural Households by Sources and Region (2011)

	(yuan)				
Region	Per capita				
	Net Income	Income from Wages and Salaries	Income from Household Operations	Income from Properties	Income from Transfers
		44%	42%	4%	9%
National Average	**6977,29**	**2963,43**	**3221,98**	**228,57**	**563,32**
Total	**231.887**	**102.735**	**98.008**	**9.348**	**21.796**
Beijing	14736	9579	1363	1537	2257
Tianjin	12321	6829	3908	742	841
Hebei	7120	3424	3006	206	483
Shanxi	5601	2685	2141	170	605
Inner Mongolia	6642	1311	4218	338	776
Liaoning	8297	3180	4271	245	601
Jilin	7510	1469	4950	396	695
Heilongjiang	7591	1497	4784	545	765
Shanghai	16054	10493	877	1244	3440
Jiangsu	10805	5969	3490	414	931
Zhejiang	13071	6721	4982	556	812
Anhui	6232	2723	2986	106	417
Fujian	8779	3890	4095	291	503
Jiangxi	6892	2994	3421	112	364
Shandong	8342	3715	3935	246	445
Henan	6604	2524	3601	108	371
Hubei	6898	2703	3731	84	379
Hunan	6567	3241	2725	112	489
Guangdong	9372	5855	2498	490	529
Guangxi	5231	1820	3008	41	362
Hainan	6446	2005	3827	86	529
Chongqing	6480	2895	2748	140	698
Sichuan	6129	2652	2762	140	574
Guizhou	4145	1714	1980	60	392
Yunnan	4722	1139	2966	219	398
Tibet	4904	1008	3143	114	640
Shaanxi	5028	2395	2017	165	450
Gansu	3909	1562	1867	82	398
Qinghai	4608	1775	2089	94	651
Ningxia	5410	2164	2730	116	399
Xinjiang	5442	805	3887	147	603

Figure 1.G.11 Per Capita Annual Income of Urban Households by Sources and Region (2011)

(yuan)

Region	Disposable Income	Total Income	Income from Wages and Salaries	Net Business Income	Income from Properties	Income from Transfers
National Average	**21.809,78**	**23.979,20**	**15.412**	**2.209,74**	**648,97**	**5.708,58**
Total	**638.827**	**702.676**	**456.371**	**58.841**	**17.222**	**170.242**
Beijing	32.903	37.124	25.161	1.191	697	10.075
Tianjin	26.921	29.916	18.794	1.059	462	9.600
Hebei	18.292	19.592	11.687	1.836	318	5.750
Shanxi	18.124	19.666	13.146	875	274	5.370
Inner Mongolia	20.408	21.890	14.779	2.320	513	4.277
Liaoning	20.467	22.880	13.094	2.285	334	7.167
Jilin	17.797	19.212	12.217	1.860	235	4.899
Heilongjiang	15.696	17.118	10.235	1.529	141	5.213
Shanghai	36.230	40.532	28.551	1.994	633	9.354
Jiangsu	26.341	28.972	17.762	3.027	667	7.517
Zhejiang	30.971	34.264	20.334	4.384	1.572	7.974
Anhui	18.606	20.751	12.916	1.874	570	5.391
Fujian	24.907	27.378	17.439	2.992	1.753	5.195
Jiangxi	17.495	18.657	11.654	1.722	472	4.809
Shandong	22.792	24.890	17.629	2.295	616	4.350
Henan	18.195	19.527	12.039	2.264	286	4.937
Hubei	18.374	20.193	12.622	1.907	357	5.307
Hunan	18.844	20.084	11.550	2.674	771	5.089
Guangdong	26.897	30.219	21.092	3.035	1.243	4.848
Guangxi	18.854	20.846	13.550	1.700	845	4.751
Hainan	18.369	20.094	12.877	2.159	715	4.343
Chongqing	20.250	21.794	13.828	1.779	434	5.753
Sichuan	17.899	19.688	12.687	1.671	523	4.807
Guizhou	16.495	17.599	10.754	1.615	356	4.873
Yunnan	18.576	20.255	12.416	1.786	1.274	4.779
Tibet	16.196	18.116	15.855	487	358	1.416
Shaanxi	18.245	20.070	14.051	772	214	5.033
Gansu	14.989	16.267	11.195	914	162	3.996
Qinghai	15.603	17.795	11.404	1.055	79	5.258
Ningxia	17.579	19.655	12.397	2.367	198	4.692
Xinjiang	15.514	17.631	12.653	1.412	149	3.416

Figure 1.G.12 Taxes

(100 million yuan)

Year	Total	Domestic Value-added Tax	Domestic Consumption Tax	Business Tax	Corporate Income Tax	Individual Income Tax	Tariffs
2011	**89.738**	**24.267**	**6.936**	**13.679**	**16.770**	**6.054**	**2.559**
2010	73.211	21.093	6.072	11.158	12.844	4.837	2.028
2009	59.522	18.481	4.761	9.014	11.537	3.949	1.484
2008	54.224	17.997	2.568	7.626	11.176	3.722	1.770
2007	45.622	15.470	2.207	6.582	8.779	3.186	1.433
2006	34.804	12.785	1.886	5.129	7.040	2.454	1.142
2005	28.779	10.792	1.634	4.232	5.344	2.095	1.066
2004	24.166	9.018	1.502	3.582	3.957	1.737	1.044
2003	20.017	7.237	1.182	2.844	2.920	1.418	923
2002	17.636	6.178	1.046	2.450	3.083	1.212	704
2001	15.301	5.357	930	2.064	2.631	995	841
2000	12.582	4.553	858	1.869	1.000	660	750
1999	10.683	3.882	821	1.669	811	414	562
1998	9.263	3.628	815	1.575	926		313
1997	8.234	3.284	679	1.324	963		319
1996	6.910	2.963	620	1.053	968		302
1995	6.038	2.602	541	866	878		292
1994	5.127	2.308	487	670	708		273
1993	4.255	1.081		966	679		256
1992	3.297	706		659	721		213
1991	2.990	406		564	731		187
1990	2.822	400		516	716		159
1989	2.727	431		487	700		182
1988	2.390	384		398	676		155
1987	2.140	254		302	665		143
1986	2.091	232		261	692		152
1985	2.041	148		211	696		205
1984	947						103
1983	776						54
1982	700						47
1981	630						54
1980	572						34
1979	538						26
1978	519						29

Figure 1.G.13 Government expenditure by region (2011)

(100 million yuan)

Region	General Budgetary Expenditure	Expenditure for General Public Services	Expenditure for Foreign Affairs	Expenditure for National Defense	Expenditure for Public Security	Expenditure for Education	Expenditure for Science and Technology	Expenditure for Culture, Sport and Media	Expenditure for Social Safety Net and Employment Effort	Expenditure for Medical and Health Care	Expenditure for Environment Protection	Expenditure for Urban and Rural Community Affairs	Expenditure for Agriculture, Forestry and Water Conservancy	Expenditure for Transportation	Expenditure for Affairs of Exploration, Power and Information	Expenditure for Affairs of Commerce and Services	Expenditure for Affairs of Financial Supervision	Expenditure for Post-earthquake Recovery and Reconstruction	Expenditure for Affairs of Land and Weather	Expenditure for Affairs of Housing Security	Expenditure for Affairs of Management of Grain & Oil Reserves	Interest Payment for Domestic and Foreign Debts	Other Expenditure
Region Total	**92.734**	**10.085**	**3**	**198**	**5.267**	**15.498**	**1.886**	**1.705**	**10.607**	**6.358**	**2.567**	**7.609**	**9.521**	**7.167**	**3.547**	**1.395**	**235**	**174**	**1.290**	**3.492**	**729**	**564**	**2.836**
Beijing	3.245	261		7	219	520	183	87	355	225	95	339	187	199	170	41	2	0	10	55	5		284
Tianjin	1.796	118		1	100	302	60	30	168	91	32	485	92	97	76	21	2		25	21	2		73
Hebei	3.537	415		12	201	652	33	50	426	303	105	239	366	261	83	54	2		74	143	25	7	86
Shanxi	2.364	252		4	130	422	27	48	322	160	82	142	241	179	45	23	9	0	135	85	17	3	38
Inner Mongolia	2.989	305	0	4	146	391	28	69	364	165	118	301	392	281	71	26	4		70	140	60	10	44
Liaoning	3.906	415		11	210	544	87	69	657	182	74	443	329	221	229	56	13	0	74	152	36	25	76
Jilin	2.202	231		4	119	320	21	44	299	144	102	154	256	150	74	22	7	1	25	124	55	35	14
Heilongjiang	2.794	256	0	5	141	374	33	45	392	171	92	180	356	250	109	29	3	0	34	183	69	3	69
Shanghai	3.915	236		8	206	549	219	69	418	190	52	579	162	137	380	51	14		12	82	17	55	481
Jiangsu	6.222	748		18	371	1.093	213	117	482	350	170	812	618	392	294	129	27	2	48	119	29	5	183
Zhejiang	3.843	472		8	291	751	144	85	292	279	78	338	373	274	138	97	6	3	30	58	13	3	109
Anhui	3.303	345		6	129	565	77	62	393	277	82	281	352	220	125	66	8		41	161	31	12	71
Fujian	2.198	247		5	145	407	40	36	185	159	38	146	208	240	96	50	2		25	56	14	3	96
Jiangxi	2.535	258		5	124	474	21	40	273	196	44	125	288	218	157	38	2		29	108	47	13	74
Shandong	5.002	618		15	275	1.048	109	92	502	360	114	402	564	295	184	119	21	1	68	68	36	32	80
Henan	4.249	559		6	205	857	57	58	548	361	96	191	480	281	127	68	17	3	64	143	40	26	63
Hubei	3.215	395		3	188	488	44	47	449	247	101	161	376	255	112	53	7	1	45	103	35	13	89
Hunan	3.521	467	0	10	174	541	42	45	484	257	85	276	394	301	120	53	4		50	127	30	13	47
Guangdong	6.712	807	0	13	570	1.228	204	171	549	434	233	518	420	533	147	92	15	19	54	146	26	152	382
Guangxi	2.545	322		8	139	457	28	37	251	233	54	119	315	249	89	24	8		39	107	14	13	40
Hainan	779	82	1	4	53	127	10	17	94	50	24	40	106	53	21	11	0		11	35	2	4	34
Chongqing	2.570	225		9	125	319	25	31	339	144	101	394	199	186	188	40	13	0	44	157	16	3	14
Sichuan	4.675	485		11	246	685	46	87	646	373	116	269	546	365	158	63	11	132	57	231	38	24	86
Guizhou	2.249	307		4	117	377	22	35	195	173	55	66	278	305	55	20	0		33	122	8	13	63
Yunnan	2.930	282	0	6	165	483	28	45	387	237	96	123	410	276	50	34	8	0	42	152	8	53	44
Tibet	758	96	1	1	52	78	3	19	58	35	16	22	127	78	50	6	0	0	6	61	2		49
Shaanxi	2.931	341		3	128	529	29	61	365	198	96	147	334	313	76	42	5	3	45	150	19	11	35
Gansu	1.791	175		2	80	284	13	33	279	143	85	66	238	159	29	17	2	9	41	93	9	9	24
Qinghai	967	65		1	35	130	4	14	164	47	42	28	105	149	25	11	7	0	16	106	5	8	5
Ningxia	706	52		1	35	103	8	14	72	41	35	82	112	42	21	16	7		7	34	3	7	15
Xinjiang	2.284	245	0	4	146	400	26	48	202	132	54	140	298	207	48	25	9	1	35	170	18	9	68

Figure 1.G.14 Government Revenue by Region

(100 million yuan)

Region	General Budgetary Revenue	Tax Revenue	Domestic Value-added Tax	Business Revenue	Corporate Income Tax	Individual Income Tax	Resource Tax	City Maintenance and Construction Tax	House Property Tax	Stamp Tax	Urban Land Use Tax	Land Appreciation Tax	Tax on Vehicles and Boat Operation	Farm Land Occupation Tax	Deed Tax	Tobacco Leaf Tax	Other Tax Revenue	Non-Tax Revenue	Special Program Receipts	Charge of Administrative and Institutional Units	Penalty Receipts	Operation Income of State-owned Assets	Income from Use of State-owned Resources (Assets)	Other Non-tax Receipts
Region Total	**52.547**	**41.107**	**5.989**	**13.504**	**6.746**	**2.421**	**596**	**2.610**	**1.102**	**617**	**1.222**	**2.063**	**302**	**1.075**	**2.766**	**91**	**1**	**11.440**	**2.695**	**3.635**	**1.263**	**1.199**	**1.782**	**867**
Beijing	3.006	2.855	238	1.072	684	273	0	146	99	40	16	121	19	12	136			152	79	44	34	- 30	21	4
Tianjin	1.455	1.005	141	353	183	52	1	64	31	22	13	47	6	12	80			451	34	184	14	25	151	43
Hebei	1.738	1.349	230	457	199	57	33	88	28	25	46	53	22	26	85	0		389	100	118	81	38	40	12
Shanxi	1.213	873	240	243	150	43	39	61	16	14	25	10	9	6	18	0		341	181	78	49	4	19	9
Inner Mongolia	1.357	986	180	284	156	54	57	60	23	14	52	31	8	31	37	0		371	147	82	30	51	48	13
Liaoning	2.643	1.975	218	556	227	77	68	103	56	28	146	129	15	140	210	1	1	668	99	159	70	143	171	26
Jilin	850	624	93	189	91	29	6	46	16	9	23	25	6	40	50	1		226	36	72	30	32	47	8
Heilongjiang	998	742	145	219	81	34	24	62	21	9	44	23	8	18	53	2		256	46	85	33	49	37	8
Shanghai	3.430	3.173	417	1.041	731	315		139	74	52	29	168	11	15	181			257	97	108	23	- 9	22	16
Jiangsu	5.149	4.125	651	1.261	731	238	12	271	121	63	126	257	20	54	320			1.024	161	321	98	286	116	43
Zhejiang	3.151	2.952	462	916	498	186	9	200	99	45	86	148	19	51	234	0		199	111	41	83	- 64	27	1
Anhui	1.464	1.108	165	379	153	40	15	75	23	14	43	52	7	42	100	1		355	80	126	34	28	62	25
Fujian	1.502	1.254	164	400	216	69	8	75	41	22	30	100	7	25	94	4		247	54	69	37	24	51	13
Jiangxi	1.053	777	106	273	98	32	19	42	11	8	18	37	6	47	78	2	0	276	49	117	39	20	31	20
Shandong	3.456	2.603	414	766	398	97	38	180	74	41	158	106	30	97	202	2		853	131	279	104	100	189	50
Henan	1.722	1.263	181	404	185	48	27	80	26	18	58	58	12	61	98	5		459	91	161	59	72	46	30
Hubei	1.527	1.067	148	367	156	49	10	78	22	16	24	63	7	51	73	4		460	49	207	50	43	46	65
Hunan	1.517	915	135	321	90	48	7	79	22	13	20	41	7	48	78	7		602	74	192	58	13	152	114
Guangdong	5.515	4.549	701	1.431	828	341	11	295	145	74	104	295	31	51	238	1		966	180	370	112	86	103	116
Guangxi	948	645	86	241	86	29	9	41	14	8	12	34	5	34	45	1		303	30	96	30	76	53	18
Hainan	340	296	20	123	43	10	2	14	7	4	9	38	1	7	18			44	9	12	7	6	7	3
Chongqing	1.488	881	82	344	115	35	8	50	21	13	25	61	3	44	76	3		607	66	309	23	90	88	32
Sichuan	2.045	1.537	185	612	201	73	22	94	34	20	42	77	13	49	109	7		507	97	141	47	30	119	74
Guizhou	773	518	76	182	71	33	12	38	10	6	13	14	4	28	24	9		255	86	46	24	6	44	49
Yunnan	1.111	882	137	278	111	41	14	79	18	10	15	30	7	47	55	40		229	80	54	36	9	22	27
Tibet	55	46	5	16	11	8	1	3		0	1	0	0	0				9	0	1	1	- 0	2	5
Shaanxi	1.500	934	176	333	124	44	49	65	20	12	19	22	9	29	29	2		566	365	70	25	61	32	13
Gansu	450	284	49	110	29	14	14	24	9	5	10	5	3	3	9	0		166	85	38	11	5	13	15
Qinghai	152	120	23	46	15	4	15	8	2	1	2	1	0	1	2			32	20	5	3	0	3	1
Ningxia	220	177	24	80	24	8	3	11	3	3	6	3	2	1	10	0		43	12	17	5	1	6	2
Xinjiang	720	593	97	210	63	38	65	41	15	8	10	13	4	6	22	0		127	46	37	14	4	15	11

Figure 1.G.15 Main Indicators of Industrial Enterprises above Designated Size by Industrial Sector (2011)

(100 million yuan)

Sector	Number of Enterprises (unit)	Gross Industrial Output Value	Total Assets	Total Current Assets	Original Value of Fixed Assets	Accumulated Depreciation	Total Liabilities	Total Liquid Liabilities	Owners' Equity	Revenue from Principal Business	Cost of Principal Business	Tax and Extra Charges from Principal Business	Total Profits	Value-added Tax Payable	Average Annual Employed Persons (10 000 persons)
National Total	**325.609**	**844.269**	**675.797**	**327.779**	**386.087**	**157.312**	**392.645**	**298.911**	**282.004**	**841.830**	**708.092**	**12.670**	**61.396**	**26.303**	**9.167**
Mining and Washing of Coal	7.695	28.920	37.936	16.493	17.608	6.693	22.558	15.181	15.294	31.413	22.633	510	4.561	2.356	521
Extraction of Petroleum and Natural Gas	271	12.889	18.785	4.323	21.788	9.765	9.138	5.627	9.631	12.882	6.076	1.251	4.300	1.072	111
Mining and Processing of Ferrous Metal Ores	3.482	7.904	7.155	2.866	2.780	847	3.732	2.392	3.393	8.114	6.210	95	1.210	415	65
Mining and Processing of Non-Ferrous Metal Ores	2.086	5.035	3.558	1.421	1.665	473	1.686	1.242	1.863	4.928	3.673	46	815	195	53
Mining and Processing of Nonmetal Ores	3.252	3.848	2.121	876	1.298	563	958	703	1.149	3.743	2.917	57	358	153	54
Mining of Other Ores	19	17	13	4	10	3	5	2	8	15	12	0	1	0	0
Processing of Food from Agricultural Products	20.895	44.126	19.725	10.888	11.429	5.358	10.658	8.894	8.948	43.849	38.437	188	2.795	861	361
Manufacture of Foods	6.870	14.047	8.512	4.382	4.562	1.795	4.232	3.483	4.250	13.876	10.921	81	1.232	478	177
Manufacture of Beverages	4.874	11.835	9.441	4.987	4.652	1.799	4.685	3.965	4.728	11.775	8.581	404	1.315	511	137
Manufacture of Tobacco	148	6.806	6.169	4.228	1.939	1.010	1.492	1.441	4.668	6.667	1.857	3.453	841	843	20
Manufacture of Textile	22.945	32.653	19.993	10.670	10.954	4.448	11.241	9.643	8.699	32.289	28.349	156	1.957	814	589
Manufacture of Textile Wearing Apparel, Footware and Caps	11.750	13.538	7.468	4.676	3.038	1.226	3.925	3.360	3.529	13.214	11.020	68	952	371	382
Manufacture of Leather, Fur, Feather and Related Products	6.081	8.928	4.260	2.659	1.715	658	2.042	1.851	2.189	8.747	7.339	43	715	255	260
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm and Straw Products	8.193	9.002	3.797	1.789	2.513	1.069	1.724	1.337	2.053	8.804	7.486	60	643	244	129
Manufacture of Furniture	4.255	5.090	2.952	1.683	1.284	472	1.544	1.352	1.395	4.947	4.133	30	341	133	106
Manufacture of Paper and Paper Products	7.073	12.080	10.934	4.907	6.945	2.835	6.275	4.700	4.630	11.807	10.146	51	760	319	147
Printing, Reproduction of Recording Media	3.789	3.861	3.147	1.669	1.887	860	1.500	1.275	1.637	3.784	3.082	21	350	129	71
Manufacture of Articles For Culture, Education and Sport Activities	2.992	3.212	1.791	1.061	822	325	916	812	872	3.134	2.696	14	176	74	110
Processing of Petroleum, Coking, Processing of Nuclear Fuel	1.974	36.889	18.870	8.877	12.600	5.668	11.894	9.601	6.925	37.275	32.635	2.888	423	1.130	96
Manufacture of Raw Chemical Materials and Chemical Products	22.600	60.825	44.919	20.925	27.380	11.046	25.166	19.233	19.759	60.098	50.479	463	4.432	1.685	455
Manufacture of Medicines	5.926	14.942	13.221	7.289	5.630	2.320	5.668	4.613	7.523	14.484	10.277	95	1.606	670	179
Manufacture of Chemical Fibers	1.750	6.674	5.237	2.757	2.835	1.197	3.242	2.710	1.992	6.647	6.005	17	368	145	46
Manufacture of Rubber	3.266	7.331	4.866	2.471	2.965	1.230	2.718	2.209	2.134	7.280	6.265	37	436	158	94
Manufacture of Plastics	13.414	15.580	9.640	5.494	5.078	2.210	5.060	4.357	4.552	15.282	13.089	71	1.017	373	254
Manufacture of Non-metallic Mineral Products	26.530	40.180	29.889	13.465	17.936	6.102	16.154	12.470	13.661	39.295	32.423	274	3.587	1.434	517
Smelting and Pressing of Ferrous Metals	6.742	64.067	52.025	23.820	32.171	14.291	35.120	28.416	16.848	65.909	60.285	200	2.239	1.388	340
Smelting and Pressing of Non-ferrous Metals	6.765	35.907	23.710	12.381	11.769	4.338	14.755	11.438	8.920	36.869	32.977	120	2.067	827	193
Manufacture of Metal Products	16.573	23.351	15.191	9.116	6.663	2.666	8.577	7.566	6.551	22.951	19.706	111	1.546	582	312
Manufacture of General Purpose Machinery	25.877	40.993	29.854	18.492	12.220	5.030	16.626	14.534	13.136	40.158	33.512	205	3.055	1.136	495
Manufacture of Special Purpose Machinery	13.889	26.149	22.778	14.511	8.247	3.319	12.839	10.952	9.875	26.060	21.353	136	2.154	730	323
Manufacture of Transport Equipment	15.012	63.251	54.341	33.049	20.052	8.315	33.305	28.262	20.925	63.132	52.893	891	5.478	1.805	579
Manufacture of Electrical Machinery and Equipment	20.084	51.426	37.584	25.028	14.315	6.978	21.901	19.279	15.619	50.149	42.545	184	3.310	1.268	600
Manufacture of Communication Equipment, Computers and	11.364	63.796	41.511	27.726	18.332	9.138	24.402	21.667	17.060	63.475	56.535	156	2.827	1.326	819

Figure 1.G.15 Savings Deposit of Urban and Rural Households

(100 million yuan)

Year	Balance at Year-end			Year-on-year Increase		
	Total	Time Deposits	Demand Deposits	Total	Time Deposits	Demand Deposits
1978	210,6	128,9	81,7	29,0	17,2	11,8
1980	395,8	304,9	90,9	114,8	138,5	-23,7
1985	1622,6	1225,2	397,4	407,9	324,3	83,6
1990	7119,6	5909,4	1210,2	1935,1	1700,9	234,2
1991	9244,9	7634,9	1610,0	2125,3	1725,5	399,8
1992	11757,3	9445,0	2312,3	2512,4	1810,1	702,3
1993	15203,5	12108,3	3095,2	3446,2	2663,3	782,9
1994	21518,8	16838,7	4680,1	6315,3	4730,4	1584,9
1995	29662,3	23778,3	5884,1	8143,5	6939,6	1203,9
1996	38520,8	30873,2	7647,6	8858,6	7095,0	1763,6
1997	46279,8	36226,7	10053,1	7759,0	5353,5	2405,4
1998	53407,5	41791,6	11615,9	7127,7	5564,8	1562,8
1999	59621,8	44955,1	14666,7	6214,4	3163,5	3050,8
2000	64332,4	46141,7	18190,7	4710,6	1186,6	3524,0
2001	73762,4	51434,9	22327,6	9430,1	5293,2	4136,9
2002	86910,7	58788,9	28121,7	13148,2	7354,1	5794,1
2003	103617,7	68498,7	35119,0	16707,0	9709,7	6997,3
2004	119555,4	78138,9	41416,5	15937,7	9640,2	6297,6
2005	141051,0	92263,5	48787,5	21495,6	14124,7	7370,9
2006	161587,3	103011,4	58575,9	20544,0	10777,3	9766,7
2007	172534,2	104934,5	67599,7	10946,9	1923,1	9023,8
2008	217885,4	139300,2	78585,2	45351,2	34365,7	10985,5
2009	260771,7	160230,4	100541,3	42886,3	20930,2	21956,1
2010	303302,5	178413,9	124888,6	42530,8	18183,5	24347,3
2011	343635,9			41656,6		

1.H Explanatory Notes on Main Statistical Indicators

Compensation of Employees refers to the total payment of various forms to employees for the productive activities they are engaged in. It includes wages, bonuses and allowances, which the employees earn in cash or in kind. It also includes the free medical services provided to the employees and the medicine expenses, transport subsidies and social insurance, and housing fund paid by the employers.

Net Taxes on Production refers to taxes on production less subsidies on production. The taxes on production refers to the various taxes, extra charges and fees levied on the production units on their production, sale and business activities as well as on the use of some factors of production, such as fixed assets, land and labour in the production activities they are engaged in. In contrast to taxes on production, subsidies on production refer to the unilateral government transfer to the production units and are therefore regarded as negative taxes on production. They include subsidies on the loss due to implementation of government policies, price subsidies, etc.

Depreciation of Fixed Assets refers to the depreciation of fixed assets in a given period, drawn in accordance with the stipulated depreciation rate for the purpose of compensating the wear-and-tear loss of the fixed assets or the depreciation of fixed assets imputed in accordance with the stipulated unified depreciation rate in the national economic accounting system. It reflects the value of transfer of the fixed assets in the production of the current period. The depreciation of fixed assets in various enterprises and institutions managed as enterprises refers to the depreciation expenses actually drawn. In government agencies and institutions not managed as enterprises which do not draw the depreciation expenses, as well as for the houses of residents, the depreciation of fixed assets is the imputed depreciation, which is calculated in accordance with the stipulated unified depreciation rate. In principle, the depreciation of fixed assets should be calculated on the basis of the re-purchased value of the fixed assets. However, currently the conditions in China do not facilitate the revaluation of all the fixed assets. Therefore, only the above-mentioned methods can be adopted at present.

Operating Surplus refers to the balance of the value added created by the resident units after deducting the labourers remuneration, net taxes on production and the depreciation of fixed assets. It is equivalent to the business profit of the enterprises plus subsidies to production, but the wages and welfare expenses paid from the profits should be deducted.

		HCOAL	BCOAL	COKE	DIESEL	GASOLINE	JETFUEL	LFO	HFO	OTHPETRO	NATGAS	OTHGAS	NonENERGY	TOTAL
Agriculture, Hunting, Forestry and Fishing	secAtB	31.798		1.281	31.516	15.991		35.910	55	674	2		909	**118.136**
Mining and Quarrying	secC	145.102	98	3.976	1.075	374		15.763	4.289	300	17.918	187	6.388	**195.472**
Food, Beverages and Tobacco	sec15t16	61.361		534	1.605	559		3.860	1.245	296	959	17	381	**70.816**
Textiles and Textile Products	sec17t18	41.520		129	2.376	827		3.117	978	203	209	87	272	**49.718**
Leather, Leather and Footwear	sec19	1.290		38	720	250		719	287	58	117	25	44	**3.548**
Wood and Products of Wood and Cork	sec20	9.164		100	1.091	380		882	27	75	153	1	134	**12.007**
Pulp, Paper, Paper , Printing and Publishing	sec21t22	47.189	44	141	1.258	438		1.439	655	190	310	11	329	**52.004**
Coke, Refined Petroleumand Nuclear Fuel	sec23	11.335		912	103	36		2.170	6.543	40.969	4.042	10.391	24.367	**100.868**
Chemicals and Chemical Products	sec24	136.007	7.555	24.309	873	304		9.088	4.714	4.683	14.307	1.268	66.120	**269.228**
Rubber and Plastics	sec25	17.339		403	1.299	452		1.810	668	84	334	8	1.034	**23.432**
Other Non-Metallic Mineral	sec26	468.616	3.335	11.037	917	319		10.350	13.317	3.566	8.769	1.438	190.821	**712.485**
Basic Metals and Fabricated Metal	sec27t28	242.864	9.521	219.812	1.066	371		10.079	5.386	2.589	6.916	42.825	86.825	**628.254**
Machinery, Nec	sec29	21.426	34	8.935	1.276	444		3.638	783	786	1.296	309	185	**39.112**
Electrical and Optical Equipment	sec30t33	5.800	20	5.440	1.684	586		2.701	711	503	1.052	228	309	**19.034**
Transport Equipment	sec34t35	12.221		4.697	667	232		3.656	415	771	2.382	46	296	**25.382**
Manufacturing, Nec; Recycling	sec36t37	3.799		64	847	295		284	107	24	35	1	169	**5.626**
Electricity, Gas and Water Supply	secE	3.271.642	478	301	426	151		4.024	10.038	1.174	35.379	2.292	373	**3.326.279**
Construction	secF	12.780		164	5.719	1.990		13.136	1.111	35.699	190	34	598	**71.418**
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	sec50												166	**166**
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	sec51	2.869		9	1.578	549		2.374	126	292		39	323	**8.159**
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	sec52	594		2	4.243	1.477		491	28	122		8	376	**7.342**
Hotels and Restaurants	secH	2.758		6	2.186	761		1.445	77	197	14.042	29	200	**21.702**
Inland Transport	sec60	12.564		3	66.585			17.751	66		890		371	**98.229**
Water Transport	sec61							35.507	64.393	72			27	**99.999**
Air Transport	sec62						78.163						11	**78.174**
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	sec63	2.075		67	8.313			17.186	904	1.934	25	89	55	**30.649**
Post and Telecommunications	sec64	321		3	4.512			750	40	84		18	86	**5.815**
Financial Intermediation	secJ			8	512	178		2.050	108	239		20	118	**3.233**
Real Estate Activities	sec70	571		10	178	62		2.651	139	301		18	137	**4.068**
Renting of M&Eq and Other Business Activities	sec71t74	10.112		41	392	136		10.593	557	1.198	2.415	71	445	**25.961**
Public Admin and Defence; Compulsory Social Security	secL	13.409		28	1.619	563		7.171	378	833	1.567	53	359	**25.981**
Education	secM	11.677		13	2.358	820		3.378	179	417		43	360	**19.246**
Health and Social Work	secN	17.900		5	743	259		1.225	65	150	871	19	1.336	**22.572**
Other Community, Social and Personal Services	secO	11.617		17	11.055	3.847		4.168	226	644	2.157	31	5.673	**39.434**
Private Households with Employed Persons	secP													
Extra-territorial organizations and bodies	secQ													
Total intermediate consumption	secTOT	4.627.720	21.087	282.485	158.793	32.652	78.163	229.366	118.617	99.128	116.337	59.610	389.593	**6.213.551**
Final consumption expenditure by households	FC_HH	181.428		1.400	27.683	150.337		20.651		57.034	34.913	5.716	3.215	**482.377**
Grand Total	total	4.809.148	21.087	283.885	186.476	182.989	78.163	250.017	118.617	156.162	151.251	65.325	392.808	**6.695.928**