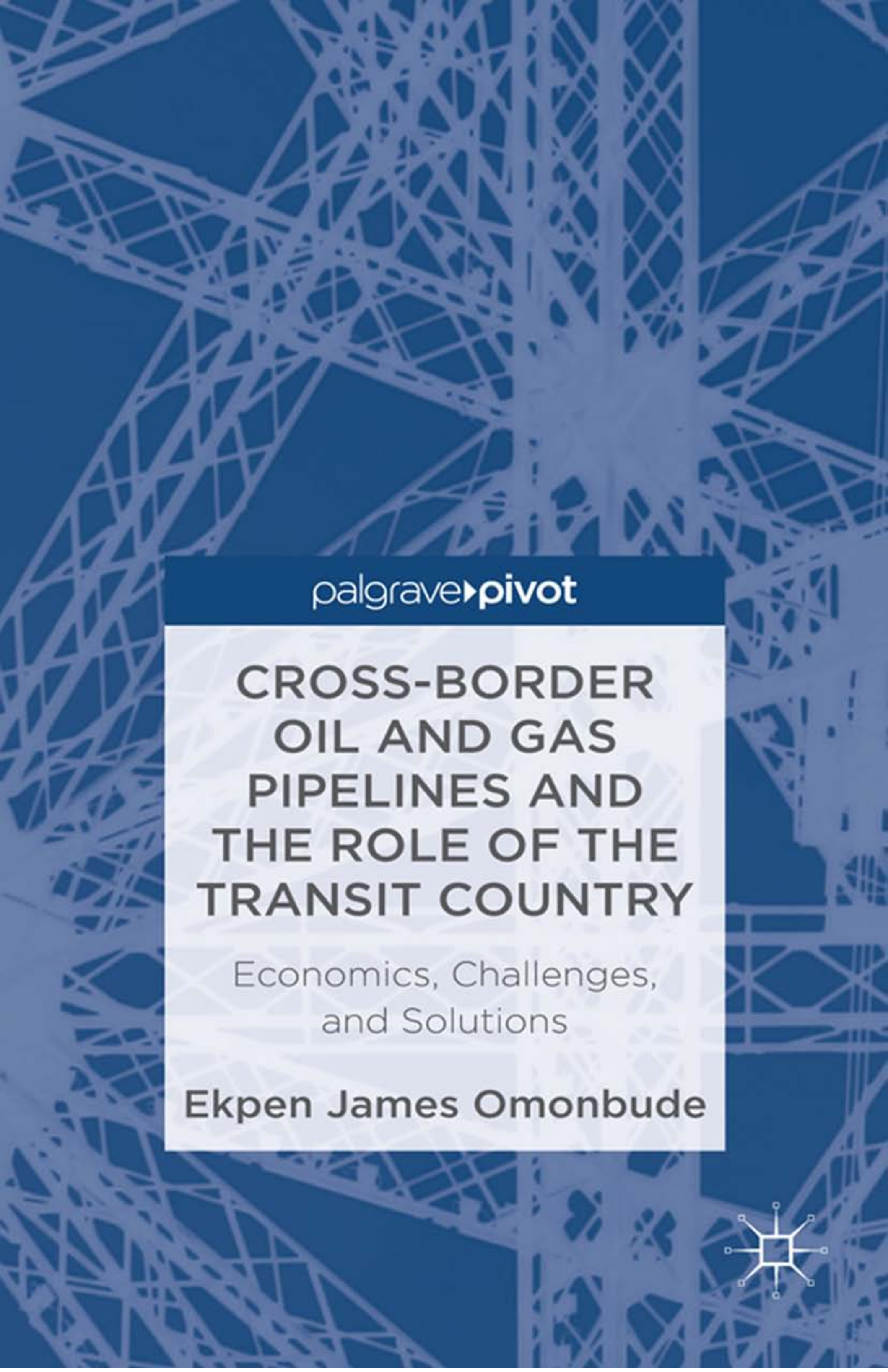
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CROSS-BORDER OIL AND GAS PIPELINES AND THE ROLE OF THE TRANSIT COUNTRY
Economics, Challenges, and Solutions
Ekpen James Omonbude

Cross-border Oil and Gas Pipelines and the Role of the Transit Country

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List of Abbreviations

ACG	Azeri–Chirag–Guneshli
BTC	Baku–Tbilisi–Ceyhan
COTCO	Cameroon Oil Transportation Company
EBRD	European Bank for Reconstruction and Development
ECOWAS	Economic Community of West African States
ECT	Energy Charter Treaty
ECTP	Energy Charter Protocol on Energy Transit
EIA	Energy Information Administration
ESMAP	(World Bank) Energy Sector Management Assistance Programme
FDI	foreign direct investment
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
IFC	International Finance Corporation
IMF	International Monetary Fund
IPI	Iran–Pakistan–India
LNG	liquefied natural gas
MNC	multinational company
NATO	North Atlantic Treaty Organization
NREP	Northern Route Export Pipeline
PSA	production sharing agreement
SCP	South Caucasus Pipeline
SOCAR	State Oil Company of the Azerbaijan Republic
WAGP	West African gas pipeline
WAPCo	West African Gas Pipeline Company
WREP	Western Route Export Pipeline
WTO	World Trade Organization

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1 Introduction

Abstract: *The past two decades have witnessed a significant increase in cross-border trade in oil and gas. It is anticipated that there will be an increase in the number of oil and gas pipelines as a result of the discovery of reserves in remote and land-locked locations and the depletion of reserves close to established markets. A number of problems arise from cross-border oil and gas transportation via pipeline. These problems are more acute in the case of pipelines passing through a transit country. Present and future pipelines face the risk of continuous conflict over legal, economic, and political issues. This book analyses cross-border oil and gas pipelines involving transit countries, with a view to addressing the problem of pipeline disruptions by the transit country. It focuses on the behaviour of the transit country prior to the commencement of operation of the pipeline and on how that behaviour changes after the pipeline has been built and put into operation.*

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1.1 Introduction

The past two decades have witnessed a significant increase in cross-border trade in oil and gas. Oil exports from the Middle East, for example, grew by approximately 65% between 1991 and 2010, and exports from the Asia-Pacific region (excluding Japan) and the former Soviet Union grew by 175% and 360%, respectively. Figures 1.1 and 1.2 illustrate this growth.

It is anticipated that there will be an increase in the number of oil and gas pipelines as a result of the discovery of reserves in remote and

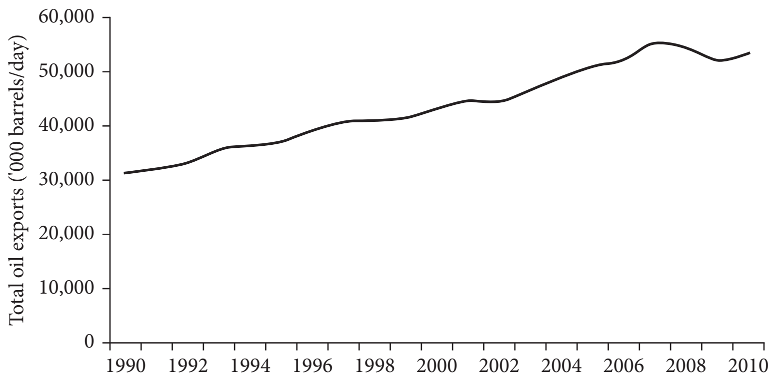

FIGURE 1.1 *Growth in international oil trade, 1990–2010*

Source: Adapted from *BP Statistical Review of World Energy 2011*.

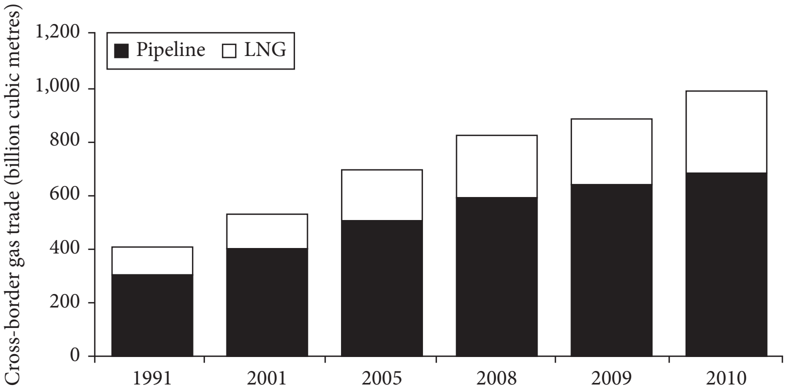

FIGURE 1.2 *Growth in cross-border gas trade, 1991–2010, by transport mode*

Source: *BP Statistical Review of Energy 2011*.

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land-locked locations and the depletion of reserves close to established markets. For example, Azeri oil and gas reserves are far from sea ports or major Western European markets. Statistics show a significant increase in million tonnes of oil equivalent exported from the former Soviet Union in the past decade. This can be argued to demonstrate the increasing role of pipelines in linking markets to the predominantly land-locked reserves of this region. Transporting energy commodities to various locations from such land-locked regions is dependent in some cases on pipelines passing through one or more transit countries. The implementation of successful transit pipeline projects is, therefore, crucial for the security of supply of these commodities. In the case of natural gas, the closest substitute for piping gas is transportation in the form of liquefied natural gas (LNG), which is dependent on coastal access for the LNG shipment. The economics of pipelines compared with the costly LNG process suggest that only at distances in excess of 3,000 miles would the LNG option be more competitive (Avidan, 1997).

A number of problems arise from cross-border oil and gas transportation via pipeline. These problems, which are more acute in the case of pipelines passing through a transit country, fall into three broad categories: reconciling the interests of the different parties involved, the lack of an overarching legal regime to regulate activities, and rent-sharing among the parties (ESMAP, 2003). Specifically, transit oil and gas pipelines face potential disruption by the transit country. Recent developments in the gas dispute between Russia and Ukraine demonstrate the role of transit pipelines in the security of energy supply, as well as the importance of a sufficient understanding of fundamental transit pipeline economics.

Present and future pipelines face the risk of continuous conflict over legal, economic, and political issues. Once the pipeline has been built and put into operation, the risk arises of disruption of the pipeline by the transit country over disputed transit terms. This is due to two key factors: first, bargaining power shifts in favour of the transit country upon construction and operation of the pipeline; second, price changes that result from changes in the value of the throughput can affect the behaviour of the transit country. This is defined as the *obsolescing bargain* – a term coined by Raymond Vernon (1971). In the literature, the obsolescing bargain is a situation in which bargaining power shifts from a multinational company (MNC) to a host country government after investments have been made in a project and the project has started operations (Vernon, 1971). The concept explains the relations between the MNC and the host country

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as a function of the goals and resources of each party and the constraints it faces. It argues that relative gains are positively related to the relative bargaining power of the parties; that is, the greater one party's bargaining power, the greater that party's share of the gains (Eden *et al.*, 2004). The literature suggests that the party with more resources, fewer constraints, and greater coercive ability gains more from the bargain. According to the original definition of the concept, relative bargaining power at first favours the MNC, which has the initial advantage of being able to invest in several locations – that is, it has alternatives and is, therefore, mobile. The host country offers incentives to attract foreign investment because of the MNC's initial bargaining advantage. According to Eden *et al.* (2004), this bargain then obsolesces over time. Once the investment has been made, the MNC can be held hostage by an opportunistic host country. The longer the MNC is in the host country, and the more profitable the investment is, the more likely it is that the government's perception of the benefit–cost ratio offered by the MNC will worsen. Other factors (e.g. technological spillovers and economic development) encourage the host country to become less resource dependent on the MNC over time. Such behaviour by host governments was evidenced in the wave of nationalisations in developing countries during the 1970s.

Transit oil and gas pipelines are susceptible to the obsolescing bargain because they are characterised by very high fixed costs and relatively low operating (variable) costs (Stevens, 1996). The *bygones rule* states that even a loss-making project will continue to operate for as long as operating costs are met and some fixed costs can be recovered. The implication is that the transit country can continue to increase its demands so long as the pipeline continues to meet its operating costs. In addition, pipelines are inflexible. The cost and security of supply implications of disruptions to an operating transit pipeline are huge, particularly in the case of gas. This enhances the bargaining position of the transit country and tempts it to extract more from the pipeline.

1.2 Objective of the study and main questions

This book analyses cross-border oil and gas pipelines involving transit countries, with a view to addressing the problem of pipeline disruptions by the transit country. It focuses on the behaviour of the transit country prior to the commencement of operation of the pipeline and on how that

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behaviour changes after the pipeline has been built and put into operation. It also looks at the problems associated with such pre- and post-construction behaviour. Given the nature of the obsolescing bargain as it applies to transit pipelines, and the problem of arbitrary disruption of the pipeline by the transit country as a sovereign state, this research aims to answer two questions. The first is how to define the characteristics of the transit fee in cross-border oil and gas pipeline agreements. The second is how to address the consequences of shifts in power to the transit country. More specifically:

1 Is it possible to have a pipeline agreement that supports the principles of reasonableness, objectiveness, transparency, and non-discrimination such that the transit country will not disrupt the pipeline in the future?
2 How can the shifts in bargaining power among the parties to a cross-border oil and gas pipeline agreement be managed such that the potential for disputes is reduced or removed and security of supply is sustained or enhanced?

This book, therefore, consists of two parts. The first part analyses the economic characteristics of cross-border oil and gas pipelines and the behaviour of the parties prior to construction and after the pipeline has been built and put into operation. The second part uses actual transit pipeline cases to investigate how the consequences of shifts in bargaining power might be mitigated.

1.3 Significance of this book

There are four major reasons why this study is important. The first reason is connected to the obsolescing bargain and the increasing involvement of transit countries in oil and gas pipelines. Compensation to transit countries takes the form either of a transit fee or of an off-take of the commodity, or both (Vinogradov, 2001). A problem arises when transit countries arbitrarily seek to renegotiate transit terms in the pipeline agreement. This leads to disruption of the pipeline, with implications for costs and security of supply. This situation is not helped by the lack of agreement concerning the economic basis for setting the transit fee. Vinogradov (2001), for example, suggests that the transit fee is compensation paid to the transit country for allowing right of way.

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The fee, in this view, is a reward to the transit country for sacrificing its sovereignty. The defect of this definition is that provided the transit country signed the agreement willingly, it cannot be argued to have lost its sovereignty. Another view is that the fee is compensation for the negative impact (or externalities) of the pipeline. However, the externalities created by the pipeline can be internalised, and usually the land used for the pipeline is paid for after negotiations between the company and the landowner (ESMAP, 2003; Stevens, 2009). The underlying fact is that there is value attached to the pipeline, and the transit country, by virtue of its contribution to the creation of this value, deserves some share of it. How such contribution to value is created, and how to ensure that the transit country does not damage the pipeline in pursuit of its perceived reward, remain unclear. Shifts in bargaining power to the transit country after the pipeline has been built and put into operation could encourage the transit country to seek to renegotiate transit terms on the basis of its perception of its value to the project. The resolution of this problem is, therefore, important to the success or failure of oil and gas transit pipelines.

Second, there have been attempts to address the problems of cross-border oil and gas pipelines using international instruments or institutions such as the General Agreement on Tariffs and Trade (GATT) and, more specifically, the Energy Charter Treaty (ECT). There is a specific provision in Article 7 of the ECT that addresses the transit of energy. The importance of energy transit is further reflected in the Energy Charter Secretariat's proposed Protocol on Energy Transit (ECTP). The ECT requires that all transit pipeline agreements be characterised by reasonableness, objectiveness, transparency, and non-discrimination. As noted in Chapter 5, these are tenets taken from other legal instruments for international trade (notably GATT). These characteristics are vague at best, simply because of the nature of transit pipelines (as analysed in Chapters 2 and 3). Also, the ECT does not specify the context in which such agreements can be defined as required. The Energy Charter Secretariat appears, therefore, to be struggling with this problem, as there are differing views as to a clear and definitive basis for transit fees.

Third, there is very little literature on the subject of cross-border oil and gas pipelines involving transit countries. Most of the available studies deal with the technical aspects of pipelines (e.g. Masseron, 1990; McLellan, 1992; Mansley, 2003); some deal with the legal aspects (Vinogradov, 2001); and a very few focus on the economic and policy aspects (Stevens,

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1996, 2000b; ESMAP, 2003). A few studies have acknowledged that the disruption of the pipeline by transit countries is a bargaining problem (ESMAP, 2003; Hubert and Ikonnikova, 2003; Omonbude, 2007, 2009). It is argued in some of the available literature that the specifics of each pipeline require that cross-border oil and gas pipeline problems be treated on a case-by-case basis. However, fundamental issues that are common to these projects suggest a broad solution to the problem of transit countries disrupting the pipeline as a result of renegotiating the transit terms.

The fourth source of the importance of this study lies in oil price volatility. The implication of volatile oil prices for current and future pipelines is obviously the change in the value of the throughput and, thus, in the rent available from the pipeline. An upward movement in oil prices can be argued to be a determining factor in the aggressive behaviour of the transit country after construction and operation, as is shown in the case of one of the pipelines studied here.

There is little in the literature that is specific to transit country behaviour before and during operation of the pipeline. Previous work has focused primarily on the legal aspects of cross-border oil and gas pipelines, third-party access to gas pipelines, and their legal implications, and a number of publications cover the role of the ECT. These studies have not explored the consequences of transit country behaviour after the pipeline has been built and put into operation. In addition, the general conclusion of these studies is that dispute settlement mechanisms such as those of the ECT are sufficient to deal with such problems case by case. However, this is not applicable here because of the inherent difficulties of binding any sovereign state to anything that includes a settlement mechanism. This study finds factors within and outside the pipeline projects that are common to cross-border oil and gas pipelines and are, therefore, generally applicable.

Some studies have considered the behaviour of the transit country in these negotiations as a bargaining problem. The literature on bargaining in the transit pipeline context includes game-theoretic approaches to explaining the bargaining positions of the various parties to the pipeline (especially gas pipelines, e.g. Hubert and Ikonnikova, 2003; Ikonnikova, 2006). Hubert and Ikonnikova (2003) recognise the shift in bargaining power to the transit country after the pipeline becomes operational, and they propose strategic investment in other pipeline capacity as a possible way to check this shift. Ikonnikova (2006) extends the analysis

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to describe the game in a partition function form because the Shapley value function applied in earlier studies of the Eurasian gas supply game is prevented from solving the game by externalities (e.g. the possibility of coalitions being formed by other parties, notably the transit country). However, as shown in Chapter 6, this solution is complex and restrictive; that is, it is specific to gas pipelines and situations in which there are actual alternative pipelines to allow for possible coalitions. This book considers the strategic investment solution in a much simpler context. It also identifies a number of other factors that could serve to check the consequences of a shift in bargaining power to the transit country.

This book essentially does three things. First, it analyses the technical and economic aspects of transit oil and gas pipelines to establish how pipelines work and what characteristics make transit pipelines vulnerable to disruption by the transit country. Second, it simplifies the core principles of bargaining and then applies these principles to the oil and gas pipeline context. The premise for this approach is simple: if this is essentially a bargaining problem, it will require a bargaining solution. Thus an explanation of bargaining principles in the context of transit pipelines is crucial to any solution. The previous paragraph acknowledges the literature on game-theoretic bargaining solutions; this approach is focused more on the outcome, but Chapters 3 and 6 demonstrate the importance of applying a framework that combines an outcome approach with a process approach. The approach taken in this book is, therefore, unique in terms of its clear and simplified adaptations of these basic principles to oil and gas pipelines involving transit. Third, the study uses the framework developed from pipeline economics and bargaining principles to analyse actual pipeline cases. It is from this analysis that factors that could mitigate the consequences of a shift in bargaining power to the transit country are defined.

1.4 Structure of the book

This book comprises seven chapters. Chapter 2 first discusses the technical and cost characteristics of pipelines and then applies the concept of economic rent to explain the economics of oil and gas pipelines involving transit.

Chapter 3 investigates the role of bargaining in relation to transit pipelines. It briefly reviews the technical literature on bargaining theory,

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from which a non-technical set of bargaining principles is derived and applied to transit pipelines in general, guided by the findings from the previous chapter on the economics of pipelines.

The findings from Chapters 2 and 3 form the framework that is applied to the case studies in Chapter 4. Four pipeline projects involving transit have been selected for this research:

- the Baku–Tbilisi–Ceyhan pipeline;
- the Shah Deniz South Caucasus Pipeline;
- the West African gas pipeline project; and
- the Chad–Cameroon pipeline.

This selection has been influenced by the difficulty of obtaining reliable publishable data. Public access to many pipeline project documents is restricted for reasons of commercial confidentiality. The 12 pipeline cases in the UN and World Bank Energy Sector Management Assistance Programme (ESMAP) analysis are classified as being successes or failures on the basis of whether or not they experienced disputes (see Table 4.1). The significant World Bank involvement at some stage during the life of the four pipeline projects selected for this study has encouraged considerable public disclosure of the relevant documents and agreements, which enables more detailed discussion and analysis based both on the criteria set out in the ESMAP paper and on the bargaining principles discussed in Chapter 3. Two oil and two gas pipelines have been selected for this study. The aim of this selection – a secondary objective of this research – is to investigate whether the differences between oil and gas have any effect on the positions of the parties to the transit agreements.

The role of the ECT is examined in Chapter 5 in relation to the pipeline cases discussed in the previous chapter. This chapter compares the findings from the case studies with the provisions of the Treaty (and, especially, the provisions of the proposed Transit Protocol).

In Chapter 6, lessons drawn from Chapters 4 and 5 are developed into a solution to address the consequences of shifts in bargaining powers to the transit country.

Chapter 7 concludes the book.

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2
The Economics of Cross-border Oil and Gas Pipelines Involving Transit

Abstract: *This chapter reviews and analyses the literature on the economics of pipelines in general. The primary intention is to identify and define the economic characteristics of cross-border and transit pipelines. The technical, economic, and political factors discussed in this chapter are relevant to an understanding of how pipelines work. The impact of these factors on the transit fee is examined. The aim is to provide a basis for generalisations regarding transit fees, and to provide the basic tools to answer the question of whether a pipeline agreement that is reasonable, objective, transparent, and non-discriminatory does exist or can exist in the long term.*

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2.1 Introduction

The previous chapter set the scene for this book by showing the importance of cross-border oil and gas pipelines involving transit. The problem of transit countries disrupting the pipeline (through higher transit fees, for example) manifests in conflicts that follow the shift in bargaining power in their favour once a pipeline has been constructed and is in operation. The basis upon which transit fees are determined remains vague and unknown in some cases. The purpose of the transit fee is not explicitly defined in the literature. Some view the transit fee simply as a negotiated compensation or tax paid for right of way, but there are other views as to the purpose of the transit fee, such as:

- compensating the transit state for loss of its sovereignty;
- compensating the transit state for its contribution to the realisation of value added in the actual trade of oil or gas; or
- compensating the transit state for its contribution to the savings created by its position as the most cost-effective route (compared with alternative pipeline routes through other potential transit states).

As argued in section 2.6.1 below, these definitions do not fully explain the purpose of the transit fee in cross-border oil and gas pipeline projects. This raises the question of what would constitute a practicable transit fee (or agreement) – that is, a long-term agreement under which none of the parties (especially the transit country) would arbitrarily seek to renegotiate terms in the future.

This chapter reviews the literature on the economics of pipelines in general. The primary intention is to identify and define the economic characteristics of cross-border and transit pipelines. The technical, economic, and political factors discussed in this chapter are relevant to an understanding of how pipelines work. The impact of these factors on the transit fee is examined in section 2.5. The aim is to provide a basis for generalisations regarding transit fees, and to provide the basic tools to answer the question of whether a pipeline agreement that is reasonable, objective, transparent, and non-discriminatory does exist or can exist in the long term.

2.2 Economic characteristics of pipelines

Pipelines are generally characterised by high fixed costs, as a result of huge capital investments, and relatively low operating costs (compared

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with the fixed costs). Moreover, large economies of scale prevail. The higher the throughput of the pipeline, which depends on its diameter, the higher the variable costs per unit of commodity (oil or gas in this case) (McLellan, 1992). Also, with continued throughput, much of the initial investment is recovered, leaving less to expropriate. It is important for the pipeline to operate at maximum possible throughput so as to spread the fixed costs over higher output levels over time.

Unit transport costs for the same level of utilisation are lower for pipelines with larger diameters. This is due to the fact that a pipeline's capacity is approximately proportional to two-and-a-half times the square of its diameter, while the capital cost is directly proportional to the diameter of the pipeline.

Figure 2.1 illustrates how fixed and variable costs per unit change with throughput as a factor of pipeline diameter. Of note is the point at which the total unit cost of transportation is at a minimum (the optimum throughput). At this point, most of the capital expenditure has been recovered (hence the continuous decline in fixed costs) and operating costs (which are minor compared with fixed costs) become the major component of the cost outlay for the rest of the life of the project. The

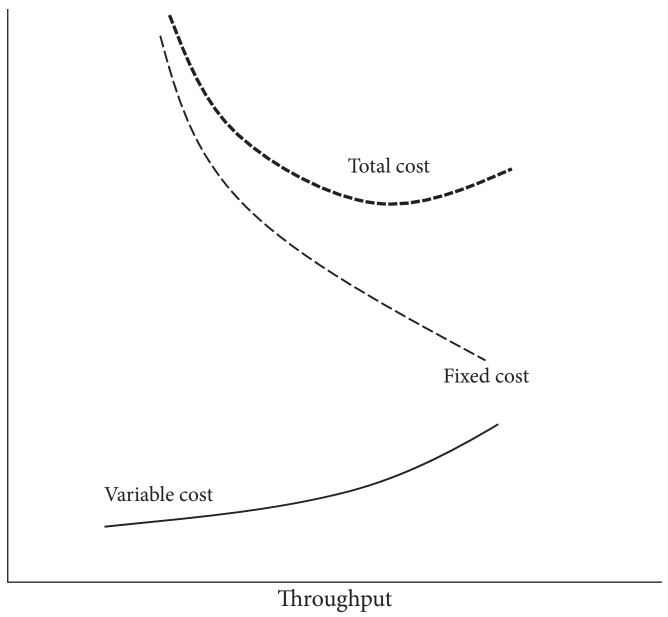

FIGURE 2.1 *Transportation costs as a factor of pipeline diameter*

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figure also indicates how low the variable costs of operating a pipeline system are compared with the fixed costs.

2.2.1 Cost characteristics and concepts

Typically, any producer will competitively minimise costs and maximise profits subject to technological constraints. In competitive markets, producers consider input prices during a given period of time to be fixed irrespective of their demand for those inputs (Besanko and Braeutigam, 2002) or their expected output for the period (Layard and Walters, 1978). The same principle applies to pipelines, especially during the construction phase. The objective is usually to minimise the operating costs, as the fixed (capital) costs are deemed to be sunk costs (this is explained further by the bygones rule, which is discussed later in this chapter).

By the nature of pipelines, both fixed and variable costs arise, but they differ from project to project. A typical cost function for pipelines would take the following form:

$$C = F(D) + G(Q, D),$$

where F(D) represents the fixed cost associated with the installation of a pipeline of diameter D, and G(Q, D) are the variable costs (Brito and Rosellon, 2001).

The capital costs of a pipeline have a direct dependence on the pipeline's diameter and length (McLellan, 1992). This can be argued to be the basis upon which some generalisations or theories regarding pipeline economic issues such as rent and transit tariffs have been formulated. (For example, Masseron, 1990, defines a pipeline transport tariff as a cost function tied to the length of the pipeline.) These capital costs are influenced by a number of factors, including:

- mobilisation (or demobilisation) costs of contractors;
- communications and control systems;
- level of difficulty of road and river crossings, as well as terrain;
- way leave costs;
- costs of compressor stations and terminals;
- costs of steel and welding; and
- environmental costs.

Pipeline costs necessarily rise with diameter, since more steel is needed. A further cost effect is that the thickness of the pipe wall needs to be

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greater as the diameter increases. This, in turn, increases welding costs. This further emphasises the importance of pipelines running at the highest possible capacity, in order to reduce average fixed costs and hasten investment recovery. For oil pipelines, throughput can be enhanced by the application of a *drag-reducing agent* (or 'flow improver') – a chemical that allows the crude oil to flow more easily. This raises the operating capacity of the pipeline. This enhancement, however, is probably subject to decreasing marginal profitability (Pipeline Industries Guild, 1984).

Pipeline operating costs (e.g. engineering, supervision, administration, overheads, interest, and contingencies) tend to be a small fraction of the capital costs over the life of the pipeline. Some of the literature suggests these costs are no more than 4–7% of capital costs (McLellan, 1992, 4%; Brito and Rosellon, 2001, 5–7%). For oil and gas pipelines, operating costs (e.g. the costs associated with pumping oil or compressing gas) will vary with throughput.

Pipeline economic feasibility is also obviously affected by the standard issues of market conditions, geology, technology, and political climate.

An understanding of the relationship between these forces and pipeline costs also shows their relevance to and impact on transit fees. These factors affect both the capital and operating costs of the pipeline, which in turn have implications for the justification and determination of transit fees.

2.2.2 Technical factors of pipeline economic feasibility

From the initial design stage through to the construction and operation of the pipeline, costs necessarily play a significant role in pipeline economics. It is important to take into account both the capital and operating/maintenance costs when choosing the optimum design. It is necessary to perform economic calculations to compare the proposed design with other combinations of pipeline size, operating pressure, and horsepower to ensure the best choice of system (Kennedy, 1993). The design of pipelines involves an attempt to achieve economic balance among the capital cost of the pipeline and its associated pumping or compression facilities and the subsequent annual cost of the pipeline's operation (Pipeline Industries Guild, 1984). The most significant operating cost is the cost of energy required to push the fluid or gas through the pipeline. One major technical factor that influences the cost of pipelines is the load factor; other factors include technical differences between oil and gas, the size of the pipeline, operating structure, compressor costs, and station spacing.

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Load factor

Load factor is the percentage ratio of the daily throughput averaged over a year to the maximum throughput on any day in that year (McLellan, 1992):

$$\text{Load factor} = \frac{\text{Average daily throughput over a year}}{\text{Maximum throughput on any day in the same year}} \times 100.$$

This definition is frequently applied to a specific stream of product passing through the pipeline. A pipeline can carry two or more streams, which are likely to be owned by different companies, in which case each stream has its own load factor. The terms 'load factor' and 'utilisation factor' are used interchangeably; however, the utilisation factor is slightly differently defined in some of the literature as the ratio of average throughput of the two or more streams over a year to the maximum daily throughput capacity of the pipeline as built. In other words, the utilisation factor can be defined as a load factor over the streams of commodities passing through the pipeline. There is an inverse relationship between the unit cost of transport in a pipeline system and the utilisation factor. This means that the higher the load factor (or the more complete the utilisation of capital facilities involving predominantly fixed costs), the lower the unit costs (and the faster the recovery of the investment).

Comparison of oil and gas pipelines

There are fundamental differences between oil and natural gas that influence the cost of transporting these hydrocarbons via pipeline. For the purposes of this book, it is important to clarify these differences because they have a significant effect on the economics of pipelines. The key distinction between oil and natural gas pipeline transportation lies in the energy required for pumping (or compressing), and in some cases the diameter of the pipeline. For natural gas, compared with oil, more energy is required for pumping for a given pipeline diameter, and pipelines sometimes require larger diameters, thus making gas pipelining comparatively less economic than oil pipelining. For the same pipeline diameter, length, and load factor, there is more energy content in the amount of oil than in the amount of gas that can be transported (the energy content in one barrel of oil is equivalent to the energy content of 6,000 cubic feet of natural gas). This obviously affects the costs of pumping the hydrocarbons, and the literature suggests that natural gas pumping costs are about four times more than crude oil pumping costs.

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