Chapter 3
Government-supported business investment strategy in gas markets:
Institutional and theoretical backgrounds

3.1 Introduction
For energy-producing and -exporting countries, management of the domestic resource base plays a crucial role in earning export revenues. These resources can also be used to balance the country’s budget or can be reinvested in other sectors of the economy. It can be argued that such a resource advantage can be translated into long-run relative advantages for producer countries. In this manner, the translation into relative advantages should be seen in a world of scarce resources and rising import-dependencies on the part of net-importing and consuming countries (of the particular resource). The revenues from the energy sector play and have played an important role in resurrecting – at least partially – Russia’s economy and other (strategic) sectors during the late 1990s and early 2000s. Yet, these same revenues can also channel the economy into a one-product economic structure, as has been the case in many energy-exporting countries before. For Russia, the question is if and when Russia should further develop and export these resources as a commodity, besides its domestic needs, amongst other socio-economic priorities.

In most of the energy-producing and exporting countries, national energy firms act as caretakers of the nation’s sovereign resources, doing so under the auspices of the government. The government’s interests in the gas market lie in, for example, the presence of economic rents, its primary need in societies, and the inherent complex inter-linkage between the government and market as institutions. When trans-national investments come into play, it attains correspondingly trans-national complexities. In consuming, net-importing countries too, governments claim an important role in their energy sectors as regulators and/or owners of gas (distribution) firms. The strong relationship between the state and market in the gas sector requires an integrated analysis of government-driven and economic determinants. The modern variant of international political economy covers the overarching theoretical background to the relationship between states and market.

Gas firms (whether they are government-owned, semi-national or private firms) must also increasingly operate in a dynamically interregional gas market. The interregional gas market exhibits changing dynamics with respect to market structure, pricing, contract types, economies of scale (in LNG and pipeline gas trade), amongst other factors. The dynamic

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3 This and the next chapter aim to provide the major theoretical and analytical tools of the research as such. In doing so, however, the empirical domain of the research cannot – and should not – be ignored. The important developments in this domain will be discussed at great length in Part II (Chapter 5-7) and Part III (Chapter 8-10).
market theory of De Jong [1989] encompasses the factors that determine an industry structure as it changes over time along its growth path. The dynamics of the market have an impact on the choice of a firm’s coordination mechanisms. Strategies of the gas firms acting in the export market have to anticipate dynamic market developments. Conversely, gas firms, when large enough, can also influence the structure of the oligopolistic gas market.

Generally speaking, private gas firms have the task for their shareholders of maximising the profits of their equity gas reserve. Conversely, national gas firms have the task to maximise the revenues of a country’s gas reserves. In addition, most of the government-controlled energy firms have to take into account the government’s wider socio-economic policy goals [Van der Linde 1999]. Depending on the resource-base and the income needs of the government (also determined by absorption capacity), the emphasis or sequencing of certain investments in the value chain is influenced by these wider goals. Therefore, the dynamics of national and private gas firms differs and, in this respect, they have other investment incentives, being more or less pro-active. However in the long run, for the purpose of this research, it is assumed that a national gas firm aims to maximise the value of gas available for its export markets. In order to capture the full long-run value creation in an uncertain and competitive environment where national gas firms operate in, valuation tools from corporate finance theory should be integrated with the ideas and principles of strategic management theory and industrial organisation [Smit and Trigeorgis 2004].

The theoretical background of the political economy of states and market will be discussed in Section 3.2, with a focus on the actors’ relative advantages. The role of governments, both in producing and consuming countries is the central focal point in Section 3.3. Section 3.4 provides an overview of dynamic market theory and its different coordination principles in dynamic gas markets. The merit order concept will be introduced in Section 3.5 in order to set the scene for forming a business investment strategy. Section 3.6 addresses the linkages between strategic investment planning and corporate finance, in light of the concept of value creation. The ultimate aim is to pave the way towards the a real-option game model to be explained in Chapter 4 to ascertain the value of investments in an uncertain market and competitive environment. This will be done in Section 3.7. The chapter ends with a conclusion.

### 3.2 The political economy of states and markets: Relative advantages

In the post-Cold War era, the international system has changed and is still in transition; see further Chapter 8, and Chapter 2 and 3 in Boon von Ochssée [2010]. In the changing international system absolute military advantages, as it was during the Cold War, have become comparatively less important than relative advantages [Strange 1994]. Relative advantage is primarily about long-run economic power. Especially in a globalising world economy, such advantage may translate into political influence, in particular through structural dependency and the ability to set the rules of engagement to one’s advantage.
This difference between absolute and relative advantages is similar to the difference between chess and “go”, one that Henry Kissinger made in 2004: “Chess has only two outcomes: draw and checkmate. The objective of the game is absolute advantage – that is to say, its outcome is total victory or defeat – and the battle is conducted head-on, in the centre of the board. The aim of Go is relative advantage; the game is played all over the board, and the objective is to increase one’s options and reduce those of the adversary. The goal is less victory than persistent strategic objectives.” [Newsweek 2004]. Within this changing international political system, Russia as a state wishes and could attain the status of great power, through developing a relative advantage. This section argues that Russia’s oil and gas wealth, and in particularly gas, offers a means to develop such a relative advantage. This section serves thus as a theoretical background in the transition from government-to-government relations to firm-level relations.

Through the acknowledgement of economic factors and non-governmental actors neoliberalism assumes that because of interdependence, states also maintain relative advantages [Keohane and Nye 1977]. The modern variant of international political economy (IPE) argues that it is essential to synthesise international relations and (political) economy in order to explain complex issues in the world, such as in the gas market [Strange 1989]. In contrast, neo-realists and realists alike make a distinction between ‘high’ and ‘low’ politics; ‘politics’ and ‘economy’; and state, and respectively market. Gilpin [1987] reasons that “the parallel existence and mutual interaction of ‘state’ and ‘market’ in the modern world create ‘political economy’; without both state and market there could be no political economy […] Although neither world can ever exist in a pure form, the relative influence of the state or market changes over time and in different circumstances” [Gilpin 1987, p. 8].

The thinking of Ricardo and Hecksher-Ohlin in international economics shows how comparative advantage plays an important role in international economic relations, based on international differences of factor endowments [Nielsen et al. 1995]. Two centuries later Porter [1990] argued on the basis of an extensive case by case study of economically well-developed countries that a combination of factors is important in the development of a country’s economy: availability and skill of labour, resources, etc. Countries are endowed with certain resources, in terms of labour, capital, resources and they employ them to develop competitive advantages in the international economic arena. Strange [1988] argues that a nation’s power consists of four dimensions in a framework of structural power:

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*International political economy (IPE) is concerned with the political determinants of international economic relations. The mainstream of IPE built further on the Liberal vision on the International Relations (IR). The core problem, which is studied by IPE, is the mismatch between two organisation principles: territorial organised state systems and de-territorial organised market systems [Voitti and Kauppi 1999].

* According to (neo-)realists and liberals, ‘high’ politics refer to matters of security, such as the strategic interests of states, in particular security and the survival of the state. They have tended to draw a distinction between such high political concerns and those dealing with socioeconomic or welfare issues of lesser interest to statesmen and so-called ‘low’ politics [Voitti and Kauppi 1999; Keohane and Nye Jr, 1977; Nye Jr. 2004].
security, knowledge, finance and production. “Structural power is the power to shape and determine the structures of the global political economy, within other states, their political institutions, their economic enterprises and (not least) their scientists and other professional people have to operate” [Strange 1988, pp. 24-25]. Increases or decreases in terms of the ability to wield power in each of these four different dimensions, thus influences a state’s relative power position vis-à-vis others. Non-governmental actors can play important roles too, but they do not have monopoly over force like governments do [Burchill et al. 2005]. A country’s knowledge and production can lead to financial wealth, which can be used to further boost production, develop the intellectual capital base and develop the means to defend itself.

Up to this point, relative advantage has been described as an economic advantage or, in the case of Strange [1988], as a combination of different power dimensions. Of increasing importance is the role of access to energy (and gas), where energy-consuming countries are becoming more dependent on ever more scarce and steadily more concentrated natural resources. In essence, countries with great endowments in energy resources have a natural absolute trade advantage [Smith 1993]. Given the concentration of natural gas in only a handful of countries (which also holds for many other natural resources), the balance of power is skewed in favour of those countries with excess resources for valuable exports or firms that have the right to exploit them. States rich in natural resources upon which others depend for economic development have a strong relative advantage. This advantage can subsequently be translated into other dimensions of power in the long run [Strange 1988]. In the specific case of natural gas, this resource is gaining in importance, particularly in a post-Kyoto world where reducing carbon emissions is becoming a pressing issue. Gas is a cleaner-burning fuel than oil and coal and the potential contribution of gas as a partly sustainable energy source mix lends it more strategic significance [IEA 2009]. The applications of gas are becoming more numerous: not just power generation, heating and cooking, but also gas-based industries, pharmaceuticals and high value liquids. The reserves for gas also exceed those of oil in terms of reserves-to-production ratio (see Figure 3.1), offering long-term potential in terms of future trade while the industry is still in a relatively early stage of development. For Russia as a state, its gas wealth also offers a means to develop relative advantages with respect to other states.

After the dissolution of Soviet Union, as will be argued in Chapter 6, Russia as a state became weak. In Porter [1990] or in Strange [1988] terms, in that period of time, Russia had limited recourses to export in order to develop a relative advantage or structural power.

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40 Next to structural power, Strange [1988] distinguishes relational power, which is “the power of A to get B to do something they would not otherwise do” [Strange 1988, pp. 24-25]. The most direct form of relational power is a military action, where a state is forced to act according to the other.

41 Before, as will be discussed in Section 3.3.1, Western countries used international energy firms to perform this function.
vis-à-vis other countries, except from its oil and gas reserves. By means of its energy revenues, especially oil, Russia tried to increase its income of hard currency and to repay its debts. However, due to low oil prices in the 1990s, the financial and production power from its oil (and gas) revenues was limited. Therefore, Russia could not broaden its oil and gas revenues from the production dimension to other structural power dimensions. In addition, due to privatisation of the energy sector the government lost partly its control over the sector’s resources and windfall profits [Åslund 2007]. Although, as will be discussed in Chapter 6, part of the gas sector fell into private possession, the gas sector remained reasonably centralised owing to the nature of the industry and the strong political lobby.

Figure 3.1 Russian oil and gas reserves and production in 2008

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<tr>
<th>World/Russian reserves*</th>
<th>World/Russian production*</th>
<th>World/Russian R/P*</th>
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<tr>
<td>Russian Oil</td>
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<tr>
<td>Oil (other regions)</td>
<td>94% 79 tmb</td>
<td>9886 tbd</td>
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<tr>
<td></td>
<td>79% 1179 tmb</td>
<td>71934 tbd</td>
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<tr>
<td>Russian Gas</td>
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<tr>
<td>Gas (other regions)</td>
<td>77% 43 tcm</td>
<td>657 bcm</td>
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<td></td>
<td>42% 142 tcm</td>
<td>2492 bcm</td>
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<tr>
<td>• Russia has almost a</td>
<td>• Russia accounts for</td>
<td>• Russian R/P ratio</td>
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<tr>
<td>quarter of global proven</td>
<td>roughly a quarter of global</td>
<td>for gas is 72 year, for oil 22</td>
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<td>gas reserves and only 6%</td>
<td>gas production and for oil</td>
<td>year</td>
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<td>percent of oil reserves</td>
<td>12%</td>
<td>22 year</td>
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<td>• In the long-run, gas will</td>
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<td>be more important for</td>
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<td>Russia than oil</td>
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Since the end of Putin’s first term however, trade and current account surpluses increased sharply and have kept on rising ever since, as a result of the sharp 1998 devaluation, among others (see also Chapter 6). The steep rise of the oil and gas prices from 2004 onwards, which provided (foreign) revenues to the state budget, freed Russia of any need for funds from the International Monetary Fund (IMF), the Worldbank or the European Bank for Reconstruction and Development (EBRD). The increase in oil (and gas) revenues lessened Russia’s debt repayment and also enabled it to repay its debt to the Paris Club [Legvold 2007]. In addition, Putin created a stabilisation fund, with the aim to manage the income streams from its energy revenues. It made Russia more financially independent as far as state finances are concerned and provides Russia with greater international structural financial power. However, Russia remained largely dependent on its foreign oil and gas income, see Chapter 10.
The increasing fuel revenues from exports are seen by Russia as a way to regain and carve out for Russia a respected position in the international political system. In this manner, Russia’s leadership saw it as merely natural for Russia to make use of its natural competitive advantages [Lavrov 2007]. Putin firmly believed that if used effectively, mineral and energy resources could provide the basis for Russia’s entry into the world economy and could offer the means to modernise Russia’s military and industrial complex and provide social stability and well-being for the Russian population [Balzer 2005]. The process of modernisation of Russia’s economy and political system is still ongoing [Åslund 2007; Trenin 2008b]. In the modernisation of Russia’s economy, Medvedev said the economy should move its focus away from energy and heavy industry towards information technology, telecommunications and space [Financial Times 2009]. However, it is expected that Russia’s oil and gas resources and revenues will continue to play an important role in this respect. For Russia, gas (in terms of production, transport, export earnings and the possible development of gas-based industries) is central to its national interest or relative advantage, particularly inasmuch as they favour and secure the means for long-run economic development. Economic development and security based on gas ultimately translates into other structural powers, such as financial wealth and intellectual capital and secures Russia’s long-run economic power. Depending on the developments in the oil versus gas market (i.e., the relation between gas-to-gas prices and oil-indicated gas prices, see Chapter 8), it can be argued that in the long run gas is better positioned as a relative advantage for Russia than oil.

Besides above-mentioned advantages of natural gas as an energy source, Russia is holder of the largest conventional gas reserves in the world. It holds roughly one quarter of the world’s total, 43.3 tcm [BP 2009]. It is also geographically well positioned to export these reserves. It produced 657 billion cubic meter (bcm) in 2008, which is more than 20 percent of the world’s total [IEA 2009]. In terms of oil versus gas reserves, Russia’s relative position differs: while it has almost a quarter of global proven gas reserves, it has only 6 percent of the world’s conventional oil reserves [BP 2009]. In terms of production levels, Russia accounts for roughly 12 percent of global oil production, producing 9.9 mb/d in 2008 and is an observer to the Organisation of the Petroleum Exporting Countries (OPEC) [BP 2009].

Additionally, in the oil market the countries of the OPEC are and will continue to be dominant exporters, where Russia has no real place as a price setter. While in gas terms, Russia may perhaps be able to develop its own dominance. Given Russia’s future decline

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42 Gas condensates also make an important contribution to Russia’s oil and gas production [Gazprom 2009].

43 The largest (government-controlled) Russian oil company, Rosneft, expects roughly the same level of output by 2020 compared to 2008. The arm’s length cooperation with OPEC and speculation premiums enables Russia to free ride on rising oil prices and to cooperate with OPEC, in the case of declining oil prices [Åslund 2007].
in oil production in the coming decades, oil can thus be seen as Russia’s current cash cow, whereas gas could have major market growth potential. In this regard, see Figure 3.1, which provides a statistical overview of Russian oil and gas reserves and production.

Moreover, gas provides Russia room to develop as an important energy hub in a rapidly developing international multi-functional gas industry. The production of gas and the institutionalisation of its use, both for domestic purposes and foreign, have always remained largely in government’s hands under a centralised decision-making structure (see Chapter 6 and 10). This optimises the production and financial dimension of Strange’s structural powers. Furthermore, most of Russia’s gas trade is conducted by pipeline and long-term take-or-pay contracts, which brings on long-term political and business relationships, due to the rigid nature of natural gas pipelines. Pipeline gas flows, upon which other countries depend, can enhance influence, perhaps more in economic rather than (geo)political terms. The structural dependency primarily of European and CIS states on Russia’s gas can be translated into the development of structural power for Russia. Conversely, Russia is just as dependent on the income stream provided by exports to mainly European countries as Europe is on its gas flows (see Chapter 10) [Hill 2004].

The lack of control exercised during the politico-economic crisis of the 1990s (see also Chapter 6) led Putin to restore some measure of order through government-centred reforms, returning Russian society to a state of relative stability, see also Section 8.2 [Åslund 2007]. In order to coordinate the strategic role of gas as a relative advantage, among others, a strong role for the state appears necessary in the eyes at least of many of Russia’s political elite. The role of the Russian government and governments in the gas sector in general will be discussed in the next section.

### 3.3 The role of governments in the gas sector: producing and consuming countries

In this section a more descriptive approach is taken in order to analyse the role of the government in the gas sector in both producing and consuming countries. Energy policy in Europe, as elsewhere, is typically a national concern. The policy measures and instruments are usually aimed toward a reliable, affordable and clean supply of energy.

Yet, pipeline trade, and particularly the development of new pipeline corridors, has always had, to a certain degree, a (geo)political dimension.

The use of gas as a tool of coercion (e.g., shutoffs) as part of their pursuit of geopolitical goals, has its risks. If and when dependence is highly asymmetric, as in the case of small, isolated gas consuming countries, geopolitical goals could be more easily achieved. This is especially the case when such geopolitical goals are of a short-term and localised nature.

Often translated as price, security of supply and environment. These goals are accepted internationally and have been applied to the energy policies of Western countries for decades.
Traditionally, there is a large difference in political interests between producing and consuming countries. Due to security of supply issues, gas-importing countries generally have a common interest in coordinating policy. Gas producing countries have an interest in avoiding a common policy in order to retain their freedom with respect to export policy [Matláry 1997].

In this context, gas-producing and net-exporting countries are distinguished from gas-consuming and net-importing countries in that they have net outflows of gas volumes. Gas-exporting countries may also be important consuming countries, which influences their gas-export strategy. Consumer countries are defined as countries, which may also be producers but require net inflows or imports to satisfy domestic gas demand. Today, the gas producing and exporting countries mostly include countries that are not member of the Organisation for Economic Co-operation and Development (OECD), such as Russia, Algeria, Qatar, Nigeria, etc. The consumer countries include mostly the OECD economies, but also new recent newcomers as gas importers, such as China and India, for example.

As argued in Chapter 2, competition within the natural gas market is imperfect, because the suppliers involved must be firms large enough to deal with a number of gas industry challenges. Such challenges include the long-lead times between the discovery of gas resources and their production and the capital intensity of the projects involved. Complexities arise in terms of the physical transportation and distribution of gas, the involvement of large sunk costs of infrastructural investments and their irreversibility and the necessity, in many cases, of long-term commitments. Due to these complexities, the natural gas sector is therefore exposed to potential market failures. Market failures fall into three categories, namely the problems of asymmetric information, problems of externalities and problems of monopoly power. They compel governments in both consuming and producing countries to intervene [Armstrong et al. 1980]. Solutions to market failures traditionally range from vertical integration (see Chapter 2), corrective taxes, regulations, aggregate demand management, price controls, subsidies, planning and government ownership [Shleifer and Vishny 1998].

Moreover, the socio-economic impact of gas on national economies, the environment and security of supply are too diverse and crucially interdependent (as an essential public interest) to be left to the market alone, both in producing as well as consuming countries. As far as the gas value chain is concerned, its governance is often not limited to a one single

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47 For a closer study of energy policy instruments and of energy policy in general, see among others: CIEP [2004], De Jong et al. [2005], and Helm [2002]. For a closer study of the national reforms and backgrounds of the European gas market, see among others: Arentsen en Künneke [2003], Helm [2003], and Finon and Midttun [2004]. Specifically for the energy markets in the CMEA-6, see among others: Van der Linde [1991].
Governments also play an important role in shaping the general investment climate. Governments are also responsible for macroeconomic, monetary and fiscal stability, as well as tax and royalty collection from energy and gas production, both in producing and consuming countries. As owners of subsurface resources (with the exception of some countries, such as the US), governments are furthermore in charge of issuing permits to explore, produce, transport and distribute gas. Moreover, both in producing and consuming countries, governments regulate markets and are often either shareholders or full owners of gas (transport) firms. The level of stability and predictability of all these aspects is important to realise the capital-intense investments in the gas value chain (see also Chapter 4) [CIEP 2008; De Jong et al. 2010]. Despite expectations during the 1990s and early 2000s for continued market-oriented globalisation, a host of events and factors have shown that globalisation is challenged by politico-strategic calculations of governments [Van der Linde 2005].

At the heart of all government intervention in the energy sector is the distribution of risks and benefits through the energy resource value chain in the short- and long-term. The government policies are often termed as security of supply and security of demand [De Jong et al. 2010].

3.3.1 Consuming country perspective
Traditionally, national and international energy firms from mainly Western countries were responsible for the energy security of net-consuming countries in the OECD. They controlled most of the world’s oil and gas-producing assets unto the late 1960s [Yergin 1991]. In addition, international energy firms have their headquarters in consuming countries and are backed by their host-governments in doing business. They also enjoyed control of the technology and know-how necessary to produce and export their oil and gas [Yergin 1991]. Only during and after the great nationalisations via national energy firms of the late 1960s and early 1970s, the international energy firms were compelled to abandon their dominant upstream stakes [Van der Linde 1999]. Since then, international energy firms have tried to maintain an edge in terms of access to capital, technological and organisational know-how and other skills, as well as access to downstream markets for both oil and gas. Mid-streamers and international energy firms create joint ventures with national energy firms, offering market access in exchange for upstream access. This does, however, oc-

\* Political economy theories of government, furthermore, assert that interest groups in society have a stake in the outcome of the regulatory process, and actively seek to influence the formation of public policy [Ordeshook 1990].

\* These events and factors include, amongst others, the US invasion of Iraq in March 2003, general instability in the Middle East, the rise of China and its influence in energy-producing and exporting countries, and the assertiveness of oil and gas-producing countries in pursuing greater control of their energy sectors as well as macro-economic shifts (see also Chapter 2, 3 and 11 in Boon von Ochssée [2010]) [Van der Linde 2005].
cur on less favourable terms for the international energy firms than was the case even as recently during the 1990s [Van der Linde 2005].

The rationality of government versus private ownership in a number of energy markets came under scrutiny during the early 1980s, when many governments had to acknowledge their failure as efficient producers and had to limit the weaknesses of their monitoring capabilities [Shleifer and Vishny 1998]. From the 1980s onwards, governments started to limit their role to market regulator and tax and royalty collector [De Jong et al. 2010]. With the collapse of the Soviet Union and the transition of centrally planned economies towards market economies during the 1990s, the privatisation of national energy firms received a major boost (see also Chapter 6) [Stiglitz 1995]. The energy sector in general, both in net-importing and exporting countries, was supposed to participate in an overall process of globalisation, driven primarily by and largely for the benefit of OECD countries and their multinational firms, including the international energy firms. Such at least, was the thinking during the 1980s and much of the 1990s, encouraged by low oil prices and a buyer’s market for oil and gas [CIEP 2004].

During the 1980s and 1990s, the processes of liberalisation and integration of markets started in the US and the UK. Member states within the EU followed suit throughout the 1990s, which occurred by means of directives [Matláry 1997]. These processes were designed to lower the barriers to entry, enhancing competition and integrating national markets into a single European gas market, which would be beneficial for a low price and security of supply [De Jong et al. 2010; Dutch Energy Council 2005]. Today, gas (and energy) importing countries are increasing control over the energy sector again, after the extended period of liberalisation and privatisation. The explanation for the more interventionist energy policies can be found in the increasing tightness, until the autumn of 2008, of the oil and gas markets [De Jong et al. 2010].

The governments of consumer countries, especially in industrialised societies, re-emphasise their public policy interests, because the market would not automatically serve these. As a result, they implemented policies to boost energy saving and efficiency, subsidise new energy sources, and diversifying their dependence on imported energy [Van der Linde 1999; CIEP 2008]. In addition, national governments in consuming countries are regulating markets within the constraints of their public interests, breaking up the value chain through (legal) ownership unbundling. At the same time, these governments tax the energy sector to capture economic rents on the ‘consumption side’ of the value chain. Some governments and international institutions, both on a country and regional level, assist

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50 The main background of the liberalisation and deregulation in the EU was the dissatisfaction regarding its deteriorating economic competitiveness in comparison to the US and Japan. In addition, the political integration process in Europe was slow moving. A more efficient market and exploiting economies of scale would strengthen the competitive advantage [Boxhoorn and Jansen 2002]. For a historical overview of the EU energy policy (and its member states), see: Lefeber and Van der Linde [1987], Stern [1998], De Jong [2007], De Jong et al. [2005].
their ‘national energy champions’ within their industries to realise gas (and energy) imports through political support, by influencing international institutions and creating guarantees, either for economic or political reasons [CIEP 2008; Finon and Locatelli 2002].

3.3.2 Producing country perspective

Of contrary to consuming countries, energy-producing and exporting countries have, throughout the 1990s and increasingly during the 2000s shown a reluctance to relinquish their national interests in the energy sectors. Governments in producing countries began reasserting control of their energy sectors in a bid to strengthen their grip on the economic rents generated by the profitable exploitation of their natural resources. In order to strengthen government’s grip on economic rents, the government can either develop a tax and royalty system or take a greater stake (majority) ownership of their national energy firms (in various upstream projects) [Olorunfemi 1991; CIEP 2008]. The last trend is visible in a large number of gas exporting countries, both non-OECD and OECD countries [De Jong et al. 2010; CIEP 2008]. Also Russia began a process of restoring majority government control and ownership over the Russian gas (and energy) sector, as is explained above and will be addressed in depth in Chapter 10.

Being in control of the vast bulk of the world’s gas resources (some 75 percent), these national energy firms have yet to shape the world’s dynamic interregional gas market. The national energy firms have a national agenda, which often largely concurs with the national agenda and interests of any energy-producing country, which may include the wider socio-economic (and sometimes political-social) interests (see above). Thus in respect to national energy firms, investments in gas must compete with wider investments in economy. Conversely, the international energy firms simply seek to maximise profits and often have a shorter, more commercially oriented time horizon when it comes to implementing projects in the energy sector. Increasingly today, the national gas firms also explore new business models of vertical integration in order to capture additional rents along the value chain [Van der Linde 1999; CIEP 2008]. As such, governments in energy-exporting countries have a principal-agent relationship with their national energy firms as an external agent. Governments in gas-exporting countries delegate to their national gas firms the task of maximising the value of a country’s gas reserves for their export markets. Operating as the government’s agent, the national energy firm determines or biases entry, especially through the administration of Production Sharing Agreements (PSAs) or through serving as a contractor with private international energy firms [Van der Linde 1999]. Contracts between the government as principal and the national energy firm as agent may involve problems of asymmetric information for both the government and the national energy firm. It is uncertain whether the trend of so-called resource nationalism

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51 These problems of asymmetric information may pertain to risk assessment (i.e., adverse selection) and moral hazard vis-à-vis the government as far as excessive risk-taking is concerned when making investments [Stiglitz 1989; Akerlof 1970].
will persist into the future, even though its rise seemed inexorable throughout the early to late 2000s [Breumer and Johnston 2009].

Once the governments in producing countries had secured their income flows, they awarded national firms by offering them a leading role in the economy [Van der Linde, 1999]. The income flows obtained from exporting raw materials (such as gas, oil, and minerals) serve a producing country’s national interest. In general, the energy-producing countries’ patterns of investment reflected the following objectives: the expansion of growth of the non-energy economy, the modernisation and diversification of the economy and reduced dependence on energy as well as the consolidation of national control over the oil, gas and other industrial sectors [Gelb and Associates 1988]. Revenues can also be accrued and saved using a variety of means, such as government-owned investment funds, i.e. Sovereign Wealth Funds (SWFs). Such funds may include mechanisms where revenues earned are taken out of the economy to avoid inflationary effects and stored either in funds for reinvestment in the economy or as foreign reserves. In addition, a large number of gas exporting countries (cross-)subsidise gas prices domestically. Some of them also subsidise their exports, see for example the Soviet subsidies to CMEA countries (see Chapter 5).

The policy towards developing a gas industry and a gas export strategy differs per country. Each country’s export strategy depends, for example, on its path-dependency and natural heritage, such as its geographical location, etc., and the policy priorities in place. This may include domestic needs, such as the development of oil exports and the perceived need to develop a gas-based industry, or merely domestic gas consumption as opposed to exports (which may constrain room for exports). Other factors may include political and geopolitical constraints.

For oil and gas producing states there exists the risk of becoming overly dependent on revenues from energy exports. This is one of the risks inherent to the so-called resource curse. The effects of these revenues on its economy depend in part on the absorption capacity of the economy in question and the management of the surplus incomes. The inefficient use of its resources and their revenues can easily give way to the comparatively unfavourable aspects of a resource-based economy, i.e., having no other sources of economic development than export revenues from energy [Ross 1999].

On the one hand,

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52 If and when a country becomes a so-called petro-state, it basically entails that a country cannot translate its sudden increase in export revenues into state welfare and an effective public system [Ross 1999]. According to Ross [1999] a state can be classified as an energy state on a political policy and institution bases and by economical arguments. The energy state based on political policy can be explained by: (1) cognitive (e.g., earning economic rent results in short-sightedness, for example high-level corruption and policy instability); (2) societal (e.g., increasing non-state actors who favour growth-impeding policies); (3) statist variables (e.g., rentier-state, tax-collecting on energy sector). Another characteristic of an energy state can be derived from the level of political institutions based on rule of law. Economical arguments for energy states can be found in the phenomena of Dutch disease. This could occur when a sudden in-
the threat of the resource curse may provide the incentive to leave a country’s resources (for example gas) under the surface, hence postponing exports. On the other hand, counter-cyclical policy, such as by using government-owned investment funds, could help alleviate the risks of the resource curse. Also the political coherence (among elites) to manage this wealth in the short and long run is important in order to avoid instability due to internal distribution issues.

The process of government involvement in the gas sector, both in producing and consuming countries, is very dynamic and uncertain and may change in the coming decades, due to changing circumstances in the increasingly interregional gas market. The theory of dynamic markets developed by De Jong [1989] offers a theoretical framework for analysing how gas-exporting and importing countries and their respective agents are compelled market behaviour over time, given dynamic market circumstances.

3.4 Interregional gas market dynamics
The current expansion, evolution and globalisation of the interregional gas market, as will described in Chapter 8, is characterised by a market structure that is naturally oligopolistic. This is the case not only because of the size and location of major reserves, which is important for the long-run, but also in terms of the capital intensity of the natural gas industry. Only a select number of players are able to compete and develop in this industry. In addition, as has been shown above, national gas firms are increasingly expanding downstream in the value chain through new sales strategies and are diversifying their export portfolios in the process. The degrees of vertical integration and concentration vary depending on the phase of evolution the market in question is in (other parameters that differ over time include: e.g., economic scales and costs) [De Jong 1989]. Other factors influenced by the evolution of the market include the propensity to compete, form joint ventures or collude, all differing in their intensity and likelihood as a function of time and market circumstances.

3.4.1 Dynamic Market Theory
There is no single model that can capture the totality of all major market changes. The so-called dynamic market theory, developed by De Jong [1989, originally 1972] argues that all these market parameters are constantly shifting in scope and value in a long-term market cycle. This cycle, pertaining to any given product, is divided into four major phases of development: it starts with an embryonic phase of development, followed by expansion and maturity and finally ends in a decline (see Figure 3.2).

The essence of dynamic market theory rests on the relationship between the product life cycle and the paradigm of structure-behaviour-result: Firms behave as a function of the increase in export energy revenues results in an increase in a country’s exchange rate, which will have an impact on the competitiveness of other export products [Van der Linde 1999; Ross 1999].
structure of the market, and to a certain extent (see below), markets are influenced by individual firm behaviour. In other words, the paradigm emphasises that the conditions of supply and demand in a specific industry determines its market structure. This can pertain to various players in the gas market: from consumers to producers, from public to private entities. Each market phase of development has different characteristics and bottlenecks, which compel actors in the market to adapt their strategies to newly emerging market situations. According to De Jong [1989], firms with market power can influence market conditions, the latter also being a function of the different market cycle phases. Particularly in markets with strong oligopolistic tendencies such as the gas market, a dynamic market approach is well-suited to analyse how players in such a market setting would interact, since they are few. Especially when it comes to the natural gas market, the approach is indeed helpful in qualitatively analysing a market strongly characterised by product homogeneity, binding capacity barriers, high barriers to entry, low price elasticity as well as necessary economies of scale [Van Witteloostuijn et al. 2004].

**Figure 3.2 Developments in the gas market: The growth cycle**

Ultimately, static models do not capture industry and market dynamics, though they help explain strategic behaviour and the incentives firms may have in cooperating or not. Strategic behaviour in general takes place in dynamic contexts, not static ones. Indeed, structural developments in markets are above all dynamic in nature [De Jong 1989]. Dynamic market theory is a useful qualitative tool for explaining the dynamics of a market as it moves from one phase to another and as the actors in the market shift from one form of behaviour to another. Market conditions change, shift from one phase of evolution into
another as circumstances alter, e.g., in terms of costs, technological know-how, economies of scale, entry into the market by new players or market structure, etc.

As such, the oil market was shown to be dynamic, with differing levels of concentration amongst market players having a major impact on the leeway for cooperation, prices, market liquidity and other market parameters [Van der Linde 1991]. For firms operating in industries such as those involving natural resources, managing the value chain in a dynamic process is central to their survival and continuity. The interregional or global gas market, as has been the case for the oil market since its very beginning, is characterised by dynamic circumstances, though revolving around different players and more rigid structures than is the case for the oil market. The gas market is, by comparison, in different phase(s) of evolution than the oil market, and so circumstances are different as well. The difference between the oil and gas markets lies also in the inherent differences between oil as a liquid and natural gas as a gaseous substance and their transportation.

The different sequential phases in dynamic market theory need not abruptly end as a new one begins. Instead, they gradually roll over into one another as the market situation and characteristics shift gradually over time. Some factors are more constant than others, but they can change and show different characteristics throughout the evolution of a market. The concept of market development relates to the sequence of different market situations, which may arise in the growth cycle. The forces associated with market developments affect market situations to the effect of metamorphosing each from one form into another. The underlying logic of importance to this discussion (i.e., with respect to natural gas as commodity) is the notion of a dynamic market in which consuming regions become increasingly inter-linked as growth and demand rise, together with fluidity (as opposed to rigidity) in a dynamically oligopolistic market (both at regional and global levels). The duration of each phase of market development or evolution is not specific in this regard [De Jong 1989], but in the gas industry one may assume each phase can last as long as several decades.53

Looking at the interregional gas market from a dynamic market vantage point, one can witness it experiencing a maelstrom of evolutionary cycles, in which producer and consumer countries are struggling to formulate their strategies, in order to strengthen their positions in an ever-changing market. LNG has made possible the globalisation of the gas market by inter-linking different demand centers and opening up new venues for commercial opportunities, while pipelines continue to play a regional role, depending on the consuming and supplying regions in question. The international gas market is not only in transition but also in expansion with emerging trends such as the increasing – though still rather limited – liquidity of LNG trade and the entry of new regional and intraregional market players, both public and private. Specifically for the European market, the sub-

53 In the oil market, each phase was consistently at about 20 years [Van der Linde 1991].
3.4.2 Coordination mechanism in dynamic markets

An essential feature in De Jong’s [1989] dynamic market approach is the idea that firms are influenced by the structure of the market, compelling them to use different strategies. Throughout the process, firms change, adapt to the new equilibrium and are again affected by new imbalances. The strategies in turn affect their environment; ultimately changing it and the cycle starts over again. The degree of competition (on the scale of monopoly to perfect competition) is directly relevant to the ‘gravity’ of this effect. In the specific case of national gas firms, the convergence and divergence of the strategies of national gas firms and gas strategies at a government-level may lead to tension between the management of national gas firms and decision-makers at a government-level (i.e., principal-agent dilemma, as mentioned in Section 3.3.2).

It is inevitable that a certain point, with the changing nature and direction of gas flows, that the producers need to take into account the impact of all these different supply allocation decisions on different (sub)regional and interregional market structures. With the uncertainties in such a transition, from one phase to the next, firms must adapt to new circumstances. Conversely, strategies of gas firms with strong market power in terms of price and volume can affect market structures. The way in which firm behaviour can be coordinated falls into two basic categories: either firms behave as rivals and compete, or they cooperate, trying to exercise some form of joint control over market processes in the value chain. Following this distinction, De Jong [1989] identifies three coordination principles, which firms tend to follow throughout the evolution of the market.

a) Control: Mergers and acquisitions

According to de Jong [1989], firms can choose to acquire assets further down along the value chain via vertical integration (see also Chapter 2). Gazprom’s acquisitions in downstream Europe in the form of storage, stakes in or complete ownership of utilities are prime examples. This form of trying to attain control of assets can materialise independently of whether firms actually compete or cooperate. Other forms of M&As, except from vertical integration, are horizontal and diagonal integration. In the oil and gas sectors, gas producers and sellers moving into oil production and sales and power generation is one example of diagonal integration. These M&As can help deal with smaller potential competitors in order to neutralise their possible effect on market share. Particularly players with a comparatively small production capacity but also low supply costs (due to their
proximity to the market, for example) and thus low economies of scale, are potential M&A targets. On the other hand, smaller players may want security of stable cash flows, resulting in cooperation with a dominant player in the market.

b) Firms behave as rivals: Direct competition
Firms can choose for a competitive model or strategy, in which, for example, as they integrate vertically, they set up direct subsidiaries to penetrate the market further and sell directly to end consumers and thus invest in ‘new’ projects or greenfields by establishing a whole new subsidiary organisation. The examples of Gazprom (via Gazprom Marketing and Trading, see Chapter 10) and Sonatrach are cases in point.

c) Joint ventures or collusion
Firms can be driven to cooperate by looking for ways to collude and avoid competition. This can result in cartels or consortia, which does not include setting up some separate organisation while syndicates, joint ventures and/or common subsidiaries or investments do include separate organisations, which can be jointly owned by the firms choosing to cooperate. Shared investments are those made together with rivals whose market-level impact may be very large in terms of production capacity and may have any level of supply costs and associated economies of scale. Particularly those with large reserves are likely to have economies of scale benefits upstream, but might also need to incur significant transportation costs to bring the gas to the market. Since shared investments are made together with other players, they are not wholly owned, i.e., they are jointly owned, and thus to the extent possible, they serve purposes other than deterrence.

According to de Jong [1989], cartels are agreements between producers, which enable them to influence the market to their advantage. Both private and government-owned firms can participate in forming a cartel. Profit sharing, the application of sales quota, the exchange of statistical information and a policy on battling non-cartel members can be agreed upon. Limiting competition, monopolistic pricing, supply restrictions are all goals, which are attributable to cartels [Jacquemain 1987].

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Footnotes:

54 The stability of collusion depends on a number of interlocking conditions: concentration, number of sellers (in a collusive organisation), barriers to entry and demand inelasticity. There also exist different definitions of what cartels actually are (tacit versus explicit collusion) and different types of cartels. See Chapter 4 in Boon von Ochssee [2010] for a theoretical background of collusion and stable agreements in relation to the gas market.
3.5 Socio-economic agendas and the merit order for gas exports

The socio-economic agendas of countries endowed with natural resources influence the sequence of investments for gas export markets, where governments play a leading role in the gas sector. Hence in this particular case, natural gas resources and facilities (e.g., production, transport, and storage) are the focal points. Throughout the remainder of this study, the merit order pertains to firm-level investments earmarked for gas export markets. For the purpose of this research, it is assumed that in the long run, a national gas firm aims to maximise the value of gas available for its export markets, given other investment variables.

The merit order is a way of ranking available sources of gas and transport options, in this case specifically in determining investments across the value chain of gas. It plays a

\[ \text{Lerner index (L)} = \frac{\text{price} - \text{marginal cost}}{\text{price}} = \frac{-q_i/Q}{\epsilon} \]

with:
- \( p \): price
- \( mc \): marginal cost
- \( n \): number of firms in the industry
- \( \epsilon \): elasticity of demand
- \( Q \): size of the market
- \( q_i \): quantity supplied by firm i

The Lerner index basically says that the firm’s ability to raise price above marginal cost is inversely related to the elasticity of demand. Thus, a Monopoly firm’s Lerner Index equals \(-1/\epsilon\). As the number of firms in an industry grows larger, the residual demand elasticity facing a firm approaches negative infinity, in which case the Lerner index approaches zero. This means firms become price takers, i.e., we have perfect markets. However, in Chapter 9, the Lerner index will be applied to the gas-exporting countries acting in the European and Atlantic region.

Box 3.1 Concentration and market power

Bain’s [1951; 1956] point of departure is that market structure greatly influences the behaviour of firms and determines the outcome of the market process. Concentration is by and large encouraged by technologically determined scale economies in production on a large scale [De Jong 1989]. A number of concentration indices exist. Indicative of concentration in an industry is the measure of market power. Market power in the gas market, whether on a local, regional, or global level, is driven mainly by long-run marginal costs, because of the long-lead times and the capital costs involved in building and completing projects. Of the three cost types, i.e., production, transport (and transit costs) and distribution, transport accounts for the bulk of long-run costs, especially over long distances and when including distribution to small customers, depending of course on the distance covered [IEA 2008]. The Lerner index (L), also known as the Lerner Index of monopoly power, is an instrument to measure market power. This is given by [Jacquemain 1987]:

\[ L = \frac{p - mc}{p} = -\frac{q_i/Q}{\epsilon} \]  

The investment variables or factors, which influence a gas export investment strategy, are summarily explained in the toolbox in Chapter 4.
crucial role for investment decisions in gas-producing and exporting countries, and differs per country.

The amount of gas available for export is constrained by the socio-economic agenda mentioned above. The incentives created by government policies may stimulate or dampen the overall gas export potential. The most important socio-economic considerations include:

- Once gas has been extracted from the subsoil, its future potential production is diminished since it is exhaustible. Some policy considerations, such as the small fields policy in the Netherlands, may include leaving some of the gas in the ground for possible future production.
- Long-term conservation policies to satisfy domestic macro-economic policies in order to avoid the negative effects of the resource curse (see Section 3.3.2).
- Decisions regarding the energy mix: e.g., the use of substitute fuels such as nuclear or coal energy to free up gas volumes for export.
- Caught between the inability to earn as much from natural gas as from crude oil, and low-revenue domestic operations, the potential gas exporter will tend to set aside the resources for future use [Davis 1984]. Thus decisions need to be made regarding alternative gas needs, including oil-lifting and the development of gas-based industries.
- Investment of gas revenues outside the gas sector, aimed to meet domestic requirements for socioeconomic welfare priorities or to meet budget deficits. The non-commercial activities hindered the firms from sustaining core operations [Myers Jaffe and Soligo 2010].
- Due to political considerations, amongst other factors, cross-subsidies of domestic gas prices and the subsidisation of gas exports to neighbouring countries through reinvested earnings from gas export markets, encourages a proactive gas export strategy.
- Pursuant to the point made above, gas exports, and gas flows in general, can play an important role in achieving political integration amongst countries. This adds to the points made above a political rather than strictly economic dimension.

Preferences resulting from the socio-economic agenda can be expressed through policy measures, such as regulation, openness to foreign investment, taxation, etc. Ultimately, these policy measures influence over time the scope for the sequence of investments for gas exports. By extension, as a government-controlled firm, Gazprom is able to play either a proactive role towards gas exports, or a less proactive one. Given the above, the dynamics of national and private gas firms differs and, in this respect, they have other investment incentives.

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6 Oil lifting refers to the process of injecting gas into oil reservoirs to boost oil production.
3.6 Theoretical background of business investment behaviour in the gas market: Strategic planning and value creation

As has been made clear previously, the energy sector can be of strategic importance to an energy or gas-exporting country, central to its national interests. These include the development of the economy, having a fund for future generations, etc. In general, gas exporting country governments delegate to their national gas firms the task of maximising the value of a country’s gas reserves for their export markets. As mentioned earlier, this is also the case for Russia. Given this task, new investments should only be made if they add value. In other words, investments should have a return in excess of the opportunity cost of capital, or investments should create or sustain economic rents (see Box 3.2 at the end of this section). On the basis of the previous sections, it can be argued that Gazprom’s investment strategy is potentially driven by a long-term view, in which politico-strategic and economically strategic investments play an important role. In this context, it has to weigh export growth strategies and market structure changes in respect to their competitors against conservation policies and domestic requirements.

In order to capture the full value creation in an uncertain and competitive environment, the traditional corporate finance valuation approach of investments, which assumes that all operating decisions are set in advance, is insufficient. According to Smit and Trigeorgis [2004], valuation tools from corporate finance theory can be integrated with the ideas and principles of strategic management theory and industrial organisation to value investments under market uncertainty and competition. Such integrated approach can be adequate in assessing long-run competitive advantage and strategic adaptability. The issue of value creation as far as strategic planning is concerned is that it pertains to both internal and external (e.g., position vis-à-vis competitors) factors. From corporate finance theory, one can make a distinction between value from assets in place and from growth opportunities. Generally, assets in place can be valued through a regular (static) discounted cash flow approach, whereas growth opportunities need to be valued via a dynamic approach: the real-option approach (see also Section 3.7.2). Therefore, a combination of strategic planning and corporate finance incorporates not only the static value of measurable cash flows, but also the managerial flexibility value and the strategic value components of investments. This section addresses the linkages between strategic planning and corporate finance, in light of the concept of value creation through investments along the growth cycle. In this respect, firms and governments have to manage a portfolio of cash-generating activities as well as future growth possibilities. The ultimate aim of Sections 3.6 and 3.7 is to pave the way towards the real-option game model in Chapter 4, which is introduced in Section 3.8.

Section 3.6 and 3.7 are largely based on Smit and Trigeorgis [2004] and to a lesser extent Smit and Trigeorgis [2001]. For an in-depth analysis on the linkage between corporate finance and strategy, see the first-mentioned reference.
Internal factors: resources and capabilities

According to the resource-based theory, which is part of strategic management theory, firms should invest in resources or capabilities for pursuing market opportunities in a dynamic environment. That means that these investments should focus on acquiring a distinctive advantage [Wernerfelt 1984; Rumelt 1984]. Resources are firm-specific assets, which are the basic inputs in the production process. According to Barney [1986] and Grant [1995], the resources should have three important features so as to add value (see also Box 3.2 for value components of competitive advantages):

1) Resources should be distinctive, scarce and relevant to establish a competitive advantage.
2) Resources should be sustainable and difficult to imitate in order to maintain a competitive advantage.
3) The firm should be able to appropriate the added value or economic rents, which result from the resources.

As an additional insight, capability (or competence) is the capacity of management to make a set of resources perform a given task or activity. The dynamic capabilities approach focuses on competitive advantage in a rapidly changing environment. The value from the capability to adapt is covered in corporate finance by the real-option approach. According to Teece et al. [1997], three main factors shape the firm’s dynamic capabilities and its ability to create value in a changing environment:

1) Managerial and organisational processes. These processes emphasise the role of learning, integration and re-orientation.
2) Strategic positions. The strategic position of a firm is partly determined by its specific asset base. For example, in the gas industry, a firm’s specialised upstream plant or equipment, its technical know-how and/or reputation among importing firms and governments may determine the firm’s position.
3) Paths and path-dependency. In shaping a competence-building strategy, strategy is also path- or history-dependent. The path-dependency not only determines which investment alternatives are open to the firm today, but can also constrain the firm’s future choices to create a competitive advantage. It emphasises the fact that investments are to some extent costly to reserve and may affect the value of future investment alternatives. For instance, the heritage of the Soviet Union, in addition to its geographical position, has resulted in Gazprom’s focus on gas exports to Europe by pipelines (see Part II). Conversely, Qatar as a relative newcomer has developed a multi-market export strategy (using also LNG) orientated towards different regional markets.

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56 One can make a distinction between tangible and intangible assets. In the gas industry, intangible assets are for instance a firm’s brand name and patents on in-house knowledge. The resources, for example, are tangible assets. Intangible assets are important in generating future valuable ‘growth options’, whereas the firm’s tangible resources (such as gas resources) may be subject to embedded options to expand or abandon (see Section 3.7.2).
External factors: competitive advantage with regard to competitors

External orientations matter in that they may potentially yield a competitive advantage with regard to competitors. The presence and strategic position of potential competitors also influences the strategic choices of the firm. The external view can be related to Porter [1980], who analyses the sources of competitive advantage and excess profits with respect to the level of industry and firm’s strategic behaviour. The industry and competitive analysis framework of Porter [1980] finds its roots in industrial organisation. In line with the dynamic market theory, Porter’s business strategy framework originates from the structure-conduct-performance paradigm. The conditions of competitive behaviour that is determined by the industry’s structure, externally affects the firm’s behaviour. In turn, it determines the performance of the industry as a whole. The competitive forces approach views concentrated industries as attractive in that entry barriers can shield market positions. The profitability and attractiveness of a specific industry or a part of the value chain depends on the so-called five forces in a specific industry, see Figure 3.3 [Porter 1980].

Figure 3.3 The Five-Forces model: industry and competitive analysis

Yet, this five forces framework does not provide a framework to quantify the trade-off between the need to compete versus cooperate. In addition, it has limitations in the conceptual reasoning in a dynamic setting regarding sequential moves. However, a competitive analysis approach involving game theory can be used to quantify these trade-offs (in

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Industrial organisation is a discipline within microeconomics, which analyses the strategic behaviour of firms, the structure of markets and their interactions.
sequential moves). Game theory is useful in obtaining insights about the structure of interaction between players, and in understanding the existing possibilities and consequences of rivalry, see Section 3.7.3 [Tirole 1988].

Portfolio of cash-generating activities as well as strategic options in dynamic markets

As mentioned earlier, at the strategic level, firms (and governments too) have to manage a portfolio of cash-generating activities as well as future growth possibilities (e.g., strategic options). The growth versus profitability matrix of the Boston Consulting Group (BCG) categorises projects (or product-market combinations) into four quadrants according to their potential for future growth and current profitability. ‘Rising stars’ are projects in growth markets with relatively high profitability. ‘Question marks’ represent projects with high growth, but with low profitability. A ‘cash cow’ is a project in a stable market environment (i.e., low growth) with high present profitability. A ‘dog’ is a project in a stable or declining market (low growth) with low present profitability. Portfolio management recommends that firms use the profits earned by cash cows to fund developments of rising stars and question marks [Smit and Trigeorgis 2004]. However, portfolio strategies must be flexible in order for them to enable the firm to adjust to an uncertain dynamically competitive and, depending on the industry, technological change. Therefore, the static aspect of the BCG growth-matrix approach is not in all cases suitable for analysing, for instance, follow-on investment opportunities in an uncertain environment. A so-called real-option growth (ROG) matrix incorporates the planning and management of a portfolio of opportunities in an uncertain and competitive environment via real-option-based valuation (see Section 3.7.2 and Chapter 4). The ROG matrix is a trade-off between short-term profitability and long-term growth potential.

In the process of decision-making, the timing of strategic investment(s) and the choice of productive capacity in growing gas markets are the most common problems in business strategy when it comes to the gas industry. As described in a previous section, each stage along the growth cycle is associated with particular, structural features, which determine competitive advantage and the level of competition. During the introduction and growth stages (cf. Figure 3.2 of Section 3.4.1), a firm can uphold an entry barrier through the establishment of economies of scale, for example, by building substantial production and transmission capacity. Such a barrier lowers the expected revenues for prospective purchaser. Late-movers would be reluctant to grow since they would be faced with the higher cost associated with the threat of price competition due to, for example, already existing excess capacity. In the first two phases, most isolating mechanisms are based on early-mover advantages (see also Chapter 4). However, it is not always fruitful to move early, which implies late-mover advantages. Lieberman and Montgomery [1988] argue that late movers can benefit from (1) the ability to free-ride on the advantages of early-movers (i.e.,

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\* See Grant [1995] for an in-depth analysis of competitive advantage and the growth cycle.
shared growth options); (2) the option value to wait in a situation of high (market) uncertainty; (3) switching benefits because of created substitutes or new technology.

During the mature phase, a usual development, which can also be applied to the gas industry, is that competition shifts from capacity to price competition. Depending on the height of exit barriers and the strength of international competition, the process of price competition may intensify during the decline phase. In such a phase, a competitive advantage can be obtained from two generic strategies: (1) a cost leadership strategy that allows a firm to produce at lower cost than its competitors; or (2) a differentiation strategy that allows the firm to set a premium price.

**Box 3.2 Economic rent: Definition, underlying sources and the link to corporate finance**

Gas is only worth what it can bring in gas markets minus transportation (and other related) costs [Davis 1984]. In this sense, the level of economic rent – profit above the opportunity cost of capital – achieved by a gas firm consists on average of the added value of the gas industry and the value created relative to its competitors (see Figure 3.4). Formally, the economic rent from the production of a natural resource can be defined as “any payment made to a production factor above the amount necessary to keep that factor of production in its present employment” [Baumol and Blinder 2000, p. 753]. Applied to the gas industry and specific from the sphere of costs, economic rent can be defined as the difference between the market price for a certain amount of gas minus the total cost of the producer at that level (of production, transport, processing, storage, distribution and use of capital for the specific producer) and the market price for that amount of gas minus the normal cost at that level (the ‘normal’ cost of production, transportation, processing, storage, distribution and capital, as it applies to competitors):

\[
\text{Economic rent of firm}_j = \text{profit}_j - \text{‘normal’ profit of competitors}_j \\
\text{Economic rent of firm}_j = q \left( p_M - c_j \right) - q \left( p_M - c^N \right)
\]

i.e.:

\[
\text{Economic rent of firm}_j = q \left( c^N - c_j \right)
\]

with, from a gas producer’s perspective:
- \(q\) = demand of natural gas in cubic meters;
- \(p_M\) = market price for natural gas per cubic meter;
- \(c_j\) = total cost per cubic meter for production, transportation, processing, storage, distribution and use of capital, for the specific producer \(j\);
- \(c^N\) = ‘normal’ cost per cubic meter for production, transportation, processing, storage, distribution and capital, as it applies to the competitors of \(j\).

(continued)
Achieving a cost advantage is only one value component as a basis for economic rents. Looking more in detail to the (other) different value components, there are two underlying sources, as described in Figure 3.4. Firstly, it depends on the general investment attractiveness of the industry in which the firm operates. In this category, barriers to entry, a natural monopoly or a monopoly imposed by the government, and vertical bargaining power can be underlying sources of excess returns in, for example, the gas industry. Secondly, value creation depends on the creation of a competitive advantage of a specific firm over its rivals. Such value driver may result in a cost advantage, for example: Economies of scale and scope and absolute cost advantages, or product differentiation [Shapiro 1991].

This value may be enhanced by means of strategic moves, which enhance market power. Within microeconomics, the producer surplus, which a firm earns on its output, is equal to the economic rent, which it earns from its scarce input. Under perfect competitive markets, the producer surplus is zero, thus economic rents cannot be achieved. Economic rents are thus related to the factor of input, and the producer surplus to output [Pindyck and Rubinfeld 2001].

In order to analyse investment opportunities to achieve economic rents, the financial-economic literature developed the concept of net present value (NPV) in corporate finance [Brealey and Myers 2005]. As mentioned above, firms look for value creation in order to maximise their shareholders’ wealth. Under perfect competition, an investor cannot earn more than the opportunity costs of capital. In that case, the net present value is zero. Profits that are greater than the opportunity cost of capital (i.e., the economic rents) are temporary when the industry is not in its long-term equilibrium. They are permanent in the situation when a firm has a structural (semi-)monopoly or structural market power. In theory, the NPV is simply the discounted value of economic rents [Brealey and Myers 2005].

Sources: based on Grant [1991]; Smit & Triigeorgis [2004].
3.7 The valuation of investments in an uncertain, competitive environment

Just as in many industries, gas firms must develop strategies in anticipation of market developments that are dynamic. Because of the complexity of the interregional gas market, primarily we focus in this paper on Cournot-type quantity competition, where suppliers are assumed to compete in quantity or gas volume rather than in gas prices. In order to deliver new volumes to market and thereby potentially capture additional market share, suppliers must build additional capacities in gas transport. For a firm with growth opportunities, infrastructure sets the stage and creates the strategic context in which the firm can thrive and preserve its continuity [Smit 2003]. This is certainly true in the gas market.

Because few investment opportunities exist in a vacuum, they must be considered in their strategic and competitive context [Smit 2003]. We therefore argue that in order to ascertain the overall value of gas transport infrastructure, account must be taken of both demand uncertainty and possible competition through strategic-economic approach. The real-option game model, developed by Smit and Trigeorgis [2001], is a two-stage entry deterrence model that captures, from an incumbent’s perspective, both the aspect of potential entry and the prevailing uncertainty in gas market demand. This real-option game, as the name suggests, also discounts the overall value of gas transport infrastructure to the beginning of the game as a function of market outcomes at the end of the second stage. The three theoretical building blocks to this real-option game approach include:

- the direct cash flow value through the discounted cash flow (DCF) approach;
- managerial flexibility value through the real-option approach; and
- the strategic value obtained through the use of game theoretical concepts (combined with real-option analysis).

These three components will be discussed in Section 3.7.1, 3.7.2, and 3.7.3 respectively. The different components provide the basis of an entry deterrence game and a real-option game framework for strategic investments, which will be discussed in Section 3.7.4.

3.7.1 Discounted cash flow model

In general, an investment is a firm-level project. The overall profitability of a project is determined by its expected annual net cash flows. In corporate finance, the DCF approach is a tool designed to value a project, by discounting the project’s expected cash flows, \( E(CF_t) \) over project’s lifetime \((T)\) at a risk-adjusted discount rate \((k)\). The risk-adjusted discount rate can be derived from the prices of a security in the same risk category, typically from the Capital Asset Pricing Model (CAPM)

\[ k = r_f + \beta (r_m - r_f) \]

\(^{61}\) The CAPM is used to determine a theoretically appropriate required rate of return of an asset by investors. This rate of return depends on: (1) compensation for the time value of money (i.e., risk-free interest rate), and (2) a risk premium, which depend on the beta and the market risk premium. The beta is the asset’s sensitivity to systematic (or market) risk. The market risk premium is the risk premium on the market portfolio [Brealey et al. 2005]. Given the empirical limitation of the CAPM, firms may prefer to use a multi-factor approach for estimating required rates of
tal, as a discount factor, for the effect of the capital structure (the mix of debt and equity financing) and tax, the weighted average cost of capital (WACC) is commonly used. The WACC is the expected rate of return on the portfolio of debt and equity securities issued by the firm. The required rate of return on each capital component is weighted via its ratio relative to the firm’s market value [Brealey et al. 2005].

The DCF approach is a standard method for using the combined effect of the time value of money and risk aversion to appraise long-term projects. The net present value (NPV) is a criterion within the DCF approach and is equal to the current value of future cash flows minus the initial investment:

$$NPV_0 = -I_0 + \sum_{t=1}^{T} \frac{E(CF_t)}{(1+k)^t}.$$  

(3.1)

with:

- $I_0$ = investment in year 0;
- $E(CF_t)$ = expected cash flow in year $t$;
- $k$ = risk-adjusted discount rate;
- $T$ = life time of the investment project.

When this current value is positive, the project adds value to the firm. Investments with positive NPV thus contribute to the wealth of shareholders (see also Box 3.2 for the relation of the NPV criterion with the concept of economic rent). Investments with a negative NPV reduce the wealth of shareholders. The rule of thumb is that firms should invest in positive NPV projects while those with negative outcomes should be rejected. According to Shapiro [2005], new investment projects should be assessed on the basis of three criteria: (1) it must focus on cash and only cash; (2) it must account for the time value of money; (3) it must account for risk. The DCF approach is consistent with these criteria.

Another criterion within the DCF valuation is the Internal Rate of Return (IRR). The IRR is the discount rate of the future cash flows, where the NPV is equal to zero (the project is thus attractive if the IRR exceeds the opportunity cost of capital). The adjusted present value (APV) is another valuation method, although it is essentially a reformulation of the DCF approach. The APV is the net present value of a project if financed only by equity, with separately including the present value of the financing benefits (in particular interest tax shields). In this respect, cash flows should be discounted at a rate that is only

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The required return on debt is measured after tax, since interest payments are deductible.

In practical cases (such as the building gas infrastructure), project investment may involve several years of initial negative cash flows.
adjusted for business risk, and tax shields at the cost of debt (as an alternative of the WACC).

### 3.7.2 Real-options approach

The standard DCF approach is a static approach to investment projects, because it assumes that all operating decisions are set in advance and because it defines an investment decision as a ‘now or never’ choice. In an uncertain, changing situation, however, an option to invest in the future could also be valuable, as alternative to direct cash inflows. In situations involving newly available market information the ability to anticipate creates additional value. The value of flexibility in projects is covered in corporate finance by the real-option approach. Such real-options offer the management board of the firm ‘managerial flexibility’ in the process of decision-making regarding investment projects, also after the initial investment has been made.

The work of Merton [1973], and Black and Scholes [1973] laid the foundation for pricing options and derivatives in financial markets. There are two basic types of options. A call option is the right to buy a stock/asset at a specific strike price on or before the exercise date. A put option is the right to sell a stock/asset at a specific strike price on or before the exercise price [Brealey et al. 2005]. In this respect, (1) the stock price at time zero, (2) the strike price, (3) the continuously compounded risk-free rate, (4) the stock price volatility, (5) time to maturity of the option, and (6) the dividend yield are variables, which influence the value of a call option [Hull 2003]. When exercised, the payoff of a call option is the value of a stock/asset minus strike price when the difference is positive (otherwise zero).

Myers [1977] explained that a firm’s value may substantially depend on its option to develop ‘real’ assets – what he referred to as ‘real’ options. Copeland et al. [2000] distinguish a number of categories in real-options, which include: (1) an option to defer investment; (2) an abandonment option; and (3) an option to adjust production. The option to defer, or postpone, investment bears basic similarity with regard to call options on a share of a firm. When applied to the gas production in the gas industry, this option may be seen as functioning through the payment of a lease-on-development price. Through such option, the owner has the opportunity to develop a gas field or not. The owner could postpone the development of the field if oil and gas prices have fallen. The expected development costs can be compared with the strike price of a call option. When exercised, the payoff of a call option is the value of a stock/asset when the difference is positive (otherwise zero).

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the postponement period, and the level of interest have thus a positive impact of the value of this postponement option; referring to the above-mentioned variables. An abandonment option functions in the opposite manner and bears similarity to a put option. The other category, which Copeland et al. [2005] explore, is the option to adjust production. A venture has a flexibility to adapt vital aspects of its investment, such as the scale, range and life span. In this category the following options can be distinguished: (1) an option to expand or contract; (2) an option to extend or shorten; (3) an option to scope up or scope down; and (4) a switching option.

Trigeorgis [1988] distinguishes real-options in simple and compound (follow-up) options, respectively proprietary and shared ones. Simple options are commercial one-stage projects that – when the option to invest has been exercised – generate cash flows. A compound option is basically an option on an option. Projects that derive their value from strategic value and not only or exclusively from cash inflows are called compound options. If a simple or compound option is proprietary, then the investment opportunity provides an exclusive right to exercise it. Conversely, if a competitor is able to influence the timing and value of the investment, then the investment opportunity is shared, which is when cooperation with competitors may be seen as desirable.

Thus, creating and securing real-options offer the firm managerial flexibility (e.g., the possibility to wait-and-see). For firms, significant ‘growth opportunities’ can hereby be considered as a collection of projects in the form of ‘options to grow’. In case of such projects, the emphasis lies on ‘option valuation’, where the DCF is (almost) irrelevant. In addition to where real options can or should be actively created, in many cases there are options that are ‘naturally’ embedded in projects (i.e., embedded option). In such situation, the static DCF approach is to be supplemented by the value of these embedded. Therefore, the DCF approach should be expanded with real-option valuation in case investments projects have embedded options or when real-options are the core of a project. The following formula summarises the impact of real option on project valuation:

$$\text{The extended Net Project value} = \text{‘direct’ (static) NPV} + \text{net real-options value} \quad (3.2)$$

**Binomial valuation of real options**

The option-pricing model of Black and Scholes [1973] and Merton [1973] offers a closed-form solution, based on rather restrictive assumption. For practical purposes Cox et al. [1979] have developed a binomial model of option valuation as a tool for generating numerical solution. It can be shown that ‘in the limiting case’ the binomial model converges into the Black-Scholes-Merton model.

Note that in formula 3.2 the component of the value from ‘strategic competition’ is not yet included.

It can be shown that ‘in the limiting case’ the binomial model converges into the Black-Scholes-Merton model.
approach, attention here is given to the binomial modelling of uncertainty and the risk-neutral valuation approach.\footnote{Implementing real-options valuation in sectors whereby correlated financial instruments do exist (e.g., futures and forwards), decision-makers can make use of the concept of replicating future cash flows. For example, in order to value a producing gas field, one can use oil and/or gas futures (although gas futures are not that liquid). For an overview of pricing through replication and the binomial risk-neutral valuation approach, see for example Hull [2006]; Cox et al. [1979]; or Trigeorgis [1991].}

To illustrate these operational valuation aspects and the advantage of the real-option approach vis-à-vis the DCF approach, consider a firm that has to decide if it should invest in a gold mine, requiring an irreversible investment of $4.5 million.\footnote{This example of valuing the gold mine is adapted from Brennan and Schwartz [1985] in Smit and Trigeorgis [2004] and Ross et al. [2005, pp. 669-675].} It is assumed that development and extraction can be started directly and there are no variable costs. The risk-free interest rate \((r)\) is 4 percent per year. The reserves of gold are 14,000 ounces and can be produced in year 1 \((t = 1)\): thus production level at \(t = 1\) \((Q_1)\) is 14,000 ounces. The level of uncertainty can be measured by the volatility of the underlying value (the price of gold). It is assumed that the current price of gold \((S_0)\) is $300 per ounce. The gold price either moves up \((S_u)\) or down \((S_d)\) over the period, where \(u\) (assumed at 1.5) and \(d\) (assumed at 0.67) are the multiplicative (up and down) binomial parameters. Depending on the development of the gold price, the operating cash flows (production level times gold price, or \(CF = Q \times S\)) will diverge.

When applying the NPV criterion, management should not invest in the mine, because it results in a negative NPV \((-\$0.3\ million)\).\footnote{When assuming that both prices under the binomial distribution in a one period (two-date) setting are equally likely (probability \(q = 0.5\)) and that the implied market-required return \((k)\) is 8.33 percent (derived from the expected gold price in \(t_1\) vis-à-vis \(S_0\)), then
\[
NPV = \frac{0.5 \times (450 \times 14,000) + 0.5 \times (200 \times 14,000)}{1.0833} - 4,500,000 = -300,000.
\] Further explanation; see Brennan and Schwartz [1985].} However, the DCF approach is not a useful instrument to determine the value of the mine via expected cash flows, because capital investment is not a now-or-never proposition. Once the firm has made its pre-investment (buy a license) to have the right to make the full investment in the mine, management has the option to wait (with the option maturity period being the time period of the license). The real-options approach considers managerial flexibility into the decision-making process based on the development of the underlying asset (gold price) and takes into account above-mentioned determinants of the project value, such as price volatility. A visualisation technique for the binomial pricing model involves constructing a binomial tree, see also Figure 3.5. This is a diagram that represents different possible paths that might be fol-
ollowed by the price of the underlying asset over the time to maturity. The binomial decision tree analysis can thus capture decision flexibility that is not included adequately by the direct NPV approach.

Figure 3.5 Proprietary opportunity (license): Wait with investing under uncertainty

Risk-neutral (or a certainty-equivalent) valuation is an important principle in the binomial model. It can be shown that in a one-period binomial setting, the value of a call option does not depend on the probability of the underlying value going up (to \( S_u \)) or down (to \( S_d \)). It is the ‘volatility’ \( S_u - S_d \) in conjunction with \( S_0 \) and the interest rate \( r \) (and also the strike price of the option) that determines the option value. Since the probabilities \( p_u \) and \( p_d \) are irrelevant, one is free to assume any convenient probability level. A very convenient one is a probability \( p \) (and corresponding to \( 1 - p \)) that complies with a result of risk-neutral valuation in the risky situation that is represented by the binomial setting [Hull 2003]. The risk-neutral probability \( (p) \) is the probability that would prevail if the underlying asset were expected to earn the risk-free return. This means: \(^{11}\)

\[ p = \frac{(1 + r - \delta) - d}{u - d}, \text{ and } (1 - p). \]

where \( u \) and \( d \) represent the multiplicative up or down moves in price, \( r \) is the risk-free interest rate, and \( \delta \) is the constant asset (dividend-like) payout yield (equal to \( k/(1+k) \) for a perpetual project, where \( k \) is the risk-adjusted discount rate).

\(^{11}\) For the calculation within the real-option game model of the risk-neutral’ or ‘certainty-equivalent’ probabilities in Chapter 4, according to Smit and Trigeorgis [2004], Formula 3.3 is adjusted by adding a constant asset (dividend-like) payout yield:

\[ p = \frac{(1 + r - \delta) - d}{u - d}, \text{ and } (1 - p). \]
\[
S_o = \frac{pS_u + (1-p)S_d}{1+r}
\]

and therefore

\[
\rho = \frac{(1+r)S_u - S_d}{S_u - S_d} = \frac{(1+r)u - d}{(u-d)}.
\]

Applying the risk-neutral valuation of equation 3.3 to the above-mentioned mine case, using the risk-neutral probability from equation 3.4, it follows that \( p = 0.45 \) and \( (1-p) = 0.55 \). When the management has, for reasons of simplicity, a costless license for a year to invest in the mine, it can postpone the investment until more information is known about the gold price (the underlying asset).

If the gold price rises \( (S_u = 450) \), the management invests. The corresponding value minus the investment at \( t = 1 \) \( (C_u) \) is \$1.8 million \( (Q_u S_u - I = 14,000 \times 450 - 4,500,000) \). When the gold price drops \( (S_d) \), the management does not invest (allow the license to expire since abandoning the project; thus \( C_d = 0 \)), because the value of the project \( (V_f) \) is only \$2.8 million \( (Q_d S_d = 14,000 \times 200) \), which is lower than the initial investment of \$4.5 million.

Using backward induction under risk-neutral valuation (i.e., working backward along the tree; see Figure 3.5), the value of the license, \( V_o \), is determined from its future up and down state values discounted at the risk-free interest rate \( (r) \), with expectation taken over the risk-neutral probabilities \( p \) and \( (1-p) \):

\[
V_o = \frac{pC_u + (1-p)C_d}{1+r} = \frac{0.45 \times 1.8 + (1-0.45) \times 0}{1.04} = \$0.78 \text{ million,}
\]

where \( C_u \) and \( C_d \) are the future \( (t = 1) \) values of the option (license) in the up and down states respectively. Implementing real-options valuation shows that the option to wait has a positive value. Using expression 3.2 the value of a license to invest in the mine equals:

\[
\text{Extended Net Project value} = 'direct' \text{ NPV} + \text{flexibility (or option) value} = -\$0.3 \text{ million} + \$1.08 \text{ million} = \$0.78 \text{ million}
\]

The difference between the extended net project value and the ‘direct’ NPV is the flexibility value.
For the purpose of this study, the real-option approach will be applied for gas infrastructure investment, especially midstream pipelines and LNG infrastructure. Such investments generate options in the follow-on project to deliver gas to a specific gas market. It is assumed that the firm can use the pipeline capacity exclusively for its own use. In Chapter 11, this assumption will be reviewed, because of regulatory policies in some regions in the world (especially the US and Europe), which may force firms to provide third parties with access to their pipeline capacity. A strategic infrastructure investment opportunity can be viewed as a call option (the right to buy an underlying value in the future). In this case the underlying value is equal to the present value of the expected cash inflows from the operating follow-on project with an exercise price being the follow-up investment outlay of the midstream infrastructure project. The ability to defer the follow-on investments under market demand uncertainty offers decision-makers managerial flexibility. In a situation in which market demand develops favourably, the firm may invest in follow-on capacities. If not, the firm may defer its follow-up investment and invest maybe in a latter stage. One can use a binomial option-valuation tree of the level of demand (applying risk-neutral option valuation) to assess the real-option value of the project, with demand itself acting as an underlying asset, just as the price of gold does in the previous gold mine example.

3.7.3 A game theoretical framework
The next step in finding a framework that takes into account both uncertainty in dynamic markets and rival behaviour, is adding a game-theoretic component. Doing so will shift this theoretical discussion from one involving merely market uncertainty (in terms of demand or price) to one also involving decisions made by an external player, a potential competitor or market entrant. This effectively adds one more layer of uncertainty, namely the risk of a negative impact on profits due to a loss in market share to competitors. In an oligopolistic market (as is the gas market) a player could influence, for example, market outcomes through strategic investments vis-à-vis the competition. These investments cannot be analysed using a static NPV approach and/or the common real-options approach. However, game theory offers a tool to assess the strategic value from competitive investment action [Smit and Trigeorgis 2001].

All oligopoly models may be seen as examples of game theory, which uses formal models to analyse situations involving conflict or cooperation between economic agents. A game is any competition in which strategic behaviour is important and where each player’s payoff depends directly on actions of other firms [Carlton and Perloff 2000]. A game represents a strategic context in which firms’ decisions are interdependent. First, this can be a game for the division of a given economic pie, a so-called zero-sum game. Second, firms can work together or have mutual beneficial decisions that enhance total value (positive-sum game theory, as a branch of mathematics and economics, has allowed for the study of the behaviour of economic agents in a broad range of economic phenomena such as bargaining, market entry, and conflicts of interest amongst many others. It has also served as a useful instrument in analysing the strategic behaviour of agents in non-economic circumstances. For an introductory text to game theory, see for example Dixit and Nalebuff [1991].
Dixit and Nalebuff [1991] distinguish between unconditional and conditional strategic moves, whereby the last one can be split up into a threat and promise. An unconditional move is a response rule in which the firm moves first and the action is predetermined. For example, a pre-commitment to invest in pipeline capacity may provide an advantage vis-à-vis a firm’s competitors, which can then alter their investment strategies because of the threat of the pre-commitment. With a conditional move, a firm may limit or condition its own actions by specifying a rule for how to respond under different circumstances. For example, this might include a threat to punish rivals if they take actions, which work against a firm’s interests. Conversely such a rule may include a promise to reward ‘rivals’ if they take actions, which work in its favour. This research will primarily focus on unconditional strategic moves.

Players engage in strategic games and their interaction results in an equilibrium, such as the Nash equilibrium. The Nash equilibrium is a dominant strategy equilibrium such that no player has an incentive to deviate from the chosen strategy given that the other players do not deviate either, i.e., such that each firm is doing the best it can given what its competitors do [Rasmusen 2001]. This situation can change, however, if games are dynamic. The essence of dynamic (or multi-period) games, as opposed to static (or single-period) games, is that firms compete repeatedly over time. In addition, players may adjust their beliefs about rivals’ behaviour over time and may use more complex strategies than in static games [Carlton and Perloff 2000]. In dynamic games, players can learn from each other’s actions and adapt their own behaviour so as to maximise their own individual payoffs [Schmalensee 1988].

Of specific interest in this context are repeated games involving strategic interaction between two players over the span of two periods, i.e., a sequential game. Sequential games are repeated games, for a limited duration of time, i.e., a specific number of periods. In such games, players choose their first-period actions while taking into account the consequences in both the first and second periods, and the final outcome is reasoned backwards towards the beginning of the game [Tirole 1988]. Having reasoned backwards (i.e., backward induction), the player is then in a position to make a particular decision at the beginning of the decision tree. A game can involve competition in quantity and price. Competing in quantities here refers to the notion of choosing a scale that determines the firm’s cost functions and thus determines the conditions of price competition. Cournot competition is a model used to describe an industry structure in which firms compete on quantity, whereas a Bertrand model describes an industry structure on price competition [Tirole 1988].

\[\text{An equilibrium is a strategy combination consisting of a best strategy for each player in a game. Related to this, an equilibrium concept is a rule that defines an equilibrium based on the possible strategy combinations and the payoff functions, see Rasmusen [2001].} \]

\[\text{A Nash equilibrium is a non-cooperative equilibrium in that without the ability to make credible commitments, players choose their dominant strategies for sake of security. It is the basic solution concept in game theory [Rasmusen 2001].} \]
In the context of gas infrastructure investment strategy, the Cournot model seems appealing when ‘quantity’ is interpreted as ‘capacity’. In such situation each firm chooses in secret a production capacity, realising that once their capacity is chosen in one sequence they will compete through price in the next (i.e., a Bertrand game) [Varian 1992].

3.7.4 Entry deterrence and strategic investments

A possibility in sequential games is for one player to act early, investing in capacity on big scale so as to deter potential entry of rivals or establish a strong market position in general. An important feature of this research is that firms are able, if they choose to, to make strategic pre-commitments in order to alter the conditions of future competition in a manner that is favourable to them. Entry deterrence and the sunk costs associated with certain ‘strategic’ investments are by definition a multi-period phenomenon. These investments are strategic in that they are not designed purely for cost-minimisation purposes, but also for deterring entry by possible entrants [Tirole 1988]. For the firm, acting strategically early on, i.e., creating a first mover’s advantage, it may deter entry because it becomes unprofitable for the entrant to invest. These investments could alter the structure of the market at some future point or to draw the structure of the market to their advantage [Schmalensee 1988].

Long-term contracts in the natural gas industry, the economies of scale involved and the capital intensive nature of the gas industry call for strategies that involve long-run investments with long-run potential to affect access to a market. Of particular interest in this framework are two-stage models involving strategic investment with sunk costs, such as the pipelines in the natural gas industry and other natural gas transportation infrastructure such LNG liquefaction, re-gasification terminals and tankers. The importance of existing contracts, which are used to underpin these infrastructures, may lie less in the benefit of their enforceability but, rather, in their ability to tap a first-mover advantage. In addition, existing relationships through sunk infrastructural costs act as a deterrent to others [Barnes et al. 2006]. One should hasten to add that in a dynamic context, a firm might want to ‘pull its punches’ because an aggressive action or long-term commitment by an opponent will induce it to behave likewise [Tirole 1988].

As Colell et al. [1995] note, in two-stage models, entrants must sink fixed costs prior to competing. While in one-stage models players can compete for sales while retaining the option not to sink these costs if a player does not make any sales. These types of investment enable firms to make use of capacities, or transport capacities in the case of natural gas markets. The aim in this setting is to show that in the natural gas industry it is possible to deter or pre-empt other suppliers by making such investment or sunk costs. An incumbent in one gas market can reduce the scale of entry of a rival firm, which is a barrier to mobility [Caves and Porter 1977]. The key aspects of sunk costs in models of industrial organisation are their commitment value. If the capital investment is to have commitment value, then the investment must be somewhat difficult to reverse [Tirole 1988].
According to Smit and Trigeorgis [2004], a framework based on real options and games hence incorporates three levels of planning that have an effect on the overall value of a firm’s project (see three corresponding layers in Figure 3.6):

- the project appraisal from corporate finance, which aims to determine the effect on the net present value of the projected cash flows resulting from the establishment of a competitive advantage;
- the strategic planning of growth opportunities, which aims to capture the flexibility (option) value, resulting from the firm’s adaptive capabilities through real-options valuation;
- the competitive strategy, which aims to capture the strategic value from establishing, enhancing, or deferring a strategic position vis-à-vis possible competitor(s) based. This value is derived using game theoretic analysis and industrial organisation economics.

**Figure 3.6 Impact of business strategic planning on the overall project value**

![Flowchart showing the impact of business strategic planning on the overall project value](image)

Source: adapted from Smit & Trigeorgis (2004).

According to Smit and Trigeorgis [2004], the decision to invest in this manner is therefore based on an overall NPV criterion that integrates the strategic and the flexibility value. Both values pertain to the impact on profitability of demand uncertainty and competitive interactions.

In line with the real-option game model as developed by Smit and Trigeorgis [2004], we can distinguish between the value of having a strategic option to compete (strategic ‘option-game’ value) and foregoing this option to compete now (the value of the option to postpone strategically). The strategic (option-game) value is the value of ‘contingent’ strategic investing commitment. Hence exercising this strategic option means committing oneself,
and not exercising the option to postpone strategically. The strategic (option-game) value includes the option value of postponing commercial investments after committing. Exercising the option to postpone means postponing to commit oneself, waiting-and-seeing strategically. Collectively, these values are an addition to the traditional direct (static) NPV, which is equal to the expected cash flows from investing immediately (see also Section 3.7.1). That is:

The overall Net Project value = ‘direct’ (static) NPV + flexibility (option) value + strategic (game-theoretic) value

(3.7)

The value components of expression (3.7) are illustrated in Figure 3.6. A firm should invest in a strategic project when the total sum of the overall net project value is positive, whereby the strategic option-game value is higher than the value from the strategic option to postpone (of making a strategic investment).

The strategic commitment and postponement values

In non-regulated gas markets infrastructures, such as pipelines and LNG trains, hence act as options for vertically integrated firms in to gaining, maintaining or expanding access to new markets or consolidate positions in existing ones. Thus for vertically integrated gas firms, producer’s commodity trade largely ensures midstream investments. In order for this to be the case, it is the exclusive ownership of the capacity (i.e., no third-party access), which ensures that these investments may be seen as an option today in order to expand commodity trade in the future. The model, which will be discussed in Chapter 4, focuses on this specific case of strategic and irreversible investments in a competitive, uncertain environment. The emphasis in the model lies on the value of the option to postpone strategically versus the strategic (option-game) value. Given the uncertainty of the value of the underlying assets, i.e., profits from demand, and potential entry, an early commitment provides a strategic option on future growth. When no early commitment is made, no option on future growth is created. By committing early, an incumbent creates an option that potentially enables it to capture intrinsic value over time by anticipating possible entry. Alternatively, a certain value derived from the option to postpone strategically is present whenever any combination between downside demand risk and the scale of entry potentially proves to be detrimental to the value of the underlying asset, a so-called wait-and-see value.

3.8 Conclusion

The bedrock for the theoretical underpinning of this chapter in order to describe the relationship between governments, firms and market consists of a multi-disciplinary combina-
tion of international relations theory, industrial organisation, strategic planning (including strategic management and game theory), and corporate finance. The modern variant of IPE argues that it is necessary to integrate international relations and (political) economy in order to explain, for example, complex issues in the gas market. Strange’s structural power, which should be seen as a relative concept between states (rather than measures in absolute terms), primarily relates to the abilities of governments and non-government actors to influence the international political system to their own advantage. The ability to exert power relies heavily on being able to engage a nation’s national resources and managing them adequately. These resources can consist of intellectual capital, natural resources, manufactured goods, etc., as Adam Smith already argued in the 18th century. Strange [1989] goes on to argue that a nation’s power consists really of four dimensions: security, knowledge, finance and production. A country’s knowledge and production can lead to financial wealth, which it can use to further boost its production, develop its intellectual capital base and develop the means to defend itself.

The government plays an important role in shaping the gas sector due to the risks and benefits (i.e., its economic rents) along the value chain, both in consuming and producing countries. When a country or nation is blessed naturally with resources, or raw materials, it already holds a major advantage relative to countries, which do not possess these resources but require them to survive economically. In the case of oil and natural gas, resources are concentrated in the hands of comparatively few countries. For Russia, having been an oil and gas producer for decades, gas is the sequel to oil in terms of earning energy revenues. In addition, as the cleanest fossil fuel with numerous applications, its centralised institutionalisation and its related political integration, gas can be seen to Russia as a relative advantage or structural production and financial power.

Roughly speaking, from a period stretching between the 1950s and late 1960s, the international energy firms controlled the main oil (and gas) producing areas. Resource nationalism has resulted in the rise of national energy firms, owning today some 75 percent of the world’s gas resources, fundamentally changing the relationship between producer and consumer countries. The national energy firm invests on the basis of the government’s socio-economic policy priorities for both domestic development and earning export revenues. Diversification of the economy may also play an important role. The socio-economic agendas of governments influence the merit order on firm-level, which in this research determines the sequence of gas sector investment across the gas value chain for its export markets, both in vertical as well as in horizontal terms. The government and the national energy firm have a principal-agent relationship where the nation’s resources are owned by the government (the principal) and managed by the national energy firm (the agent). The prevailing threat for energy producing countries lies in the essence of the resource curse. Its consequences may provide energy producing countries with the incentive to leave a country’s resources undeveloped below the surface or to develop a countercyclical policy by saving and financially isolating the revenues from exports. The main
difference between international energy firms and national energy firms is their investment horizon, which may be influenced in the case of national energy firms, by a broad politico-economic agenda.

Having said that, the international gas market is currently undergoing a major transformation, one that pertains to economies of scale, trading patterns, pricing, concentration of production, the vertical integration of major firms in the business, et cetera. The dynamic market theory argues that all these elements are constantly shifting in scope and value in a long-term market cycle. This cycle, pertaining to any given product, is divided into four major phases of development: it starts with an embryonic phase of development, followed by expansion and maturity and finally ends in a decline. Each market phase of development has different characteristics and bottlenecks, which compel actors in the market to adapt their strategies to newly emerging market situations. De Jong [1989] recognizes the possibility that firms with market power can influence the market conditions as do the different market development phases. Depending on the phase of the market these firms operate in they are likely to interact in different ways, by competing or colluding. Collusion and cooperation may include a range of forms of cooperation, from tacit collusion to explicit agreements. Attempting to control the value chain through M&As is another possibility from an organisational perspective.

Strategies of firms acting in the market have to anticipate on these dynamic market developments. In most gas exporting countries, governments delegate to their national gas firms the task of maximising the value of a country’s gas reserves for their export markets. Capturing new market opportunities (e.g. to generate a profit stream in excess of the opportunity cost of capital) are based on the exploitation of scarce firm-specific, internal resources and dynamic capabilities. In order to capture the full long-run value creation in an uncertain and competitive environment, the static valuation approach of investments, which assumes that all operating decisions are set in advance, is insufficient.

According to Smit and Trigeorgis [2004], valuation tools from corporate finance theory can be integrated with the ideas and principles of strategic management theory and industrial organisation to value investments under market uncertainty and competition. The combination of traditional corporate finance and strategic planning can be adequate in assessing long-run competitive advantage and strategic adaptability. Such a combination incorporates not only the static value of expected cash flows (via the discounted cash flow method), but also the flexibility (option) value (via the real-option approach) and the strategic value components (via concepts of the game theory). For vertical integrated firms, it is the exclusive ownership of the capacity of infrastructure, which ensures that the infrastructure investments may be seen as an option today in order to expand commodity trade in the future. Such strategic investments may alter the conditions of future competition in a manner that is favourable to them (e.g., entry deterrence).