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Edward Hunter Christie (Ed.), Joseph Francois, Waltraut Urban, Franz Wirl

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China is a rising global power with a growing role and impact on the world's energy markets as well as on the Earth's climate system. China pursues its development in an essentially non-confrontational manner, a vision encapsulated by the notion of peaceful rise which is viewed positively in the world's major capitals. Nevertheless, China's rapid growth represents a genuine global challenge and raises many questions. How is China dealing with its growing need for imported crude oil? What is the impact of China's rise on the global oil market, notably in terms of oil price developments? Are Chinese actions on oil markets different from those of other major importers? What opportunities and risks arise as a result of china's growing role on the global oil market from the viewpoint of other global players? In this report we seek to offer some answers to those questions with a review of China's developing energy policy, of the actions and revealed preferences of its national oil companies, and of broader economic and geopolitical analyses of the impact of China's growing oil consumption on other global players.

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FIW Project Report

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Abstract

China is a rising global power with a growing role and impact on the world's energy markets as well as on the Earth's climate system. China pursues its development in an essentially non-confrontational manner, a vision encapsulated by the notion of *peaceful rise* which is viewed positively in the world's major capitals. Nevertheless, China's rapid growth represents a genuine global challenge and raises many questions. How is China dealing with its growing need for imported crude oil? What is the impact of China's rise on the global oil market, notably in terms of oil price developments? Are Chinese actions on oil markets different from those of other major importers? What opportunities and risks arise as a result of China's growing role on the global oil market from the viewpoint of other global players? In this report we seek to offer some answers to those questions with a review of China's developing energy policy, of the actions and revealed preferences of its national oil companies, and of broader economic and geopolitical analyses of the impact of China's growing oil consumption on other global players.

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Introduction

China was self-sufficient in oil until the early 1990s. However her impressive economic growth is fuelling a boom in energy consumption in general and in transportation needs in particular. This should lead to a large increase in demand for petroleum products while domestic oil supply is expected to stabilise and then decline slightly over the next two decades. As a result, China's demand for imported oil and therefore its role on the international oil market is expected to rise substantially. According to the IEA's 2009 Reference Scenario (see IEA, 2009), China's oil consumption would more than double in the medium-term, from 7.7 million barrels per day (mb/d) in 2008 to 16.3 mb/d in 2030. Concurrently IEA (2009) projects that China's domestic oil production will fall from 3.8 mb/d in 2008 to 3.2 mb/d in 2030. As a result, the country's net import needs would sky-rocket, from 3.9 mb/d in 2008 to 13.1 mb/d, making China the world's largest net importer of crude oil by 2030, slightly ahead of the United States (13.5 mb/d in 2008, 12.7 mb/d in 2030).

From the Chinese perspective this means moving from a net import dependence ratio of 51% in 2008 to 80% in 2030. As a comparison, the United States is expected to remain in a range of 73%-74% up to 2030, while OECD Europe[2] is expected to move from a dependence ratio of 70% in 2008 to 88% by 2030, essentially due to falling North Sea production. For the global oil market, China's rise means that the world will have three large importers by 2030 (China, the US and the EU) rather than just the latter two currently.

China is therefore set to become quite vulnerable, both to oil price shocks and to physical disruptions. Oil security concerns that the United States (and Europe) know only too well are therefore expected to become important preoccupations for Chinese policy-makers. How China deals with those concerns is crucial for her development and for her economic security. It is also bound to impact other major consumers, as well as producers, and could lead to a range of re-alignments in economic and security relations in many world regions.

China's *de facto* foreign oil policy is formulated at the intersection of China's broader energy policy and of China's broader foreign policy. Additionally, other policy areas and programmes have an important influence, notably China's 'go abroad' policy, as well as the country's environmental, industrial, and fiscal policies. Accordingly, many actors are involved in the policy making process, with the big national oil companies taking a prominent role. In a

[2] The sum for the following group of countries: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

general sense, the overlaps between policy areas found in the case of China are not fundamentally different from those found in many other countries, though there are some noticeable structural differences especially as compared to Western countries. In particular, the main corporate players on the Chinese side are state-owned, while in the case of both the EU and the USA the key players are privately-owned (if state-influenced) companies. In terms of upstream investment, Chinese companies have been very active in recent years in many regions of the world. In addition, Chinese upstream investments have on a number of occasions been components of broader bilateral cooperation agreements. The recent flurry of oil exploration deals has led some observers to question China's priorities and strategies, and to assess the extent to which China and the West might be heading for zero-sum (or even negative sum) competition. Other observers have stressed a broader observation, namely that China is naturally and perhaps inevitably creating or strengthening bilateral ties with many countries across the world as any other rising power would. Whether this should necessarily lead to clashes with other powers would then be a matter of deliberate choice for world leaders. In any case, China's stated preference for a *peaceful rise* should be seen as a positive signal that this need not necessarily be the case. Finally, China's declared interest in long-term supply contracts coincides with recent demands from oil producing countries for changes in how oil is traded and priced, leading some analysts to predict a partial fragmentation or regionalisation of the world's oil market.

This report is made up of four chapters. The first chapter provides a detailed overview of China's energy needs, of its domestic energy policy debate and of the foreign investments of its National Oil Companies (NOCs). In the second chapter we present the results of a global trade model simulation in order to highlight the impact of China's growing role for the world economy in general and for global oil prices in particular. In the third chapter we provide a more formal discussion on oil price formation and on selected economic aspects of China's interventions on the global oil market. In the fourth and final chapter, a conceptual framework for assessing the oil security position of a net importer of oil is developed and then applied to the case of China.

The report ends with concluding remarks and some general policy suggestions for EU member state governments and institutions.

Chapter 1 – Genesis and Deployment

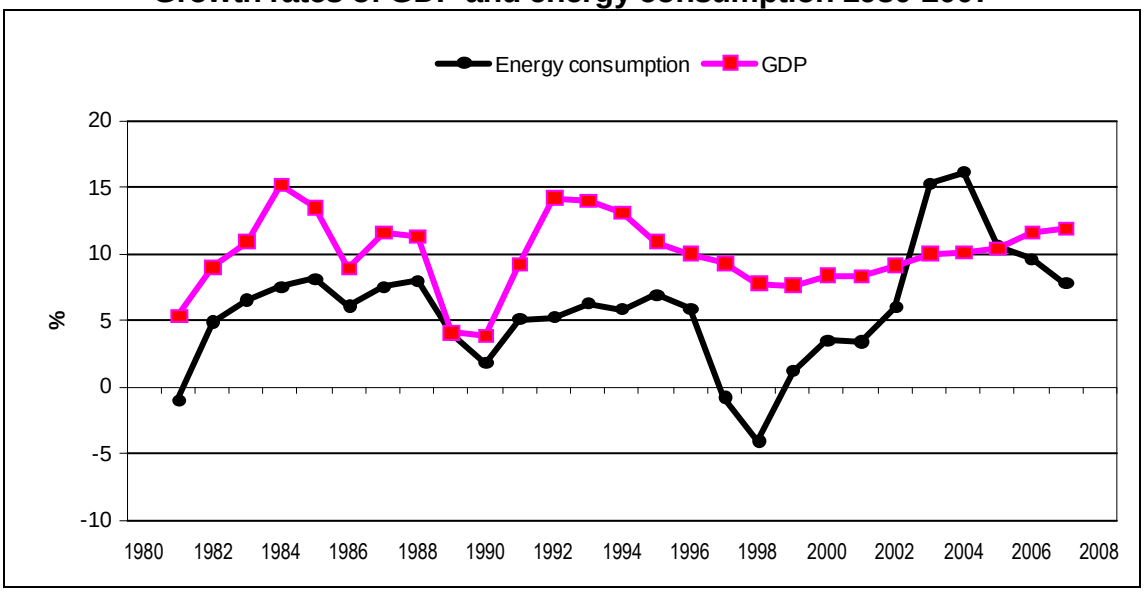
1.1 Domestic environment

Overall energy supply and demand

Since the beginning of the economic reforms in 1978, China's economy has expanded at a spectacular average annual growth rate of nearly 10%. Energy consumption has expanded fast as well, but the growth rate of energy consumption (in real terms) remained well below the growth rate of GDP until 2002 (see Figure 1.1). Between 1980 and the late 1990s, GDP quadrupled but energy consumption only doubled thanks to a massive shift of Chinese industry from heavy to light industries (e.g. textiles, leather, electronics) and to gains in energy efficiency. Accordingly, the energy elasticity of GDP stayed below one until that year, but fluctuated significantly (see Figure 1.2). However, to reach the current target of China's development plan 'to quadruple GDP while only doubling energy between 2000 and 2020', the energy elasticity of GDP would have to remain around 0.3 for the rest of the period (Sinton, 2005, p.3). The amount of energy used to generate one unit of GDP fell significantly from 3.4 tons of coal equivalent (tce) per 10,000 yuan GDP (at constant prices 2005) in 1980 to 1.2 in 2007 (In 2002 a minimum was reached of 1.1 tce per 10,000 yuan); see Figure 1.3. But this level is still 2.5 times the world average and 7.2 times the value in Japan (Chinese Academy of Sciences (CAS), 2009).

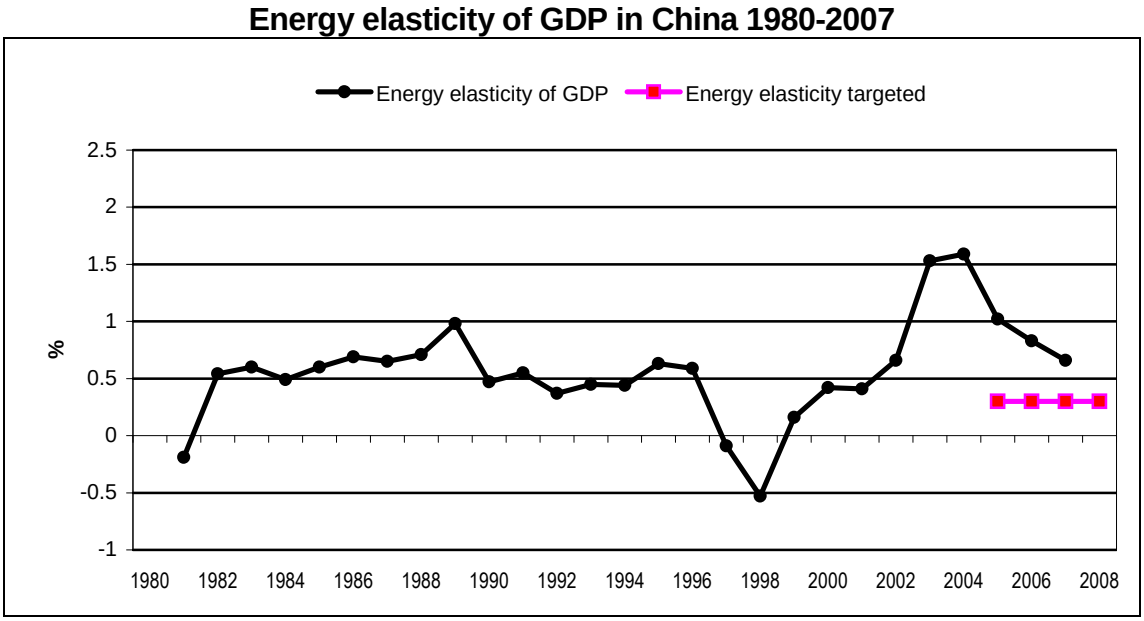
Figure 1.1

Growth rates of GDP and energy consumption 1980-2007



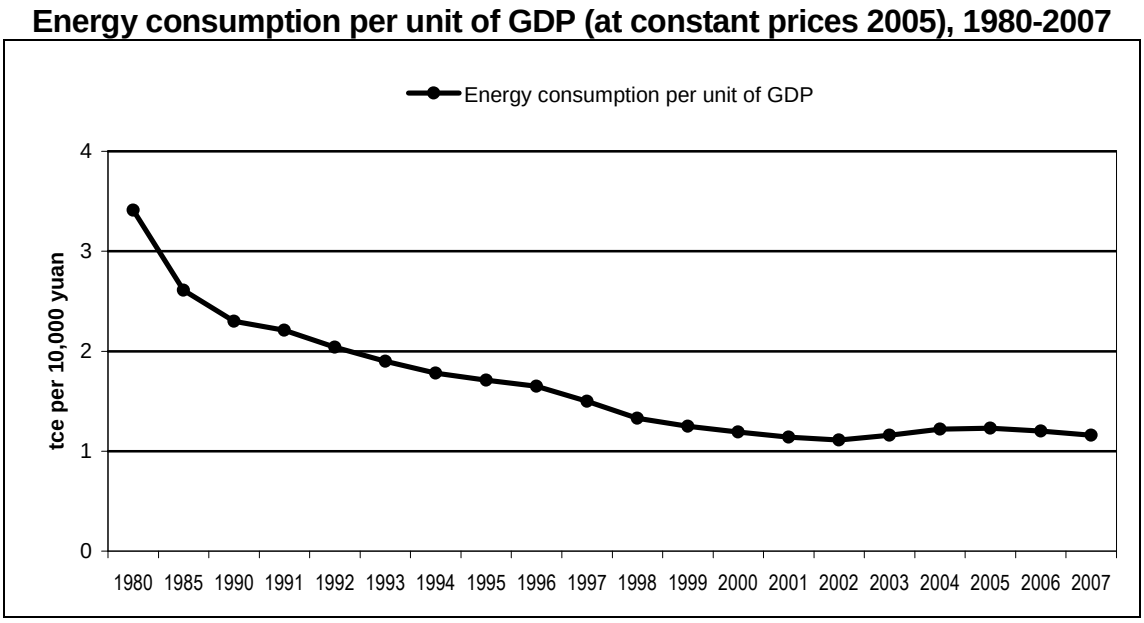
Source: China Statistical Yearbook 2008, Tables 6-8, and Sinton (2005)

Figure 1.2



Source: China Statistical Yearbook 2008, Tables 6-8, and Sinton (2005), Figure 1

Figure 1.3



Source: China Statistical Yearbook, 2008

China's major source of energy is coal, covering about 70% of consumption. Crude oil accounts for a relatively small share in China's energy mix (Figures 1.4a and 1.4b). But while the relative importance of crude oil in primary energy consumption is fairly stable, domestic production does not keep pace. Crude oil made up about 20% of energy consumption in

1980 and in 2007, but the share of crude oil in energy production fell from 24% in 1980 to 11% in 2007 as oil production in China becomes more challenging and more costly.

Figure 1.4

Components of energy production and consumption in China

Figure 1.4a: Energy production

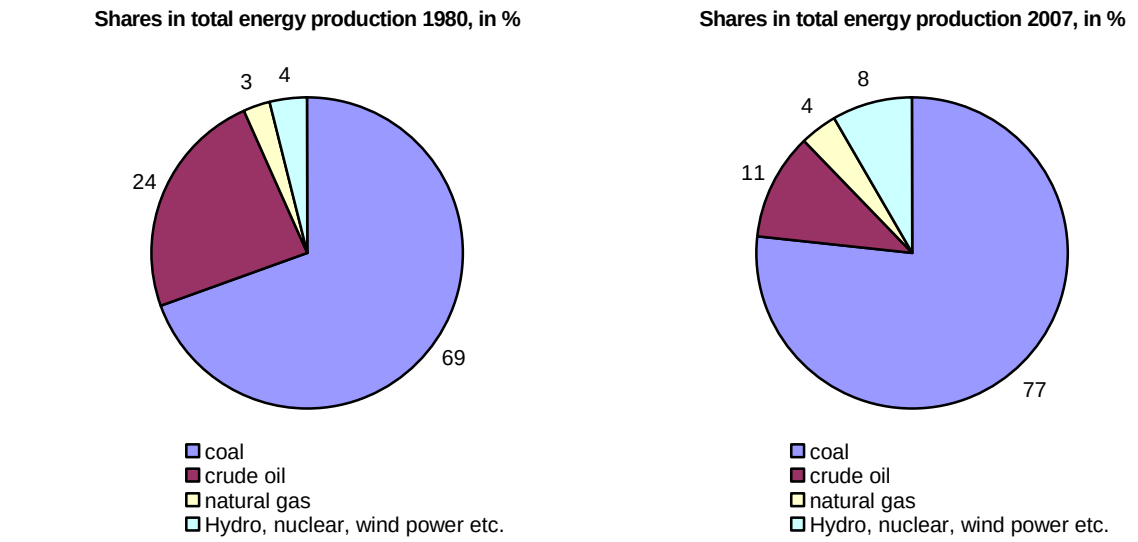
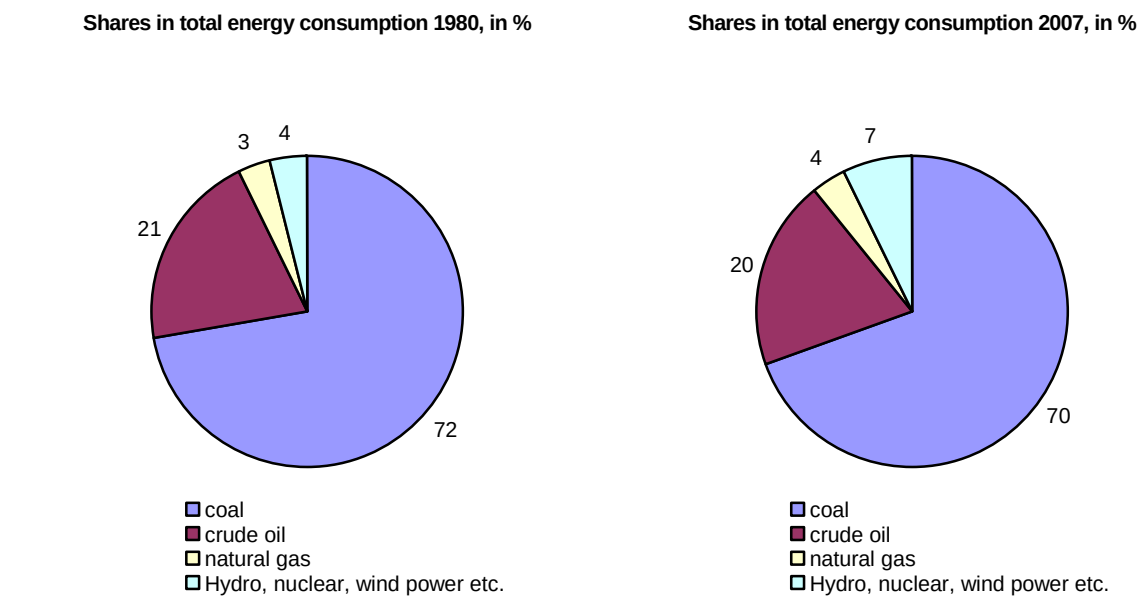


Figure 1.4b: Energy consumption



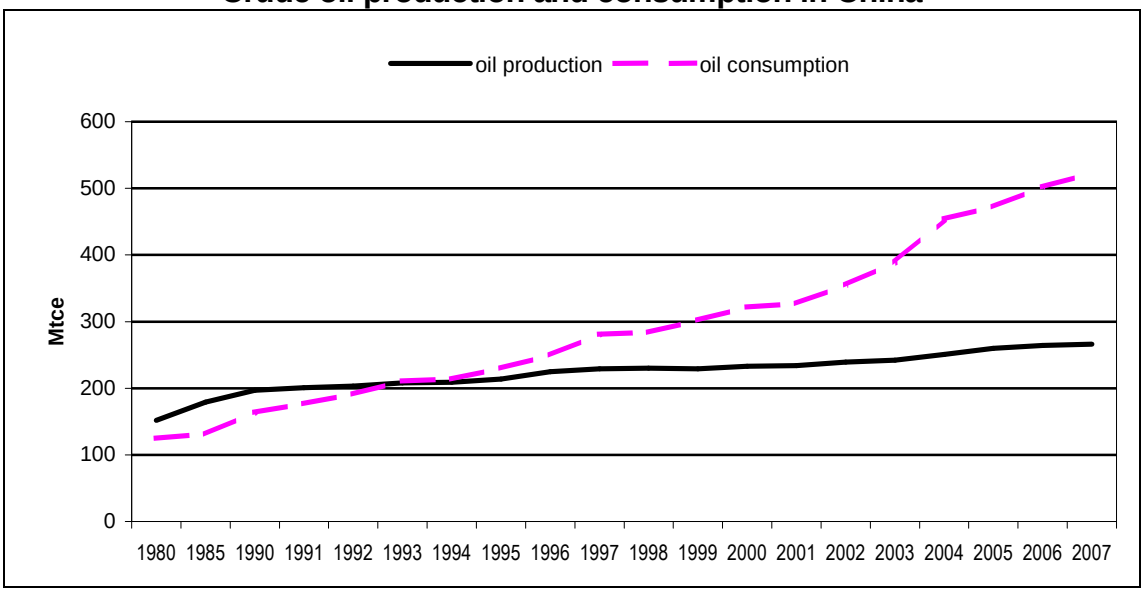
Source: China Statistical Yearbook, 2008

Chinese oil demand exceeded supply for the first time in 1993 (Figure 1.5) with the balance to be imported. Chinese oil imports have risen significantly, reaching 257 Mtce (179 Mtoe) in 2007 (Table 1.1). The share of imports in domestic oil consumption reached 50% in 2007.

Nevertheless, per capita oil consumption in China is still only one half of the world average while per capita oil imports come up to one quarter of the world's average.

Figure 1.5

Crude oil production and consumption in China



Source: China Statistical Yearbook, 2008

Table 1.1

Basic data on China's energy demand and supply, 1990, 2000 and 2007

	1990	2000	2007
Total energy production, 10,000 tce	103,922	128,978	235,445
Total energy consumption, 10,000 tce	98,703	138,553	265,583
Crude oil production, 10,000 tce	19,745	23,281	26,605
Crude oil consumption, 10,000 tce	16,385	32,158	52,320
Crude oil balance (prod.-cons.),10,000 tce	3,360	-8,878	-25,715
Share of crude oil balance in crude oil consumption, in %	20.5	-27.6	-49.1
GDP (at constant prices 2005), in 100 mio yuan	42,982	115,948	228,803
Total energy elasticity of GDP	0.47	0.42	0.66
Total energy consumption per 10,000 yuan of GDP	2.30	1.19	1.16
Total energy consumption per capita, tce	0.86	1.09	2.01
Oil consumption per capita, tce	0.14	0.25	0.40

Source: China Statistical Yearbook 2008, Sinton (2005), Development Research Center, own calculations

China's rising demand for crude oil is driven by the over-proportionate consumption of petroleum products for transportation and to a smaller extent for construction and residential activities. In absolute terms, consumption of petroleum products for transportation increased more than threefold between 1990 and 2000 and more than two-fold again from 2000 to 2007. The major reasons behind this development are increasing urbanisation, higher per capita incomes and a corresponding growth in the private vehicle fleet. Between 1990 and 2007, China's total urban population doubled from 300 million to 600 million, per capita

income (at constant prices 1995) more than quadrupled, and the number of passenger cars increased from 1.6 million to 32 million (China Statistical Yearbook 2008).

Future development of China's energy demand and supply

In 2003 the Development Research Center of the State Council assembled leading energy research institutes in China in order to recommend a long-term energy strategy and policy for the country. The resulting 'National Energy Strategy and Policy 2020' (DRC, 2004) is the first of its kind in China. One major finding of that report is that China should be able to keep energy demand growth at a relatively low rate for the next 20 years if the right energy strategies and related policies and measures are taken. The relevant policy target is that energy demand should only double between 2000 and 2020 while GDP would grow four-fold. According to the central projection (Scenario B in Table 1.2), energy demand in China would reach 2021 Mtoe in 2020. Final consumption of oil would reach 554 Mtoe. Domestic oil production is expected to stay at the current level of around 180 million tons per annum. Output in the old eastern oilfields has been dropping over the years, while increased output in north-western and central regions (mainly from the Ordos Basin) has roughly made up for the decrease in eastern regions. Further compensating increases in output could come from coastal regions as well[3]. In light of future trends, it is estimated that China will experience a petroleum output peak around 2015 with maximum output possibly reaching 200 Mtoe[4].

In a 'Business as Usual Scenario', with no new policy measures taken to mitigate energy demand (Scenario A in Table 1.2), oil imports would reach 453 Mtoe in 2020 (72% of total consumption). In the most optimistic Scenario (Scenario C in Table 1.2), on the other hand, stronger policy adjustments would occur, leading to a strong mitigation of demand growth. All in all, DRC (2004) foresees China's net oil import volume in a range of 174 – 228 Mtoe for 2010 (central projection: 218), and in a range of 287 – 453 Mtoe for 2020 (central projection: 396). Correspondingly, China's import dependence should be in a range of 49% - 56% in 2010, and in a range of 61% - 72% in 2020.

Those projections are more-or-less in line with recent projections from the IEA's World Energy Outlook 2009. The two scenarios presented in IEA (2009) are also shown in Table 1.2 for purposes of comparison, as well as in order to present projections for 2030. The IEA's Reference Scenario is a kind of 'business-as-usual' scenario that takes into account policies enacted until mid-2009. Interestingly, the projections from that scenario are quite close to those of Scenario B from DRC (2004). On the other hand, the IEA's 450 Scenario assumes that bold action is taken globally in order to stabilise the atmospheric concentration of CO2 at

[3] Some offshore resources could become viable depending on price developments. In addition, China has some potential in terms of shale oil. The scenarios discussed here do not take those possible resources into account.
[4] DRC (2004), English Summary Report, p. 13.

450 parts per million. The 450 Scenario yields consumption and import levels that are substantially higher than those of Scenario C from DRC (2004), suggesting that the latter may be very difficult to achieve. Lastly, IEA (2009) foresees a slow decline in China's oil production over 2015-2030. As a result, IEA (2009) implicitly foresees an import dependence ratio in a range of 76% to 79% for 2030[5].

Table 1.2

China's oil balance and net imports, scenario projections (2010-2030)

	DRC (2004)						IEA (2009)			
	Scenario A		Scenario B		Scenario C		Ref. Scenario		450 Scenario	
	2010	**2020**	**2010**	**2020**	**2010**	**2020**	**2020**	**2030**	**2020**	**2030**
Total final consumption, all energy products	1489	2286	1441	2021	1296	1719	1910	2353	1795	1924
Total final consumption, oil and oil products	375	611	365	554	321	445	524	736	494	636
Non-final consumption, oil and oil products (1)	33	22	33	22	33	22	33	22	28	28
Oil production (2)	180	180	180	180	180	180	183	162	183	162
Net imports	228	453	218	396	174	287	374	596	339	502
Import dep. ratio (%)	56	72	55	69	49	61	67	79	65	76

Source: DRC (2004), IEA (2009) and author calculations.
(1) IEA (2009) Reference Scenario values are assumed for the NESP (2004) scenarios
(2) For the IEA scenarios, IEA (2009) data in mb/d was taken and converted into Mtoe

In August 2009, the Chinese Academy of Sciences (CAS) released the 'Chinese Energy Development Plan' which elaborates various options for the development of the energy sector in China until 2050. In that context a new long-term scenario was sketched out, assuming continued strong economic growth and a massive expansion of the urban population (from 600 million in 2007 to 1100 million in 2050). The scenario also assumes that the economy's energy intensity would reach (down) to the world average by 2020 and converge with that of Japan by 2050. With oil production assumed to remain at around 180 Mtoe, oil imports would reach around 800 Mtoe in 2050. The scenario may be seen as a useful thought experiment, and perhaps also as a means to awaken elite opinion in China about future challenges. China's prospective development path will likely require very high total levels of energy consumption, even if substantial energy efficiency improvements occur.

[5] The high end of that range is slightly different from the ratio of 80% mentioned in the introduction. This is due to the difficulty of converting between energy units (Mtoe) and units of volume (barrels). Oil is not a homogeneous product. One barrel of Chinese oil currently has an average higher heating value (HHV, or GCV) of 5.879 MBtu per barrel according to EIA (US DoE) data. Further conversion calculations are necessary to arrive at a lower heating value (LHV, or NCV) value. In this paper a ratio of 0.937 was used, based on the average HHV / LHV ratio for crude oil in general (US DoE data). Assuming 365.25 days per year, this yields a factor of 50.72 for converting data in mb/d into annual Mtoe equivalents for oil produced in China.

While the latter may be feasible overall, a business-as-usual approach with respect to transportation would, in principle, take China's oil demand needs to extreme levels. However it seems just as reasonable to assume that global oil supply constraints (which would affect prices, and thus demand) combined with technological and economic shifts in transportation could lead to completely different outcomes.

1.2 Institutional framework and actors in energy policy

Although the pivotal role of energy for the economic and social development of China was stressed from the very beginning of the reforms in China, no adequate institutional framework to monitor the sector has been developed. While external observers tend to assume a powerful 'China Inc.', and well-coordinated actions of politics and business interests behind the acquisitions of oil resources abroad, energy experts and Chinese scholars rather complain about a lack of coherence, coordination and implementation of energy policy in China, including foreign oil policy.

There is no Ministry of Energy in China. Several government agencies that are roughly equal in political power (and not subordinate to each other) are involved in the management of the energy sector. The only government agency whose authority extends over the entire energy sector is the National Development and Reform Commission (NDRC), China's top economic planning body. Its functions include long-term development planning, examining and approving foreign cooperation projects, approving investment plans and setting energy prices. But other government institutions have administrative power relevant for the energy sector as well (e.g. the Ministry of Land resources, the State Environmental Protection Administration, the Ministry of Construction, the State Administration of Taxation). Lately the Ministry of Foreign Affairs has also sought to play a larger role, particularly with respect to foreign co-operations or acquisitions.

To strengthen the energy administration, in 2005 a 'Leading Group on Energy' (LGE) was established by Prime Minister Wen Jiabao, composed of 13 members of the NDRC and other key ministries. The Leading Group is to act as the steering committee for the country's energy sector and make recommendations to the State Council. A State Energy Office (SEO) provides the administrative support to the LGE, see Meidan (2007: 38). In a further step, in 2008, the National People's Congress, China's legislative body, approved the establishment of two new institutions with a focus on energy policy: The National Energy Commission (NEC) and the National Energy Administration (NEA). NEA replaces the NDRC's Energy

Bureau and also absorbs the State Energy Office under the LGE[6]. NEA has a broad mandate which includes managing the energy industries, drafting energy plans and policies negotiating with international energy agencies and approving foreign energy investments. It reports directly to the State Council on substantive matters, though NDRC retains responsibility for NEA's logistics.

Reportedly, NEC is conceived as a full cabinet level regulatory body for energy, consolidating the fuel related responsibilities of different existing ministerial and sub-ministerial bodies to oversee the nation's energy sector today and will replacing the LGE[7]. However, specific functions, organisation and staffing are not revealed to the public yet. The plan to unite the various functions into one Ministry has been raised several times already since the dismantling of the Ministry for Energy in 1992, but with no success so far. However with the NEC reporting directly to the Prime Minister, energy policy has clearly acquired top priority.

China's large state-owned energy corporations, and especially her national oil companies (NOCs), have considerable influence on energy policy. According to Downs (2007), the power of the NOCs is rooted in China's transformation from a centrally-planned to a socialist market economy, which entailed transforming ministerial structures into corporations. As part of this process (see Box 1.1), CNPC and Sinopec retained a ministry-level status, with their chief executives holding vice-ministerial ranks. CNOOC has the (political) status of a general bureau. As a result, China's NOCs enjoy easy access to the top-tier of government and can deploy significant influence on energy policy formulation. Consequently, many China analysts characterise China's energy sector as one of *strong firms and weak institutions*, see Downs (2007: 70). Another way of looking at this would be to wonder to what extent China's NOCs are *policy-makers* as opposed to policy-takers, as they have retained the political benefits of ministerial power and influence while moving towards a commercial model of economic behaviour. So while economic efficiency may have been boosted, the question of the domestic political balance of power between key actors remains complex. As Downs (2007) points out, some inter-weaving of individual careers between government and the NOCs occurs. Downs (2007: 71) gives three prominent examples (Zeng Qinghong, Zhou Yongkang and Wu Yi) of individuals who had careers in the oil (or oil-related) industry before

[6] It further incorporates the nuclear power administration of the Commission of Science, Technology and Industry for national Defence (COSTIND) (Downs, E.S. (2009). China's 'New' Energy Administration. The China Business Review, November-December. Retrieved 21 November 2009 from: http://www.brookings.edu/~/media/Files/rc/articles/2008/11_china_energy_downs/11_china_energy_downs.pdf

[7] NPC: National Energy Commission formed as ministerial level regulatory body (2008, March 11). China Briefing. Retrieved on 25 November 2009 from: http://www.china-briefing.com/news/2008/03/11/npc-national-energy-commission-formed-as-ministerial-level-regulatory-body.html

reaching high political office, as well as two prominent examples (Wu Yaowen and Jiang Jiemian) of former government officials who reached very senior executive positions at CNPC. In terms of China's foreign oil policy, Downs (2007: 76) identifies examples of the NOCs pursuing 'corporate objectives that do not always coincide with national policy priorities'. In particular, she highlights the case of competitive bidding between CNPC and Sinopec for pipeline projects in Sudan, and indicates that elements within China's political leadership were displeased. The latter would prefer if Chinese NOCs worked 'as a team', at least abroad, for example by focusing on mutually-exclusive geographical regions so as to avoid direct competition.

BOX 1.1

Milestones of China's energy administration after 1978

1980: State Energy Commission in charge of the oil department, coal department and the electricity department.

1982: The State Energy Commission is removed and the Ministry of Petroleum industry, the Ministry for Coal and the Ministry for Electricity are set up. Within the new Petroleum Ministry, the China National Offshore Oil Corporation (CNOOC) is created for foreign cooperation with regard to China's offshore oil.

1983: The China National Petroleum and Chemical Corporation (Sinopec) is established by merging assets from the Ministry of Petroleum Industry and the Ministry of Chemical Industry

1988: The Ministries for the Petroleum Industry, for the Coal Industry and for Electricity are restructured and become state corporations instead (China National Petroleum Corporation, China Coal Corporation and China Power Corporation). But these corporations retained ministerial level. Sinopec was granted ministerial level as well, while CNOOC has the (lower) status of a general bureau.

1993: The State Planning Commission (SPC) and the Ministry of Mineral Geology take over the administrative functions of the Energy Ministry with respect to oil.

1998: Restructuring of China National Petroleum Corporation (CNPC), Sinopec and CNOOC into commercial enterprises. Further on, CNPC and Sinopec both become 'integrated' oil companies, including upstream, midstream and downstream activities. The SPC absorbs the remaining administrative functions and regulatory power with regard to the oil industry, such as drafting long term development plans, examining and approving foreign cooperation projects, approving investment plans and price policy.

2000: PetroChina Co., Ltd., a subsidiary of CNPC and Sinopec Co., Ltd. are listed at the New York stock exchange and in Hong Kong.

2003: The SPC is renamed State Development and Reform Commission (NDRC). Within the NDRC a 'Bureau of Energy' is established with the task to coordinate and regulate the *energy industry*

2005: Leading Group on Energy (LGE) and the State Energy Office (SEO) providing administrative support are set up by Prime Minister Wen Jiabao.

2008: The National Energy Commission (NEC) and the National Energy Administration (NEA) are approved by the NPC. NEA replaces the NDRC's Energy Bureau and also absorbs the State Energy Office. NEA has a broad mandate which includes managing the energy industries, drafting energy plans and policies negotiating with international energy agencies and approving foreign energy investments. NEC is at ministerial level and will replace the LGE. Details are not revealed yet.

1.3. Plans, energy strategies and other policy fields relevant for foreign oil policy in China

'Energy is the priority issue in the economy' (Deng Xiaoping, 1980)

In the course of transition from a centrally planned to a market economy, the responsibility for energy security shifted from the government to the big national energy companies which developed step by step from ministerial bodies to commercial enterprises. The companies in charge of oil supply are the China National Petroleum Corporation (CNPC), the China Petroleum and Chemical Corporation (Sinopec) and the China National Offshore Oil Corporation (CNOOC). Until the year 1992, oil supply from domestic sources was sufficient to meet China's rising demand and a certain amount of crude was even exported (see Section1, Figure 6). When in 1993 demand exceeded supply for the first time, the Chinese leadership startled and then-Premier Li Peng designated as the primary goal of the country's energy strategy 'to secure the long- term and stable supply of oil to China'.[8] Due to restricted domestic supply and rising demand, China stayed a net importer since then. But in the beginning, the quantities of oil imported were comparatively small and in the 1990s the international oil market was a buyer's market, with ample supply and relatively low and stable prices (between 20 and 25 $/bbl), posing little threat for China's energy security. Further on, during the Asian financial and economic crisis 1997/1998, China's oil demand and imports were slowing down.

The picture changed dramatically in 2001. After the September 11 terrorist attack on the World Trade Center and the beginning of the second Iraq war, the Middle East, the most important source for Chinese oil imports, was perceived as less secure. At the same time, domestic demand for energy, including oil, accelerated dramatically (see Section 1.1, Figure 1.2); power shortages all over China raised the awareness for energy security as a basis for economic development and called for government action. Also, with increasing amounts of oil imported, China became an important factor on the international oil markets. In 2003, China surpassed Japan as the world's second largest petroleum consumer after the USA. In the light of this development, the Development Research Center of the State Council assembled leading energy research institutes in China to analyse the energy situation and to recommend a comprehensive energy strategy. The team produced a summary report and 11

[8] Quoted from Calabrese (2008), p. 244

sub-reports which were published in 2004 as the 'China National Energy Strategy and Policy' (NESP), the first comprehensive long term energy strategy of China. Also, in March 2003, a new leadership generation, the so called 'fourth generation' under president Hu Jintao and Premier Wen Jiabao, came into power, who emphasised qualitative instead of quantitative growth and paved the way for a demand oriented energy policy.

The 'China National Energy Strategy and Policy' (NESP)

After analysing the current situation and prospects for energy supply and demand in China, the experts collaborating in NESP recommended the flowing strategies:

- Make the best use of domestic resources, while looking actively for foreign resources.
- Keep a better balance between supply and demand oriented energy policies, with the latter given priority (by energy saving and increasing efficiency).
- Make environmental protection an integral part of energy development strategy.

'Making good use of international resources' basically refers to *foreign oil policy*. Under the assumption that China's domestic oil output will stay more or less stable, and consumption will increase, imports will increase substantially and oil dependency may reach 60%-70% in 2020 (see Section 1.1, Table 1.1) and up to 80% by 2030 (see IEA, 2009). Thus oil security will increasingly be an important policy consideration for China.

According to NESP, oil security entails guaranteeing that the country's demand for oil (which is necessary for the sustainable development of both economy and society) is met in satisfactory terms as regards quality, quantity and price. Oil insecurity, on the other hand, refers to potential damages on the country's economy due to temporary and abrupt supply cut-offs, broader shortages, or price shocks. NESP also acknowledges that the rapid growth of China's energy demand will exert increasingly greater influence on the international energy market and that as a result "China's energy issues have become hot issues in international political and diplomatic realms", See DRC (2004), p. 4 and p. 15.

To get a correct outlook on 'petroleum security', China must first understand the functioning of the international oil market and corresponding geopolitics. In the view of NESP:

- Neither OPEC nor OECD can unilaterally decide petroleum prices and control the international market in the long run
- Non-OPEC petroleum exporters play a more and more important role in oil (and gas) export, especially Russia, Norway, Mexico and some west African countries.

- More countries with rapidly expanding oil imports are appearing, especially in Asia (e.g. India, Indonesia).
- Both petroleum consuming and exporting states are diversifying their export (import) channels to stabilize supply and demand and obtain better economic benefits
- A new batch of grand multinationals has mushroomed in the world's major exporting/importing countries via mergers and acquisitions and the development of upstream and downstream supply channels. These multinational giants have allied with international financial consortiums to emerge as major players, influencing the international market.

As a consequence, the international oil supply may have temporary shortages and short-term local shortages. World oil prices may suffer short-term violent fluctuations (If the oil price is too high it may reduce China's GDP growth rate, if it is too low, it may result in losses for the domestic oil sector). Natural and other disasters may have grave impacts on production and transportation of oil. China's petroleum companies seem not strong enough and lack experience in international comparison.

In the light of these challenges, the following measures and strategies to provide oil security are proposed[9]:

- China should use the international oil market as a major way of getting oil and oil products, including future markets.
- China should diversify the sources of her oil imports, with a focus on Russia and the Middle East. (The Middle East will be still the most important oil import source until 2030). In the Middle East, especially Saudi Arabia, Iran and Iraq offer great potential for China's oil business, including exploration, development, refineries and pipelines, taking advantage of China's advanced technology in these fields. The areas around the Caspian Sea and Central Asia are very interesting in this respect as well.
- Chinese oil companies should invest more upstream. In the last century, these companies have not invested enough upstream, especially in oil exploration, in China and abroad. Also, research and development in this area should be enforced.
- The reform of the Chinese national oil companies must be deepened and strong and powerful international oil companies should be constructed, including both upstream and downstream activities. They should engage in joint ventures and seek to obtain

[9] Development Research Center of the State Council (eds.) (2004), English Summary Report, China's Oil and Gas Resources and Safety Countermeasures.

shares in petroleum exploration blocks, natural gas fields, oil and gas pipelines and other energy assets.

- A proper mix of competition and alliances should be aimed at, with regard to countries as well as companies.
- To better handle fluctuations in oil prices and quantities supplied, China should establish a strategic reserve and precautionary system for petroleum[10].

Probably as a consequence of priority in NESP given to demand oriented policies, in the 11th Five Year Plan 2006-2010 of the Chinese government, the target was stipulated to reduce the amount of energy used to generate one unit of GDP by 20% compared to the level of 2005 until 2010.

In 2007, when world oil prices started to rise very fast, reaching 80 USD/bl in December 2007, increasing quantities and prices together made China's oil bill climb by more than 70% in the first 11 months of the year and energy security was in the focus again. In December 2007, the State Council Information Office published a White Paper entitled 'China's Energy Conditions and Policies'[11], building largely on the NESP, but with a stronger focus on environmental issues and the promotion of new and renewable energies. Regarding energy security, in addition to the recommendations in the NESP, the White Paper criticises the current heavy reliance on spot trading of crude oil and encourages to sign long-term supply contracts instead, which has to be seen in the light of the strong increase of oil prices in 2007 and the intensifying debate on climate change as well.

With regard to safeguard world energy security, the White Paper suggests that 'dialogue and cooperation between energy exporting countries and energy consuming countries as well as between energy consuming countries should be strengthened'[12]. Probably with a view to China's perception as a threat to the world's energy security by other countries, the paper states that 'Energy issues should not be politicised and triggering antagonism as well as the use of force should be avoided'.

[10] Strategic reserves should be equivalent to 40 days' demand by 2010 and 55 day's demand before 2020.
[11] China State Council Information Office (2007, December 12).
[12] Notably, China is a member of the energy working group of the Asia –Pacific Cooperation (APEC), the ASEAN plus China Japan and the Republic of Korea (ASEAN +3) Energy Cooperation, the International Energy Forum, the World Energy Conference, and Asia –Pacific Partnership for Clean Development and Climate. It is an observer of the Energy Charter, a member of the World Energy Council, and collaborates with such international organizations as the IEA and OPEC. Regarding bilateral cooperation, China has established a mechanism for dialogue and cooperation in the field of energy with a number of important energy consuming and producing countries, such as the US, Japan, Russia, and the European Union, see China State Council Information Office (2007, December 12), p. 12.

Investments of Chinese oil companies abroad are also supported by China's so called 'go abroad' policy. This policy, proclaimed by the Chinese government in 2002 supports politically and financially foreign direct investment of Chinese enterprises abroad[13]. It is aimed at various targets: to make efficient use of China's huge foreign exchange reserves, to secure resources, to acquire technology, to gain access to established distribution networks, and to reduce the risk of Chinese enterprises getting caught by non-tariff barriers to trade. In a longer-term perspective, the goal is to generate a group of 30 to 50 big transnational companies[14] and most probably, the national oil companies will be among them.

Further on, in 2009, China's National Energy Administration (NEA) put up a three year plan for the oil and gas industry. The plan was submitted at the National Work Conference on Energy held in Beijing in February 2009. As part of this plan, the government considers to set up a fund to support firms in their pursuit of foreign mergers and acquisitions (China Daily, 12-22 February, 2009). In January 2009, the long-debated draft for a new 'Energy Law' was submitted to the State Council Legislative Affairs Office for Consideration from which it will go to the full State Council and the National People's Congress (NPC), the legislative body of China. That will push ultimate passage of the legislation into 2010[15].

1.4. Means to achieve policy targets: China's de facto foreign oil policy

1.4.1. The early period (1993-2000)

When China became a net oil importer in 1993, her national oil companies (NOCs) as 'newcomers' to the international oil market had to buy most oil on the spot market. The major sources of oil were the Middle East, the largest oil producing region world wide (42%; Oman 26%, Yemen 11%), (Southeast-) Asia (33%; Indonesia 26%) and Africa (13.6%; Angola 7.8%) – see Table 1.3. But when it became clear that China will remain a net importer of oil for the years to come, the Chinese began to look for longer term oil deals and contracts that went beyond mere supply contracts.

[13] As the Chinese currency is still convertible at the current account only, a special permit is required for trans-border capital flows.
[14] Urban (2009)
[15] China's Energy Law & 12 Energy Five Year (2009, February 6).China Environmental Law. A discussion of China's environmental and energy laws, regulations, and policies. Retrieved on November 22, 2009 from: http://www.chinaenvironmentallaw.com/2009/02/06/chinas-energy-law-12th-energy-five-year-plan/

When Iran made significant oil discoveries in 1995, Chinese oil companies immediately tried to get involved, in line with the government's policy 'to secure long term and steady supply of crude oil' with investment and participation in exploration, development and construction of oilfields and infrastructure (see Section 1.2). China tripled oil purchases from Iran to 60,000 barrels a day and agreed to build a joint oil refinery in China and to cooperate in oil exploration[16]. The agreement came shortly after President Clinton had banned trade with and investment in Iran, in response to Iran's nuclear program and its support towards terrorist organisations such as Hizbollah (Iran Sanctions Act, 6 May 1995).[17]

Table 1.3

Main sources of China's oil imports (1993 and 1998)

	1993					1998		
rank		mn tonnes	Share (%)		rank		mn tonnes	Share (%)
	World	*15671*				*World*	*27323*	
1	Oman	4089	26.1		1	Oman	5793	21.2
2	Indonesia	4018	25.6		2	Yemen	4043	14.8
3	Yemen	1655	10.6		3	Iran, Islamic Rep.	3620	13.2
4	Angola	1224	7.8		4	Indonesia	3387	12.4
5	Papua New Guinea	776	5.0		5	Saudi Arabia	1808	6.6
6	Libya	708	4.5		6	Angola	1105	4.0
7	United Arab Emir.	572	3.6		7	Argentina	1057	3.9
8	Malaysia	513	3.3		8	Vietnam	866	3.2
9	Australia	403	2.6		9	United States	854	3.1
10	Singapore	316	2.0		10	Iraq	607	2.2
11	Vietnam	289	1.8		11	United Arab Emir.	515	1.9
12	Saudi Arabia	215	1.4		12	Norway	490	1.8
13	Argentina	201	1.3		13	Malaysia	451	1.7
14	Pakistan	196	1.3		14	Kazakhstan	409	1.5
15	United Kingdom	189	1.2		15	Congo, Rep.	382	1.4
16	Gabon	127	0.8		16	Australia	354	1.3
17	Guinea	70	0.4		17	Kuwait	282	1.0
18	Iran, Islamic Rep.	68	0.4		18	Equatorial Guinea	243	0.9
19	Korea, Dem. Rep.	19	0.4		19	Egypt, Arab Rep.	199	0.7
20	Russian Federation	14	0.1		20	Canada	163	0.6

Source: UN Comtrade

In 1997, a production sharing contract with Iraq was concluded (Alterman & Garver, 2008, p.25), and in 1998, China entered a USD 1.5 billion deal for a large Sino-Saudi oil refinery in China and concluded a supply contract for 10 million tons of *Saudi* oil annually for a 50 year-period[18]. Partly as a consequence, in 1998 Iran ranked 3rd, Saudi Arabia 5th and Iraq 10th

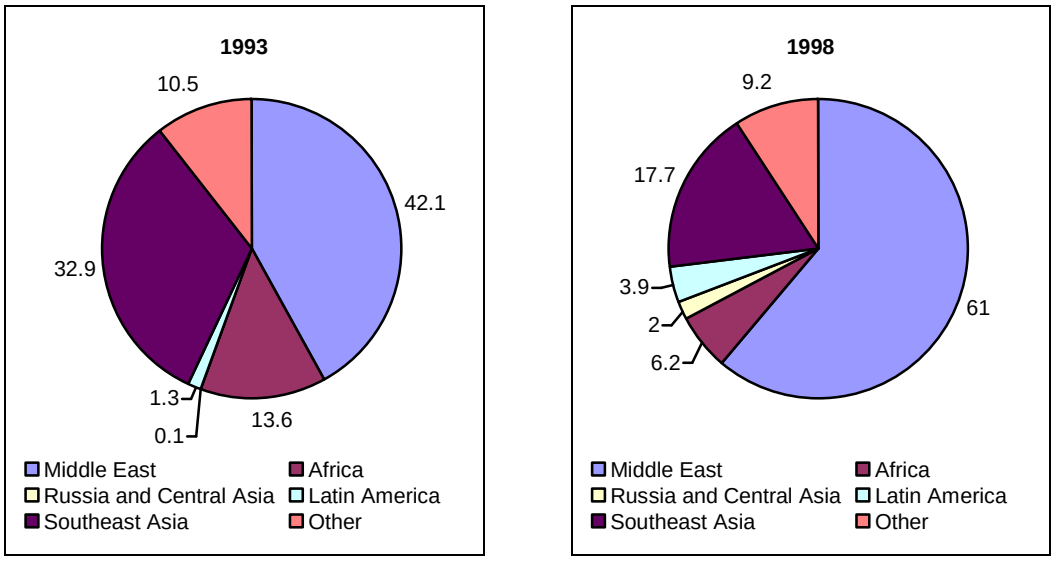
[16] Rubin B. (1999 March 1). China's Middle East Strategy. Meria Middle East Review of International Affairs, p.3. Retrieved 1 December 2009 from: http://meria.idc.ac.il/journal/1999/issue1/jv3n1a4.html
[17] Katzman K. (2007, October 12). The Iran Sanctions Act (ISA). CRS Report for Congress. Retrieved 1 December 2009 from: http://www.fas.org/sgp/crs/row/RS20871.pdf
[18] Rubin B. (1999 March 1). China's Middle East Strategy. Meria Middle East Review of International Affairs, p.5. Retrieved 1 December 2009 from: http://meria.idc.ac.il/journal/1999/issue1/jv3n1a4.html

among China's foreign suppliers of oil. In total the Middle East increased its share in China's oil imports from 42% to more than 60% (see Table 1.3 and Figure 1.10).

In June 1997, the China National Petroleum Corporation (CNPC) outbid US and other companies to win a major share in two of Kazakhstan's largest oilfields and a contract to build a 3000-kilometer pipeline from Kazakhstan to China. Chinese Premier Li Peng lobbied actively for this USD 4.4 billion agreement[19]. Finally, China started co-operation on oil exploration in Sudan. Because of the beginning of a civil war in 1984 and related atrocities and human rights abuses, Western companies gradually the country. China and other Asian countries then filled the gap. In 1996 CNCP acquired a 40% stake in the Greater Nile Petroleum Operating Company (GNPOC), a newly created consortium and now the biggest oil company in Sudan. (The other shares belong to Malaysia, India and a small share to the government of Sudan). In May 1997, the consortium won a twenty-year project for the production and transportation of oil in Western Kordofan. Chinese companies also participated significantly in the building of a 1500 km export pipeline and a refinery north of Khartoum, both finished in 1999. CNPC provided half of the total investment of USD 540 million and built and operated the refinery[20].

Figure 1.10

Major regions of China's oil imports 1993 and 1998



Source: UN Comtrade

[19] Rubin B. (1999 March 1). China's Middle East Strategy. Meria Middle East Review of International Affairs, p.4. Retrieved 1 December 2009 from: http://meria.idc.ac.il/journal/1999/issue1/jv3n1a4.html
[20] Shichor, 2008, p.75

Sudan thus became China's second most important source of African oil and by 2003 the country had become the 5th most important source of Chinese oil imports worldwide (see Table 1.4).

China's oil-relations with Angola, on the other hand, were at that time based of trade only, as the Angolan civil war was still ongoing and the Chinese government was a supporter of the opposition movement (National Union for the Total Independence of Angola, UNITA) rather than of the government.

- Chinese national oil companies acting in line with government policies / strategies while the Chinese government supports their activities
- Engagement in upstream, midstream and downstream oil operations abroad[21]
- Geographical diversification of activities, starting with relatively small fields
- Readiness to cooperate with countries respectively regimes who are internationally ostracised ('rogue states')

As pointed out by various authors in the field, the latter two characteristics of Chinese foreign oil policy need not always reflect a deliberate strategy, but could be related to the fact that most of the existing oil reserves of the world are already in the hands of (mostly) national oil companies (NOCs) of resource-rich countries and (to a much more limited extent) of large Western international oil companies (IOCs). As a result, it has been written that '*China's oil companies arrived late to the petroleum Olympics […] The prizes left in play are expensive and often in countries where Western companies refuse to operate because of human right issues and geopolitical risk.*'[22]

[21] Upstream operations include: searching for oil and drilling exploratory wells and at the same time operate the wells that recover to re-direct the crude oil to the surface ('exploration and production'). Midstream operations are processing and storing, marketing and transporting oil. Downstream operations include: refining, the petrochemical industry and petroleum product distribution via affiliated outlets and distribution companies. (However, the trend is to include the midstream operations within the downstream category.)

[22] McKenzie-Brown, P. (2008). China's Energy Strategy: Panda or Dragon? Oilweek, August, 2008. Retrieved 26 June 2009, from: http://seekingalpha.com/article/91074-china-s-energy-strategy-panda-or-dragon

Table 1.4

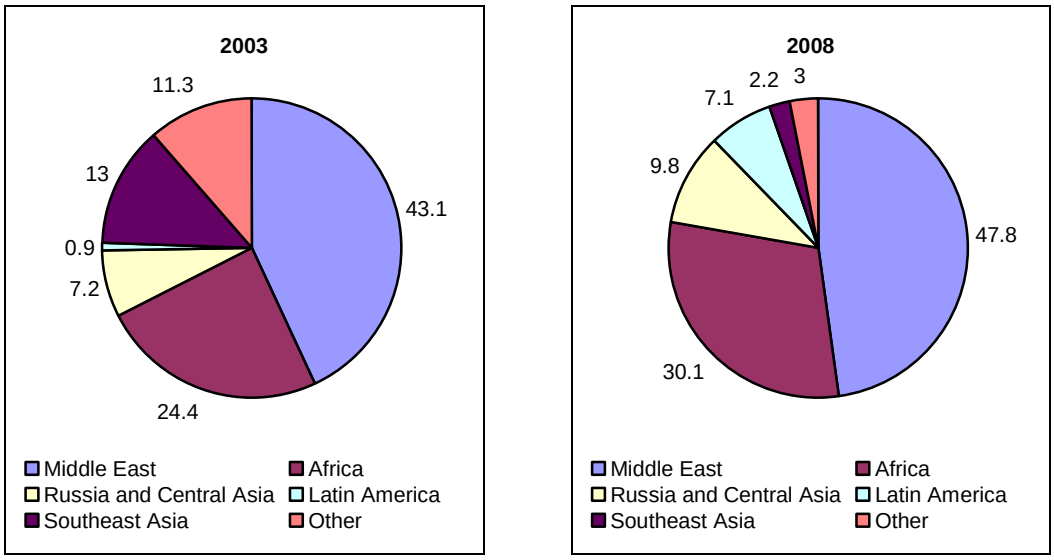
Main sources of China's oil imports (2003 and 2008)

	2003				2008			
rank		mio t	in %		rank		mio t	in %
	World	*91020*				*World*	*178885*	
1	Saudi Arabia	15080	16.6		1	Saudi Arabia	36368	20.3
2	Iran, Islamic Rep.	12394	13.6		2	Angola	29894	16.7
3	Angola	10103	11.1		3	Iran, Islamic Rep.	21322	11.9
4	Oman	9268	10.2		4	Oman	14582	8.2
5	Sudan	6257	6.9		5	Russian Fed.	11638	6.5
6	Russian Fed.	5254	5.8		6	Sudan	10500	5.9
7	Vietnam	3506	3.9		7	Venezuela	6463	3.6
8	Congo, Rep.	3389	3.7		8	Kuwait	5896	3.3
9	Indonesia	3333	3.7		9	Kazakhstan	5671	3.2
10	Malaysia	2031	2.2		10	United Arab Emir.	4579	2.6
11	Australia	1780	2.0		11	Congo, Rep.	4373	2.4
12	Thailand	1610	1.8		12	Libya	3189	1.8
13	Equ.Guinea	1460	1.6		13	Brazil	3022	1.7
14	Brunei	1358	1.5		14	Equ.Guinea	2709	1.5
15	Kazakhstan	1196	1.3		15	Iraq	1860	1.0
16	Norway	932	1.0		16	Indonesia	1392	0.8
17	Kuwait	907	1.0		17	Colombia	1141	0.6
18	United Arab Emirates	864	0.9		18	Ecuador	1048	0.6
19	Qatar	676	0.7		19	Algeria	898	0.5
20	Venezuela	444	0.5		20	Australia	897	0.5

Source: UN Comtrade

Figure 1.11

Major regions of China's oil imports 2003 and 2008



Source: UN Comtrade

1.4.2 Towards a comprehensive oil policy (2000-2008)

After the year 2000, driven by accelerating domestic energy demand, a changing international environment and a new orientation in economic policy at home (see Section 1.1), China's foreign oil policy became 'broader and deeper', by:

- Developing support measures to secure oil for China on a long-term basis (term contracts, equity oil);
- Supporting the Chinese NOCs to rival big multinational corporations;
- Offering comprehensive packages to oil suppliers such as 'oil for infrastructure' and 'oil-for- loan' contracts;
- Promoting international cooperation (with Western partners), with a view to acquiring advanced engineering technology and services;
- Diversifying sources with a focus on Africa, Russia, Central Asia and Latin America;
- Diversifying transit and transport routes;
- Turning 'financial reserves' into 'resource reserves'.

Different modes of acquiring oil from international markets

Long-term supply contacts provide a guarantee of delivery for the term of the contract (subject to 'force majeure'), but do not provide a hedge against future price increases as they are usually adjusted monthly to reflect changes in global prices. Global oil prices are determined at the *spot market*. The functioning of the spot market is to swap the mismatch of either volume or quality between contracted crude and product demand.

Equity investments, where a company purchases ownership of future oil output, provide a hedge against international price increases and allow within a certain range to swing production according to current needs. The cost of buying an equity stake in an oil field reflects an implicit valuation of expected future output, with the investor assuming the risk of price fluctuations; also one might pay a premium for security of supply. (Equity investment usually takes the form of 'production sharing contracts' whereby the host country retains the bulk of the output, typically 65%-80%.)

However, ownership does not always guarantee access. Apart from political and economic risks in the host country, there are transport risks as well. Therefore, China strives for a regional diversification of her oil bases and is also engaged in building and diversifying transport routes for oil. Her naval modernisation can be seen in this light as well. However,

under normal conditions, the market provides supply security as well, since buyers can always purchase the amount of oil they want at the global price[23].

There is also a third mode of long-term upstream involvement, the so-called 'buy-back' contractwhich is in a sense between mere trade and an outright equity contract. In such a case, the foreign investor does not gain property rights, but receives a pre-arranged remuneration rate for its investment, e.g. in the form of an allocated production share, and is allowed to extract resources for a set period, e.g. 25 years. The investor then transfers operation of the field back to the host country when the contract expires[24].

Because of China's rapidly growing oil import needs, most of China's oil imports are supplied by long term supply contracts or bought on the spot market rather than derived from equity investments. Between 2001-2006, 1 to 2 USD billion were invested abroad per year, but the oil imports from licence contracts came up to about 10% of total oil imports only[25]. But for reasons partly related to the current financial and economic crisis equity investments have strongly accelerated recently, see Section 1.4.3.

1.4.2.1 Policy support for long-term contracts

The White Paper on Energy (2007) stipulated that China should gradually change its current position of relying 'too heavily' on spot market purchases. Nearly three quarters of the world's oil reserves are in the hands of state-owned or state-dominated companies, e.g. Saudi Aramco, National Iranian Oil Company (NIOC), Rosneft, Petroleos de Venezuela (PDVSA). This is an increasing tendency (see e.g. Lechner, 2007, p. 11). As a result, the negotiations of China's oil companies are often backed by high-level state–to–state negotiations and take advantage of good overall political relations and/or of 'package deals' (discussed in more detail below). One recent example is a 10-year contract concluded between Petroleo Brasileiro SA (Petrobras) and Sinopec in February 2009. Petrobras would supply Sinopec with 150,000 barrels per day for the first year, rising to 200,000 barrels per day for the following nine years. (Currently Brazil is supplying 60,000 b/d). At the same time, Brazil receives a USD 10 billion loan from the China Development Bank. China-Brazil relations have substantially improved after president Liuz Inacio Lula da Silva took office in 2003. Another significant long-term supply contract, of around 1 mb/d, was concluded in 2005 between Sonangol, the Angolan NOC, and Unipec, an affiliate of Sinopec. The agreement

[23] For further discussion on this issue please see Chapter 3 of this report.
[24] See e.g. Buy back section, Petroleum Iran web-site. Retrieved 2 December 2009 from: http://www.petroleumiran.com/buyback.html
[25] Herbert Lechner (2007), ‚Grenzenloser Energiehunger, China als Global Player im Wettlauf um Energieressourcen', in energy1/07, Zeitschrift der österreichischen Energieagentur, 1/07, p. 9

came three years after the end of the civil war in Angola. Political relations between China and Angola improved rapidly, and in that context China's Exim Bank pledged an USD 2 billion oil-backed loan to Angola to fund the rebuilding of infrastructure throughout the country[26].

One should also mention that Venezuela's interest in a long-term supply contract for China, possibly reaching 1 mb/d by 2012. President Chavez openly displays affection for China, as well as an urge to diversify its export destinations away from the USA. Currently the Chinese side is said to be cautious. The quality of Venezuelan heavy crude is one aspect, but doubts regarding the credibility and reliability of President Chavez may play a certain role as well.

Another interesting piece of oil diplomacy is China's long term contract with Russia: In April 2009, after 15 years of top-level negotiations, China and Russia finalized an agreement to build an oil pipeline between the two countries, in combination with a long-term contract to deliver 300 million tons over 20 years starting in 2011.

1.4.2.2 Equity oil and package deals

Acquisition of equity oil seems an attractive way to secure oil supplies and to hedge against price increases. It is also felt that this paves the way for Chinese NOCs to catch up with the IOCs, and is in line with China's 'go abroad' policy. In 2009, as measured by market capitalisation, PetroChina became the largest enterprise in the world. Also, its proven reserves are estimated to exceed those of Exxon, the second biggest company (Neue Zürcher Zeitung. 7 July, 2009). The Chinese government has chosen to support these developments and deploys both financial and political forms of support.

Financial support is provided in the form of access to preferential (below-market rates) loans from China's state-owned policy banks and commercial banks to Chinese companies which invest abroad in priority sectors as defined by the Chinese government, most notably natural resources, including of course crude oil. This gives Chinese enterprises a significant competitive advantage over other potential investors, as investment projects in the natural resources sector typically require large and long-term financial commitments and are characterised by enormous uncertainty in profitability. China Export and Import Bank (sometimes referred to as China Ex-Im Bank) and China Development Bank (CDB) are the two state-owned policy banks responsible for most of the financing. The companies are

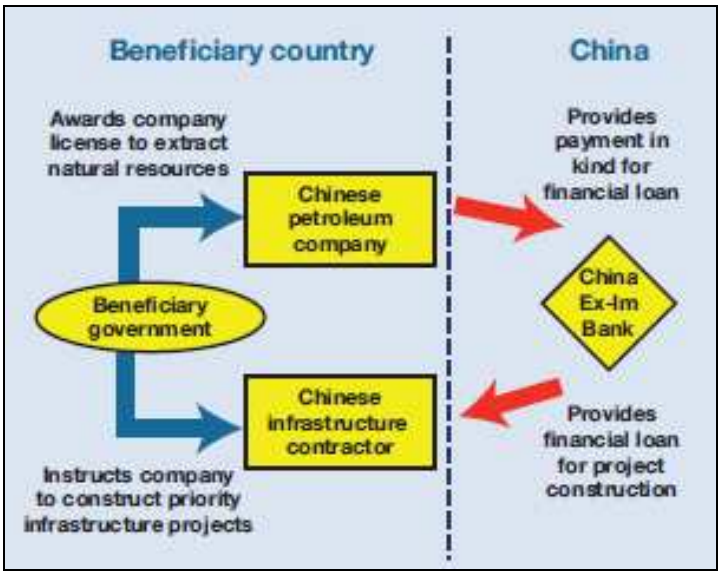
[26] The loan is payable over 12 years at a strongly concessional interest rate: Libor plus a spread of 1.5% with a grace period of up to three years.

further supported by Sinosure, China's official export credit insurance. Sinosure can also insure China's overseas investments, and can guarantee both shares and loans.

Political support involves high-level government-to-government negotiations, often leading to *package deals*, especially 'oil for loans' and (or in combination with) 'oil for infrastructure', and to some extent 'oil for weapons'[27]. In such cases, Chinese upstream investment is openly or implicitly linked to the concomitant provision of loans, and/or infrastructure development work, and/or weapons sales. In the most developed case the host country simultaneously approves both the upstream investment in its oil resources and obtains infrastructure projects which are carried out by Chinese construction firms. The infrastructure projects are, moreover, partly paid for using the cash-flow from concessional loans granted to the host country by Chinese banks. Obviously such arrangements are particularly suited for developing countries which combine interesting natural resources, but have underdeveloped infrastructure and weak financial means. The typical case has been referred to as the 'Angola mode' by Foster et *al*. (2008) who provide a graphical illustration which we reproduce in Figure 1.12.

Figure 1.12

Chinese package deals in Africa: the 'Angola Mode'



Source: Foster (2008)

[27] China is expanding its arms exporting activities in general. In many cases there is no connection with oil, but Sudan (and potentially Iran) are relevant cases, see e.g. Blank (2009).

This type of approach has become an integral part of China's Africa policy (see Section 1.2). It is clear that, with such package deals, a large share of the value added is recycled in favour of China in some form, although the preferential financing rates are a boon for the host country as well. From the Chinese point of view, these comprehensive deals serve the interests of her NOCs (interested in upstream as well as downstream operations); in addition, these deals may support, e.g., the Chinese construction industry if infrastructure projects are included. Finally, closer political ties may be created which could turn out to be beneficial for other purposes as well. Depending on the level of economic development and the policies in the host countries, package deals take different forms in different world regions. Concretely, the most developed and broad-based package deals are found in China's dealings with African countries.

1.4.2.3 Comprehensive package deals in Africa

The clearest examples of (successful) package deals in Africa are Angola and Sudan, though relevant examples are found in the cases of Chad, the Republic of Congo, Equatorial Guinea and Niger. The main counter-example is Nigeria, where none of the contracted infrastructure projects were realised and where two of the four oil concessions that were initially awarded were later abandoned due to low prospectivity, see Downs (2007: 54).

In Angola, after the end of the civil war in 2002, reconstruction became the Angolan government's top priority and although China had supported the anti-government rebels during the war, it played a particularly important role in assisting reconstruction. The first loans granted by the China Construction Bank and by China's Export-Import Bank (Exim Bank) in 2002 amounted to about USD 150 million and supported the rehabilitation of the Luanda Railway and of the electrical network of Luanda. In 2004 China's Exim Bank pledged an initial USD 2 billion oil-backed loan to Angola to fund the rebuilding of shattered infrastructure throughout the country[28]. Following the opening of this credit line in March 2004, China acquired its first stake in Angola's oil industry in July of the same year, namely a 50% stake in Block 18 through Sonangol Sinopec International Holding Ltd. (SSI)[29]. Unsurprisingly, critics claim that China's loans in the months prior provided Sinopec with an

[28] The loan is payable over 12 years at deeply concessional interest rate, Libor plus a spread of 1.5% with a grace period of up to three years. In a new credit line opened in 2007, the spread is 1.25% above Libor and repayment was extended to 15 years.

[29] SSI is majority owned by Sinopec (55%). The other partners are Dayuan International Development Ltd. (31%) and CSIH (13.5%). China Sonangol International Holdings Ltd. (CSIH) is a joint venture between Angola's national oil company Sonangol (30%) and a Hong Kong-based private business group (New Bright International Development Ltd.,70%) which is allegedly linked to both, the Chinese as well as the Angolan government and to both national oil companies in opaque ways (Vines, Wong, Weimer & Campos, 2009 pp. 52-53; Levkowitz, McLellan Ross, & Warner, 2009, July 10, p. 2).

unfair advantage over its Indian competitor, ONGC-Videsh. The credit line was later extended, much of it in return for increased exports of Angolan crude. However, the loan agreement signed between China's Exim Bank and the Angolan government stipulate that the contracts tied to the loan are allocated primarily to Chinese firms and that most of the building materials and machinery should be sourced from China[30]. In 2007, SSI was awarded further equity (25%) in Blocks 3 (05) and 3(05a). Yet signature bonus payments had reached very high amounts during the 2004 and 2006 licensing rounds, indicating that China faced severe competition in these rounds despite ongoing loans to the Angolan government (Vines et *al*., 2009, p.45).

The close link between oil exploration and infrastructure investment in Sudan before 2000 has been illustrated in Section 1.4.1 already. In the meantime, China has built 2 pipelines to Port Sudan and 2 new oil terminals and has significantly extended the refinery north of Khartoum. Apart from the oil business, the Chinese are also building power stations, financed by Chinese loans, and are supporting industrial projects and medical facilities.
On the other hand, CNPC has obtained concessions in 2 Blocks in the Melut basin and one in Block 6 in the Fulda field, with a combined capacity of up to 280,000 b/d (calculated from Shichor, 2008, p. 75). In July 2007, it was reported that CNPC had signed a 20-year contract with the Sudanese government for exploration rights in northern Sudan's Red Sea waters. CNPC will have a majority share of 35-40% (AFP, July 2, 2007; Sudan Tribune, July 2-3, 2007 – quoted from Shichor, 2008, p. 75). In 2007, CNPC's Sudanese assets were valued at about USD 7 billion[31]. Yet only part of the oil retrieved in Sudan is shipped to China. Sudan also represents an interesting example for a case where the Chinese government stopped supporting outward investment (for political reasons, in 2007), but China's NOCs continued to invest.

Further examples of successful combinations of loans, infrastructure and equity oil business in Africa include:

Chad: In 2007, CNPC bought the rights to a vast exploration zone around Koudjiwai and is to invest in a joint venture with the Chadian government to build a refinery. There are also plans to construct a pipeline between Chad and Sudan to export oil via Port Sudan. Also, the CNPC Service and Engineering Ltd, a wholly-owned subsidiary of CNPC, has signed an

[30] Only about 30 percent of contracts have been awarded to Angolan companies (Levkowitz et al., 2009, p. 13). In 2009, according to Chinese officials, over 100 Chinese firms were operating in Angola (over 50 of them of significant size). Many of these companies use mainly a Chinese workforce; some 40,000, according to Chinese officials, work on official infrastructure projects.
[31] Estimate based on data provided by Wood Mackenzie, quoted from Downs (2007), p. 58.

agreement with the Chadian government to jointly invest in a refinery north of N'Djamena. According to an announcement on the website of CNPC (6 October, 2007), CNPC entered service contracts worth USD 3.09 billion in 2006.

The Congo (*Republic of the Congo*, also known as *Congo-Brazzaville*): In 2005, China and the Congolese government signed two deals that would authorize Sinopec to explore off-shore blocks. Cheap loans for investments in infrastructure come as part of a package deal. In 2007, China bought half of the country's annual oil production[32].

Equatorial Guinea: The country was, as of 2008, the third largest oil producer in Sub-Saharan Africa. This is a recent development, and the country only formed an NOC in 2001, GEPetrol. In 2006, CNOOC signed a production sharing contract (PSC) for an offshore oil field with GEPetrol. CNPC also acquired 70% of a block in the Rio Muni Basin (CNPC homepage). CNPC and CNOOC signed further contracts to explore an offshore block each in late 2007 (African Oil Journal, September 12, 2007).

Republic of Guinea (also known as *Guinea*, or *Guinea-Conakry*): In October 2009, amidst major unrest and killings of protesters, Guinea's military rulers announced a huge mining and oil deal with the China International Fund Ltd. (CIF). CIF is registered in Hong Kong and is part of an opaque network of private businessmen with good connections to both the Chinese and the Angolan governments[33]. According to Mines Minister Mahmoud Thiam, the Chinese firm would invest more than USD 7 billion in infrastructure projects. In return, the company would be a 'strategic partner' in all mining projects[34].

Niger: Although mainly attracted by the country's uranium reserves, China is also active in the exploration of oil in Niger[35]. In June 2008, CNPC struck a USD 5 billion deal with Niger's government to pump oil from the Agadem Block within three years, and lay a 2000-km pipeline to export it. CNPC also said it would build a refinery (Niger's first), of a capacity of 20,000 barrels per day.

[32] Tom Gjelten (2007, June 26), 'Congo and China Forge Economic Partnership, National Public Radio (npr), online , http://www.npr.org/templates/story/story.php?storyId=11428653 , retrieved on 13 July 2009.
[33] Levkowitz et al. (2009, July 10).
[34] See e.g. 'Guinea and China 'agree big deal'', BBC Online News, 13 October 2009.
[35] In April 2009, China granted Niger a USD 95 million preferential loan for the SOMINA uranium mining operation, a joint venture between China National Uranium Corporation and the Niger government (China's oil and mineral deals in Africa (2009, November 4). *Reuters*, quoted from *Yahoo! Malaysia News*. Retrieved 4 November 2009 from: http://malaysia.news.yahoo.com/rtrs/20091104/tbs-africa-china-resources-21231dd.html

Frustrated by the failure of the politically motivated 'package deals' in Nigeria, the Chinese oil companies turned to the market. In 2005, Sinopec acquired 28.67% of JDZ[36] Block 2 from ERHC, a private Houston-based oil and gas company. Further on, in January 2006, CNOOC bought through a private sale[37] a 45% working interest in a lucrative Block, OML 130, in the Akpo field for USD 2.3 billion, with significant financial support from China's Exim Bank[38]. In March 2006, CNOOC made a second acquisition, again through a private sale. It paid USD 60 million for a 35% working interest in OPL229. The Block was wholly owned by two indigenous companies. Its funding was guaranteed by China's Export Credit agency, Sinosure. In August 2009 Sinopec also acquired Addax Petroleum Corporation, which has significant stakes in Nigeria.

Altogether, China's oil imports from Africa surged from 6.2% of total imports in 1998 to 24.4% in 2003 and came up to 30.1% in 2008, second only to the Middle East.

1.4.2.4 Fresh opportunities in Latin America

Oil relations between Latin America and China are less advanced than for instance with Africa and the Middle East. But fresh opportunities have come up for China recently with the discovery of more reserves in the region. Furthermore, a general political re-orientation has occurred in the region, with many countries becoming less deferent to US interests and more receptive to strengthening both regional cooperation and bilateral relations with far-away powers. Those developments are most vividly illustrated by openly leftist leaders such as Hugo Chavez of Venezuela and Evo Morales of Bolivia. In a more moderate camp, leaders such as Brazil's Luiz Inàcio Lula da Silva, Michelle Bachelet of Chile, Tabaré Vázquez of Uruguay and Rafael Correa of Ecuador, are seen as more pragmatic than ideological. The case of Argentina under Cristina Fernandez de Kirchner (from 2007) and her husband Nestor Kirchner (2003-2007) seems somewhat in between the two groups and is perhaps most revealing of the economic rationale for these (partial) regional shifts[39].

[36] Joint Development Zone between Nigeria and Sao Tome & Principe

[37] From South Atlantic Petroleum Ltd., a company owned by General Theophilus Danjuma, former Defence Minister – see 'Chinese firm targets Akpo Field to boost output', Oilwatch SouthEast Asia, retrieved 19 October 2009 from: http://oilwatch-sea.org/content/view/222/1/

[38] A 10 year low-interest loan of USD 1.6 billion was extended to CNOOC. See Erica Downs (2007), 'The fact and fiction of Sino-African Energy Relations', *China Security*, vol. no.3, Summer

[39] Argentina firmly rejected neo-liberal economic policies after its disastrous financial crisis of 2001, while moving closer to oil-rich Venezuela. On the other hand Argentina's ruling Partido Justicialista (of Peronist, i.e. big-tent corporatist, inspiration) has remained a member of the Centrist Democrat International, rather than join the Socialist International as suggested by Nestor Kirchner himself. So while left-wing ideology has played a role in the region, the relative shift of economic power away from the United States and towards both oil producing states and China offers an explanation for recent developments as well.

One major obstacle to increased energy cooperation between China and the region is the sheer distances involved, and the lack of straightforward shipping routes. That is why China considers considering funding a pipeline through Columbia, which would take Venezuelan crude to the Pacific[40].

To take advantage of new opportunities China has adjusted her oil policy to better fit the different requirements of Latin American oil producers. Brazil, for instance, is not interested in selling equity oil for the moment but needs financial means for the exploration of recently discovered oil reserves off-shore. Thus a long-term supply contract combined with an oil-backed loan turned out the best solution for both parties. However concessions could be discussed in the future[41]. Some of the other Latin American countries welcome equity investment, as well as downstream investment, often in the form of joint ventures with their respective national oil companies. In general, 'oil for loan' packages seem to be more attractive for countries of the region than 'oil for infrastructure' packages, thus reflecting the higher development level of the region as compared to most of Africa. If infrastructure projects are included in a deal, however, the projects are typically oil-related infrastructure items such as pipelines. In 2004, for instance, China's president Hu Jintao, on his tour of Latin America, signed a USD 10 billion energy deal with Brazil for investments in its energy and transport infrastructure. Prior to that, Sinopec had agreed to a USD 1.3 billion project with Brazil's Petrobras to build a 2,000 kilometer natural gas pipeline.

Another dimension of the expanding links between China and Latin America concerns the negotiation and conclusion of Free Trade Agreements. The first such agreement was between China and Chile. It covers trade in goods and came into effect in mid-2006. While that agreement was perhaps more a reflection of Chile opening up to the world economy[42] than of China 'moving in', it is not to be the last FTA between China and Latin America. Indeed, China and Peru signed an FTA in 2009, to come into force on 15 January 2010.

China's special relationship with Venezuela

Relations between China and Venezuela are close and are largely driven by President Chavez's strained relations with the USA and his fierce attempts to reduce Venezuela's dependence on the US market which currently takes more than 50% of its crude. Venezuela hopes to supply 15 to 20 per cent of China's oil import needs in the future[43].

[40] Ethical Corporation, March 8, 2006.

[41] On 20 May 2009, Petrobras and Sinopec signed a memorandum of understanding on oil exploration, refining and petrochemicals. China will explore for oil in two areas of Brazil.

[42] Chile has FTAs and PTAs (preferential trade agreements) with countries across the Americas in addition to trade agreements with several Asia-Pacific countries, e.g. Japan, India, New Zealand.

[43] *China Daily*, August 27, 2005. Retrieved 10 July 2009 from:

In December 2004 already, President Chavez offered China wide-ranging access to the country's oil reserves. The offer, made as part of a trade deal between the two countries, will allow China to operate oil fields in Venezuela and invest in new refineries. Chinese firms would be allowed to operate 15 mature oil fields in the east of Venezuela. He also offered to supply 120,000 barrels of fuel oil a month to China. In August 2005, CNPC signed an initial agreement with PDVSA, to develop and manage Venezuela's Zumano oilfields in the eastern part of the country. In 2006, CNPC acquired licenses to explore Venezuela's Orinoco oil belt and the Caracoles and Intercampo Norte oilfields, and holds options on others. Also, China is building a plant to process Orimulsión, a heavy tar fuel. In 2006, oil shipments to China reached around 120,000 barrels a day[44]. As a result of these developments, China's oil imports from Venezuela surged from 444 million tonnes in 2003 to 6,463 million tonnes in 2008 (see Table 1.3). This trend seems set to continue. In 2008, CNPC entered into two agreements with PDVSA, under which a joint venture was established to drill for super-heavy oil at Junin-4 block in the Orinoco belt. The annual production target of the joint project, in which CNPC has a 40-percent stake, is 20 million tons. During a visit to China in September 2009, President Chavez announced a deal worth USD 16 bn with China to drill for heavy oil in the resource-rich Orinoco basin[45].

Another special feature of the China-Venezuela relationship is the 'Joint Financing Fund' which was set up in 2007 and which aims at investments in education, health and infrastructure programs in Venezuela. Although not tied to a particular oil deal, it certainly backs oil business between China and Venezuela in general. As an indication of that, in February 2009, during Vice President Xi Jipings South America tour, the Fund was boosted from USD 6 billion originally to USD 12 billion (with China contributing USD 8 billion and Venezuela the rest) and at the same time 12 cooperation agreements between China and Venezuela were signed, e.g. one calling for Venezuela's state oil company, Petroleos de Venezuela SA (PDVSA) to sell CNOOC between 80,000-200,000 barrels of oil per day to pay off a debt between development banks in both nations. Another agreement calls for building a refinery in China to handle Venezuelan crude from the oil-rich Orinoco basin (China Daily, June 29-July 5, 2009).

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http://www.chinadaily.com.cn/english/doc/2005-08/27/content_472663.htm

[44] What does intrigue observers, however, is not so much the volumes, but the price. According to one well-versed source in the Venezuelan oil industry, China is reportedly paying only USD3 to –USD 4 a barrel, a small fraction of the world market price charged to other foreign consumers, see Schiller, B. (2006, March 2). The axis of oil: China and Venezuela. *Open Democracy*. Retrieved 18 September 2009 from: www.opendemocracy.net/articles/View.jsp?id=3319

[45] Wan Zhihong (2009, September 18). Venezuela, China ink $ 16b oil deal. *China Daily*

The energy relationship between China and Bolivia displays a certain ideological component as well. On 21 July 2009 Bolivia completed nationalisation of its oil and gas sector. This may open up fresh opportunities for China for cooperation in this field, as Evo Morales considers China a 'political, ideological and programmatic ally of the Bolivian people'[46] and has invited China to help develop the country's natural gas resources.

China's oil relations with the other Latin American countries are more pragmatic. Many negotiations are conducted on a commercial basis and Chinese oil companies find themselves competing with other private or national oil companies. But in certain cases governments are also involved and political support is used to finalise agreements or to obtain more favourable conditions. For instance, in July 2009, PetroChina started to negotiate with Ecuador for oil purchases of 0.096 mb/d over two years. The deal foresees an advance payment of USD 1 billion for future oil purchases. In essence this is an 'oil for loan' deal. As part of the negotiations, Ecuador asked that China uses the crude oil for consumption purposes, rather than resell it to Peru or Chile as that would 'distort the market' *(China Daily*, 2009, July 15).

Some examples of major private deals of Chinese oil companies

In 2005, PetroChina and Sinopec jointly purchased oil and gas assets from Ecana in Ecuador, and established Andes Petroleum Ecuador Ltd.[47] In 2006**,** the Indian Oil & Natural Gas Corp (ONGC) and Sinopec formed a 50/50 joint venture to acquire Omimex de Colombia from Texas-based Omimex Resources for USD 850 million. Omimex' assets constitute a 100% interest in the Velasquez oilfield and a 50% interest in the Nare and Cocorna oilfield where the Columbian national oil company, Ecopetrol SA, holds the remaining 50%. Omimex also owns a 189 km pipeline to a refinery[48]. In 2008, a consortium with CNPC, the Korea National Oil Corp (KNOC) and Argentina's Pluspetrol was formed to explore an oil field in an oil rich area in Colombia. Under the consortium, KNOC owns a 30 percent stake in the field, while Pluspetrol and CNPC own 40 percent and 30 percent, respectively[49].

[46] The Washington Times, 10 January 2006.
[47] China Daily, 2009, 15 July
[48] ONGC, Sinopec acquire Columbia's Omimex (2006, September 21), *The Financial Express/-Press Trust of India.* Retrieved 22 October 2009 from http://www.financialexpress.com/old/latest_full_story.php?content_id=141077
[49] Moon A. (2008, July 24). KNOC says wins Colombia oil exploration rights. *Reuters*. Retrieved on July 2009 from http://uk.reuters.com/article/idUKSEO8580020080724

CNPC operates five oilfields in Peru, accounting for about 33 percent of the country's total oil output[50]. In 2010, the government of Peru will auction new lots, providing fresh opportunities for China. Some challenges exist, however, as a large part of Peru's oil reserves are located in the country's south-eastern rainforests, allegedly one of the most bio-diverse areas on earth and home to remote tribes, especially in the Madre de Dios region at the border with Brazil. Already in 2005, when Peru had signed an USD 83 million contract allowing CNPC firm to explore for oil in this area, fierce protests from environmentalists were raised.[51]

Altogether, after falling behind between 1998 and 2003, China's oil imports from Latin America have increased significantly and reached 7% of total imports in 2008. Finally, one should mention China's interest in developing an overland pipeline from Venezuela through Colombia and onto the Pacific coast of South America. That project may be seen as an attempt to diversify transit routes from the Chinese point of view. Such infrastructure would reduce China's dependence on transit through the Panama Canal.

1.4.2.5 Russia and Central Asia

From a geopolitical perspective the second most important world region for oil is Eastern Europe and Eurasia, including Russia and the Caspian Basin. The share of this region of about 20% in world oil trade will stay more or less constant, with Russia's importance declining and that of Central Asia rising. Compared to that, the share of Russia and Central Asia in China's oil imports is rather small though rising from 7.2% in 2003 to 9.8% in 2008. Beyond that, the region is in China's direct neighbourhood and is the only one from which oil need not be shipped but can be transported overland (typically by pipeline) instead. This gives the region a special importance from the Chinese perspective, as both supplier diversification and diversification of transit routes are increased simultaneously. For historical reasons, however, until recently all existing pipelines for oil as well as for gas ran westwards towards Russia and Europe. China's most important policy issue with regard to oil in this region is therefore the building and securing of transport routes from the region to China. A second issue is to secure that the pipelines can be filled appropriately to keep pace with the rising demand for oil in China, by long term contracts respectively an extension of the oil bases there. Again, China frequently uses concessional loans from her policy banks to achieve acceptance of her goals from her partners.

[50] Zhu,Winnie (2007, August 28). China may expand oil exploration, refining, investments in Peru. *Bloomberg.* Retrieved October 22, 2009 from http://www.bloomberg.com/apps/news?pid=20601086&sid=atJuj9oQFLBU&refer=latin_america

[51] Ford D. (2009, August 5). Interview: Peru sees energy investments up despite protests. *Reuters* *http://www.reuters.com/article/latestCrisis/idUSN05283599*

In April 2009, after 15 years of negotiations, China reached an agreement with Russia, to build an oil pipeline between the two countries, in combination with a long term contract to deliver 300 million tons over 20 years (15 million tons p.a.) starting in 2011. As part of the deal, China will supply a USD 25 billion loan (20 years) to Russia's state-run energy companies (USD 15bn to oil company Rosneft[52] and USD10bn to pipeline monopoly Transneft) – at a preferential interest rate of 6%. The new pipeline will be a branch of the East Siberia Pacific Ocean (ESPO)[53] pipeline and will run from Skovorodino via Mohe to Daqing in the Chinese province of Heiliongjiang. The Russian section Skorovodino-Mohe (67km) will be built by Russia, the Chinese section from Mohe to Daqing (965km) by China and should be operational by the end of 2010[54]. The pipeline will be jointly operated by China (PetroChina) and Russian partners.

The second successful deal so far is with Kazhakstan. Relations between China and Kazakhstan in the field of oil and gas are deep and were further extended by an agreement on a 'strategic partnership' signed in 2005 and a further agreement signed in 2006 called the 'Co-operation Strategy for the 21st Century'. Further strengthening of bilateral relations has been signalled in the course of 2009.

Already in 1997, CNPC had won a major share in two of Kazakhstan's largest oilfields and a contract to build a pipeline from Kazakhstan to China which would also supply Iranian refineries. Chinese Premier Li Peng lobbied hard to secure this USD 4.4 billion deal[55]. In 2004, CNPC and KazMunaiGaz, the Kazakh state energy company, agreed to build a cross-border pipeline. The first part of that pipeline, of a length of 962 km, runs from Atasu in Central Kazakhstan to Alashankou, in China's western province of Xinjiang. From there a further pipeline, of a length of 246 km on Chinese territory, leads to the Dushanzi refinery, also in Xinjiang. Construction of the first part of the Kazakhstan-China oil pipeline took place between September 2004 and December 2005. The first oil shipments reached Dushanzi in July 2006. For the moment the capacity of the line into China is 10 million tonnes per year

[52] In 2006, CNPC bought a USD 500 million slice in Rosneft's USD 10.4 billion initial public offering (China Daily, 11-12 November 2006

[53] The ESPO will be 4700 km long and will lead from Taishet to Kazmino bay, near Nakhodka, at the Sea of Japan. The first section from Taishet to Skovorodino should be finished by 2009, the second section from Skovorodino to Kazmino (Kosmino) should then start. The ESPO is an attempt o Russia to diversify its supplies to the East. By 2020 exports to the Asia-Pacific region should reach about 30% (compared to 3% in 2008).

[54] Obviously, prices for Russian oil follow world market prices, as in January –March 2009, Russia exported 3.28 millions of crude to China, 5.8% up year-on-year. But first quarter Russian crude supplies to China were 52.1 percent down in terms of value.

[55] Rubin B (1999 March 1). China's Middle East Strategy. Meria Middle East Review of International Affairs, p.4. Retrieved 1 December 2009 from: http://meria.idc.ac.il/journal/1999/issue1/jv3n1a4.html

(roughly 0.2 mb/d) and relies on supplies from central Kazakhstan. The key missing link was to build an extension through Central Kazakhstan to connect China all the way to Kazakhstan's large Caspian fields. That work was completed in July 2009, so there is now a full-length link, totalling 2,228 km, linking China to Caspian oil fields in Kazakhstan. Transit capacity upgrades therefore seem likely in the medium-run.

Also in 2005, CNPC acquired PetroKazakhstan, a Canada based oil company operating in Kazakhstan, for USD 4.18 billion (the then largest overseas acquisition ever made by a Chinese company), which is going to fill a substantial part of its oil production (10 million tons per year in 2008) into the new pipeline. PetroKazakhstan has a 50:50 joint venture with KazMunaiGaz in the important Akschabulak oilfield and operates jointly with Lukoil in the Kumkol and in the Northern Buzachi fields.

In 2009, the China National Oil & Gaz Exploration and Development Corporation (CNODC, an affiliate of PetroChina) and KazMunaiGaz formed the company Mangistau Investments B.V., a joint venture in which each side took a 50% stake, to acquire 100% of MangistauMunaiGas (MMG), one of Kazakhstan's largest private oil and gas exploration companies. The deal includes oil and gas fields and other upstream exploration assets. By 31 December 2008, MMG's proven plus probable exploitable crude oil reserves reportedly totalled about 370 million barrels, with annual production at about 40 million barrels (0.11 mb/d).[56] To help fund the project, PetroChina lent KazMunaiGaz USD 5 billion, and China Exim Bank lent a further USD 5 billion. CNPC will then receive half of the oil that will be produced by the jointly owned MMG (the other 50 % will be owned by the Kazak state-owned firm KazMunaiGaz). As a result, some commentators have labelled this recent deal as a 'loan-for-assets' deal, rather than a 'loan for oil' deal[57], though the former remains clearly more frequent than the latter in general.

China's focus in Uzbekistan and Turkmenistan is on natural gas, given the resources of those countries. However CNPC has signed an agreement with Uzbekistan to jointly develop a small oilfield as well. In July 2005, Turkmenistan and China signed an agreement on oil and gas cooperation and China extended a USD 24 million low-interest loan to Turkmenistan for the development of its oil and gas industry.

[56] China Stakes.com. Retrieved July 2, 2009 from, http://www.chinastakes.com/2009/4/petrochina-and-kazmunaigaz-team-up-to-acquire-kazakhstans-mmg.html

[57] See e.g. Jian W. (2009), 'China's oil partners hang onto assets', Alexander's Oil and Gas Connections, volume 14, issue #13.

1.4.2.6. The Middle East: China's hot spot for oil

From the very beginning, the Middle East has been the most important source for Chinese oil imports. And taking into account the fact that according to IEA (2007) almost two thirds of the worlds proven oil reserves are located there and that between 2007 and 2030 net exports from this region will contribute 60% to the increase in total oil trade, it will remain so in the future. However, over the last ten years China has significantly diversified her imports and the share of the Middle East in total imports came down from over 60% in 1998 to 48% in 2008 – compare Figures 10 and 11. Within the region, Saudi Arabia became the shooting star while the smaller suppliers such as Yemen and Oman lost importance. Since 2003, Saudi Arabia is the biggest supplier of oil to China. Iran is the second exporter of Middle East oil to China and ranks third (after Angola) in total oil trade (Table 3). The rising importance of Saudi Arabia for China is a result of its huge production capacities but also a consequence of the endeavour of both sides for a persistent good relationship and of co-operations both upstream and downstream. The latter is partly related to the technical difficulties to process heavy or 'sour' crude oil but could be seen in the light of oil security as well.

Already in 1998 China made a USD 1.5 billion deal for a huge Sino-Saudi oil refinery in China and concluded a supply contract for 10 million tons of *Saudi* oil annually for a 50 year-period[58]. In 1999, an agreement was reached to open up the Chinese refinery sector to Saudi investment and to make oil exploration and development opportunities available to Chinese investors. However, large scale Sino Saudi cooperation in the energy field kicked off in 2003 only.[59] As a result, Sinopec and Saudi Aramco began to collaborate on downstream projects in China, joining forces to build a refinery in Qingdao and to expand a petrochemical facility in Quanzhou. Saudi Basic Industries Corporation (SABIC), the Middle East's largest petrochemical company, has reportedly been involved in talks regarding several downstream projects in China as well[60]. In Meanwhile, Chinese companies are seeking to acquire and expand their footholds in Saudi Arabia as well. In 2004, Sinopec won the bid for a natural gas project in a north-western block of the Rub al-Khali gas fields, an area that Saudi Arabia has opened up to foreign firms for the first time in 25 years (worth about USD 300 million)[61].

[58] Rubin B (1999 March 1). China's Middle East Strategy. Meria Middle East Review of International Affairs, p.5. Retrieved 1 December 2009 from http://meria.idc.ac.il/journal/1999/issue1/jv3n1a4.html

[59] See Chen Mo**,** Chinese Academy of Social Sciences, Institute of West-Asian and African Studies; in IIAS Newsletter 51, summer 2009. Retrieved 18 October 2009 from: http://www.iias.nl/article/securing-chinas-oil-supply-saudi-arabia-sudan

[60] In 2006, it was agreed that Saudi Arabia will set up a 10 million cubic-meter oil storage facility on Hainan Island Alterman & Garver, 2008, p.25.

[61] Alterman & Garver, 2008, p.25 and Calabrese, J. (2005, 25 September). Saudi Arabia and China Extend Ties Beyond Oil. *China Brief*, Vol 5, issue 20, The Jamestown Foundation. Retrieved 22 October 2009 from:

Saudi Arabia's upstream oil sector, which was developed with American technology, has not yet been opened up for foreigners[62]. In 2006, China and Saudi Arabia signed five agreements including one on closer energy cooperation (China Daily, January 24, 2006).

Oil trade between Iran and China accelerated sharply during the 1990 and kept pace with rising Chinese oil demand thereafter. A number of agreements are worth looking at. In 1995, the two countries signed a general bilateral trade deal, reportedly worth USD 2 billion trade deal. As a result, China tripled oil purchases to 60,000 barrels a day and agreed to build a joint oil refinery in China and cooperate in oil exploration. China also built power plants and cement factories in Iran. Still, arms sales have been China's leading single field of endeavour[63]. In 2001, Sinopec signed a USD 150 million deal to design and build an oil-unloading terminal at Neka and modernize refineries at Rey and Tabris[64]. In 2007, after 3 years of negotiations, Sinopec signed a contract with Iran, to jointly develop the new Yadawaran oilfield estimated to contain 3 billion barrels (first phase: USD 2 billion) – neglecting the US embargo against Iran. In the first 4 years, production is expected to reach 85,000 b/d, which will be extended later. In exchange, China agreed to purchase – at market rates – 10 million tonnes of LNG a year over 25 years. (There was also an agreement with CNOOC for upstream and downstream development of the North Pars natural gas field).

Iraq has been a minor supplier of oil to China in the recent past, not least due to the Iraq War and its aftermath. However Iraq's large reserves and correspondingly large export potential have made the country a primary target for China's foreign oil policy[65]. In 2008, an old contract concluded between Saddam Hussein and China in 1997, which included production sharing rights, was revived but transformed into a 20 year service contract of a value of USD 3 billion, under which China would be paid in oil for its work at the al-Ahdab oil field southeast of Baghdad, with an estimated production capacity of 90,000 bbl/d, but would not be a partner in the profit (International Herald Tribune, August 21, 2008). In this context, China agreed to cancel a large portion of Iraqi debt to China[66]. This was Iraq's first contract with a large foreign oil company since the fall of Saddam. The contract also requires China to build

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http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews%5Btt_news%5D=3895&tx_ttnews%5BbackPid%5D=195&no_cache=1

[62] Chen Mo**,** Chinese Academy of Social Sciences, Institute of West-Asian and African Studies; in IIAS Newsletter 51, summer 2009. Retrieved 18 October 2009 from: http://www.iias.nl/article/securing-chinas-oil-supply-saudi-arabia-sudan.

[63] Rubin B (1999 March 1). China's Middle East Strategy. Meria Middle East Review of International Affairs, p.4. Retrieved 1 December 2009 from: http://meria.idc.ac.il/journal/1999/issue1/jv3n1a4.html

[64] Alterman & Garver, 2008, p.25.

[65] 'Domestic companies can never find bigger opportunities in other places than in Iraq, which has the third largest proved oil reserves in the world', Prof. Lin Boqiang, Xiamen University (China Daily, July 7, 2009).

[66] Alterman & Garver, 2008, p.25.

a major electrical station in the area[67]. In June 2009 CNPC, together with BP, won the bid to increase output at the Rumaila oilfield, Iraq's largest oilfield. The technical service contract was signed in November 2009. BP and CNPC will work towards increasing production from around 1 mb/d to up to 2.85 mb/d and plan to invest up to USD 15 billion for that purpose[68].

1.4.2.7 Transit security investments

One of the weakest points in China's oil transit security is the fact that all oil shipments from the Middle East, the most important source of oil for China, have to cross the narrow Straits of Malacca between Singapore and Malaysia. The Straits of Malacca constitute a 'choke-point' for oil transit, making it a potential target for terrorist attacks, piracy, or naval blockades. In addition, accidents and natural disasters at a choke-point could also have knock-on effects affecting transit. In order to reduce the potential damage from such incidents, the Chinese government agreed in March 2009 with the Myanmar government to construct oil and gas pipelines linking the two countries. The two pipelines will run in parallel. Both will start in Kyaukryu port on the west coast of Myanmar and enter China at the border city of Ruili in China's Yunnan province. The 1100 km oil pipeline will end in Kunming. It is expected to transfer 20 million tonnes of crude from the Middle East and Africa annually. CNPC will hold 50.9% and manage the project, and Myanmar Oil & Gas enterprise will own the remainder. The oil pipeline will also reduce the transport route compared with ocean shipping by 1200 km.

A broader strategy to avoid the Straits of Malacca (and indeed the seas altogether) is to shift more strongly towards Eurasian sources of oil that can be brought into the country using overland pipelines. In this respect China's interest in Russian and Caspian oil fulfils a desirable goal of diversification of transit routes, in addition to contributing to diversification of sources of supplies. A third example worth recalling in this sub-section is China's stated desire to build a pipeline across South America so as to bring Venezuelan oil to the Pacific coast of South America, thus avoiding the use of the Panama Canal (or of circumnavigating the whole of South America).

[67] Reuters, "Iraq Reaches Oil Agreement with China", 28 August 2008; Amit R. Paley, "Iraq and China Sign $3 Billion Oil Contract," The Washington Post, 29 August 2008; Gina Chon, "China Reached $3 Billion Deal to Develop Oil Field in Iraq," The Wall Street Journal, 29 August 2008.
[68] See e.g.: http://www.bp.com/genericarticle.do?categoryId=2012968&contentId=7057650

1.4.3 Awash in cash: swapping financial resources for natural resources

In the course of the current global financial and economic crisis, China's acquisitions of oil sources and other natural resources have significantly accelerated. China has ample cash on hand to support overseas investment, with USD 2.9 trillion in foreign financial assets (USD 1.9 trillion of which are official forex reserves) at the end of 2008[69]. Suffering from the depreciation of the US dollar and with low interest rates world wide, there is a strong motivation for the Chinese government as well as Chinese enterprises to offload foreign exchange holdings in favour of 'real sector' investments, notably (but not exclusively) oil-related foreign investments. To facilitate outward investment, the Chinese government has recently relaxed its foreign exchange controls significantly and is supporting loans for acquisitions abroad. One example is a five-year USD 30 billion loan at a discounted rate from the China Development Bank to CNPC to fund its 'go global' strategy. This loan doubles the amount that the company had earmarked for capital expenditure in 2009[70]. A prominent example for recent, large acquisitions in the oil sector by Chinese companies is the acquisition of Addax for USD 7.2bn in August 2009 by Sinopec[71]. Addax is listed in Calgary (CA) but has its headquarters in Geneva and is a small but significant oil producer in West Africa and in the Kurdish part of Iraq. Other important example is the purchase of a majority stake in two Canadian tar-sand projects for USD 1.7 billion, also in August 2009 (The Economist, 3 September 2009).

Beyond that, several large projects are in the pipeline: in August 2009, China expressed its interest in a 30% stake of Ghana's Jubilee oil field. The new (offshore) oil field is thought to hold more than 1.8 billion barrels of light sweet crude oil (Ghana Business News, August 27, 2009). Then in October 2009, CNOOC and the Ghana National Petroleum Corporation (GNPC) announced to jointly bid for a 23.5% stake in the Jubilee oil field. (Investment News: Money Morning, October 12, 2009).

According to media reports in Argentina and in the U.S. in August 2009, CNPC and CNOOC are offering USD 17 billion for the acquisition of 84% of YPF, the Argentine unit of Spanish-based energy giant Repsol YPF. YPF is the leading oil exploration and refining company in Argentina with a 60% market share. Chinese media, citing an authoritative source even

[69] According to the State Administration of Foreign Exchange (SAFE), quoted in Fei Ya, (2009, May 20), 'Overseas assets in 2008 soar to $ 2,92t'. China Daily.

[70] According to Gordon Kwan, head of regional energy research at Mirae Asset Securities in Hong Kong (Lau J. and Dyer, G. (2009, September 9), 'CNPC boosts war chest with $30 bn loan'. Financial Times

[71] Sinopec Declares Successful Acquisition of Addax (2009, August 19). China International Investment Promotion Platform (CIIP). Retrieved on 22 October, 2009 from http://www.ciipp.com/en/index/view-12995.html

suggest a bid for 100% of YPF, whereby CNPC expects to hold 75% of the asset and CNOOC plans to get the remaining 25%. The price offered by the two Chinese national oil giants totals USD 22.6 bn. If the deal succeeds, it would be the largest-ever overseas acquisition for a Chinese company. However, none of the companies has confirmed the rumours so far.

In September 2009, The Financial Times reported that CNOOC has started negotiations with the Nigerian government to acquire a 49% stake in 23 prime blocs, which would provide China with additional reserves of 6 bn barrels of oil, equivalent to one in every six barrels of proven reserves of Nigeria and significantly more than the estimated 4.7 billion barrels of crude China has so far secured in its other African pacts. The offer's value is not disclosed, although some details suggest a figure of about USD 30 bn. Some oil sector executives said, the total was USD 50bn.

Finally, in October 2009, certain reports indicated that CNOOC was in talks with the Ugandan government about investing with London-listed Tullow Oil to develop the Lake Albert fields in western Uganda.

The projects mentioned in this sub-section have mostly yet to be confirmed. Some of them could fail due to competition from other oil companies or due to protectionist reactions in target countries. That said, the general pattern of acceleration is clear and reflects the relative financial advantage that China has over most other nations in the midst of the 2008-2009 financial crisis.

Chapter 2 – Global economic effects

2.1. Introduction

In the following sections we describe our basic macroeconomic projection modelling, and the application of the model to estimate the impact of China's economic growth on global macroeconomic developments. This is done with a quantitative model called a CGE (computable general equilibrium) model, in which trade and production data are mapped to CGE model sectors. We proceed with a brief outline of the model, and our projection scenario. This is followed by a more detailed analysis of the impact of China's growth. A more detailed overview of the core projections through 2020, and the underlying model, is provided in the companion FIW report (Christie et al 2009).

2.1.1. Overview of the projection model

We employ a general equilibrium model that enables us to estimate the impact of basic macroeconomic trends on global production and trade patterns. The model is based on the Francois, Van Meijl, and Van Tongeren model (FMT 2005) and is implemented in GEMPACK – a software package designed for solving large applied general equilibrium models. The model builds on Francois (2000), and its versions have recently been employed for EC-mandated studies of World Trade Organization negotiations, prospective EU-Korea and EU-MERCOSUR free trade agreements, as well as a recent large-scale Asian Development Bank assessment of regional integration schemes in Asia (Francois and Wignaraja 2008, 2009). The model is solved as an explicit non-linear system of equations, through techniques described by Harrison and Pearson (1994). Investment mechanisms are included along the lines of Francois, McDonald, and Nordstrom (1996). Social accounting data are based on the most recent Version 7 GTAP dataset (www.gtap.org). The GTAP data on protection incorporates a set of ad valorem equivalents (AVEs) of border protection across the world.

The sector and regional aggregation schemes for the model are summarized in Table 2.1 below. Our trade and production data are all valued in 2008 euros. Trade data are based on UNCTAD COMTRADE data as reported (in the case of the EC) by Eurostat and as integrated into the GTAP database. The basic database is built from the GTAP7 database (benchmarked to 2004). We use the basic input-output structure of the database, combined with more recent trade and national accounts data, to re-base our dataset to 2008. This is the starting point for out analysis. In addition to the 32 sectors listed in Table 2.1, the model also includes 16 regions. These are detailed in Table 2.2. Critically, the regions include

Austria's major trading partner (Germany), the remaining EU13 (old EU) and EU12 (new EU) Members, as well as other major OECD and non-OECD countries and regions. Table 2.2 also presents underlying macroeconomic trends for these regions from 2008 through 2020. The 2020 projections are based on the most recent (October) macroeconomic projections from the IMF, as reported in its World Economic Outlook. We have extended the IMF medium-term projections through 2020.

Table 2.1

Model Sectoring Scheme

Primary	light manufactures
coal	chemicals rubber plastics
oil	petrochemicals
gas	electrical machinery
mining	other machinery and equipment
processed foods	utilities
textiles	construction
clothing	trade
leather	transport
lumber	communications
paper and publishing	other finance
metals	insurance
fabricated metals	other business services
non-metallic minerals	rec and other consumer servs
motor vehicles	other Services
other transport equipment	

Table 2.2

Regional Aggregation Scheme

	GDP 2008, billion euros	real growth rate, 2008-2020
Austria	283	1.46
Germany	2,509	1.04
EU 13	8,446	1.55
EU 12	1,321	3.12
EEA	662	1.29
NAFTA	11,631	2.10
Other OECD	4,768	2.07
China	3,103	9.33
Brazil	1,074	3.26
Latin America	1,801	3.49
India	824	7.51
Russia	1,145	2.92
ASEAN	863	5.10
Middle East and North Africa	1,485	4.45
Sub-Saharan Africa	678	4.98
Rest of World	1,014	10.26

source: IMF WEO, October 2009 (with projection through 2020).

2.1.2. IMF-based macro projections

The model, with its sector and regional aggregation scheme as outlined in Tables 2.1 and 2.2, is used to project the global economy through 2020. The core of the baseline projections is the real GDP growth rates reported in Table 2.2. This is combined with estimated growth in population and labour force by region (from the IMF, and also from EUROSTAT). Macroeconomic projection then involves imposing the baseline GDP and demographic trends on the CGE model, linking investment to underlying income and savings rates, and then using the model to estimate the underlying TFP growth rates, at the national level, consistent with the IMF-based growth projections. We also impose medium-term real price trends for energy, based on IEA projections. Because the model also includes employment, production, and consumption at the national level by industry, as well as bilateral trade flows, we are then able to also estimate changes in the underlying structure of the global economy as well. The estimated changes in global production, employment, and trade are consistent with baseline 2008 economic structures (input-output shares), which are taken as a starting point.

Table 2.3 below reports the baseline energy price trends, valued at 2008 prices. We work with late 2008 and early 2009 energy prices, as these better reflect long-term trends than do the short-term spike in energy prices in early 2008.

Table 2.3

Energy price trends in the 2008-2020 baseline

Benchmark prices				
		2004	2008/9	2020
Crude oil, average	€/bbl	30.4	41.0	85.0
Natural gas, average	€/mmbtu	4.1	4.5	6.0

Source: World Bank Pink Sheets; IEA; industry projections.

2.1.3. China's impact

To estimate China's global impact, we take as a starting point the full set of macro projections summarized above in Tables 2.2 and 2.3. In the baseline, underlying growth trends through 2020 mean an increased shift in the centre of global economic activity, with Asia in particular accounting for a rising share of global production and trade. This proves important in the estimated impact of China on global energy prices. As highlighted in Christie et al (2009), the high income (OECD) economies account for 70% of global economic activity in 2008, while this share drops to 58% by 2020. This is driven especially by rapid growth in China, which rises from 7.5% of global GDP in 2008 to 14.5% in 2020. NAFTA drops from

29.9% to 23.9%, while the EU drops from 30.2% to 24.4%. Austria's economy is estimated to be 19% higher by 2020 than its level in 2008.

For China, the counterfactual means we "unwind" or remove the direct labour force, output, and productivity and investment changes in China in the 2008-2020 baseline projection, leaving the size and average productivity level of China's economy at 2008 levels, while retaining the full projected mix of labour force and productivity growth for other regions from the baseline projection. We do allow global investment levels to adjust in response to the smaller size of China's economy and the impact this has on savings and investment levels. The result is an estimated set of changes linked directly to China's economic growth, and the impact this has on the global economy and on energy prices.

We summarize the basic impact on global growth rates in Table 2.4 below. It is clear that China's rapid growth has a major impact on the growth rates of the rest of the world. Indeed China's growth is apparently an important driver of growth for a number of countries. In the EU, China's rapid growth, and the export opportunities this implies, contributes 0.5% to annual growth rates. In the NAFTA block and the other (Pacific-Asia) OECD countries, this contribution is 0.3% per year. India, at the other extreme, benefits from a smaller China, as India competes more directly in product space with China, both in terms of exports, and in terms of demand for raw materials. Indeed, India's annual growth is estimated to be 1.12% higher, approaching China's current growth rates, in the absence of this competition. The rest of the World region (primarily lower-middle income developing countries) also are impacted negatively by China's rapid economic growth, as they, like India, are competing with China in export markets, and also for raw materials, including energy. The impact of China on global energy prices is summarized in Table 2.5. In the Table, we provide both the projected baseline increase in real energy prices (valued in 2008 euros) through 2020, and the marginal contribution that China makes to overall changes in these prices. Two results stand out. The first is that China is the dominant driver in energy price increases in the 2020 baseline. From the table, approximately 90% of projected oil price increases are linked to growth in China. The second is that China's appetite for oil dampens, slightly, prices for gas. The reason is that China's industrial expansion, fuelled by oil and coal, displaces industrial production in the OECD, which is fuelled relatively more by gas.

Table 2.4

China's Impact on GDP trends in the 2008-2020 baseline

	GDP 2008, billion euros	real growth rate, 2008-2020	real growth rate, without China	China's impact on growth
Austria	283	1.46	0.95	0.51
Germany	2,509	1.04	0.54	0.50
EU 13	8,446	1.55	1.04	0.51
EU 12	1,321	3.12	2.93	0.19
EEA	662	1.29	0.61	0.68
NAFTA	11,631	2.10	1.81	0.29
Other OECD	4,768	2.07	1.77	0.30
China	3,103	9.33	0.00	9.33
Brazil	1,074	3.26	2.64	0.62
Latin America	1,801	3.49	2.88	0.61
India	824	7.51	8.63	-1.12
Russia	1,145	2.92	2.30	0.61
ASEAN	863	5.10	5.08	0.02
Middle East and North Africa	1,485	4.45	3.81	0.63
Sub-Saharan Africa	678	4.98	4.18	0.80
Rest of World	1,014	10.26	10.59	-0.32

Source: Alternative baseline assumptions for projection model. See text.

Table 2.5

Energy price trends in the 2008-2020 baseline

	Benchmark prices 2008/9	benchmark prices 2020	prices without China's growth	China's share of total price increase, %
Crude oil, average €/bbl	41.0	85.0	45.6	89.6%
Natural gas, average €/mmbtu	4.5	6.0	6.2	-12.7%

Source: Alternative baseline assumptions for projection model. See text.

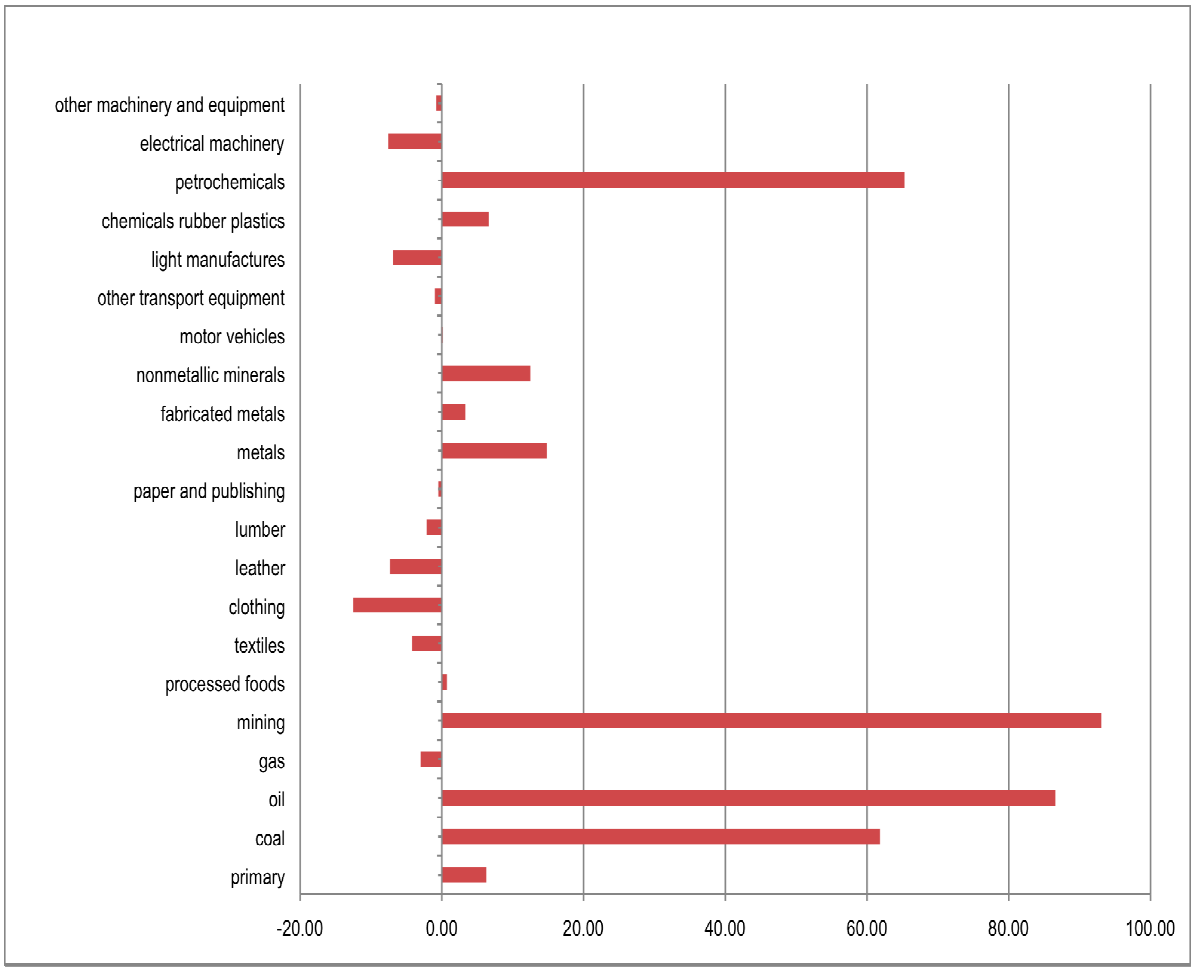
This shift in industrial production also means a shift in industrial energy demand from gas to oil and coal. In the absence of this industrial expansion in China, the corresponding production is shifted back to OECD countries, with a corresponding drop in oil and coal demand and a rise in gas demand. Consumer product sectors that are otherwise served by a growing China, like textiles, clothing, and electronics, shift production back to the OECD (including Austria) to meet growing consumer demand. At the same time, sectors that realize drops in demand as China's industrial production, including metals and chemicals,

contract under the alternative baseline. The same holds for processed foods, where 3.9% of Austria's 2020 production is supported by growing consumer demand in China.

From the results in Tables 2.4 and 2.5 China is an important factor in global energy markets. This holds especially for oil and coal, and less so for natural gas. Indeed, in the baseline projections, 2008-2020 growth in China causes a 61.8% real increase in coal prices, and an 86.6% real increase in oil prices. The shift in industrial production to China actually puts downward pressure on gas prices, driving them down 2.5% over the projected baseline. The China effect is not limited to energy, as primary industrial inputs (steel, non-ferrous metals, industrial chemicals, and petro chemicals) all experience strong increases. The overall impact on global traded goods prices in shown in Figure 2.1.

Figure 2.1

China's impact on global goods prices



Source: Alternative baseline assumptions for projection model. See text.

Chapter 3 – Oil market effects

3.1. Introduction

In this chapter we explore and present explanations for China's attempt to meet part of its oil needs through upstream investments and through a greater recourse to long-term supply contracts. What are the possible consequences of those choices, and what motivates them from an economic perspective? To be more precise, what do resource (and agricultural) property titles (i.e. upstream oil investments) provide when trade and functioning markets exist? In a similar vein, what is the advantage of favouring long-term supply contracts if there is a spot market that allows efficient arbitrage?

Our analysis starts with a few characterizations of the world oil market and then surveys standard economic reasons for acquiring property titles or for signing up to long- term contracts. These economic rationalizations are then applied to concrete objectives China or respectively the Chinese companies, most of them national companies, pursue and how much that makes sense. Given the opaqueness and difficulty of quantifying the consequences of these Chinese undertakings, a simple demand model is calibrated using published elasticity estimates and forecasts. Using this framework projections are made, the consequences of Chinese oil demand on global demand, supply and market clearing prices are computed, and the consequences of supply disruptions are studied. A final section discusses a few other quantitative approaches that could be the subject of future research.

3.1.1 The oil market - characteristics and history

The first and most important characteristic of the world oil market is that one can indeed speak of a global oil market, i.e., a common pool from which all consumers may buy and into which all suppliers may sell, thus leading to 'one oil price' through arbitrage[72]. This is not the case with other energy products. Cross-border trade in electricity is very limited and large price differences between countries can persist and sustain themselves. Natural gas markets, to take another example, are strongly fragmented along regional lines[73]. The situation of crude oil is, from one point of view, a seeming paradox. Physically speaking it is a

[72] Of course, prices do differ between different types of crudes but those differences are relatively minor and reflect location – Brent is closer to the market (here in Western Europe) than Arab Light – as well as quality (gravity, the lighter the better, and sulphur content, the less the better).

[73] LNG notwithstanding, arbitrage between national markets is very limited, allowing very different price formation patterns, e.g. between European countries and North America, see Anderson (2008).

less homogeneous commodity than electricity or even natural gas. From the economic perspective however, the crucial issue is the extent to which arbitrage can operate, and the latter can only be effective at the global level if trade, and therefore transportation, is possible and relatively cheap. In this respect, the safety and cost-effectiveness of sea-bound transportation of oil is the key enabler.

The history of the oil market has seen different price arrangements (in chronological order):

- *Posted prices*: Prices were posted as reference for the tax revenues (plus royalties) to be paid by the major oil companies. This system was in place until 1973 and although OPEC was founded in the sixties, it could only moderately increase the posted price until the Yom-Kippur war. This system was clearly favouring the oligopoly of the seven sisters that controlled the entire supply chain from the field to the pump.
- *The OPEC reference price* (based on Arab Light with its up to 5mb/d providing something like a residual resource). This turned the tables, favouring the OPEC oligopoly as a whole, but working at the expense of Saudi Arabia upholding the price. The system was brought down by Saudi Arabia in 1986.
- *Netback pricing*. Crude oil price deals were based on realised prices of petroleum products on established spot markets (such as Rotterdam, Singapore and New York). This was disliked by OPEC as it led to low crude prices.
- *Market-related pricing* (the current system), which is related to the reference crudes WTI, Brent und Dubai.

Given the acknowledged imperfections of all these systems, it is obvious that they can only prevail if it suits the interests of crucial participants. Mabro (2005) describes the situation as follows: “The determination of oil prices in the current regime involves complex relationships between the market and OPEC. To put it more precisely, a key determinant of prices relates to the ways in which OPEC signals to the market and the ways in which the market receives, interprets and responds to these signals.”

The Spot Market

The original functioning and creation of the spot market was (and to some extent still is) to swap the mismatch of either of volume (too high or too low) or quality (say lighter crudes to meet high gasoline demand as in the US) between contracted crudes and product demand.

The reason is that prior to 1973, the international oil companies ran an integrated network from the oil fields to the gas pump, as mentioned above. After 1973 and the subsequent nationalization of the oil reserves in most oil producing countries, the establishment of independent freight and refining business, the power of the International Oil Companies (IOCs) was broken. As a consequence, long-term contracts replaced partially (but not completely) the former control of supply. In parallel, the share of crude acquired on the spot market increased. Furthermore, the system of official OPEC crude oil price (a price for the marker, Arab Light, and a differential based on quality (API gravity), sulphur and location) was the reference for trades in the spot market, sometimes the spot market 'leading' the official prices such as during the Iranian revolution. The spot prices are actually 'made' by information companies, first *Platts* and *Petroleum Intelligence Weekly*, which report (or at least claim to report) on actual transactions in different markets. One of the main problems of this spot market was and is that very little actual trading occurs which makes the process of price discovery very difficult. In particular, in the last few years there have been some serious doubts about the ability of the physical spot market to generate a price that reflects accurately the margin of the physical barrel of oil. However as a matter of fact (and enforced by the law of no arbitrage), the contract prices are linked to the spot prices. And any discount should be close to zero, because otherwise the buyer could sign a long-term contract and resell on the spot market for a profit. Conversely, oil offered at a higher price than the spot price should logically not find any buyers at all.

The Futures Market

At the moment, three crudes are traded on merchandise exchanges:

- Brent (actually, Brent, Forties, Oseberg and Ekofisk, BFOE)
- Western Texas Intermediate (WTI)
- Dubai

All of the above have a rather marginal contribution (in particular Dubai) but nevertheless serve as markers after Saudi Arabia and OPEC stopped posting a reference price for its reference crude Arab Light. Nearly all oil traded outside America and the Far East is priced using Brent as a benchmark. WTI is the main benchmark used for pricing oil imports into the US. Dubai-Oman is used as a benchmark for Gulf crudes (Saudi Arabia, Iran, Iraq, the UAE, Qatar and Kuwait) sold in the Asia-Pacific market.

Let us have a closer look at Brent futures (following Varma, 2008). This is a deliverable contract based on EFP delivery with an option to cash settle as explained in the contract specifications: the ICE Futures Brent Index "is the weighted average of the prices of all confirmed 21-day BFOE deals throughout the previous trading day for the appropriate delivery months." Essentially, therefore, the underlying for the Brent futures is the cash (21 day) BFOE market. From the lack of a 'money pump' it follows that the futures price cannot deviate too much from this underlying 'spot' price. Now the Brent contract is used to price over 65% of the world's traded crude oil although BFOE is only a miniscule part of the total crude oil production in the world and far more important and influential than any of the markets for physical crude.

The current price regime

Following Mabro (2005), the current oil price determination system can be described as follows. The marker prices are determined in two futures exchanges: NYMEX in New York and IPE in London. OPEC attempts to influence price by signalling its price preferences, by altering the level of its policy-determined production ceiling (and the associated production quotas). Those that buy or sell futures contracts may or may not respond to the signals. A positive market response to an OPEC (production) signal depends on how credible (that is how realistic) the OPEC policy decision appears to be. The nature of the responses also depends on whether the market is taken by surprise by the policy decision or whether it had widely expected it and therefore fully discounted it in the price.

There is, however, a further important point. An OPEC decision on production is one, among several factors, that exercises an influence on the market. It often carries much weight but can be neutralised in certain instances by other factors if those are sufficiently powerful. In other words the general market context is of significance and it is always essential to assess an OPEC policy decision within its broader context, not in isolation.

Both OPEC and the market continually assess the world petroleum situation, i.e., the likely future movements in supply and demand. Ironically, an organisation whose main policy is an oil production programme (OPEC) with an overall ceiling and individual quotas, bases this policy on data provided by 'secondary sources' and not from the member countries themselves. And finally inventories are crucial and based on the weekly data on US oil inventories produced by the American Petroleum Institute and the US Department of Energy. With the oil price collapse in 1986 due to Saudi Arabia opening the valves of its oil fields after its output collapsed from above 10 mb/d to 3.6 mb/d (in 1985) and the subsequent switch

from a price-to-production or quota strategy of OPEC, market quotations became the oil price. With the loss of the marker crude Arab Light, the role of crudes for which organized exchanges exist increasingly filled the void of a reference price.

The narrowness of the spot market and the perceived inadequacies of the spot market (vulnerable to manipulation as already indicated) caused many oil-exporting and consuming countries to look for an alternative. A futures price is determined by actual transactions in the futures exchanges and not on the basis of some assessed prices by oil reporting agencies. Furthermore, the timely availability of futures prices enhances price transparency. The volume of daily transactions and open positions is additional useful information to gauge the liquidity of the market. Formula pricing constitutes the basis of the current international oil pricing regime. The formula used in pricing oil is straightforward: the price of a certain variety of crude oil is set as a differential to a certain marker or reference price. The most important element of formula pricing is the identification of the reference or benchmark crude. Brent, WTI and Dubai-Oman are the main crude oil benchmarks of the current oil pricing system. Nearly all oil traded outside America and the Far East is priced using Brent as a benchmark. WTI is the main benchmark used for pricing oil imports into the US. Dubai-Oman is used as a benchmark for Gulf crudes (Saudi Arabia, Iran, Iraq, the UAE, Qatar and Kuwait) sold in the Asia-Pacific market.

Stocks

Petroleum inventories can serve the following purposes:

1. Inventories of crude oil are readily available to refineries (petroleum product manufacturers) for production of products such as gasoline and distillate heating oil, and inventories of primary petroleum products are readily available to be sold to end users.
2. Inventories are needed to cushion a system that delivers products in batches.
3. Companies build or draw down discretionary inventories based on their price expectations and sale opportunities.
4. Inventories provide a convenience yield as explained above.

And since stocks can provide the marginal barrel either releasing or via the need to build, they can have a significant influence on oil prices. Of course, inventories also build or fall due to uncertainties or unexpected changes in production and demand.

3.1.2 Upstream investments with ownership rights

A property right allows the owner to decide about all issues that are not specified in the contracts that govern the business transactions, i.e. to take (or keep) 'residual rights', see Hart (1995). That is, in a world with incomplete contracts, the owner can fill the gaps according his own needs. In the case of 'owning' an oil field with, say, an average production of 100,000 b/d compared with a contract for delivery of 100,000 b/d is that the control over the oil field allows to extract extra barrels in case of tight supply or even shortages, or conversely to lower output in case of a glut, or to be able to extract when contracts are not honoured due to an embargo or other forms of political turmoil (i.e. the latter operates like an inventory, but below ground).

In the absence of severe security crises (embargo, blockade, war, civil war or revolution), the ability for a consuming country to adjust production abroad to better fit current market conditions would be an advantage. However the same outcome can theoretically be achieved by holding inventories at home and by combining that safety margin with financial hedging using futures contracts. That said, one could also argue that the latter does not exclude the former, and that both types of security arrangements can work towards the same goal. The question remains, however, as to whether upstream residual rights lead to intrinsically different and intrinsically favourable outcomes for the home (net importer) country.

In case of severe security crises, the kind of arrangement which would in theory be required is neither politically feasible nor politically desirable, e.g. full ownership and control over large fields in countries such as Saudi Arabia, Iran or Russia. Producing countries, for their part, are naturally reluctant to cede residual rights to foreign investors for both economic and security reasons. As a result, and as was illustrated by the examples from Chapter 1 of this report, China's foreign upstream investments typically involve limited ownership rights (if any), particularly where more mature and larger producers are concerned. On the other hand, Chinese (or for that matter Western) leverage over minor emerging producers can be relatively high, but the resulting gain in terms of supply guarantees (if one assumes that such are achieved) is small compared to the impact on world prices which more established producers can have. Of course, this is not to say that import dependent nations should do nothing. The question is rather whether upstream ownership makes economic sense from a security of supply perspective if one focuses strictly on short-term physical availability of oil and if one assumes normal relations between net importer and net exporter states.

Another motivation for upstream ownership stakes is as a long-term insurance against unanticipated high oil prices. Hence, one is willing to pay prices for ownership of fields that are above expected levels in order to be insured against higher than expected future prices. Foreign investors are typically entitled to what is called equity oil (with all the caveats of course). The host country retains the bulk of the output, typically 80% although weaker governments may accept up to 65-35 split. In this case the investor, in our case China, gets for example 20% of the output from which it has to pay taxes and royalties. This provides somewhat reliable supply and a financial hedge since the investor (China) owns a share of the output. However even this entitlement to crude oil is less certain than appears on paper. The reason is that substantial gains for the contractor will attract domestic politicians and rent-seekers to renegotiate the favorable terms (of course, favorable from a pure ex-post perspective). Recent examples include the nationalization of the Petrobras gas fields in Bolivia, the forced sale of Shell's share to Gazprom from the joint operation in Sakhalin and the progressive elbowing-out of BP from its joint venture with TNK in Russia. Furthermore, the amount of financial hedge can be substantially diminished by ex-post negotiations if the terms appear ex-post as too favourable for the investor from the point of view of the host government. This phenomenon has been widely observed, even in traditionally law-abiding countries like the UK, where even a Conservative government lowered pre-contracted price caps after observing higher-than-expected profits. (The subsequent Labour government went further of course, and introduced, ex-post, a windfall tax on past profits.) Of course, these degrees of possible ex-post exploitation differ: owning an oil field in Texas will be less risky to this kind of ex-post expropriation than an oil field in Russia or Venezuela. On the other hand, a big country like China may have leverage over small developing countries as mentioned earlier, particularly if 'package deals' are used.

3.1.3 Upstream investments without ownership rights

Convenience yield

Holding physical barrels either as an inventory above (i.e., conventional inventory and the corresponding section on inventories) or below the ground (i.e., property or more precisely, control rights on extraction) can provide an additional so called convenience yield, which is a little bit a slippery concept. However, most of the following convenience characteristics apply, strictly speaking, only to inventories since they are the only ones than can be used quickly. Hence, this yield is of only tangential relevance to the objective of this investigation. Oil inventories provide convenience (beyond capital gains) to at least some inventory holders (otherwise no one would hold them). Finch (2005) lists the following:

- The *Marginal Convenience Yield* is the convenience gained from holding an extra barrel of inventories;
- The *Net Marginal Convenience Yield* is the marginal convenience yield net of physical holding costs;
- The *Percentage Net Marginal Convenience Yield* is the net marginal convenience yield divided by the spot price of the commodity.

Because the marginal convenience from holding an added barrel of oil typically outweighs the physical cost of holding that extra barrel, those who buy inventories are in effect buying a "dividend stream" of future convenience yield. This stream of additional benefits causes the price of oil, like the price of dividend-bearing stocks, to increase more slowly than the overall required return. As a result, the expected long-run growth of oil prices is less than as predicted by Hotelling's rule.

Supply side politics

Another economic rationale could be that China sees these upstream involvements as a part of an optimal energy supply portfolio. Actually, China's intention goes beyond that in the sense that it simply scared about the security and reliability of its energy and in particular oil supplies that are needed for its breath taking development. This point of view may appear paranoid, but given the political turmoils affecting crude oil markets, not entirely. One may add that the expansion of future global oil production may be modest and that further and substantial oil fields, let alone the option of owning them, are rare. Hence, one might foresee stronger competition about future supplies and controlling some of them (but how?) may prove vital in particular for a country like China with substantial increases in demand, compared with the rather flat oil demand in the old industrialized world.

3.1.4 Long-term supply contracts

Seller and buyer relationships can operate according to various modes, e.g.

- At arm's length on the spot market
- With long-term contracts = a contract where signing date and delivery date(s) are different.
- Clusters
- Vertical integration

The reasons for designing and signing long-term contracts can be quite different, e.g.:

- To insure specific investments, e.g., for pipelines in natural gas markets
- To lower transaction costs (in the narrow sense)
- To allocate risk: the risk averse party is willing to pay (accept) a constant contract price above (below) the expected price as an insurance against price uncertainty and volatility.
- To screen contract partners

The accruable potential benefits from long-term contracts depend on the details. For example, a long-term contract linked to market prices – either following the netback scheme of the late 1980s or the spot or even futures prices – will not provide a hedge against oil price volatility. In contrast, a fixed-price contract would ensure the buyer against oil price volatility. However the existence of such arrangements is not documented in publicly available literature and they should in principle be very infrequent due to arbitrage possibilities. Long-term supply contracts with a price that essentially tracks the spot price should therefore be the most frequent option. Chapter 1 of this report documents some cases of long-term supply contracts between China and some of its partners. Those examples suggest that such arrangements occur especially if they are 'packaged' together with other commercial or financial benefits.

In the general case, however, arbitrage means that any contractual discount should be small (or zero), because otherwise the buyer would sign up to a long-term contract and resell on the spot market for a profit while the producer would be deliberately forgoing future income. That type of scenario seems very unlikely, except for special favours 'among political friends' (e.g. Chavez to Cuba). If fixed-price contracts were to occur, they would furthermore be subject to ex-post opportunism especially if prices go far beyond the contracted level, e.g. due to a shortage or a crisis. In such a situation, the supplier may try to ask for extra remuneration to compensate for 'lossed earnings'. In a more hard-headed version, the supplier may resort to various tactics such as delaying or reducing shipments due to 'technical problems'. In turn this raises the question of why long-term contracts exist at all in the specific case of oil. In the extreme case, assuming that the price is exactly the same as the spot price, what are the advantages of a long-term oil supply contract?

One rational explanation for long-term oil supply contracts with take-or-pay clauses and spot pricing can be posited if transportation costs are taken into account; for instance, a supplier may invest in an oil pipeline, and may wish to ensure that the utilisation rate of the pipeline

will remain within a certain range so as to ensure cost-effective and technically acceptable use of the pipeline; in this latter case it is not the price that matters, but the stability in terms of production and transportation costs that arise from fixing the quantities far into the future. Another advantage of a long-term contract with strategic suppliers is that is easier to get marginal barrels, or to cancel them. Outside of such a relationship a supplier would typically charge a premium for extra barrels; a long-term relationship may reduce that problem.

3.2 Quantitative assessments of the impact of China's oil demand

In the following sections we present three approaches from the energy economics literature which can be applied to analyse the impact of China's oil demand growth on the global oil market and on oil prices.

3.2.1 Resource models

One approach is to consider a standard demand resource model (based on OPEC exports) and how the resource price changes due to an increase in the trend. This may be crucial, despite all the critiques aimed at the Hotelling-type models, since according to Jeroen van der Mer[74], retired CEO of Shell, 'prices are increasingly dictated by long-term assessments of demand and supply, rather than current market fundamentals.' Therefore, he advises a long-term view. However there is no market that explicitly trades on this long-term perspective. There are however some indirect channels. Trading of shares of oil companies is one of them. Another is that a perception of higher future prices encourages a more conservative OPEC extraction policy (to save oil in the ground for the more profitable future, see the quote of Saudi Arabia's King Abdullah below) impacting already on today's price. In any case, "the $140/barrel price in the summer of 2008 and the $60/barrel in November of 2008 could not both be consistent with the same calculation of a scarcity rent warranted by long-term fundamentals" according to Hamilton (2008).

Starting point is oil cartel that chooses its extraction, or equivalently its price policy $\{p(t), 0 \leq t \leq T\}$ and the depletion date T, by maximizing its net present value of profits (using the constant discount rate $r > 0$)

[74] From Jad Mouawad, Wild Swings in the Price of Oil Jeopardize Economic Recovery, in *The New York Times* taken from *Der Standard*, 20th of July 2009.

$$\max_{\{p(t)\},T} \int_0^T e^{-rt} p(t)x(t)dt \quad (1)$$

subject to the laws of demand:

x(t) = D(p(t), t) = f(t) - ap(t) *(2)*

where D is the demand function, which is assumed for simplicity to be linear, and p(t) is the price in period t, more precisely price net of costs since costs are ignored and its resource constraint (R denotes the resource volume available for sales).

$$\int_0^T x(t)dt = R\,. \quad (3)$$

The solution of this simple variant of the model of Hotelling (1931) is well known: marginal revenues must grow at the rate of interest, with an explicit analytical solution except for the depletion date, T, which should be determined numerically (e.g. using Newton-Raphson).

Of course, testing this hypothesis depends on the numbers that one uses. For example consider the 'monopoly' of the Gulf exporters; a similar result holds for total OPEC. Using the calibrated demand relation (in billion barrels per annum) with exponential growth (similar results hold for linear growth) shown in (4):

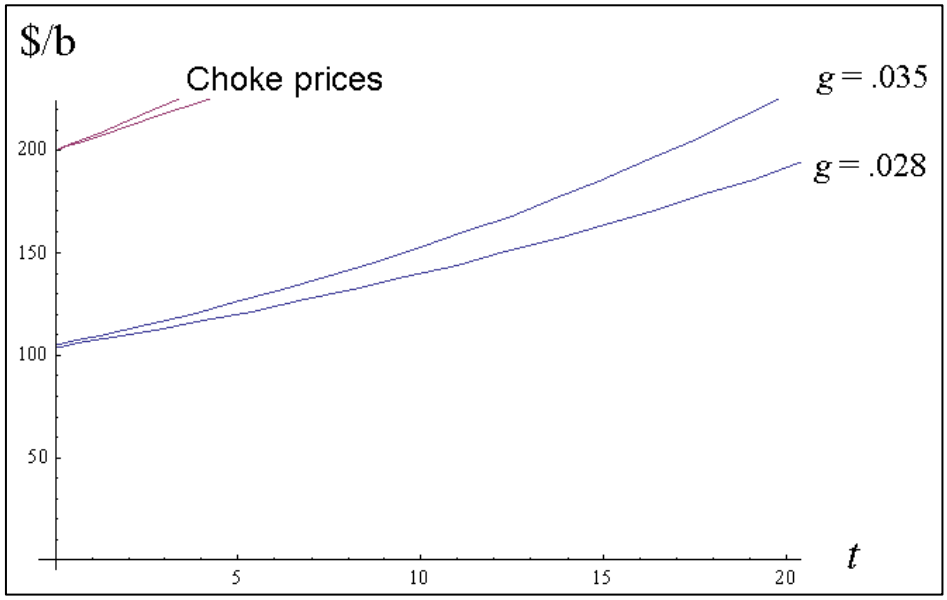
xt = 8.70egt – 0.0435pt (t = 0 corresponds to 2010) *(4)*

pt is the real crude oil price (in 2008-$) in period t. We use a low and a high growth rate: g = 2.8% (= average 2000/1990) and g = 3.5% (annual) to trace the consequences of higher demand growth. This growth is slightly higher than the one implied by the GDP growth assumptions in Table 3 (3% annual, globally) and the income elasticities in Table 1, which would imply a growth of around 2.4%. The remaining assumptions are: a low discount rate of r = 5% (annual) which we assume are used by the Gulf countries somewhat reflecting the quote of King Abdullah; and the availability of R = 500 billion barrels for exports from a given proven reserve base of above 700 billion barrels (BP, 2009); using a higher reserve assumption diminishes the relatively meagre short-run effect even further.

Fig. 3.1 shows the implications of the higher growth path. Prices start very close to a value of above $100/bl (= calibrated static monopoly price) thus the short-run effect of this higher growth is small, but grows then significantly over time. From the point of view of the net present value, the higher growth rate increases the value of an additional barrel (extracted over the next 20 years) from $142/bl to $157/bl, or roughly a 10% increase.

Figure 3.1

Oil price projection based on a calibrated resource model



Note: based on equation (4) and assuming r = .05, R = 500 and g as indicated.

3.2.2 Market clearing approach (static)

Another way to look at the consequences from China's (and others') future oil demand is to sketch how expected growth in demand and likely supply determine market clearing price levels making some sensible assumptions about income and price elasticities. Of course these back of the envelope calculations exclude all major structural changes in demand, e.g., severe restrictions due to global warming that are accepted at a global level, which is not very likely, compare Mitrova (2009) on Russia and Zhang (2009) on China.

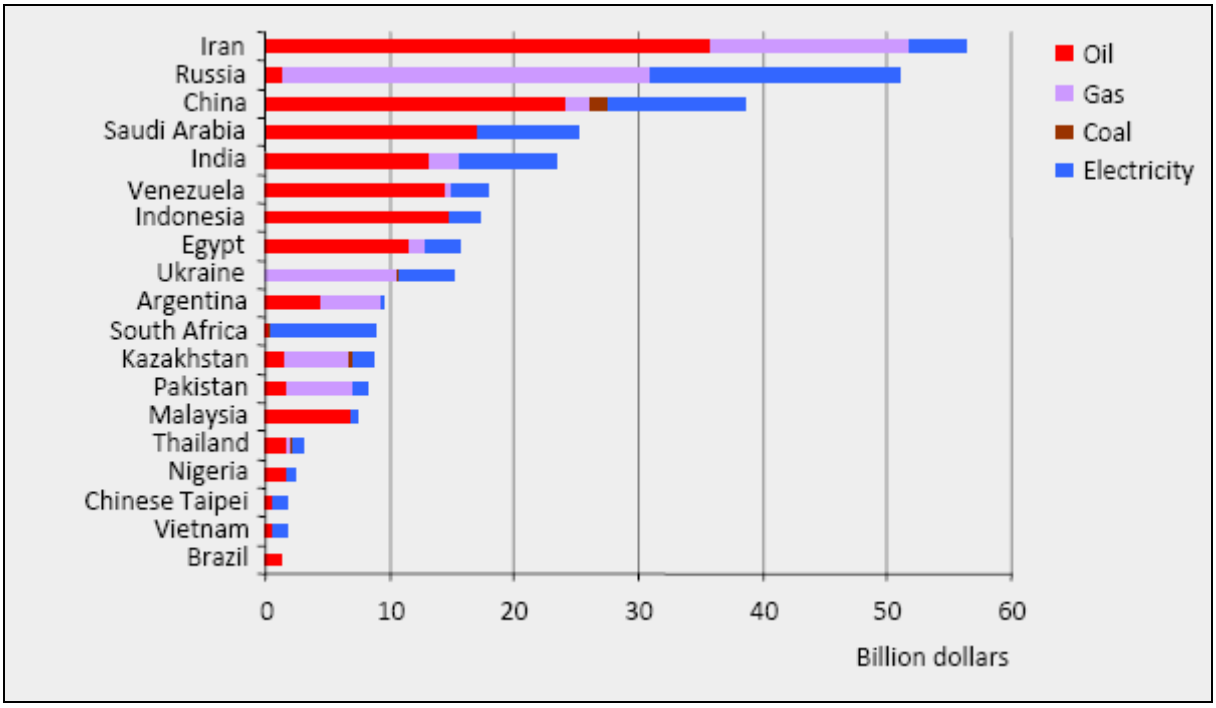
A common rule of thumb concerning aggregate energy demand is that income elasticities are around 1. One may actually put them above 1 for a number of developing countries and slightly below 1 (maybe) for industrialized countries due to structural changes (their output is getting 'lighter'). Indeed, even if empirically estimated elasticities are lower then this may be due not to the underlying demand but may capture the improvements in energy efficiencies during the last decades, most of which were triggered by past price increases or high prices. Ignoring issues of asymmetry across price jumps up and down (compare e.g., Wirl (1988) and Walker and Wirl, 1993), a long run elasticity of final energy prices is around 0.5, i.e. it takes 2% real increase to lower demand by 1% (ceteris paribus).

Now oil is only a part of the total energy demand picture and due to inter-fuel substitution final oil price elasticity may be larger. This works in the opposite direction at the primary level, i.e. at the level of crude oil prices, where the elasticity will be much lower due to the substantial and additive tax components, e.g. above 50% on gasoline in European countries. Furthermore, oil is today in the industrialized world primarily a transport fuel only. Hence, inter-fuel substitution is almost gone such that the oil price elasticity assumed below in Table 3.1 seems quite optimistic about real demand flexibility. And since it is restricted to transport, the income elasticity will be above average (and may be even above 1 considering the growth in air travel). Developing and other countries are generally less price-elastic at the level of final prices but face lower taxes (or are even subsidized) and have more scope for fuel substitution. The elasticities shown in Table 3.1 are taken from a recent investigation of Dargay, Gately and Huntington (2008) that is documented in more detail in the Appendix. An interesting feature is that the income elasticities for oil are across the regions below 1 despite transport demand being often a superior service. And this fact explains the high income elasticity in the OECD where oil is almost reduced to a transport fuel. In the Appendix one finds slightly different assumptions about these elasticities, which end up in markedly different outcomes in particular about the market clearing oil price level (significantly higher prices result). This exercise in the Appendix stresses the uncertainty of future oil prices even ignoring any political factors. Although Dargay, Gately and Huntington (2008) find no price elasticity for China and the former Soviet Union and the oil exporters, the table below assumes at least some price responsiveness in these regions too. One potential source is the huge amount of subsidies developing countries including China spend on fuels, see Fig. 3.2. This is clearly unsustainable, and 'if something cannot go on forever, it will stop' according to Herb Stein. Assuming that China and most other developing countries solve this problem (a strong assumption), this can be reflected by increasing the oil price elasticity (or by reducing the income elasticity). With these modifications in mind the above assumptions about elasticities are our best guesses and used for simulating the impact of Chinese policies on global oil markets.

In our opinion, the recent projections which are used to calibrate the model downplay the demand pressures if the availability of oil supply growth is indeed in the order of 1% per annum. Also, a scenario of peaking oil would dramatically aggravate the issue.

Figure 3.2

Fuel subsidies in developing countries



Source: Lew Fulton, IEA Transport Energy Outlook, EIA/NEMS Conference, Washington DC, April 7th, 2009.

Table 3.1

Basic Assumptions about income (GDP) and price elasticities for oil demand

	Income elasticity	Oil price elasticity
OECD	0.90	0.40
China	0.80	0.20
Russia + trans.	0.70	0.15
Dev. countries	0.70	0.20

Major recent forecasts, notably from the IEA, from OPEC and from Fesharaki (2009), agree (almost suspiciously in our opinion) on 1% annual growth in oil demand rising to around 105 million barrels per day by 2030, see Table 3.2. One could debate the likelihood of that demand level occurring. However we decide, in the present simulation exercise, to take it as a given, and look at the price that should be consistent with it.

Table 3.2

Recent Oil Demand Projections for 2030 (mb/d)

	2008	OPEC 2009	growth/a	IEA 2008	growth/a
OECD	47.3	43.4	-0.4%	44.8	-0.2%
China	8.0	15.9	3.2%	17.0	3.5%
Russia + trans.	5.1	6.1	0.8%	6.1	0.8%
Dev. Countries	24.1	40.2	2.4%	36.1	1.9%
World	84.5	105.6	1.0%	104.0	1.0%

Table 3.3

Assumptions about economic growth (avg. 2008-2030)

OECD	1.7%
China	6.3%
Russia + transition	2.3%
Dev. Countries	4.0%
World	3.0%

Source: OPEC World Oil Outlook 2009.

We assume the elasticities given in Table 3.1 and the economic growth rates given in Table 3.3. Moreover we assume that the price in 2008 (94 USD/bl) was a temporary out-of-equilibrium price. Instead we assume that the demand level observed in 2008 is consistent with an equilibrium price of 60 USD / bl. Based on these assumptions, we constrain global oil demand at 105.6 mb/d in 2030 and solve for the regional demands and the equilibrium price. We find a solution for the equilibrium price in 2030 of 164 USD/bl (at 2008 prices), i.e. an increase of 74%, or 2.5% per year, in real terms, from 2008 to 2030.

The vector of solutions for demand by world region is given in Table 3.4. The major difference with recently published scenarios is the higher projection for Chinese oil demand: 19 mb/d compared with, e.g., 16.3 mb/d in IEA (2009: 81). This stresses two points: first, the central position of China; second, the substantial sensitivity of such projections which are necessarily based on parameters that are only rudimentarily known.

What are the consequences of higher growth in China, say 7% instead of the assumed 6.3%? In this case we find a market-clearing price in 2030 of 177 USD/bl (at 2008 prices), i.e. an increase of 88%, or 2.9% per year, in real terms.

Table 3.4

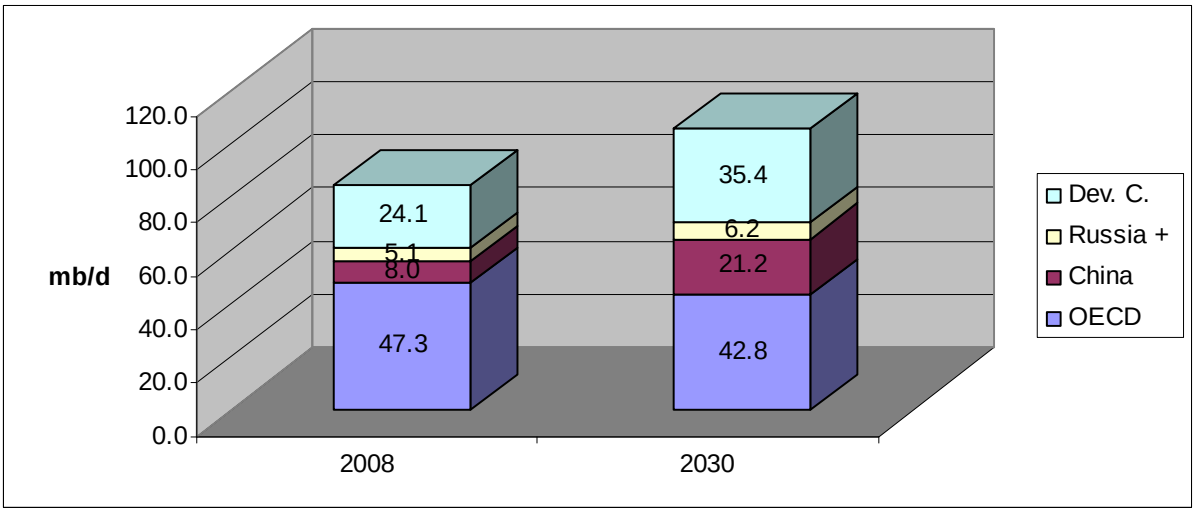
Projection for 2030 (mb/d)

	2008	2030
OECD	47.3	44.2
China	8.0	19.2
Russia + trans. Econ.	5.1	6.2
Dev. Countries	24.1	36.0
World	84.5	105.6

Note: based on the following assumptions: elasticities from Table 3.1, GDP growth according to Table 3.3, oil price at $ 164/b, which clears world demand from Table 3.2 (OPEC 2009).

Figure 3.3

Oil demand by world region in 2030 (high growth scenario)



Furthermore, the composition of world oil demand would change raising China's share from 18% to 20% compared with below 10% in 2008. However, not everything must go in this pessimistic direction. If, as Zhang (2009) claims, 'Chinese investments in oil fields in African countries help to pump more oil out of the fields and enlarge the overall availability of oil on the world market' then these Chinese involvements may mitigate future demand pressure. If we assume that these Chinese investments trigger an increase in oil supply by around 1% or 1 mb/d, what are the consequences? The effect is in fact very limited: it would lower the price in 2030 by around 3% (to 159 USD/bl) with of course insignificant effects on the global demand pattern.

3.2.3 Sluggish demand framework and supply disruptions

The above scenarios ignore short-run effects by assuming that consumers move along their equilibrium demand path perceiving a smooth price evolution in line with the given growth rates (at 2.5% per annum in real terms). This assumption is of course unrealistic given the sluggishness of demand and the less-than-perfect foresight of consumers. Rather than re-simulating the entire demand, supply and price paths, the following analysis considers the short-run effect of a supply disruption when consumers and other suppliers react sluggishly to this unforeseen effect. This can be used to address the issue of a supply shock or of the effect of hitting a peak in oil production. For this purpose, we assume the same long-run income and price elasticities from Table 3.1. Furthermore, we assume that demand reacts to income instantaneously since higher output requires more inputs immediately, ceteris paribus. However we ignore how oil prices affect GDP growth. In contrast, the reactions to prices are sluggish (and symmetric) with a time constant of demand adjustment of 5 years (the 'lag' parameter is then 0.8333…), which one may consider as fairly optimistic given the lifetimes of energy-consuming devices, e.g. over 10 years for cars and many appliances (heating), 50 years and more for buildings.

Let us assume, therefore, that a revolution in Saudi Arabia wipes out its entire oil production (around 10 mb/d) for half a year, i.e., around 5 mb/d for the year as a whole. For the record and as a reminder: Iran's Islamic revolution slashed output by about 75% from close to 6 mb/d to below 1.5 mb/d in 1980, afterwards only slowly increasing (admittedly inhibited by the war with Iraq) and reaching 3 mb/d only in 1990 and 4 mb/d only in 2003.

Table 3.5

Short-run effects of 5 mb/d supply disruption

	2008	No disruption	10 mb/d cut for 6 months
OECD	47.3	49.3	45.8
China	8.0	11.4	11.0
Russia+	5.1	5.6	5.5
Dev. Countries	24.1	28.8	27.7
World	84.5	95.0	90.0
USD / bl		***73.0***	***220.0***

We assume furthermore that demand is 95 mb/d just before the crisis, which corresponds to an equilibrium demand reached 8 years from now, under the assumptions used in our previous simulation exercise, with a corresponding equilibrium price of around 73 USD/bl.

What will this half-year disruption do to the average annual oil price? As indicated in Table 3.5, we find an equilibrium price peak for the year of the crisis of 220 USD/bl. This result may arguably even underestimate the possible effect, given the real-time uncertainty about the length of the crisis during its occurrence, as well as given relatively long shipping times which we left out from our simulation. A longer crisis, e.g. taking Saudi Arabia's output off for a whole year, would surpass any commonly understood threshold: our calculations yield a price of 700 USD/bl, which we dare to report. Slight parameter variations can substantially aggravate such effects. For example doubling the time constant lets the price quintuple (on an annual basis, so the half-year effect would be much larger). In any case, our results lend strong support for hedging against such risks.

Another potential question to ponder for oil security analysis is the following. Suppose China's strategy of acquiring equity oil and having a diversified portfolio of suppliers would allow China to secure an additional 1 mb/d, off-market in a sense, during a crisis similar to the one simulated earlier. In these circumstances, the Chinese economy would better withstand the shock than others who would have to make deep cuts in consumption. China would however face the opportunity costs, at 220 USD/bl, for using the equity oil instead of putting it on the spot market.

Peak oil

The framework sketched earlier could also be used to investigate a peak oil scenario. Another scenario which could be simulated (and which we find would be an interesting exercise for further research) would be to assume a deliberate reluctance of oil producers to expand output for strategic purposes. This lack of a corresponding economic motivation was raised in the simulations of Dermot Gately (2001, 2004), and was well expressed by Saudi Arabia's King Abdullah in 2008, who said[75] he had ordered some new oil discoveries left untapped to preserve oil wealth in the world's top exporter for future generations: '*I keep no secret from you that when there were some new finds, I told them, 'no, leave it in the ground, with grace from God, our children need it.*'

[75] Saudi Press Agency, Reuters, 13 April, 2008.

Chapter 4 – Oil security: actors, targets and incentives

4.1 Introduction

In this final part of the report we provide an analytical framework for the assessment of the oil security position of a major net importer of oil, and then apply it to the case of China within the global context that seems to be emerging by 2020-2030. We start by a brief review of the concepts of energy security in general and of oil security in particular.

4.2. Energy security and oil security

Energy security in contemporary Western discourse can be defined as '*the availability of energy at all times, in various forms, in sufficient quantities, and at affordable prices'*, see Meidan (2007: 16). The International Energy Agency, for its part, suggests the following short formulation[76]: '*the uninterrupted physical availability at a price which is affordable, while respecting environment concerns*'. The IEA goes on to distinguish between long-term energy security, related to '*timely investments to supply energy in line with economic developments and environmental needs*', and short-term energy security, related to '*the ability of the energy system to react promptly to sudden changes in supply and demand*'.

In a sense, the inclusion of environmental sustainability goals, particularly with respect to greenhouse gas emissions, has made the analysis of and the discourse on energy security less clear. There is no doubt that climate change can affect energy supplies (e.g. due to a higher occurrence of extreme weather events which may damage critical energy infrastructure) as well as energy consumption patterns (at the very least due to temperature changes). It is also clear that energy and climate policies must be assessed and designed in concert. However energy security (and a fortiori oil security) is best analysed as a separate general policy target, alongside climate security. This is particularly relevant in the context of short-term energy security (e.g. how to deal with a sudden but short-lived supply disruption), as the time horizons involved are much too short for climate change to matter. In this report, therefore, the definition of Meidan (2007: 16) is preferred over the IEA definition.

[76] http://www.iea.org/subjectqueries/keyresult.asp?KEYWORD_ID=4103 (accessed 15 December 2009)

Guaranteeing uninterrupted supplies in sufficient quantities, as separate from what price must be paid, is the next clarification which needs to be made, both for short and long time horizons. For short-term scenarios, one type of risk for the consumer is a physical supply disruption, i.e. due to accidental breakdowns of infrastructure or uncontrollable natural events, or due to hostile actions on the part of state or non-state actors. In that case, the energy product is not available in the usual quantity, regardless of how much the consumer is prepared to pay. The other main type of risk is a price spike which may occur as a result of a physical supply disruption, of abusive and abrupt use of market power on the part of a supplier, or of a spike in demand which leads to a price spike. As outlined in Chapter 3, the most damaging types of price spikes would come from shocks on the supply side rather than on the demand side, since, e.g., a major upheaval in a key producing country or a devastating terrorist attack on large elements of critical oil infrastructure could occur much more abruptly than a jump in demand. Concerning long-term energy security, the core risk would be an unexpected structural insufficiency of supply as compared to demand which may lead not only to short-term losses but to a prolonged period of hardship and of (necessarily slow) re-adjustment of demand patterns, e.g. a peak oil scenario which confounds the expectations of governments and industry.

In the acute case most of all, and it is important to remember this, *energy security is national security*[77]. This holds true for energy security in general, and for oil security in particular. The decisive issue with respect to crude oil is that it is a *strategic commodity*, i.e. it is:

1. Indispensable for core functions of modern economic systems (and national defence);
2. Not substitutable in the short-run (or even in the medium-run);
3. In insufficient supply in most states, while abundant in a few others.

As aptly noted in Korin and Woolsey (2008), 'the unique strategic importance of oil to the modern economy stems from the fact that oil has a virtual monopoly in the global economy's very enabler — the transportation sector'. The latter statement effectively covers points 1 and 2 of the definition proposed above. Point 3 of the definition naturally leads to the notion of asymmetric interdependence[78] (or power asymmetry) between states, in this case between net importers and net exporters of crude oil.

[77] This exact statement is frequent in US political discourse, see e.g. the February 28, 2006 speech by Barack Obama bearing that title.

[78] See Christie and Graetz (2009) for a (very) compact exposition and an application to Europe-Russia asymmetry with respect to natural gas.

Assessing a country's oil security position can be achieved in a number of ways. The most compact and yet still highly informative analytical exercise is to compute an oil vulnerability index as developed for instance in Gupta (2008). More broadly, the notion of energy vulnerability is a natural complement of the notion of energy security and may be defined as: '*the extent to which adverse exogenous events with respect to a country's energy supply system may detrimentally affect the welfare of the country's population and/or the integrity of the State, its territory or its institutions',* see Christie (2009: 277).

By implication, the correct approach towards assessing a country's oil security position consists in identifying the risks and threats to the country's oil supplies and assessing the likelihood of their occurrence and the potential impact of their occurrence. In a second step, the formulation of an oil security policy should take as its main target the level of the country's oil vulnerability, subject to other policy constraints (e.g. climate policy, industrial policy) and to feasibility constraints (e.g. economic, political, financial, legal). The target variable chosen in this view is the level of vulnerability, i.e. it is not necessarily the case that vulnerability must always be reduced, that depends on the risks and threats at hand.

As mentioned, the simplest assessments are based on the computation of vulnerability indices. In that context a number of well-known concepts of energy security typically enter the index calculations in some form. Drawing from Gupta (2008), Gnansounou (2008), Percebois (2007) and Vivoda (2009), and from the discussion thus far, the variables below may be considered (not listed in order of priority).

1. Oil import dependence ratio
2. Total oil imports
3. Oil intensity of the economy
4. Share and substitutability of petroleum products in transportation
5. Share and substitutability of petroleum products in other sectors
6. Domestically-held oil stocks
7. Diversity of import sources
8. Diversity of transit routes
9. Risks or threats with respect to supplier countries
10. Risks or threats from third parties (e.g. transit countries, terrorist groups, other net importers of oil, other)
11. Risks of accidental breakdowns and natural disasters

The oil import dependence ratio is quite an obvious choice. A net exporter (dependence 0%) can rely on domestic production to fulfil all domestic needs. We assume additionally that risks and threats to the *domestic* oil industry (if there is one) can be dealt with at an acceptable cost, i.e. that the risks of domestic oil production are never so high that the best policy would be to shut down the sector altogether. The total level of oil imports is a complementary variable, though its effect may be ambiguous. In an acute situation, needing less oil from the world market in absolute terms may be an advantage, though negotiating power may be lower. The oil intensity of the economy reflects (imperfectly and very generally) the extent to which the economy can function with less or no oil. This is complemented by indicators on the share and the substitutability of oil products in transportation and in other sectors (e.g. for industry, for heating in the residential sector). An indicator of diversity of fuels in transportation is used in Gnansounou (2008), and it is to be seen in a forward-looking manner, e.g. with respect to hybrid and electric passenger vehicles, see for example the *450 Scenario* assumptions in IEA (2009: 323). The role of domestic stocks, both commercial and strategic, is intuitive in case of an acute supply shortfall. Broader linkages with respect to oil price formation are also in evidence for major consumers, see e.g. Kaufmann et al. (2008).

4.2. Diversification, risks and threats

Diversification is one of the cornerstones of energy security. On that topic, Winston Churchill reportedly remarked that: '*the key to oil supply security is with diversity and diversity alone.*'
There are three types of diversity that are relevant for energy security: *diversity of suppliers*, *diversity of routes*, and *diversity of fuels*. Diversity of fuels is implicitly addressed by points (4) and (5) above. Concerning diversity of suppliers, one potential pitfall is the general idea that the more diversity there is, the better. This is of course not true in the general case, since the goal is to reduce overall risk, not maximise diversity per se. In other terms, being entirely dependent on one stable and reliable supplier may be safer than being dependent on two unstable and unreliable suppliers (especially if their actions are coordinated or otherwise correlated). The assessment therefore depends on the risk factors, an issue which is addressed in the literature by using political risk indicators. That approach is nevertheless incomplete, as it implies an omni-directional concept of country risk. The latter is sufficient if the only risk posed by the supplier is its own collapse, e.g. civil war, revolution. If the supplier uses its energy resources as a foreign policy instrument, then supplier actions (and risks) should be looked at on a bilateral basis. For example, a supplier may deliberately halt deliveries to a specific country. That type of risk should be assessed for each (target) country individually. Fortunately, today's global oil market offers a set-up in which diversity of

suppliers (and solidarity between consumers) is achieved easily. As a result, the impact of a targeted bilateral oil supply cut is mostly spread throughout the world market. Unless the target country is in a landlocked and highly isolated region, alternative volumes of oil can usually be bought and delivered quite quickly from the spot market.

The issue of diversification of routes should also be assessed within a risk analysis framework, taking into account the costs and benefits of developing and maintaining new routes as compared to the risks and threats to existing routes. If the importer is an island, then everything will depend on the safety of sea-lanes. If the importer is land-locked, then more than one overland route should be used (if cost-effective, taking the likelihood of disruptions into consideration). If the importer has a coastline but is not an island, then a combination of sea-bound and overland transit options seems sensible.

We now turn to the main categories of risks and threats. In this context we follow the main categories defined in French Ministry of Defence (2008) by defining *risks* as adverse events that do not result from hostile intent, and by defining *threats* as those that do. Among risks, and focusing on short-term risks alone, one finds accidental breakdowns due to technical failures and/or human error, as well as uncontrollable natural events. The most relevant natural events with respect to oil security are extreme weather events which may be such as to damage or otherwise disable elements of oil infrastructure. Other short-run risks include price spikes which could occur for reasons not elsewhere classified (e.g. new information creates panic on markets). Longer-term risks may be taken to include the build-up of unsustainable or vulnerable trends at home or abroad, e.g. stocks at a persistently low level, strongly increasing import dependence. Among threats one finds hostile acts on the part of State and/or non-State actors (e.g. terrorist groups) who may target critical energy infrastructure. Long-term threats are more difficult to define.

4.3. China's oil security targets

In the case of China the situation with respect to transit routes was sketched out in Chapter 1 of this study: some oil resources are available from Russia and the Central Asian states and can be (or will be) brought to China by existing or new pipelines. In parallel, however, the bulk of China's imported oil comes by sea, and an important share of that import flow goes through the Straits of Malacca. It is therefore useful to explore what risks and threats China may reasonably have in mind by looking at China's actions under the assumption that those are 'revealed energy security preferences'.

Shifting some of the oil transit away from the Straits of Malacca is a non-confrontational measure on the part of China to improve its oil security. Conceivable threats include large-scale terrorist attacks, piracy, and naval blockades. Conceivable risks include major shipping accidents and/or extreme weather events. Like any major power, China has to base some of her security assessments on 'worse-case scenarios', while working towards preventing their occurrence, preferably in a non-threatening manner. In this context it is an open secret that one concern is a possible conflict with the United States (and perhaps some of its allies) over Taiwan, and that this could conceivably lead to the US Navy trying to interdict oil shipments to China. Since the Straits of Malacca are an obvious naval choke-point it stands to reason that the potential impact of such a scenario should be reduced. Concurrently, China's interest in developing a more powerful 'blue water' navy is also discussed in the public domain. The latter would help to secure oil shipments in the face of any of the threats mentioned above, not only in the Straits of Malacca, but potentially further afield, e.g. in the Indian Ocean for both Middle Eastern and African oil. In parallel, Chinese interest in Eurasian resources that can be delivered by pipeline displace (in relative terms at least) some of the oil that it would otherwise import over the seas. In the Eurasian context, China's broader relations with the region, e.g. within the Shanghai Cooperation Organisation (SCO), are complementary to her oil security goals.

The considerations above, which are a direct application of the framework outlined in the previous sections, find some confirmation in the literature. Tønnesson and Kolås (2006: 19) cite a US assessment according to which Chinese policy-makers have three main (short-term) oil security concerns:

1. Sudden disruptions in provision of oil to the global market could trigger serious energy shortages and sharp price spikes that would have severe adverse effects on the Chinese economy.
2. China might be affected by disruptions in tanker flows from unstable exporting regions such as the Persian Gulf, Central Asia and Africa.
3. Japan and the USA might attempt to deny China vital oil supplies in the event of a confrontation, particularly over Taiwan, due to US strategic dominance in the Persian Gulf and other key oil exporting regions, US naval control of critical transportation routes, and its cooperation with the Japanese navy.

4.4. China's geopolitical fears: the US, the Middle East and Oil

A recent and detailed CSIS report on the state of the 'Vital Triangle' made up of the US, China and the Middle East, reports that there is a '*nearly universal belief in China that US policy in the Middle East is essentially about seizing control of that region's oil in order to coerce countries dependent on that oil, as part of a drive for global domination*', see Alterman and Garver (2008: 12) (emphasis added).

Many observers in many countries, including the US and other members of the 'Coalition of the willing' that invaded Iraq in 2003, have discussed the oil aspect of the Iraq War. Even before the war started, opponents used a simple catch-phrase: 'it's all about oil'. But in what way exactly was it 'about' oil? One possible interpretation was offered by Alan Greenspan[79] in 2007, i.e. that: '*Saddam, looking over his 30-year history, very clearly was giving evidence of moving towards controlling the Straits of Hormuz, where there are 17, 18, 19 million barrels a day*'. As a result, Greenspan stated that he supported the overthrow of Saddam Hussein for reasons of US (and ultimately global) economic security, as he feared that Saddam could, at some stage, deliberately disrupt oil exports in the region so as to generate a massive oil price spike (and earn money while crashing the world economy). Greenspan's statement was rejected by US officials. However the vague notion of 'securing oil supplies in the region' has stuck, without any clear interpretation as to what 'securing oil supplies' actually means, and why whatever it does mean might be a good idea for the United States (and for the governments who supported the US decision). At the same time, few Western critics seem to share the Chinese interpretation that the US planned (or plans) to manipulate Middle Eastern oil exports in order to coerce other net importers, notably China, into making political or economic concessions.

China's incomplete line of reasoning was reported in a milder form in Washington Post (2005) and is worth citing at length. In that article a number of Chinese scholars and other experts were interviewed. Pan Rui, an international relations expert at Fudan University in Shanghai, stated: '*Iraq changed the [Chinese] government's thinking […] The Middle East is China's largest source of oil. America is now pursuing a grand strategy, the pursuit of American hegemony in the Middle East. Saudi Arabia is the number one oil producer, and Iraq is number two [in terms of reserves]. Now, the United States has direct influence in both countries.*' Zhu Feng, a security expert at Beijing University, stated: '*Many people argue that oil interests are the driving force behind the Iraq war. For China, it has been a reminder and a warning about how geopolitical changes can affect its own energy interests. So China has*

[79] 'Greenspan: Ouster of Hussein Crucial For Oil Security', *The Washington Post*, 17 September 2007.

decided to focus much more intently to address its security.' Tong Lixia, an energy expert at the Chinese Academy of International Trade and Economic Cooperation stated: '*The turning point in China's energy strategy was the Iraq war. After 2003, both the companies and the government realized China could not rely on one or two oil production areas. It's too risky.*'

All in all, the Chinese leadership may have believed that the US was seeking hegemony over the Middle East, but another matter was whether the Chinese leadership believed that US hegemony over such a large region is at all possible. Barack Obama's arrival in office in 2009, and the access that Chinese NOCs have received to bid for Iraqi oil fields may have allayed the worst fears. On the other hand, a more moderate description of China's views about oil security in the Middle East also appears through the cracks. As stated by Tong Lixia, the realisation was that relying too heavily on the Middle East is 'too risky' in general (which in recent years was certainly true).

4.5. Actors, incentives and coordination

China's oil companies are state-owned, so one could think that China's political leadership retains ultimate power over the NOCs (but may be reluctant to exercise that power in many cases). On the other hand, one could wonder whether the partial independence that Chinese NOCs seem to be increasingly acquiring is necessarily a problem for China. After all, oil companies in OECD countries that are net importers of oil are typically private joint-stock companies. Also, the 'revolving door' between government and oil companies is sometimes observed in OECD countries as well (most strongly under the Bush Presidency). An interesting question, therefore, is the extent to which China's leadership may be deliberately allowing the NOCs to behave increasingly like independent private companies, while keeping some options for political leverage in case things go wrong. In parallel some Chinese analysts, e.g. Dan (2007), argue for further reforms so as to foster more competition in China's oil sector. In terms of China's foreign oil policy, Downs (2007: 76) identifies examples of the NOCs pursuing 'corporate objectives that do not always coincide with national policy priorities'. In particular, she highlights the case of competitive bidding between CNPC and Sinopec for pipeline projects in Sudan, and indicates that elements within China's political leadership were displeased. The latter would prefer if Chinese NOCs worked 'as a team', at least abroad, for example by focusing on mutually-exclusive geographical regions so as to avoid direct competition.

It is interesting to recall the restructuring process that was described in Chapter 1 of this report. Essentially, China's political leadership restructured government ministries and

transformed them into profit-seeking (but state-owned) companies while keeping strong individual links between government and the NOCs. If one takes this restructuring process at face-value, then it is not surprising if China's NOCs are beginning to pursue corporate objectives that do not necessarily coincide with national policy priorities. However the NOCs are state-owned, which means that the Politburo has some residual rights (and leverage) over what they do, just as surely as the oil industry has influence on government.

The opposite stances taken by Dan (2007) and by some Politburo members suggest interesting policy futures. If China liberalises further, e.g. in terms of creating liquid and transparent domestic markets for oil products, then this could further push the NOCs towards independence. On the other hand if the views of some Politburo members gain more traction, then China could end up trying to 'have it both ways', i.e. economic efficiency thanks to competition at home, but coordinated market-sharing activities abroad, as if China's NOCs could behave like a single 'national champion' on the world stage, but compete at home.

Catching-up with the West

Several arguments as to why China's NOCs are so keen to make upstream investments were discussed in Chapter 3 of this report. In this sub-section a rather more standard explanation is offered based on standard incentives. Simply put, China's NOCs are profit-seeking enterprises that are interested in upstream investments if they can get them. The political leadership could simply leave things at that, while pursuing liberalisation, and China would slowly start to resemble the United States more than any other country, i.e. a large, powerful country with substantial domestic oil production which is however far too low to cover demand, and with several large and ambitious oil companies that compete with each other and with other IOCs and NOCs for upstream investments in the world.

However China's political leadership actively supports and encourages foreign upstream investments on the part of the NOCs and has developed a relatively standard view on oil security issues. As a result, one could argue that China's political leadership is deliberately blowing wind into the sails of the NOCs to push them to make rather more acquisitions than they would otherwise commit to, and that this bias in favour of upstream investment is partly motivated by a belief that such investments would 'lock down' resources in case the international situation were to deteriorate again as it did in the 2003-2008 period. The problem with this interpretation is that one would have to clarify exactly what access to resources is secured through those many deals that China's NOCs have entered into.

Conclusions

Over the last two decades China has played an ever-increasing role in the massive expansion of global trade and investment flows and has grown from an economically under-developed country to a major power. China's impact on the world economy in general and on oil demand and oil prices is already large and is predicted to be considerable in future as outlined in Chapter 2. More broadly, some observers foresee that China could become a fully-fledged peer-competitor to the United States in most of the major dimensions of power by mid-century. The structure of the global balance of power, in other terms, is shifting. China's rise to superpower status is not inevitable, though it is widely considered to be very likely. Difficulties and delays may arise for China, economically, politically, socially, and environmentally. The adequate management of energy policy is a central challenge which China's leadership will have to solve. Energy efficiency as a whole will have to improve considerably. Also, as pointed out in Chapter 3 of this study, oil market developments could turn out to be less favourable than the most recent scenarios from the International Energy Agency. As a result, and given her still very small passenger vehicle fleet, China may have a window of opportunity to try to achieve a relatively clean vehicle fleet sooner rather than later. Since China surely wishes to develop into a mature high-technology economy then road transportation could be a good place to start.

Summing up from Chapters 1, 3 and 4, the major reasons for China's engagement and activity in international acquisitions of oil companies appear to be the following:

1. Fears about the future physical availability of oil as a crucial fuel for its development;
2. China's companies are awash with cash and China's NOCs are strongly incentivised to make upstream investments.

Given the fears in (1) and the incentives in (2), it is no surprise that (national) Chinese companies continue to outbid others ignoring the winner's curse, one of the first lessons in any course on auctions. But what are the consequences of this on oil markets? Given the (current) functioning of oil markets, i.e. the link of all oil contracts to market quotations (plus an adjustment) it is hard to see how shifts in ownership (which are anyway limited) could affect future oil market operations. First of all owners, and the Chinese companies presumably more than the host countries, will sooner or later realise the opportunity costs and thus behave economically. An issue of second order is the related expertise. On the one hand one may argue that the Chinese participation increases the efficiency of these

companies compared with purely national ones, on the other hand, these Chinese bids may win against even more competent oil companies.

Therefore, the substantial effect on the future oil market is the demand pressure coming from China that despite its size may still be under-estimated by published forecasts. However, not everything must operate in this direction. For example Zhang (2009) claims that Chinese investments in oil fields in African countries will help to pump more oil such that these (costly) Chinese involvements provide a positive externality to others. It may be questionable whether this Chinese engagement fosters higher output compared with, say, if the international oil companies do it with all their know-how, but even if true, this effect is presumably very small, at least according to our calculations.

A broader lesson from this report is that there needs to be more engagement and more understanding between China and the United States in matters of oil security. By 2030 (at the latest) both countries will have very similar oil import needs and very similar import dependence ratios. As major consumers, China and the United States can understand each other's needs, particularly if China chooses to move closer to a market-based view of the global oil market which would connect its domestic end-users to the world. The European Union and its member states have similar vulnerabilities and concerns as well. Unfortunately, EU member states have been reluctant to pool substantial sovereignty in matters of energy policy. EU states have lived for some time under the assumption that oil security issues could be left mostly to the Americans. With the arrival on the world stage of a new global power which will import just as much oil as the US by 2030, the oil game will become more complex. All three major consumers of tomorrow have an incentive, first, to avoid negative-sum or zero-sum competition for resources; second, to uphold a transparent global market with functioning arbitrage; and third, to work constructively together and with reference to the interests of oil producers towards a new transportation system which will no longer be based on petroleum products.

In order to achieve this outcome, a new trilateral body should be created so as to enable regular meetings and exchange of information on energy trends and scenarios, oil investments and oil security policy coordination, and transportation sector transformation.

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Appendix to Chapter 3

Oil demand elasticities

Table A1: Oil demand elasticities from Dargay, Gately, and Huntington (2008)

Country Group	Oil Product	Long-run elasticities of demand							
		Income				Price			
		symmetric	asymmetric			symmetric	asymmetric		
		Income	Ymax	Ycut	Yrec	Price	Pmax	Pcut	Prec
OECD	Total Oil	0.88					-0.55	-0.22	-0.38
	Residual Oil	0.57					-3.05	-1.14	-1.99
	Other Oil	0.94					-0.48	-0.27	-0.42
Income Growers	Total Oil	0.79				-0.18			
	Residual Oil	0.41				***-0.15***			
	Other Oil	0.92				-0.17			
China	Total Oil	0.77							
	Residual Oil	0.07							
	Other Oil	0.90							
Oil Exporters	Total Oil		1.08	0.33	0.65				
	Residual Oil		0.54	-0.09	***-0.91***				
	Other Oil		0.68	0.18	0.49				
Former Soviet Union	Total Oil		***0.34***	1.20	***0.12***				
	Residual Oil		***-1.86***	1.82	***-1.19***				
	Other Oil		0.75	1.04	0.36				
Other Countries	Total Oil		0.40	0.65	0.33		-0.50	-0.34	-0.25
	Residual Oil		***0.09***	0.90	***0.25***		-0.68	***0.07***	***-0.08***
	Other Oil		0.54	0.67	0.39		-0.23	-0.28	-0.20

Table A2: Oil demand elasticities from Hamilton (2008)

Study	Product	Method	short-run price elasticity	long-run price elasticity	long-run income elasticity
Dahl and Sterner (1991)	gasoline	literature survey	-0.26	-0.86	1.21
Espey (1998)	gasoline	literature survey	-0.26	-0.58	0.88
Graham and Glaister (2004)	gasoline	literature survey	-0.25	-0.77	0.93
Brons, et. al. (2008)	gasoline	literature survey	-0.34	-0.84	---
Dahl (1993)	oil (developing countries)	literature survey	-0.07	-0.30	1.32
Cooper (2003)	oil (average of 23 countries)	annual time-series regression	-0.05	-0.21	---