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**China's New Demographic Challenge:
From Unlimited Supply of Labour to
Structural Lack of Labour Supply.
Labour market and demographic
scenarios: 2008-2048**

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Abstract

The paper focuses on the demographic and labour market consequences of the dramatic decline in fertility that has characterized China starting at the beginning of the '50s. It is shared opinion that a sustained decline in fertility below replacement level will provoke a decline in Total population, an even more pronounced decline in Working age population and very relevant ageing phenomena. I have recently shown that, on the contrary and coherently with empirical evidence, a decline in fertility provokes a structural lack of labour supply that determines positive migration balances and, finally, positive demographic trends. The paper applies the same approach to China with similar results. The decline in fertility, determined by the process of economic development and its impact on education and urbanization, but promoted also trough the one-child policy, will provoke a relevant and growing structural lack of labour supply, even in the hypothesis that Chinese employment growth should sharply decline. The implication is that in order to continue its road to economic growth and social development, China will have to rely on large and growing migration flows that will determine a demographic expansion. In conclusion, the decline in fertility, actively pursued to set a ceiling to population growth, will end up provoking the opposite result. The uncertainty about the age structure of the Chinese population makes it impossible to determine in which year China will start to be affected by serious labour shortages. Our scenarios do however clearly show that China will reach the Lewis turning point in the next few years and before the middle of the century will become the world largest importer of labour. Our analysis does therefore clearly suggest that any legal restriction to fertility and territorial mobility is totally unwarranted, and that China should start to consider educational and labour policies aimed to mitigate labour shortages. It also indicates the necessity to start an in depth discussion of which immigration and social integration policies could better serve the interests of China, on the light both of the experiences of other countries, and of the role that China wants to play in the international arena.

JEL Classification: J11; F22; 015; 053

Keywords: Demography; Labour market; Demographic and labour market scenarios; Migrations; Lewis turning point; China.

There is, of course, the abstract possibility that the number of people will become so great that limits will have to be set to their increase. But if at some stage communist society finds itself obligated to regulate the production of human beings, …., it will be precisely this society and this society alone which will carry this out without difficulty.

(Engels, 1971:119)

1. Introduction

China economic growth and its impact on the global economic and political arena are at the centre of increasing attention. In 2009 China's GDP growth has ranked first in the world and China has shown the capacity to deal with the global financial crisis better than any other country. In 2010, the record growth of the first quarter (+11.9 per cent) did already clearly indicate that China was going to return to a two digit rate of growth. In the longer-term China's GDP is projected to surpass the American GDP by 2020, after having become the second largest during the current year.

While the sustainability of China's economic growth has been and is largely debated from a macroeconomic perspective, the shear size of its population and the widespread idea of the presence of a large reservoir of rural labour have prevented to consider the possibility that in not too far a future China could be affected by a structural lack of labour supply, although the presence of labour shortages[1], signals of an increasing wage pressure[2], and of growing phenomena of illegal immigration[3] have been reported by national and international observers and are attracting growing attention from the media.

The paper will focus on the labour market and economic implications of the fast decline in fertility that has characterized China starting at the beginning of the '50s. It is shared opinion that the decline in fertility below replacement level will determine a relevant reduction of total population, an even more pronounced decline of Working Age Population (WAP), and progressive ageing phenomena. A lot of attention has been paid to the problem of ageing and its consequences on the welfare systems; much less attention to the impact of a declining WAP on the labour market and to its implications in terms of migration flows. The Report on Replacement Migration published by the United Nations population Division in 2000 [4] represents the most notable exception.

The Report -that was received with skepticism and widespread criticisms[5], based more on ideological standings than well-formulated arguments- sustains the unorthodox position that immigrations represents the only possible solution to a declining WAP. The Report raised a vey relevant issue, put the right question and, in my opinion, provided the correct answer. However, the definition of Replacement migration only on the basis of demographic criteria represents a serious limit of this otherwise very relevant concept.

The Report adheres to the same logic adopted by the standard approach to demographic projections that the demographic and economic spheres are independent from each other and, therefore, that population can be forecasted only on the basis of hypothesis about fertility,

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[1] See for instance:" Defying Global Slumps, China Has Labour Shortages", The New York Times, New York edition, February 27, 2010.

[2] The last empirical evidence is provided by the increase in the minimum wage decided by the city of Guangzhou starting May 1st.

[3] The China daily as recently reported a growing presence of Vietnamese illegal workers in the Province of Guanxi and in numerous other Southern China cities and areas, where immigrants find jobs not only in factories, but also as farmers. www.chinadaily.com.cn/china/2010-04/11/content_9713105.htm. Illegal immigration in Guangzhou from Vietnam, Myanmar and Africa has been reported by the press since 2008.

[4] Population Division, 2000.

[5] See inter alia J.R. Bermingham (2001), L.F. Bouvier (2001), D.A. Coleman, 2000 and 2002; G. McNicoll (2000), F.A.B. Meyerson (2001).

mortality and migration. The only difference of the exercise presented by the Report is that immigration is not assumed on the basis of past trends, but estimated in relation to three demographic objectives: 1) to maintain the size of total population at the highest level it would reach in the absence of migration after 1995; 2) to maintain the size of working-age population (15 to 64 years) at the highest level it would reach in the absence of migration after 1995; 3) to maintain the potential support ratio (PSR)[6] at the highest level it would reach in the absence of migration after 1995[7]. These three targets, as well as the corresponding values of Replacement migration, do not have any relevant labour market implications and, therefore, are of little interest to economic analysis and policy formulations.

In recent papers[8], I have shown that a prolonged decline in fertility will produce a *structural lack of labour supply* that can be defined as a situation in which labour supply and labour demand can not be equated by the real wage. In the short run labour force cannot be created and its maximum level is determined by the size of working age population. In a situation of structural lack of labour supply, the local labour force is not sufficient even to maintain the existing level of production and foreign labour is necessary to ensure economic growth. The size of the structural lack of labour is jointly determined by the rate of decline in WAP and by the rate of growth of production, given the activity rate of the local population. The size of the structural lack of labour determines the level of the migration balance. This allows providing an economic definition of Replacement migration as *the international migration needed to offset the structural lack of labour supply and keep the real wage constant.*

I have also proposed estimates of the future structural lack of labour supply and migration balances for two areas [EU15, NWC (Australia, Canada, USA)], and for four countries (Russia, Japan, Italy and Moldova) in alternative scenarios of employment growth[9]. The main conclusions are that the size of the immigration flows needed by Europe, Australia and Canada, but not by the United States, will be much larger than those presently hypothesized by United Nations projections and that, contrary to existing forecasts, the population of countries with below replacement fertility will necessarily increase due to the immigration flows induced by economic development and demographic trends and the higher fertility of the migrants.

This paper applies the same approach to China with similar results. The decline in fertility, determined by the process of economic development and its impact on education and urbanization, but promoted also trough the one-child policy, will provoke a relevant and growing structural lack of labour supply, even in the hypothesis that Chinese employment growth should sharply decline. The implication is that in order to continue its road to economic growth and social development, China will have to rely on a large and growing quota of immigrant labour. The decline in fertility, actively pursued to set a ceiling to population growth, will end up provoking the opposite result.

The first part of the paper briefly describes the successful way by which China has faced, between 1950 and 2010, the challenges generated by the demographic trends provoked by the so called "demographic transition"[10] in the areas of education and employment.

The demographic projections produced by the Population Division (PD) for 2010-2050 are then analyzed and discussed. Both the medium and low variants show that China's WAP will dramatically decline, the amount of the decline depending on the hypothesis about fertility.

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[6] The PRS is the ratio of the working-age population (15 to 64 years) to the old-age population (65 years or older).

[7] The exercise was carried on for 8 countries (France, Germany, Italy, Japan, Republic of Korea, Russian Federation, United Kingdom, United States) and two areas (Europe and European Union).

[8] M. Bruni (2010), (2009a), (2009b), (2008)

[9] M. Bruni 2009a

[10] The classical model of the demographic transition envisages the passage from an equilibrium condition, characterized by high fertility and mortality rates, to an equilibrium situation characterized by low fertility and mortality rates, migrations playing no role in attaining such results. While there are ne empirical indications that such a transition will take place, no theoretical arguments have been put forward to show its long–run inevitability.

The PD forecasts are based on an age population structure that largely differs from the one estimated by the Chinese National Bureau of Statistics (CNBS), being characterized by higher values for the younger generations and lower values for the older ones. The consequences of such difference on future WAP are explored through two comparable projections of the Chinese population, one using the CNSB structure, the other the PD structure. The projections, whose aim is only that of producing a demographic canvas to outline and discuss alternative policies, are based on the simple hypothesis of constant age-specific mortality rates and constant fertility rates. These projections, while confirming the general trends of the UN projections, point out the extreme relevance of the initial population structure in assessing the moment in which the structural lack of labour supply will become manifest, and the size of the phenomenon.

The implications of both projections for the Chinese labour market are separately discussed for two periods: 2008-23 and 2023-2048. In the first period, the level and trends of WAP depend only on the initial population structure since all the young people that will enter working age are already born. A set of hypothesis on employment growth allows measuring the level and timing of 1) the structural lack of labour supply and 2) the corresponding level of replacement migration, as previously defined. Our elaborations show that population structure plays a major role in assessing the two variables, but in both cases China will soon become the world largest importer of labour force. In the second period, the level and trends of the structural lack of labour supply will depend on the future trends in fertility (and therefore also on the decision of the Chinese government whether to keep or abolish the one-child policy), on the number of immigrants and their rate of fertility and on the demographic, economic and social policies that will be adopted during the first period. A major role will be played by the rate of employment growth, and therefore by the speed, typology and geographical distribution of China's economic growth.

The novelty and complexity of the demographic and economic scenarios suggested by the paper, coupled with the uncertainty about the age structure of the Chinese population, make both premature and presumptuous to try to fully assess the impact of demographic trends on economic development and growth. However, our analysis clearly suggests that any legal restriction to fertility and territorial mobility is totally unwarranted, and other educational and labour policies addressing the problem of labour shortages should be considered as soon as possible. It also indicates the necessity to start an in depth discussion of which immigration and social integration policies could better serve the interests of China on the light both of the experience of other countries, and of the role that China wants to play in the international arena.

Demographic transition theory has for long time postulated that the decline in fertility would have leveled out at replacement level, ruling out the possibility of population decline. This idea has been always strongly imbedded in economic theory that was developed in a phase of population growth. In the classical model the supply of labour is unlimited. Lewis model provides an influential application of this hypothesis. In neoclassical model the supply of labour is limited, but it is assumed that population is characterized by a long-run non-negative trend.

At present there are no doubts that, in absence of international migration, a growing number of developed and developing countries will register a dramatic decline in WAP that in its turn will provoke a structural lack of labour supply, the size of which will depend on the rate of growth of employment. The paper suggests that this should bring to the forefront the theoretical and policy implications of this new demographic perspective for the single countries, for the development of a future international labour market and for the political and economic relationships between, on one hand, countries affected by a structural lack of labour supply and, on the other, countries affected by a structural excess of labour supply. China could represent the most interesting arena for the development of new ideas and innovative policies.

2. China's past demographic challenges: 1950-2010 [11]

In 1950, with a total population of around 545 million, China was the country with the biggest population in the world and accounted for 21.5% of world population. It also accounted for the largest share of births (more than ¼) and provided the biggest contribution to the increase in world population (around 23 per cent).

In 2010, China is still the most populated country in the world. With around 1,334 million[12] inhabitants it accounts for 19 per cent of world population; its contribution to the total number of births registered in the planet has, however, has decreased to 13.3 per cent and its contribution to the increase in world population to 11 per cent.

Between 1950 and 2010, the Chinese population has increased by around 809 million (148 per cent), while at least 8.6 million Chinese have migrated to other countries, 4 million in the last ten years. The increase in Working age population (WAP) has been even more dramatic, +189 per cent, from 337 million to 974 million.

This extraordinary demographic growth has been paralleled by equally notable changes in the age-structure and geographical distribution of the Chinese population. The weight of WAP has increased from 61.9 per cent to 71.9 per cent[13]; the percentage of young people has decreased from 33.6 per cent to 19.9 per cent, and the proportion of the elderly has increased from 4.5 to 8.2 per cent. This radical transformation has been determined by an extremely rapid decline in fertility [the Total Fertility Rate (TFR) has decreased from 6.11 to an estimated value of 1.77] and a parallel rapid increase in life expectancy (from 40.8 to 73 year[14]).

At the same time, according to national statistics, the pace of urbanization has progressively accelerated so that the share of urban population has risen from 12.5 per cent in 1952 to 45.7 per cent in 2008, the last ten years accounting for one third of the total increase.

These demographic trends have generated huge challenges in the areas of education and employment.

Education - Between 1950 and 2010 births have amounted to 1,363 million, i.e. almost 23 million per year. After a maximum of more than 28 million, reached between 1965 and 1970, births have declined to an average yearly value of around 16-18 million in the last five years.

Therefore, the first challenge China had to face was a tremendous increase in the number of young people in the training phase of life. The 5-19 age bracket, a reasonable proxy of education demand, has increased from an initial value of 162 million to a maximum of 357 million in 1980. It has then slightly decreased to 324 million in 2005, to drop to 288 million in 2010.

Given these numbers, the educational results obtained by China are to say the list remarkable. Around 1950 the literacy[15] rate was around 15-20%. According to Census data, the literacy rate had increased to around 66 per cent by 1964, to 77 per cent by 1982, to 84 per cent by 1990 and to 93 per cent by 2000.

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[11] To allow for international comparisons, unless differently indicated, the demographic data used in this section of the paper, including the 2010 estimates, are those published by the Population Division (2009). The differences with Chinese data will be discussed in following sections of the paper.

[12] According to national sources, in 1952 the Chinese population amounted to 575 million and in 2009 to 1.328 million.

[13] The share of WAP did however decline until 1965 when it reached a minimum of 55.4 per cent. In that year the percentage of the 0-14 age group peaked at 40.2 per cent.

[14] The progress has been impressive both for men (from 39.3 to 71,3) and for women (from to 42.3 to 74.8).

[15] In 1950 the government set recognition of 1,000 characters as the standard for literacy and 300 for illiteracy. Until 1978, adult literacy was given priority. A reading primer for peasant was distributed in 1951 to rural people, pinyin was developed; Putonghua became the standard and characters were simplified.

Graph 1 - China; births, deaths and total balance; yearly values in million; 1950-55/2005-10
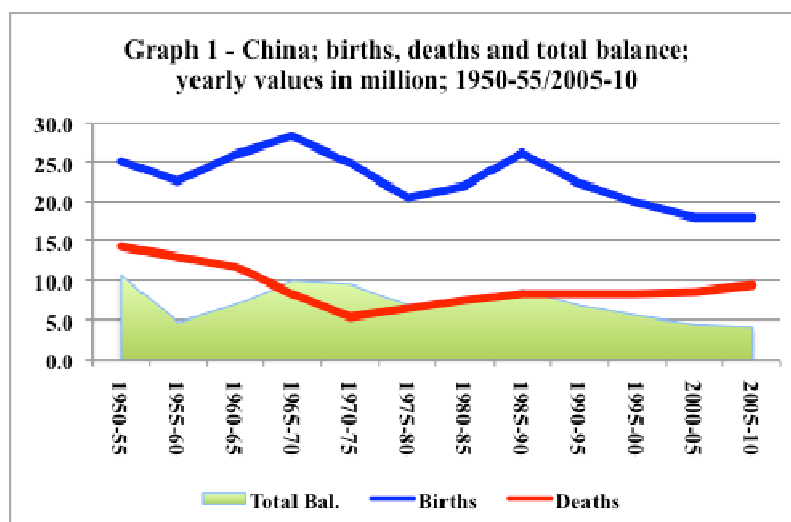
In 2008[16] the rate of illiteracy in the population aged 15 or more was estimated at 7.8 per cent[17]. It affected mainly women and the rural population[18]. Most importantly, it was concentrated between the elderly. In the same year the percentage of population (aged 6 and over) with at least a senior secondary education, college or more had reached 20.4 per cent. Beijing (51.5 per cent), Shanghai (47.7 per cent) and Tianjin (40.2 per cent) lead the provincial ranking followed, at notable distance, by the other provinces with values included between 25.4 per cent in Jilin and 5.1 per cent in Tibet.

Employment - The second, even bigger, challenge that China had to face was creating a number of jobs coherent with a fast growing supply. As we have already seen, working age population -that we will define between 15 and 64 in accordance with international standard and in consideration of the fact that agriculture and the informal economy are still the dominating employment sectors- has increased by 189 per cent in 60 years.

Also in this case flow data provide a more dramatic representation of the problem (Graph. 2). During the sixty years we are considering, WAP has increased on the average by 10.6 million per year, as a difference between 18.8 million generational entries and 8.3 million exits[19]. Moreover, between 1950 and 1985 WAP balance grew from an average value of two million per year to an historical maximum of 18 million per year. After 1985 it has progressively declined to a minimum of 9.8 million between 1990 and 1995, a value that has also characterized the last five years, after having been slightly higher in the previous decade.

Although employment data must be taken with extreme caution, there is no doubt that China's employment performance has been impressive. According to official figures, between 1952 and 2008 employment has grown, on the average, by 10.1 million per year.

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[16] The current literacy rate is set at 2,000 characters for urban dwellers and to 1,500 for rural dwellers.

[17] CNSB, 2009

[18] Women represent 74.1 per cent of the illiterate; 71.8% of the illiterate belong to the rural population.

[19] Generational entries are represented by the people who become 15 in the period considered. Exits include generational exits (the people who become 65), deaths in working age, and net migration. For a more formal definition of generational concepts and a description of a labour market stock-flow generational model see M. Bruni, 2009b.

Graph 2 - China; WAP; Generational entries, exits and total balance; yearly average values in million; 1950-55/2005-10
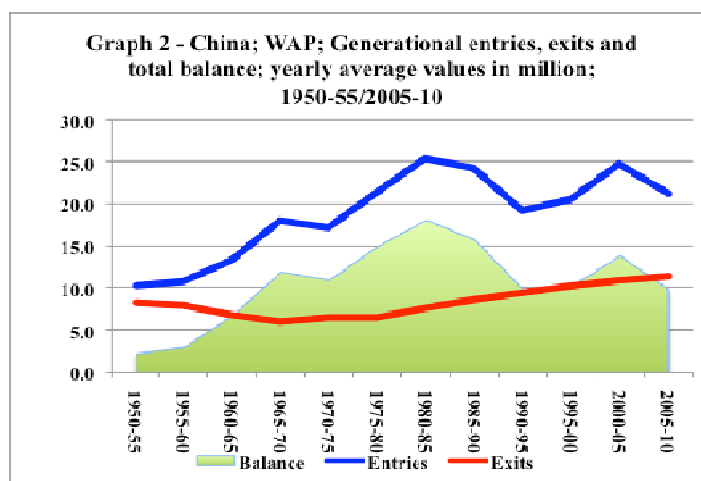
Two main phases must however be distinguished. In the first, covering the 1952-1991 period, total employment grew at an average yearly rate of 11.5 million per year, the agricultural sector playing a major role and contributing for almost 50 per cent to total employment growth. In the second, the average annual growth declines to 7.1 million: the relative higher increases in industrial employment (4.2 million per year) and especially in services (6.9 million per year) are partially counterbalanced by an average decline in agricultural employment by 5 million per year.

These tendencies have progressively accelerated and in the 2003-2008 period employment in agriculture has declined, on the average, by 11.8 million per year, while employment in the other two main sectors has increased respectively by 10.1 and 7.8 million per year. It must also be pointed out that, starting in 2001, the rate of growth in total employment has progressively declined and has always remained at or below 1 per cent, with a minimum of 0.6 per cent in 2008.

As a consequence, the share of the agricultural sector has declined to 39.6 per cent, while the shares of industry and services have increased respectively to 27.2 per cent and 33.2 per cent[20].

3. China's demographic future
3.1 The demographic projections of the Population Division

The United Nations Population Division publishes demographic projections that represent the main reference point for national governments and international organizations. The projections are based on the 2010 estimated population level and structure and on

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[20] In the same year agriculture ha contributed to GDP by 11.3 per cent, industry by 48.6 per cent, and services by 40.1 per cent.

alternative assumptions on fertility, mortality and international migration, the assumptions on fertility playing the major role[21].

For what relates to China, the Population Division medium variant projection (the one that is normally used, being considered the most probable) assumes that the TFR will progressively increase from the 2005-2010 estimated average value of 1.77 to 1.85 in the period between 2020 and 2025, and will then remain constant for the following 25 years. This assumption reflects the equilibrium hypothesis that still underlines demographic transition theory that fertility will, sooner or later, converge toward the equilibrium level of 2.1. In the case of China this goal has not been judged realistic and a sub-equilibrium level of 1.85 has been preferred.

The low variant projection assumes that the TFR will remain 0.5 children below the level hypothesized by the medium variant. In this scenario the TFR does, therefore, progressively decline from 2010 to 2025 when it will reach a minimum of 1.35 children per woman and will then remain constant in the following 25 years[22].

Table 2 compares the two variants:

- According to the medium variant projection, Total population will increase up to 1930, when it will reach a maximum of 1,462 million, to then decline to 1,417 million in 2050; in the low variant the maximum is reached in 2020, juts below 1.4 billion; total population then drops to 1,237 million in 2050;

- The number of young people steadily declines over the whole period, both in the optimistic (high fertility) and pessimistic scenario. The decline is obviously more pronounced in the latter (-137 million, -19.7 per cent.) than in the former (-53 million, -51 per cent);

- The 40 years time interval is not sufficient for different fertility levels to affect the 65 and over age group; therefore, the number of elderly increases by 219 million (+197 per cent) in both scenarios;

- WAP reaches a maximum of 998 million in 2015, to then progressively decline in the following 35 years. The two variants start to differ in 2030 due to the fact that the fertility rate begins to impact on WAP entries in 2025; between 2025 and 2050, WAP will decline by 126 million (-12.8 per cent), according to the medium variant projection, by 222 million (-22.4 million) according to the low variant;

- As a consequence of the previous trends, the population age structure will undergo major changes: in both variants the shares of the young and of WAP progressively decline, while the shares of the elderly progressively increase. More specifically, in the medium variant the percentage of young people drops from 19.9 per cent in 2010 to 15.3 per cent in 2050; the percentage of WAP from 71.9 per cent to 61.4 per cent, while the percentage of the elderly increases from 8.2 per cent to 23.3 per cent. In the low variant the decline in fertility determines an even more pronounced drop of the share of the young (to 10.7 per cent), a more pronounced increase of the share of the elderly (to 26.7 per cent), and therefore a lower decline of the share of WAP (to 62.6 per cent).

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[21] For 2008 the Population Division produced eight different scenarios: five differ only with respect to fertility trends (low, medium, high, constant, instant-replacement fertility). The other three are based on the medium variant scenario: the "constant mortality" variant differs with regard to the path followed by future mortality, the "no change" variant differs with respect to both fertility and mortality, the "zero migration" variant only with regard to the path followed by future international migration; see Population Division (2009).
[22] Both variants share the same hypothesis about mortality and international migration: life expectancy at birth is expected to progressively climb to 77.4 years for men and to 81.3 for women; international migration is set at around -300,000 per year.

Table 2 – China: population by main age groups and scenarios: absolute values and percentage composition: 2010-2050

	Absolute values (million)				% composition		
	0-14	15-64	65 and +	Total	0-14	15-64	65 and +
2010	285.4	973.3	111.4	1384.1	19.9	72.9	8.2
Medium Variant							
2015	265.9	998.2	131.9	1396.0	19.0	72.5	9.4
2020	288.3	996.0	186.9	1431.2	18.7	67.6	11.7
2025	282.4	996.5	194.2	1453.1	18.1	68.6	13.4
2030	246.6	983.2	232.7	1462.5	16.9	67.2	15.9
2035	230.4	950.6	281.3	1462.4	15.8	65.0	19.2
2040	222.4	916.1	316.6	1455.1	15.3	63.0	21.8
2045	218.7	897.4	323.2	1440.3	15.3	62.3	22.4
2050	218.4	875.1	336.6	1417.0	15.3	61.4	23.3
Low Variant							
2015	253.1	998.2	131.9	1383.2	18.3	72.2	9.5
2020	235.9	996.0	186.9	1398.8	16.9	72.2	11.9
2025	258.0	996.5	194.2	1398.8	17.9	72.2	13.9
2030	181.4	973.5	232.7	1387.6	14.3	67.9	16.8
2035	166.4	918.4	281.3	1366.2	12.2	67.2	20.6
2040	155.3	861.9	316.6	1333.9	11.6	63.6	23.7
2045	141.4	822.8	323.2	1296.4	11.2	63.6	25.0
2050	132.0	771.4	336.6	1237.0	10.7	62.6	26.7

Source: Elaboration on Population Division Data (2009)

In both scenarios generational entries into WAP are characterized by a long-run negative trend (Table 3). However, the increase in fertility hypothesized by the medium variant determines an increase in entries between 2025 and 2035, while in the low variant entries decline in all five-year intervals. Both scenarios share the same amount of exits, and in both scenarios the 2025-30 period marks a historical moment in Chinese demographic history: the beginning of a phase of uninterrupted structural decline of WAP. A temporary negative natural balance is however registered between 2015 and 2020, while in the following 5 year period the balance is positive, but equal to only half a million.

Table 3 – WAP: Medium and low variant: generational entries, exits and natural balances: 2000-05/2045-50

	Entries M.V.	Entries L.V.	Exits	Balance M.V.	Balance L.V.
2010-15	94.3	97.3	88.4	24.9	27.9
2015-20	86.5	86.5	88.7	-2.1	-2.1
2020-25	87.0	87.6	86.5	0.5	0.5
2025-30	81.0	70.2	94.2	-13.3	-26.0
2030-35	89.1	69.6	121.7	-32.7	-52.1
2035-40	81.3	59.3	115.9	-34.5	-56.6
2040-45	75.2	57.7	93.9	-18.7	-39.2
2045-50	73.0	57.7	166.3	-27.2	-69.6
2050-55	267.9	267.9	241.6	33.3	25.3
2055-50	-186.6	373.6	536.0	-126.4	-222.5

Source: Elaboration on Population Division Data (2009)

Graph 3 visualizes the generational flows of the two scenarios and the impact of the two fertility hypotheses on the number of entries and on the total balance of WAP.

Graph 3 - WAP; Generational entries, exits and total balances; Medium and low variant; 2000-05/ 2045-50
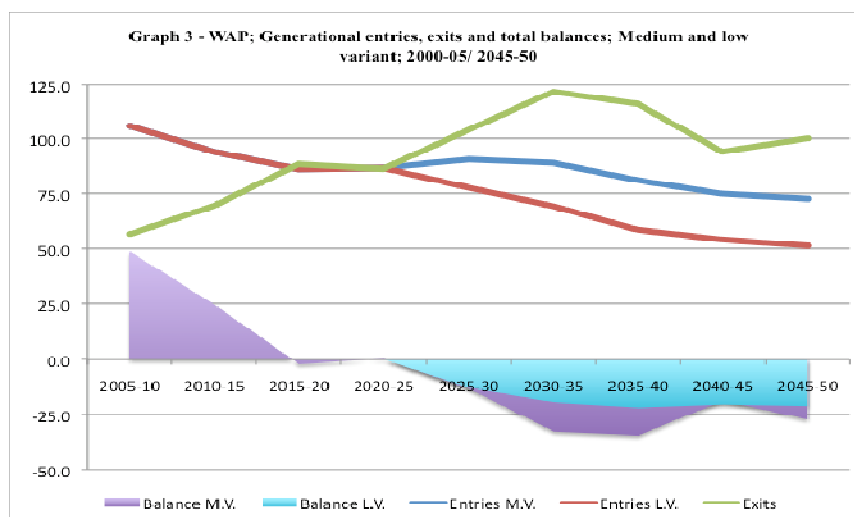
In conclusion, the projections of the Population Division show not only that the Chinese population is going to enter a period of fast and irreversible ageing, a phenomenon that has already attracted a lot of attention, but also that WAP will unavoidably decline even if the fertility rate would moderately increase up to 2025. The size of the decline depends on the dynamic of fertility, but is very relevant in both scenarios (-126 million in the medium variant, -222 million in the low variant).

Since in both variants WAP id assumed to be affected by around 12 million net migrants, Replacement migration, as defined by the United Nations Report, can be estimated respectively at around 114 million and 210 million between 2025 -when WAP is expected to peak at 997 million- and 2050. To put this value in an international perspective we can recall that the UN Report on Replacement migration provides an estimate of 161 million for Europe between 2005 - when European WAP would reach a maximum of 493 million (around 50 per cent of the Chinese WAP in 2025)- and 2050, and of only 18 million for the USA, between 2015 and 2050.

3.2 Alternative demographic scenarios: 2008-2048

The forecasts of the Population Division present, however, some serious shortcomings. In the first place, as we have just seen, both variants assume that in the next 40 years China will be affected by a consistent net migration balance. This hypothesis is based on past trends and it appears totally inconsistent with the WAP trends exhibited by the projections[23]. The second, more important problem is represented by the fact that the age structure proposed by the Population Division largely differs from Chinese estimates.

Chinese sources do not provide absolute values of the Chinese population by sex and five year age group. Two sets of information are available. The first provides the total population structure by three main age groups *based* on the results of the annual national sample survey on population changes[24]; the second the *actual structure*, by sex and single year of age, estimated by the same survey.

As table 4 indicates, there are notable differences between the three estimates. We will show that, *ceteris paribus*, such differences do strongly affect population projections and bring to different assessments of the dimension and urgency of the demographic problems China will experience in not too far a future.

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[23] For a detailed discussion of this point see M. Bruni, 2009a
[24] See China Population & Employment Statistics Yearbook 2009, note p.5.

3.2.1 The assumptions

The goal of the paper is not that of providing full fledged demographic scenarios, a task that should be urgently undertaken by Chinese Institutions, but to discuss the impact of demographic evolution on the labour market and, therefore, on the sustainability of Chinese economic growth and social development.

Since we do not have any mean to assess the reliability of the sources, we will propose two projection of the Chinese population based on two different age structure in the base year (2008): the first (structure 1) is based on the estimates proposed by the Chinese National Statistical Bureau (CNSB); the second (structure 2) is derived from the estimates of the Population Division structure. More specifically:

- Structure 1 has been computed ri-proportioning the original weight of the five years age group of the sample survey on the basis of the adjusted weights of the main age groups computed by CNSB on the basis of the same survey;
- Structure 2 has been computed interpolating the 2005 and 2010 Population Division data to obtain an estimate for 2008; the data have then been normalized to the population level estimated by CNSB[25].

Therefore, in the base year, the two populations coincide with respect to the level, but differ with respect to the weight of the five-year age groups[26].

Structure 1 is characterized by higher values of all generations born before 1970 and lower values of those born in the following years, the difference amounting to almost 40 million for the 0-14 age group and to 58.7 million for the 20-34 age group (Graph 4).

Table 4 – Population age structure according to different sources: 2008 (Chinese sources, 2010 (UN)	0-14	15-64	65 and over
National Sample Survey	17.5	73.0	9.5
General Survey	19.0	72.7	8.3
Population Division	19.9	71.9	8.2

Moreover:

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[25] The level of the total population obtained trough interpolation is very close to the estimate of the CLSB (1329.01 versus 1328.02)

[26] The two structures suggest a very different evaluation of the level and timing of the decline in fertility that has affected China and, probably, of the level and timing of the ageing process.

- According to structure 1, the most numerous age group is the 35-39, while according to structure 2 the most numerous age group is the 40-44;
- According to both structures, a local minimum of births was recorded at the beginning of the '70s and a local maximum at the beginning of the 80s; both structures agree that, starting at the beginning of the '90s, the number of births has sharply declined.

In opposition to standard practice, we will take the view that the demographic and economic spheres do strongly interact on, and through the labour market. In order to analyze the impact of demographic trends on labour market variables and then the demographic consequences of the labour market dynamics, what we need is a demographic canvass that allows discussing alternative sets of demographic, economic and labour policies.

We have therefore projected the Chinese population over the 2008-2048 interval, using both the PD and CNSB population structures, on the simple hypothesis that the age-specific fertility rates and the age and sex-specific mortality rates registered in 2008 will remain constant, and that no international migration will occur. The data proposed by the two scenarios do therefore depend mainly on the 2008 population structure.

3.2.2 The demographic scenarios

Table 4 summarizes the main results of our projections. According to CNSB data (scenario 1):

- WAP will increase during the 2008-13 period and then progressively decline from a peak value of 995 million to 785 million, loosing 210 million (-21.1 per cent) in 35 years;
- The number of people in the 0-14 age bracket will steadily and progressively decline from 252 to 177 million (-75 million), and their weight will decrease from 19 to 13.5 per cent;
- The number of elderly will peak at 370 million in 2038 and then decline to 347 million; the share of the elderly will reach a maximum of almost 27 per cent in 2043;
- Total population will peak at 1.437 million in 2028; it will then decline to 1.309 million in 2048 (-128 million).
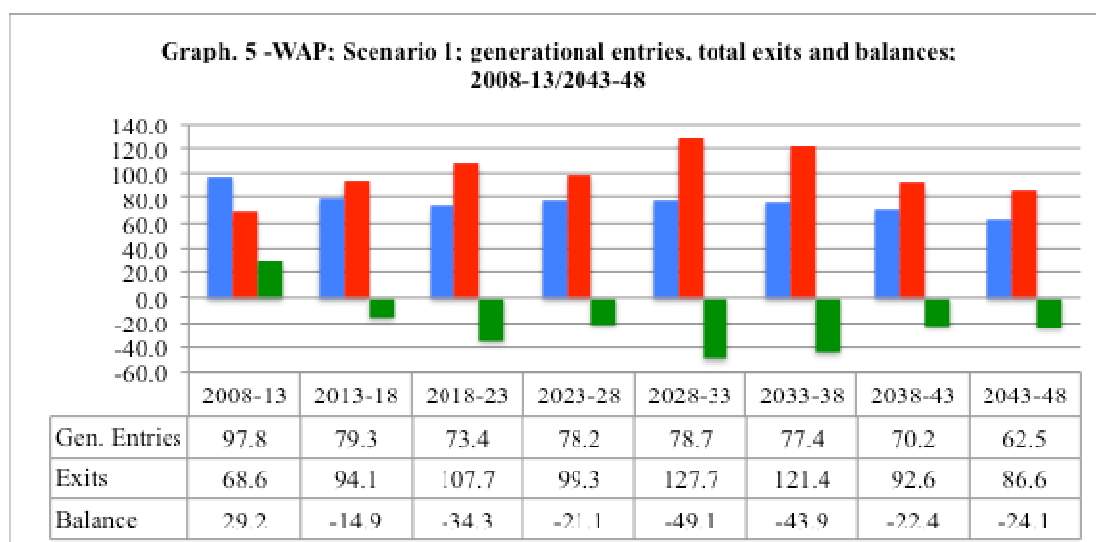
Table 4 - China population projections by main age groups: CNSB and PD data: absolute values and percentage composition: 2008-2048

	0-14	15-64	65+	Total	0-14	15-64	65+
CNSB							
2008	252.4	965.6	110.0	1328.0	19.0	72.7	8.3
2013	252.8	994.9	141.7	1372.4	17.0	72.5	10.3
2018	231.2	980.0	185.6	1397.8	16.5	69.6	13.0
2023	236.2	945.7	249.8	1431.7	16.5	68.2	17.4
2028	228.0	924.7	284.6	1437.4	15.9	64.3	19.8
2033	211.7	875.6	336.3	1423.7	14.9	61.5	23.6
2038	193.5	831.7	370.0	1395.2	13.9	59.6	26.5
2043	181.8	808.3	364.5	1355.6	13.4	59.7	26.9
2048	177.3	785.2	346.8	1309.3	13.5	60.0	26.5
PD							
2008	280.8	943.2	104.1	1328.0	21.1	71.0	7.8
2013	265.9	988.3	129.1	1383.3	19.2	71.4	9.3
2018	263.6	1006.0	163.6	1433.2	18.4	70.2	11.4
2023	263.4	1006.0	202.0	1471.4	17.9	68.4	13.7
2028	255.5	988.6	238.2	1483.3	17.2	66.9	16.0
2033	238.4	936.6	283.7	1458.7	16.0	65.2	18.9
2038	220.3	911.7	327.9	1459.9	14.8	63.2	22.0
2043	207.9	911.9	346.5	1466.4	14.2	62.2	23.8
2048	201.0	886.2	351.2	1438.4	14.0	61.6	24.4
2008-48							
	0-14	15-64	65+	Total	0-14	15-64	65+
CNSB	-75.0	-180.4	236.7	-18.8	-5.5	-12.7	18.2
PD	-79.7	-57.0	247.2	110.4	-7.2	-9.4	16.6

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According to PD data (scenario 2):
- WAP increases until 2018, it remains substantially stable in the following 5 years to then decline by 120 million;
- The decline of the 0-14 age bracket will be slightly higher than that in the previous scenario (-79 million), as well as the increase in the number of the elderly (+248 million);
- At the end of the period, the population age-structure is characterized by higher shares of the young (14 per cent) and of WAP (61.6 per cent) and by a lower share of the elderly (24.4);
- Total population will peak just short of 1.5 billion in 2033 and will then decline by 60 million in the following 15 years.

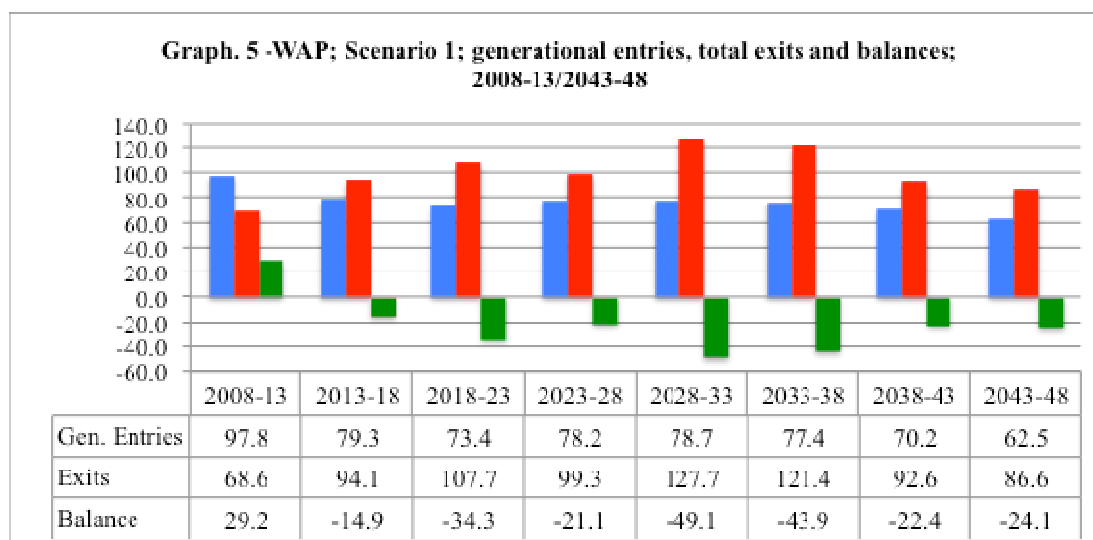The trends in the stock values of WAP are "explained" by generational flow data.

In scenario 1 generational entries into WAP exceed exits only in the first time interval (graph 5). Starting in 2013, WAP balances become negative, due to a notable decline in entries and a relevant increase in exits, so that in the following 10 years WAP declines by around 49 million. Starting in 2023, exits start to decline, but continue to exceed entries and in the following 25 years WAP declines by other 160 million. As we have already seen, the end result is that between 2013 and 2048 WAP declines by 21.1 per cent (-210 million). The maximum gap between entries and exits is registered between 2028 and 2033 when the largest generation - the one born at the end of the sixties- reaches retirement age. In this period WAP declines, on the average, by 10 million every year.

Graph. 5 -WAP: Scenario 1: generational entries. total exits and balances: 2008-13/2043-48

	2008-13	2013-18	2018-23	2023-28	2028-33	2033-38	2038-43	2043-48
Gen. Entries	97.8	79.3	73.4	78.2	78.7	77.4	70.2	62.5
Exits	68.6	94.1	107.7	99.3	127.7	121.4	92.6	86.6
Balance	29.2	-14.9	-34.3	-21.1	-49.1	-43.9	-22.4	-24.1

In scenario 2, due to the bigger size of the younger generations and the smaller size of the older generations that characterize the base year, entries continue exceeding exits until the 2023-28 period and the negative balances remain lower than those of scenario 1 until 2038. In the last ten years we have considered, the absolute values of the balances of scenario 2 are bigger than those of scenario 1 (Graph 6).

We can summarize the situation observing that between 2010 ands 2050:
- In scenario 1 entries average 15 million and exits 20 million;
- In scenario 2 entries average 17 million and exits 19 million;
- This generates an overall negative balance of 180 million in the first scenario and of 57 million in the second.

Graph. 5 -WAP; Scenario 1; generational entries, total exits and balances; 2008-13/2043-48

	2008-13	2013-18	2018-23	2023-28	2028-33	2033-38	2038-43	2043-48
Gen. Entries	97.8	79.3	73.4	78.2	78.7	77.4	70.2	62.5
Exits	68.6	94.1	107.7	99.3	127.7	121.4	92.6	86.6
Balance	29.2	-14.9	-34.3	-21.1	-49.1	-43.9	-22.4	-24.1

However, the most relevant point is that in scenario 1, WAP peaks in 2013 and then declines by 210 million; in scenario 2, WAP peaks in 2023 and then declines by 120 million against a value of 160 million of scenario 1 in the same period. In conclusion, the different age structures proposed by CNSB and UN determine a different date for the beginning of WAP decline and a different size of the phenomenon. Both sources do however support the idea that, starting in 2023, the decline in WAP will be massive, so that in the following 25 years Replacement migration (according to the United Nation definition) will be included between 4.8 million (PD data) and 6.4 million (CNBS data) per year.

4 Labour market scenarios.

The young Chinese people that will enter WAP between 2008 and 2023 are already born and their number can only be affected, in a minor way, by educational choices and policies. In substance, until 2023 labour supply can be affected only by changes in participation rates and policy measures.

In the following period, entries into and exits from WAP, and therefore entries into and exits from the labour market, will be affected by numerous factors, namely the number of births that will be registered between 2008 and 2023, the rhythm and typology of economic growth, as well as by the demographic, social and economic policies that will be enacted during the same period, and finally by the immigration flows that China will eventually register.

Therefore, while for the first period it is reasonable to produce labour market and demographic scenarios, including estimates of Replacement migration according to the definition we have proposed, for the second period such exercise will be done only to

understand which problems China will have to face if no international migration will take place, and to assess which measures should be immediately enacted.

4.1 The 2008-2023 period
4.1 Labour market hypotheses and employment data

In order to build labour market and demographic scenarios we need to formulate a set of hypotheses on the future trends of the employment level and structure.

Between 1993 and 2008 WAP has increased by 173 million (+21.8 per cent). In the same period China has created around 107 million jobs (+16 per cent). The growth in employment has resulted from an increase of 177 million jobs in extra-agricultural sectors and a decline of 70 million jobs in agriculture. Between 2003 and 2008, the decline in agricultural employment has accelerated reaching almost 12 million per year, while extra-agricultural employment has increased, on the average, by 17.9 million per year. Total employment has, therefore, increased by 6.1 million per year. China remains, however, a predominantly rural country, employment in agriculture still accounting for almost 40 per cent, with services at only 33 per cent.

Table 6 - China - Employment growth: total and by sector: yearly average values: 1993-2008 and 2003-2008				
	Total	Agriculture	Industry	Services
Valori totali				
1993-2008	107	-70	81	1.6
2003-2008	31	-59	51	38
Valori annuali				
1993-2008	7..	-1.7	-1..	7.7
2003-2008	6..	-11.8	1v..	7.8

On the basis of the past employment trends, we have formulated the following, rather conservative, hypotheses on the employment trends that will characterize the 2008-23 period (table 7)[27]:

- Total employment will increase by 60 million against the 107 registered in the previous 15 years; the average annual rate will progressively decline: 5 million between 2008 and 2013, 4 million in the following five years period and 3 million between 2018 and 2023[28];
- Employment in agriculture will decrease by 120 million against the 70 million of the previous 15 year interval; on the average, 9 million in the first five years period, 8 in the second and 7 in the third;
- Employment in the extra-agricultural sectors will increase by 180 million against the 116 million of the previous 15 years, at a declining average yearly rate of 14, 12 and 10 million;
- Total employment will therefore climb to 835 million in 2023, and the share of employment in agriculture will decline from 39.6 to 22.3 per cent.

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[27] It must be underlined that in this part of the paper we are not interested in the way in which China will achieve the "goals" set by our hypotheses since this will not affect the conclusions we are going to derive.

[28] This corresponds to an average yearly rate of growth of 0,65 per cent in the first period, of 0.5 per cent in the second and of 0.37 per cent in the third.

Table 7 - China: Hypotheses on employment change by sector and five years intervals: 2008-2023	Agriculture	Extra-agriculture	Total
2008-.3	-15	75	25
2013-.8	-10	60	25
2018-23	-35	50	15
2008-23	-120	180	60
2008	307	468	775
2023	187	648	835
2008	39.6	60.4	100
2023	22.4	77.6	100

The labour market statistics published by the CNBS present some very relevant limits, the most important one being that no estimates are provided of the employment level by age groups. The available information on employment structure does, however, allow computing such data that have then been used to estimate the specific employment rates based on our two previous demographic structures in the base year.

As graph 7 shows, the specific employment rates based on population structure 1 present the standard shape, with values above 90 per cent for the central age groups, values increasing with age for the younger age groups and values declining with age for the older age groups. The WAP age distribution based on population structure 2, characterized by lower values of the younger generations and higher values of the older generations, produces lower employment rates for the young, extremely high values for the last cohorts and values above 100 for the 40-44 and 50-54 age groups. This indicates that there is no coherence between the population age structure proposed by the Population Division and the employment age structure estimated by the Chinese Bureau of Statistics.

This makes impossible to carry on a flow analysis, based on the comparison of the generational turnover generated, on one hand, by employment and, on the other, by population on the basis of this demographic scenario. We will therefore proceed on two steps. We will first propose labour market scenarios based on a stock approach that allow comparing the implications of the demographic trends resulting from CNBS and PD data. A labour market scenario based on a flow approach will then be estimated in order to better discuss the dynamic implications of scenario 1.

4.2 The labour market and demographic scenarios

4.2.1 The stock approach

Table 8 reports the number of additional jobs (Additional labour demand) that will be created in each of the next three five-year intervals, according to the previous labour market hypotheses, the additional supply generated by demographic trends of scenarios 1 and 2, and the structural lack or excess of supply determined by demographic trends.

Additional supply has been computed on the hypothesis that the total rate of activity (taken for convenience equal to the total rate of employment) will remain constant over the 2008-2023 period. In 2008 the rate of employment was equal to 78.3 per cent, according to scenario 1 and to 80.5 per cent according to scenario 2[29]. This, together with the different WAP evolutions of the two scenarios, determines a much higher additional supply for scenario 2 than for scenario 1.

The difference between Additional supply and Additional demand of labour provides an estimate of what we define, if positive, "structural excess of labour supply", if negative, "structural lack of labour supply". It must be underlined that this datum is the result of the interaction between the increase in employment generated by economic growth and the impact of demographic trends on labour supply, therefore of the interaction of the demographic and economic spheres on the labour market.

Table 7 – China: Hypotheses on employment change by sector and five years intervals 2008-2023		
	Agriculture	Extra-agriculture	Total
2008 - 13	-18	7%	3%
2013 - 18	-10	4%	2%
2018 - 23	-35	5%	1%
2008 - 23	-120	16%	4%
2008	307	-16%	773
2013	187	44%	8%
2018	55.6	46.4	1%
2023	23.4	77.6	1%

The different age structure on which the two scenarios have been built, although providing a similar qualitative trend over the medium term, have a large impact on the size of the shortage of labour that will characterize the Chinese economy between 2008 and 2023.

If the age structure estimated by the CNBS is correct, the national supply of labour will start to be insufficient in the present 5 year interval and the structural lack of labour supply will then rapidly expand to an average yearly value of more than 6 million between 2013 and 2018, and to more than 8 million in the following five year period. According to scenario 2, labour supply will still be sufficient between 2008 and 2013, but a structural lack of labour supply, although of a much lower dimension (2 and 3 million per year), will characterize the following two intervals.

An alternative and more intuitive way to capture this situation is the following. China could keep its extremely high rate of employment constant destroying, over a period of 15 years, 75 or 10 million jobs, depending on whether the CNSB or PD population structure more closely reflects reality. Alternatively, if between 2008 and 2023, employment will grow at an average rate of 4 million per year, China will have to push its employment rate to 92 per cent in the first scenario and to 87.9 per cent in the second scenario.

Both situations are obviously unrealistic. On one hand, the reduction of the employment level is not a possible option if China wants to pursue its road to economic growth and social development. On the other, the hypothesis of raising the employment rate would imply to invert the present negative trend in participation provoked by the increase on the average duration of education, by the ageing process of the labour force and by the process of urbanization. It must also be underlined that no industrial country is characterized by a total rate of employment above 80 per cent.

These data do, therefore, suggest that, under the hypothesis of "no policy change", China will need migrant workers to sustain its economic growth. International data show that the net migration balance is always in excess of workers needs since migrant workers bring

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[29] The different rates of employment depend on the different value of WAP that in its turn is provoked by the different share of WAP of the two population structures.

with them, or are followed by, family members, and more specifically that the ratio between the two variables is approximately equal to 1.5. Table 8 reports the estimates of Replacement migration (as defined in this paper) on the basis of the previous parameter.

In scenario 1 Replacement migration progressively increases from 3.2 million in the first five-year interval, to 48 million in the second to 63 million in the third for a total value of 113 million. Scenario 2 presents a less dramatic situation: Replacement migration is needed only starting in the second period, when is estimated at 9 million; in the third period its value increases to 23 million, bringing the total value for the 10 year interval to 31 million.

4.2.2 The flow approach

A generational stock-flow[30] model allows analyzing the process through which young generations enter for the first time into the labour market due to i) the death and retirement of older workers (Replacement demand) and ii) the creation of additional jobs (Additional demand). The level of Replacement demand depends mainly on the age structure of the employed, while the level of Additional demand is determined by the rate of economic growth, the rate of technological progress and the employment-income elasticity. The Total labour demand in terms of flow -given by the sum of Replacement demand and Additional demand- measures the total number of first entries into employment needed, on one hand, to replace the definitive exits of older workers and, on the other, to occupy additional jobs.

The following table presents estimates of Replacement demand, Additional demand and Total Labour demand in terms of flows for the 2008-2023 period, articulated in three five-year intervals. Additional demand reflects the previous hypothesis of employment growth; Replacement demand has been computed under the assumption of constant specific rates of employment.

Replacement demand will progressively increase from an initial value of 73 million to almost 100 million between 2018 and 2023, due to the fact that progressively larger generations will reach retirement age, while the increasing average age of the employed will determine an increasing number of exits due to death. Taking into consideration the level of Additional demand that we have previously hypothesized, the Chinese labour market will need, almost 20 million generational entries into employment per year between 2008 and 2013, more than 22 million between 2013 and 2018, and almost 23 million in the following five-year period.

Table 9 – Generational flows, structural lack of labour supply and replacement migration by 5 year periods:million: 2008-2023				
	2008-13	2013-18	2018-23	Total
Replacement demand	73.2	91.4	99.2	263.7
Deaths	9.5	10.5	10.9	30.9
Generational exits	63.7	80.8	88.2	232.8
Additional Demand	25.0	20.0	15.0	60.0
Generational Labour Demand in terms of flow	98.2	111.4	114.2	323.7
Generational labour supply in terms of flows	90.3	84.5	73.7	248.5
Structural lack of labour	-7.8	-26.8	-40.5	-75.2
Replacement migration	11.8	40.3	60.8	112.8

According to scenario 1, during the same period, generational entries into Labour Force (generational labour supply) will progressively decline (from an average yearly value of 18 million less than 15 million) since progressively smaller generations will enter the working phase of life. Therefore, labour supply not only will constantly fall short of labour demand, but the difference between entries into the labour force and the requested entries into employment will progressively increase from 8 million in the first period to 41 million in the last period. According to our definition of Replacement migration, in order to equate labour

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[30] For a full description of the model see M. Bruni 1988 and 2009b.

demand and labour supply, China will need to import almost 12 million people in the first time interval, 40 million in the second, and 61 million in the third.

In conclusion, between 2008 and 2023, the Chinese labour market will need 324 million first time entries into employment (264 million to substitute the workers that will definitely leave the labour force and 60 million to occupy additional jobs). Our data show that, due to the decline in fertility that has affected the country between 1993 and 2008, generational entries into the labour force will amount to only 249 million, and therefore will not be sufficient even to replace the exits of older workers. The result is, as we have already seen, a dramatic structural lack of labour supply that could be offset only by importing 75 million workers.
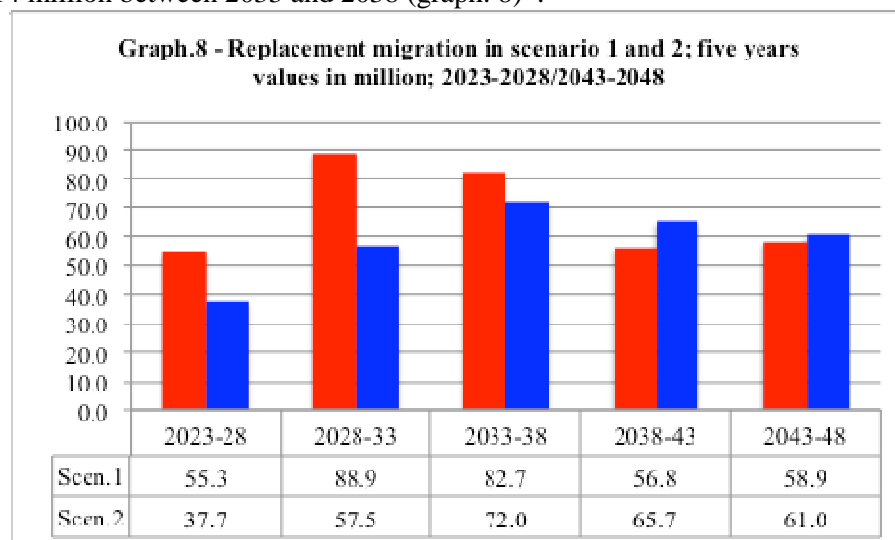
The flow approach does therefore confirm the estimates of a Replacement migration of around 113 million, but suggests an higher value for the 2008-2013 period and slightly lower values for the following two periods.

4.3 The 2023-2048 period

In the 2023-2048 time interval, the two demographic scenarios we have produced, using CNSB and PD data, present a much higher level of similarity than those of the previous period. In both scenarios WAP balances are negative in all five years intervals, and their values tend to converge. As we have already seen, WAP will decline by around 160 million, according to Scenario 1, and by around 120 million according to Scenario 2 (Graphs 5 and 6, and table 5). In the perspective of the PD Report[31], these two values measure the level of Replacement migration required to keep WAP constant.

Replacement migration, as it has been defined in this paper, (i.e. the amount of immigration needed to satisfy the structural lack of local labour supply) will depend not only on demographic trends, but also on employment growth. Assuming, for instance, a rate of participation of 80 per cent, the decline in labour supply from 2023 to 2048 would be of 128 million in Scenario 1 and 96 million in Scenario 2. If over this time interval China would create 100 million jobs (4 millions per year), the Chinese labour market would be affected by a structural lack of labour supply of respectively 228 million and 196 million and Replacement migration would amount respectively to 343 million and to 294 million.

Even more astonishing is the fact that in scenario 1 the level of Replacement migration would peak at almost 18 million per year between 2028 and 2033, and in scenario 2 at more than 14 million between 2033 and 2038 (graph. 8)*.

Graph.8 - Replacement migration in scenario 1 and 2; five years values in million; 2023-2028/2043-2048

	2023-28	2028-33	2033-38	2038-43	2043-48
Scen.1	55.3	88.9	82.7	56.8	58.9
Scen.2	37.7	57.5	72.0	65.7	61.0

Both scenarios do therefore suggest that, everything else constant, the lack of labour supply not only will become a structural factor of the Chinese economy, but due to the dimension of the Chinese population, its size will be larger than that registered by any developed country affected by below replacement fertility.

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[31] Population Division, 2000

It must, however, be clear that what we have presented are not forecasts, but projections based on very specific assumptions on:

- Population structure on the base year
- Fertility rates
- Mortality rates
- Employment age-structure
- Employment growth

and, even more important, under the assumption of "no policy change", an assumption that in the long run can play a crucial role.

5. Structural lack of labour supply, replacement migration and policies

The Replacement Migration Report of the United Nations Population Division argued: "among the demographic variables, only international migration could be instrumental in addressing population decline and population ageing in the short to medium term"[32]. This conclusion stands on the simple argument that an increase in fertility would have only a minor impact that, moreover, would be felt with a delay of at least 20 years, while the reduction in mortality would continue to be an overriding policy goal in every country. As I have already noted, the Report does not provide a sound theoretical explanation of why countries with below replacement fertility should need immigrants: a contraction of WAP is not by itself a *sufficient* reason to provoke immigration, as shown by the present global crisis, nor, under special circumstances, a *necessary* reason and the same can be said of a decline in total population or an increase in the Potential support ratio.

Our thesis is that the decline in WAP determines a reduction in the supply of labour and once unemployment has been brought to the frictional level, the activity rate of the local population have expanded to the physiological level, the excess of labour supply available in the less developed areas of the country have been absorbed via internal migration, then only immigration will allow a country to sustain economic growth.

It should be pointed out that economic immigration could be needed and occur before all previous requirements are fulfilled. In modern societies, and China is no exception, labour is far from homogeneous and the supply for many occupations could become insufficient long before a frictional level of unemployment is reached. The institutional setting could prevent even large segment of labour supply to enter the labour market. For instance, in absence of adequate social services for the care of the children and of the elderly, women could be obliged or find economically more convenient to abstain from work. A restrictive legislation or the lack of sufficient information could prevent or discourage internal migration, necessary to bring workers where they are needed. Finally, a lack of labour supply could emerge even in the presence of a constant or slowly growing WAP in the measure in which employment growth would exceed the possible growth in labour supply.

Up to now the dimension of the Chinese population, the widespread idea that China has a vast reservoir of underutilized agricultural labour –in 2003 it was estimated in around 150 million people by IMF [33]-, have not allowed considering the possibility that China could face a large, long lasting structural lack of human resources. But the fact is that China has rushed through the same demographic "transition" that has brought all developed countries to a situation of structural lack of labour supply and has already determined massive immigration phenomena.

In 2000 the total WAP of USA, Canada, Australia, EU15 countries and Russia was estimated at 577 million, i.e. 69 per cent of China's WAP. In the following five years these 19 countries registered an increase in employment of 19.5 million, similar to that we have hypothesized for China between 2013 and 2018. In the same period the labour supply of these 19 countries increased by 9.7 million. The result was a structural lack of labour supply of 9.8 million and a migration balance of 16.7 million[34]. We have moreover to consider that in all 19

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[32] Population Division, 2000, p. 9
[33] Brooks Ray, Ran Tao (2003)
[34] Michele Bruni, 2009

countries the total activity rate was lower that that recorded by China (allowing the possibility that the need of foreign labour could be faced by an increase in labour market participation) and that the real migration balance has been certainly higher than that indicated by the official figures we have reported.

The scenarios we have proposed, the model on which they are based, the empirical evidences provided by international comparisons should be sufficient to take into .consideration the fact that China will have to face a serious, structural shortage of labour. In my opinion the real issue is not whether China labour supply will become insufficient, but when will this happen, how large will be the structural lack of labour supply and whether China will become the greatest importer of labour or suitable policies could provide alternative solutions.

The first problem is timing. Our elaborations have shown that in this respect the crucial factor is the age structure of the Chinese population. If Chinese data are correct, the supply of labour will start to become insufficient in the next few years. If the population structure proposed by the UN is correct, the lack of labour supply will become manifest at the middle of the present decade. We have however to point out that this forecast is based on the assumption that entries in the working phase of life take place at 15. The present average duration of education suggests that young people enter into the labour market at an average higher age, probably around 19-20. Since the size of the younger generations declines with age, this implies that, everything else constant, the shortage could appear with a few years of delay with respect to our forecasts, the generations entering the labour market in any period being larger than the ones we have considered. In conclusion, it is reasonable to expect that in the first case the shortage of labour will be a very visible and evident problem around 2015, in the second around 2020.

It has also been shown that the size of the structural lack of labour supply does crucially depend on the dimension of the younger generations. If UN data are correct, the problem is going to be severe, but if Chinese data are correct the lack of labour supply will assume huge dimensions even before the end of this decade.

A correct evaluation of the age structure of the population is, therefore, fundamental in order to get a reliable assessment of the timing and size of the labour shortage China will have to face in the next years. This should represent a priority goal for the CNBS.

The demographic data provided by both sources bring, however, to the same conclusion, that in the long run China is going to be affected by a labour shortage of large dimensions, which bring us to the basic issue that this paper wants to raise: is China going to become not only the biggest economy, the bigger exporter of goods, but also the bigger importer of labour? Are there measures that if timely and effectively implemented will allow China to avoid this for the moment unexpected historical turn of events that not only could strongly affect the social fabric of China, but also jeopardize its economic aspiration or at least require a faster than programmed change in its typology of economic growth?

The only possible way to avoid or reduce migration is obviously that of eliminating or reducing the structural lack of labour supply. According to the model we have proposed, the lack of labour supply is generated by the concurrent impact of demographic and economic factors. On one hand, by the decline in WAP, that in its turn is provoked by the relative size of entries into and exit from the working phase of life and, on the other, by the increase in the employment level that depends on the rate of economic growth and the typology of economic development pursued by a country. A third factor is represented by the labour market participation of the local population: an increase in the rate of activity can partially offset the lack of labour supply, while a decline in participation will have the opposite effect[35].

We have therefore to explore if and in which measure it is possible to reduce the demographic determinants of the lack of labour supply, i.e. the unbalance between entries in to and exits from WAP; if and in which measure it is possible to intervene on the economic sphere reducing the increase in employment without affecting economic growth; if and in

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[35] For a formalized version of the model used to build labour market and demographic scenarios see M. Bruni 2009a and for a description of the labour market stock-flow approach used by the model M. Bruni 2009b.

which measure it is possible to keep or enlarge the presence of the local population in the labour market and how effective these measures can be in relation to the estimated lack of labour supply.

From a labour market perspective, this boils down to analyze which measures can increase the supply of labour and which measure can reduce the demand of labour in order to minimize the difference.

5.1 The supply side
5.1.1 Is it possible to increase Working age population?

In a dynamic perspective the decline in WAP is the result of a quantitative mismatch between entries and exits. The number of entries depends mainly on the number of births that have taken place 15 years before and the exits on the number of births that have taken place 65 years before, deaths in working age playing a relatively rather important, but diminishing role[36].

As we have already argued, entries into the labour force take place with a delay with respect to entries in WAP that depends on the average duration of education, and that we will take equal to a 5 year period to facilitate computation. The first obvious conclusion is that for the next 20 years the young Chinese that will enter the working phase of life are already born and that changes in the number of births will affect the level of labour supply proposed by our scenarios only starting in 2028.

The only relevant questions with reference to WAP entries are therefore long run questions: how much should the number of birth increase in order to ensure a future WAP natural equilibrium? Is the required growth achievable and which measures and policies could foster it?

For what relates to the first question the two scenarios present very different answer for the first 15 years, but converging data in the long run. According to scenario 1, in order to avoid the demographic causes of the forecasted lack of labour supply in the 2023-2038 period, the number of births should increase over the forecasted level (computed under the hypothesis of constant specific rates of fertility and no policy change) by 26.7 per cent between 2008 and 2013, by a maximum of 62.4 per cent in the following five year and by 56.8 per cent between 2018 and 2023. The corresponding values for scenario 2 are 7.4 per cent, 25.8 per cent and 40.7 per cent. Both scenarios do then agree that in order to bring WAP to a situation of natural equilibrium around the middle of the century the amount of births forecasted for the 2028-2033 period should increase by more than one third.

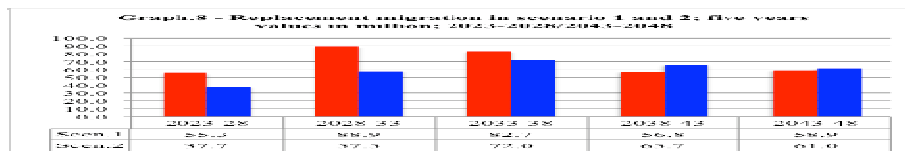| Table 9 – Generational flows, structural lack of labour supply and replacement migration by 5 year periods million: 2008-2023				
	2008-3	2013-9	2018-23	Total
Replacement demand	93.2	9.4	99.2	263.7
Deaths	9.5	10.5	10.5	30.9
Generational exits	63.7	80.8	88.7	232.8
Additional Demand	25.0	20.0	15.0	60.0
Generational Labour Demand in terms of flow	98.2	11.4	114.2	323.7
Generational labour supply in terms of flow	90.3	84.5	73.7	248.5
Structural lack of labour	-7.8	-26.8	-40.5	-75.2
Replacement migration	11.8	40.3	60.8	112.4

The number of births depends on the rate of fertility and on the number of women in fertile age.

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[36] According to our estimates, in scenario 1, the percentage of employment due to death decline from 18.6 per cent between 2008 and 2013 to 11.9 per cent between 2033 and 2038, to then increase to 14.6 per cent between 2043 an 2048. In other words every year between 2 to 3 million young people can find a job due to the death of people in Working age.

At present China is still enforcing the one-child policy that was implemented in 1980 and whose impact has received very different assessments as shown, for example, by a comparison between the population official age structure and the age structure proposed by UN. After remaining stable for the first ten year, although during that period the one-child policy was very harshly implemented[37], the Chinese TFR has plunged below replacement level in a period in which the Chinese society was affected by all the phenomena normally associated with a decline in fertility: the employment level in agriculture sharply fell, while the percentage of urban population rapidly expanded, the level of educational attainment and the average standard of living increased. During the same period, the one-child policy slowly evolved in to a multi-policy regime that has resulted in what has been estimated a 1.5 child policy. It is, therefore, extremely difficult to evaluate in which measure the decline in fertility has been due to population planning and in which measure to socio-economic-development; even more difficult to evaluate the quantitative impact of abolishing the one-child policy.

Coming to the number of women in fertile age, according to Chinese sources, their number will progressively and sharply decline between 2008 and 2023 (-61 million, -17.3 per cent); according to PD data the number of women in fertile age will peak in 2013, but will then decline by around 30 million in the following 10 years (-8.2 per cent).

Graph.8 – Replacement migration in scenario 1 and 2; five years. Values in million: 2013-2028/2043-2048

The previous observations seem to support the idea that even the immediate abolition of the one-child policy will have minor effects on the size of future generations. While a short term baby boom could be generated by the unfulfilled desires of a certain number of couples and of their extended families, it appears probable that the process of urbanization, the increase in educational attainment, the changes in the traditional vision of the family brought about by increasing contacts with Western culture will then produce a return to the negative trend in fertility that has characterized the last 20 years. Moreover, given the expected increase in the duration of the training phase of life, the impact on the labour market of an improbable long lasting baby boom would be felt only after around 20-25 years.

As it is evident that no foreseeable increase in fertility of the Chinese population will be able to bring back WAP natural equilibrium before the half of the century, so it is evident that the Chinese government should not only immediately abolish any legal restriction to fertility, but adopt all possible social and economic measures that could refrain the TFR from continuing along the present negative trend. The experiences of other countries show, however, that the impact of such measures is in general very limited. A government can be successful in enforcing reproduction restrictions; much more difficult to induce people to have more children.

In this perspective the Chinese Government should immediately start to consider other measures aimed to increase WAP entries. One possibility is to extend the policies aimed to attract young foreigners to study in Chinese schools and universities and then facilitate their stay in the country. The relative advantage of such a measure (whose quantitative impact will however be rather limited) with respect to workers immigration is that these young people will have some knowledge of the Chinese language and way of life before entering the local labour market. In the same direction it would be advisable to consider measures that would promote and facilitate the return of the Chinese working abroad. Also in this case international data suggest that no quantitatively relevant results must be expected, but that returning migrants can play a relevant role in promoting a modern economic culture.

If it is impossible to increase labour market generational entries for at least 20 years acting on fertility and it is highly improbable that a consistent reduction in WAP decline will

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[37] This result was partially due to the lowering of the legal age of marriage at the beginning of the '80s.

derive from the increase in births up to the middle of the century, it is also evident that nothing can be done in order to decrease the number of exits.

Increasing the legal age of retirement would, in fact, create only a temporary window during which WAP exits would decline, to then go back to the forecasted level after a number of years equal to that of the increase in the legal age of retirement.
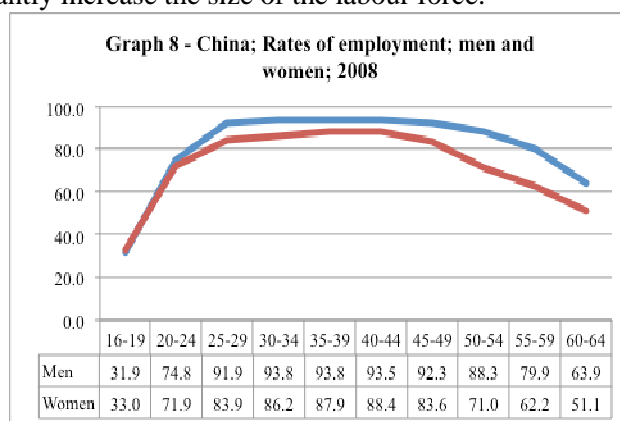
In conclusion, the measures that could be adopted in order to increase the size of WAP acting upon natural entries and exits will have only marginal or temporary effects and cannot be expected to solve the structural problem and bring WAP back to a situation of natural equilibrium, at least for the next 40 years.

5.1.2 Measures to fully exploit the local supply of labour

Let's now consider the measures that could increase the size of the labour force, for any given level of WAP.

The first possibility is to increase the legal age of retirement. While, as we have seen in the previous paragraph, such a measure would have only temporary effects from a flow perspective, it would have a permanent effect on the number of cohorts co-present in the labour market and, therefore, on the potential stock of labour supply. This measure would also be on line with the suggestion often made by International Organizations that countries with fertility rates below replacement level should strive to increase the labour market participation of specific socio-economic groups characterized by a relatively low presence in the labour market, namely women and older people.

It must, however, be considered that the Chinese labour market presents special features. Its total rate of employment is certainly one of the highest in the world. At more than 78 per cent it compares favorably with the 75.2 per cent recorded by Japan and largely exceeds the 65.5 per cent of EU15 (both data refer to 2005). Men, not only register specific rates of employment above 90 per cent for all central age groups, but also very high rates for all the other age groups. More specifically, although the legal age of retirement is presently set at 60, men in the 60-64 age bracket register a rate of employment of 63 per cent. Women's rates of employment are above 80 per cent in correspondence of all central age groups, and the gender differential is relevant only for the age groups above 55, women's legal retirement age (graph. 8). As a consequence, the gender differential is extremely low (82.1 per cent for men and 74.5 per cent for women). Therefore, even the abolition of the legal retirement age would not significantly increase the size of the labour force.

Graph 8 - China; Rates of employment; men and women; 2008

	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Men	31.9	74.8	91.9	93.8	93.8	93.5	92.3	88.3	79.9	63.9
Women	33.0	71.9	83.9	86.2	87.9	88.4	83.6	71.0	62.2	51.1

Moreover, as we have already noted, in the next years the percentage of young people present in the labour market will progressively decline since the increase in per capita income will allow more and more families to realize the desire to give children a better education, an objective in line with national policies and the needs of an expanding modern service sector.
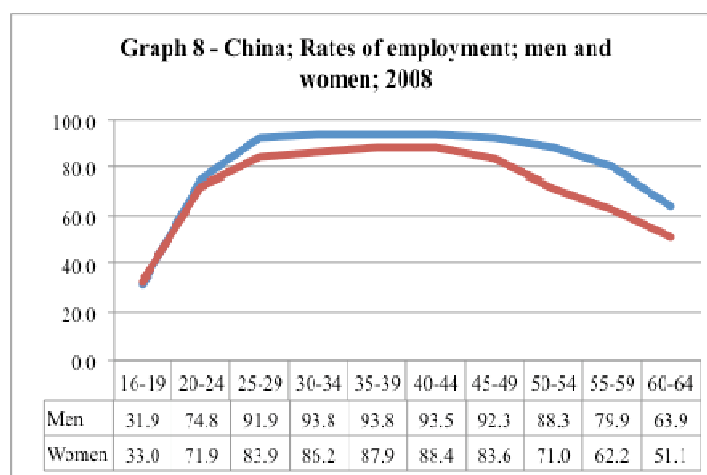
The structural lack of labour supply can be reduced through a more efficient use of the available labour force. A situation of declining labour supply raises the probability of geographical unbalances compounded with unbalances at the occupation level. Free mobility over the territory and information are the obvious tools to face such problems.

The first implication is, therefore, that any limitation to free labour circulation should be abolished. Moreover, internal migration should be sustained by employment services capable of providing information and recruitment over the whole territory[38], and linking the growing urban demand with the supply in rural areas.

The development of long run forecasts of the demand of labour by occupations should be developed in order to plan a coherent structure of the educational offer, paying special attention to vocational training. The goal is to strive for a long-run coherence between the structure of exits from schools and vocational centers, on one side, and labour demand by occupations on the other.

Let's finally consider the widely spread idea that China has a vast reservoir of rural labour. We observe first of all that our previous analysis has been conducted at the global level and therefore allows for any possible amount of inter-sector labour mobility. In the second place, we have explicitly assumed a decline in agricultural employment of 39 per cent between 2008 and 2023. To fully understand the implications of this hypothesis we have to view the problem using a generational perspective and therefore considering the employment age structure both at the total level, and in the main sectors[39]. The necessary employment data by age group have been estimated on the base of CNSB data.

They show that the employed in agriculture are, on the average, considerably older than those in the non-agricultural sectors, the weight of the generations up to 44 being lower and the weight of the generations above 45 being higher (graph. 9). As a consequence, while in 2008 employment in agriculture represents around 40 per cent of total employment, in the following 15 years natural exits from agriculture will exceed 50 per cent of total exits (i.e. around 130 million). Therefore, under our hypothesis of a contraction in agricultural employment of 120 million over the same time interval, the agricultural sector cannot represent a potential source of labour supply. Employment in agriculture will progressively decline mainly because of a very low substitution of older generations by the incoming ones, while direct passages of agricultural workers to other sectors will play a marginal role. Rural families will, however, continue to represent a potential source of labour because the large majority of their descendants will move to the more attractive urban areas. This will end up provoking in not too far a future a lack of labour supply also for the agricultural sector.

	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Men	31.9	74.8	91.9	93.8	93.8	93.5	92.3	88.3	79.9	63.9
Women	33.0	71.9	82.9	85.2	87.9	88.4	83.6	71.0	62.2	51.1

Graph 8 - China; Rates of employment; men and women; 2008

[38] According to an ADB document (ADB, 2006), around 120 million workers had migrated from rural to urban areas in the previous 20 years in search of improved employment and income and it was expected that the phenomenon would continue at an average rate of 10 million per year. Only 15 per cent of the migrant had received assistance from publicly supported ES. According to the same document: "The current ES system no longer meets ES needs ... Processes, information systems, and staffing levels are inadequate to meet current needs and urgently need to be reviewed and strengthened. An improvement of the ES would not only reduce the costs of migration supported by workers, but would lead to more orderly and effective rural-urban migration and contribute to a more balanced development.

[39] The analysis will be conducted using the CNSB data since employment by age group is coherent only with WAP data coming from this source.

This conclusion, that will certainly look even more farfetched than the previous assertion that China as a whole will need foreign labour, is however supported by the future demographic trend of rural areas and by the experience of other countries.

At the beginning of the '60 the Italian employment structure by sector was similar to that registered by China today, while the country was entering into a phase of industrialization and modernization. Agricultural employment was, as in China today, around 40 per cent of total employment and it was assumed that it could represent a vast reservoir of labour. In fact, the downsizing of the sector took place according to the pattern we have just indicated and it was brought about mainly by the non-substitution of older workers by new generations. Inter-sector mobility was very limited, while the sons of rural families provided an important contribution to the labour needs of the industries located in Northern areas already affected by a structural lack of labour supply. At the beginning of the '80 the Italian agricultural sector started to use (illegal) immigrants and now foreign workers represent a fast-growing structural element of the Italian rural landscape.

5.2 The demand side

It has often been suggested that a decline in WAP can be faced by an increase in labour productivity[40]. In China, Cai Fang, Director of the Institute of Population and Labor Economics of the Chinese Academy of Social Sciences has proposed this thesis at the end of 2006 [41]. After having acknowledged that "China's oversupply of labour is on its way to becoming a thing of the past"[42], Cai Fang maintained that "China should adjust to the change by cultivating greater productivity. When labor becomes scarcer, economic growth should be based on increased productivity".

A high rate of technological change, a growth process based on capital-intensive sectors, everything else equal, will certainly lower the employment-income elasticity and therefore the need of additional labour. The real question is, however, a different one: can the increase in productivity offset a structural lack of labour supply? This would imply an increase in productivity that exceeds the percentage increase in production by an amount equal to the percentage increase in employment. In our case, in order to offset a structural lack of 75 million workers over the next 15-year, the percentage increase in productivity would have to exceed the percentage increase in production by 10.2 per cent, a result that no country has ever realized and that appears totally out of reach in an economic phase that will register an accelerated growth of the service sector. For the same reason even the possibility to offset the much smaller lack of supply generated by the population structure estimated by the PD through increases in productivity appears unrealistic.

5.3 Conclusions

A country that has been characterized by a long period of below replacement fertility will necessarily enter a phase in which WAP will decline. This will determine a reduction in labour supply that, together with the growth in employment, will determine a structural shortage of labour. This structural problem allows only for a structural solution: the return to a situation of positive demographic growth. During the phase of structural lack of labour supply a country should enact all possible measures that can reduce as much as possible the difference between demand and supply of labour, but should also be aware that such measures will have a limited effect.

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[40] This solution was for instance proposed after the presentation in Los Angeles of the UN Report by ….The same
[41] Cai Fang, 2006, "How to deal with the Future Labour Shortage", China Daily, 03/09
[42] More recently a different assessment of the future trend in labour supply has been proposed by Ma Li, former director of the same Institute and presently counselor to the State Council on population issues. According to Ma Li, the Chinese labour force will be sufficient to maintain economic development for at least the next 40 years. According to estimates produced by the Migrant Population Management Division of the National Population and Family Planning Commission, Ma Li has stated that the Chinese labour supply will peak in 2016 and 2026 and by 2050 its value will be equal to the 2020 value that will be above the 2009 level. See Song Wei, 2010.

In such a situation, only international migration can close the gap between labour demand and labour supply.

In the case of China, it is evident that given the demographic trends and its economic implication, the one-child policy and the present restriction to geographical mobility are anachronistic and should be substituted by measures acting in the opposite direction. Other measures to be considered in the very near future include an enlargement of the number of cohorts in working age, the empowerment of Employment services that should be able to provide an efficient, on real-time information over the whole territory, a careful planning of the educational offer in order to reduce as much as possible the qualitative mismatch in the labour market. To support the timely enactment of such polices, an assessment of the demographic and labour market information presently available should be carried on as soon as possible. This would allow building reliable labour market and demographic scenarios.

Up to this moment we have considered labour demand as exogenous. This was necessary in order to estimate scenarios of structural lack of supply. It is however evident that in reality demographic trends and economic development are interconnected.

6. From unlimited supply of labour to structural lack of labour supply.

In 1954, when W.A. Lewis wrote his seminal article on the role that an unlimited supply of labour could play in fostering economic growth in developing countries, he could not forecast the demographic tendencies that have characterized China and its extraordinary economic success, partially based, as Lewis had suggested, on the presence of an unlimited supply of labour.

Lewis did not provide an explanation of how and why certain countries, in a given moment of their history, happen to be characterized by an unlimited supply of labour. Adopting a static stock approach, he simply stated that "an unlimited supply of labour may be said to exist in those countries where population is so large relatively to capital and natural resources, that there are large sectors where the marginal productivity of labour is negligible, zero, or even negative." and that: "The existence of a situation of unlimited supply of labour is made evident by the fact that the supply of labour exceeds demand at the subsistence level." The role of demography is introduced only to note that the unlimited supply of labour can be fueled by population growth.

The decline in WAP being not foreseeable, Lewis concluded that it would be capital accumulation to create a shortage of labour and raise wages above the subsistence level, in presence of a positive rate of population growth: ".. we can say that if conditions are favorable for the capitalist surplus to grow more rapidly than population, there must come a day when capital accumulation has caught up with labour supply".

The situation considered by Lewis is obviously different from the one we are discussing: in one case, the problem is the transition from an unlimited to a limited supply of labour, in the other, a much more dramatic transition from an unlimited supply of labour to a structural lack of labour supply. This, as well the unexpected role played by demography in bringing to an end a situation of unlimited supply of labour, does not infringe the relevance of Lewis' conclusions: "When capital accumulation catches up with the labour supply, wages begin to rise above the subsistence level, and the capitalist surplus is adversely affected. However if there is still surplus labour in other countries, the capitalists can avoid this in one of two ways, by encouraging immigration or by exporting their capital to countries where there is still abundant labour at a subsistence wage".

Lewis' discussion of the role of immigration is far from exhaustive. He simply argues that mass immigration could keep the wage level near the subsistence level, and that "The export of capital is a much easier way out for the capitalists, since trade unions are quick to restrict immigration, but much slower in bringing the export of capital under control". Similarly the analysis of the second option (the export of capital) could not reflect the complexity of today global economy.

A thorough discussion of the implication of a structural lack of labour supply on economic growth, of the solutions suggested by Lewis, and of their consequences in the

Chinese case exceeds the scope of this paper as should be based upon more reliable demographic data, and therefore more reliable labour and demographic scenarios. Some general observations can however be outlined.

Let's observe, first of all, that developed countries faced by structural lack of labour supply have been exporting capital, while receiving a growing amount of immigrants. I am not aware of any empirical analysis connecting capital export with lack of labour supply. What seems, however, evident is that in no instance capital export has been sufficient to prevent immigration to grow at approximately the same rate as the structural lack of labour supply.

It is moreover evident that if our projections will be proven correct, the implications of mass immigration will be numerous and far-reaching not only for the economic sphere but also at the social and political level.

China is still an underdeveloped country and economic growth is necessary to increase the standard of living and more generally its level of social development, while ensuring that the greater wealth will be equitably shared among the Chinese population. Therefore, the goal of immigration cannot be that of keeping wages at the subsistence level, but of avoiding wages to increase faster than productivity; to allow a progressive shift from labour intensive to capital intensive production not only in the industrial sector, but also in the agricultural sector -a process that would avoid boosting even more the need of foreign labour-, while keeping the competiveness of Chinese products; to maintain the attractiveness of the Chinese market for foreign investments, an attractiveness that is not based only on cheap labour, but also on consideration of social and political stability, and the growing importance of the local market.

In order to do so the first goal of China should be that of reducing, as much as possible, the structural lack of labour supply through an integrated set of social and labour policies, such as those we have previously indicated. In the second place, the governance of the immigration process should be based, on one hand, on correct quantitative and qualitative evaluation of the future level and structure by occupations of the lack of labour supply and, on the other, on a correct regulatory system.

In this respect the lesson coming from the western world is very clear. A myopic vision based on the position, often justified only on ideological basis, that no foreign work is in fact really needed has provoked the adoption of restrictive immigration policies. This has brought, on one hand, to expensive measures to control the borders, measures that have however failed to interrupt the large illegal immigration flows required by the market. On the other, has provided a lucrative market for criminal organizations, has provoked the deaths of thousands of immigrants, many children and women, trying to cross militarized borders with any possible mean, and the exploitation of an illegal labour force without any contractual power. The presence of a growing number of illegal migrants has then resulted in social tensions and brought to the necessity of frequent and costly processes of legalizations.

Chinese economic polices have always been inspired by a very pragmatic approach. It is to be hoped that a pragmatic attitude will characterize China's policy on migration. Our analysis has shown that China's future economic growth will require large immigration flows and that the demographic and labour market policies that can and should be adopted will only marginally decrease the level of structural lack of labour supply that will affect the Chinese labour market. If this result will be confirmed by more refined statistical analysis, China will have two possible choices. It can follow the Western "example" and fall in the trap of letting the lack of supply to be filled by illegal immigrants, with all the consequences that we have previously outlined. Alternatively, it can break with this "tradition" and try to govern the phenomenon to the advantage of its own citizens and of its international reputation. In this case China should establish in advance the amount of immigration needed to reach the goals of balanced growth we have previously indicated and govern the immigration flows with correct and human measures, inside a far-sighted institutional frame that should include the necessary policies of integration.

Such approach could also be an important instrument for China's international policy. In this perspective, the need of foreign labour could represent a powerful political and

economic tool for a country that needs natural resources often available in countries that will be affected by a growing structural excess of labour supply. The dimension of the need of foreign labour we have forecasted implies also that China could play a major role in starting or sustaining the economic development in the countries of departure, providing the premises for relevant flows of remittances. This would strongly enhance China's political role in the global arena and in the international leadership.

Paraphrasing Engels, it is to be hoped that if at some stage China will be obliged to regulate the import of human resources, it will be the first society to carry out the process in an intelligent and informed way, having in mind not only the well being of its citizens, but also that of the citizens of departures countries.

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