Fondazione Eni Enrico Mattei

NOTA DI LAVORO

05.2010

Profit Sharing under the Threat of Nationalization

By **Luca Di Corato,** Department of Economics SLU Uppsala, Sweden

INSTITUTIONS AND MARKETS Series
Editor: Fausto Panunzi

Profit Sharing under the Threat of Nationalization

By Luca Di Corato, Department of Economics SLU Uppsala, Sweden

Summary

A government bargains a mutually convenient agreement with a multinational corporation to extract a natural resource. The corporation bears the initial investment and earns as a return a share on the profits. The host country provides access and guarantee conditions of operation. Being the investment totally sunk, the corporation must account in its plan not only for uncertainty on market conditions but also for the threat of nationalization. In a real options framework where the government holds an American call option on nationalization we show under which conditions a Nash bargaining is feasible and leads to attain a cooperative agreement maximizing the joint venture surplus. We find that the threat of nationalization does not affect the investment time trigger but only the feasible bargaining set. Finally, we show that the optimal sharing rule results from the way the two parties may differently trade off rents with option value.

Keywords: Real Options, Nash Bargaining, Expropriation, Natural Resources, Foreign Direct Investment

JEL Classification: C7, D8, K3, F2, O1

I wish to thank Michele Moretto for helpful discussions.

Address for correspondence:

Luca Di Corato
Department of Economics
Swedish University of Agricultural Sciences
Box 7013 Johan Brauners väg 3
Uppsala 75007
Sweden
Phone: +46 0 18671758
Fax: +46 0 18673502
E-mail: luca.di.corato@ekon.slu.se

Profit Sharing under the threat of Nationalization*

Luca Di Corato[†]

Department of Economics *SLU* *Uppsala, Sweden*

18 October 2009

*This paper is part of my PhD thesis. I wish to thank Michele Moretto for helpful discussions.

[†]Corresponding address: Department of Economics, Swedish University of Agricultural Sciences, Box 7013, Johan Brauners väg 3, Uppsala, 75007, Sweden. Email: luca.di.corato@ekon.slu.se. Telephone: +46(0)18671758. Fax: +46(0)18673502

Profit Sharing under the threat of Nationalization

Abstract

A government bargains a mutually convenient agreement with a multinational corporation to extract a natural resource. The corporation bears the initial investment and earns as a return a share on the profits. The host country provides access and guarantee conditions of operation. Being the investment totally sunk, the corporation must account in its plan not only for uncertainty on market conditions but also for the threat of nationalization. In a real options framework where the government holds an American call option on nationalization we show under which conditions a Nash bargaining is feasible and leads to attain a cooperative agreement maximizing the joint venture surplus. We find that the threat of nationalization does not affect the investment time trigger but only the feasible bargaining set. Finally, we show that the optimal sharing rule results from the way the two parties may differently trade off rents with option value.

keywords: Real Options, Nash Bargaining, Expropriation, Natural Resources, Foreign Direct Investment.
jel classification: C7, D8, K3, F2, O1.

1 Introduction

Many developing countries are rich in natural resources such as oil, natural gas and minerals. This endowment may be crucial for funding their economic growth and welfare.[1] However, developing countries may often lack the needed technological knowledge and/or they must cope with limited funds for exploring the resource fields and building the infrastructures required for extraction. Foreign direct investment (hereafter, FDI) may overcome these difficulties. In fact, a multinational corporation may be willing to undertake the initial investment costs and extract the resource if an adequate return is paid. Multinational corporations may engage in FDI by forming a joint venture with a local firm which is usually owned by the government (Schnitzer, 2002). The agreement between the two parties entitles the foreign investor to a property right on the infrastructure installed and to a compensation for the investment. The compensation may be represented by a share on profit's flow accruing from extraction.

However, once the investment has been undertaken, matching the economic interests of both parties may be problematic. In fact, given the sunk nature of the investment,[2] the local government may expropriate the enterprise's investment and run the project on its own. In this case, being the host a sovereign country, no court may impose the respect of contract's terms or a compensation for the assets expropriated.[3] Although not on legal ground, the expropriation may be punished by imposing international sanctions such as a limited access to world capital markets and restrictions on international trade (Schnitzer, 1999, 2002). In addition also a cost due to the loss of reputation must be accounted. Nevertheless, even if a punishment may be triggered, high profits from extraction and/or populist pressure on governments for rents' distribution may justify this opportunistic move on the basis of benefits covering the costs (Engel and Fischer, 2008).

Nationalizations[4] have been an important issue over the sixties and the seventies when many colonies became independent countries. Later, during the eighties and the nineties, their frequency[5] declined (Minor, 1994). Despite this evidence, a bunch of examples in the last few years seems to support a new trend. For instance, let us refer to Bolivia whose leader Morales announced in 2006 a plan to nationalize the local natural gas industry, to Venezuela where over the last three years the president Chavez ordered the nationalization of foreign firms in several extractive industries, to Ecuador where a contract with the oil company Occidental Petroleum was cancelled on 2006.[6]

However, the relationship between multinational corporations and host countries is char-

[1] The relationship between natural resource and economic growth is still a controversial issue. See Brunnschweiler and Bulte (2008) on the "resource curse" debate.

[2] See Barham et al. (1998) for an analysis of investment in extractive industries and Guasch et al. (2003) for investment on infrastructures.

[3] As long as only a light penalty or no penalty at all may be imposed for the violation of the agreement's terms it is hard to have a host country credibly committed to their respect (Schnitzer, 1999).

[4] Following Duncan (2006) by expropriation we mean a partial confiscation of the foreign investor's assets. Instead, the term nationalization will be used for total confiscation.

[5] Data on expropriations have been collected and presented in several studies. See Tomz and Wright (2008), Kobrin (1984) and Hajzler (2007).

[6] See http://www.nytimes.com/2006/05/17/business/worldbusiness/17oil.html?_r=1 and http://en.wikipedia.org/wiki/Nationalization for further details.

acterized not only by such conflict but also by mutual economic interests (Kobrin, 1987). The activation of the extractive project requires a mutually convenient agreement inducing the initial investment. Needless to say that without investment both parties are worse off. Mutuality may then lead to a joint venture where the profit distribution accounts and compensates for the threat of nationalization.

The aim of this paper is to account for conflicting and convergent economic interests and determine such distribution. This will be done setting up a model of cooperative bargaining where the foreign investor and the local government are viewed as holding an American call option, respectively on investment and nationalization (Mahajan, 1990). The analysis will be developed in a real options framework where both investment and nationalization are economic decisions characterized by uncertain pay-offs and irreversibility. Both parties are equally exposed to profit fluctuations following a geometric Brownian motion. Uncertain profits and irreversibility makes information on future prospects valuable and regret may be reduced keeping an option open and collecting such information (Dixit and Pindyck, 1994). Finally, differently from the host, the investor must also account for the threat of nationalization (Brennan and Schwartz, 1985; Long, 1975).

Our proposal to merge cooperative bargaining and real options theories is an innovative attempt in the literature on political risk. Up to our knowledge only few contributions have approached expropriation using option pricing methods (Mahajan, 1990; Clark, 1997, 2003). Since expropriation depends on project pay-offs Mahajan (1990) suggests the contingent claim analysis to price the expropriation risk. Developing the Mahajan's frame, Clark (1997) shows that the cost of expropriation for the investor is equal to the value of an insurance contract covering the firm for the expropriated profits. In this paper only the position of the firm is considered and the occurrence of expropriation is modelled as a Poisson process with a constant exogenous intensity parameter. Clark (2003) extends this frame including in the model the government's position. This allows to determine the timing of expropriation through the maximization of the value of the option to expropriate.

Our analysis has a different focus in that we study the impact of the threat of nationalization on investment. We assume that no compensation is paid to the investor. If nationalization occurs, the cost for the government is due to sanctions and loss of reputation while for the firm the cost is represented by expropriated asset and returns on the initial investment. Three main features characterize our set-up. First, the lack of a credible commitment on the respect of initial contract. Second, a foreign investor aware that "almost from the moment that the signatures have dried on the document, powerful forces go to work that quickly render the agreements obsolete in the eyes of the government" (Vernon, 1993, p.82). Last, a mutual interest in the initial investment. In this frame, we let the parties cooperatively bargain to set up an agreement inducing investment.[7] By applying the Nash bargaining solution concept to the underlying cooperative game we can determine an optimal sharing rule and fully characterize a cooperative agreement. We find that to induce investment the profit distribution must trade off the probability of nationalization with the share paid to the foreign investor.[8] An interesting finding is represented by the invariance of the investment

[7] See Kobrin (1987) for a review of literature on bargaining paradigm in the extractive sector.

[8] Differently from Long (1975) and Brennan and Schwartz (1985) where an exogenous probability of nationalization is considered.

time trigger. That is, with or without threat of nationalization the investment occurs at the same time. On the contrary, the threat of nationalization does impact on the set of feasible levels for the distributive parameter. In fact, as the threat becomes more severe we show how its extent shrinks and bargaining failure may occur. We also find that, as expected, the multinational corporation's share must be higher than without the threat of nationalization. This makes economic sense and two possible interpretations are provided. On the one hand, this wedge can be simply seen as the way the investor is compensated for the additional risk, while on the other hand it may be viewed as balancing for the local government being compensated not only through the share on profits but also indirectly through the option to expropriate. Developing the last interpretation, we contribute also by proposing the cooperative bargaining frame for pricing the option to expropriate. Finally, studying the impact of market volatility on the investor's share, we can observe two different scenarios. On the first, as uncertainty raises, the foreign corporation accepts a lower share to delay investment. Such loss is compensated by a high profit level when investing and a less acute threat of expropriation. On the second, as uncertainty soars up, to encourage earlier investment the local government accepts a lower share. A more valuable option to expropriate and a lower trigger for its exercise will balance the loss.

The reminder of the paper is organized as follows. In section 2 the basic set-up for the model is presented. In section 3 we determine the efficient bargaining set where the cooperative game is played. In section 4 the cooperative game outcome is derived. In Section 5 we discuss results using comparative statics and illustrate the model by a numerical solution. Section 6 concludes.

2 The Basic Set-up

Consider a joint investment project for the extraction of a natural resource in a developing country. The extraction of such resource is lucrative and generates a flow of non-negative[9] profits π_t which randomly fluctuates over time following a geometric Brownian motion with instantaneous growth rate α and instantaneous volatility σ:

$$\frac{d\pi_t}{\pi_t} = \alpha dt + \sigma dW_t \tag{1}$$

where W_t is a Wiener process with $E\left[dW_t\right] = 0$ and $E\left[dW_t^2\right] = dt$.

The two parties forming the joint venture, a multinational corporation (hereafter, MNC) and the government of the host country (hereafter, HC), are risk-neutral. The project to be activated requires a sunk investment $I > 0$. For simplicity we assume that the extractive project has a term sufficiently long that can be approximated by infinity. Suppose that HC is fund-constrained and cannot finance the project while MNC can undertake it. The parties agree on sharing each unit of profit in two parts, respectively θ to MNC and $1 - \theta$ to HC where $\theta \in (0, 1)$. Assume also that once the project is activated, the parties have joint

[9] The simple form for π_t may be thought as a reduced form of the more complex $\pi_t = \pi\left(v_t\right)$ where v_t is a vector representing the several variables (market prices, technology, regulation, etc.) which may affect such flow in the reality.

control on the extractive process and that the plant runs at capacity (Engel and Fischer, 2008).

Once the agreement has been signed MNC holds an option to invest in the extractive project. Since MNC faces uncertainty about market conditions then delaying the investment to gather information on future profit realizations may be valuable. Market is not the only source of uncertainty on MNC's profit flows. In fact, once the investment is undertaken HC holds an option to nationalize it. Since HC cannot credibly commit not to exercise this option, MNC's accounts for such threat when bargaining for the distribution of profits. HC is a sovereign country and no legal court may oblige it to pay a compensation for assets and returns expropriated. Nevertheless, we assume that HC's opportunistic behaviour may be triggered by a known and constant[10] sunk cost $N > 0$. Let N include the losses due to international sanctions, such as limited access to capital markets and restrictions on trade, to the ruined reputation[11] and to the lack of technological and managerial competences to run the project on its own.[12] Given that nationalization is a costly and irreversible move, also HC may postpone it to benefit from information on fluctuating future profits. Finally, note that if the option to nationalize is kept open, a dividend, i.e. the profit share $1-\theta$, is paid to HC.[13]

2.1 HC's and MNC's objective functions

Since MNC is a foreign firm, the value of the project for HC accounts only for the profits accruing to the local government (Engel and Fischer, 2008). That is, its share on profits as long as the project is jointly run plus the share expropriated minus the cost of expropriation once nationalization occurs. Hence, before investment has been undertaken the expected net present value for HC at the general initial π is

$$\begin{aligned} H(\pi,\theta) &= E\left[e^{-\rho T^I} \mid \pi_0=\pi\right]\cdot E\left[\int_{T^I}^{T^N}(1-\theta)\,\pi_t e^{-\rho\left(t-T^I\right)}dt+\right. \\ &\quad \left. +\int_{T^N}^{\infty}\pi_t e^{-\rho\left(t-T^N\right)}dt - Ne^{-\rho T^N}\right] \\ &= E\left[e^{-\rho T^I} \mid \pi_0=\pi\right]\cdot G(\pi_I,\theta) \end{aligned} \tag{2}$$

where $\rho > \alpha$ is the riskless interest rate[14] and $T^k = \inf(t > 0 \mid \pi_t = \pi_k)$ for $k = I, N$ is the random first time the process (1) hits respectively the time trigger for investment, π_I, and

[10] Our frame may be easily modified to account for a stochastic cost of nationalization following, as in Clark (2003), a geometric Brownian motion.

[11] Or changing perspective it may be equivalently interpreted as HC's respect for property and contract law.

[12] Such costs may be also seen as a flow over time. In this case, the analysis would not change in that one may consider N as their present value at the time of nationalization.

[13] This is technically the main difference between the two American call options.

[14] To account for an appropriate adjustment for risk, we should have taken the expectation with respect to a distribution of π adjusted for risk neutrality. See Cox and Ross (1976) for further details. Finally, note that if $\rho \leq \alpha$ investing would never be optimal for MNC.

the trigger for nationalization, π_N.[15] By $G(\pi_I, \theta)$, we will denote the value accruing to HC at the investment time, T^I.

Similarly, MNC's expected net present value expected is given by

$$M(\pi, \theta) = E\left[e^{-\rho T^I} \mid \pi_0 = \pi\right] \cdot E\left[\int_{T^I}^{T^N} \theta \pi_t e^{-\rho\left(t - T^I\right)} dt - I\right] \tag{3}$$

where the flow of profits gained from T^I to T^N minus the investment cost are discounted at $\pi < \pi_I$.[16]

2.2 The bargaining

MNC and HC's relationship is characterized by conflict but also convergent economic interests. Both parties are interested in the activation of the extractive project. Before the project starts an agreement on the distribution of the profits must be reached. The parties must agree on a distributional parameter, θ, which maximizes their joint interests. This situation can be framed as a cooperative game which outcome may be determined applying the Nash bargaining[17] solution concept (Nash, 1950; Harsany, 1977).

HC and MNC gather the same information on the future prospects for π_t and are averse to the risk of internal conflict.[18] This allow to represent both parties by the concave Von Neumann-Morgenstern functions $W(H)$ and $U(M)$ respectively defined on the set of HC's and MNC's expected net discounted values.[19] A feasible outcome of the bargaining process,[20] $0 < \theta^* < 1$, maximizes the following joint objective function

$$\nabla = \log[W(H) - \widehat{w}] + \log[U(M) - \widehat{u}] \tag{4}$$

where $\widehat{w}$ and $\widehat{u}$ are disagreement pay-offs. However, note that in our problem $\widehat{w} = \widehat{u} = 0$ since if the bargaining fails the resource is not extracted.

3 Efficient Bargaining Set under Uncertainty and Irreversibility

In this section we define the set of value over which the two parties play the bargaining game.

[15] See Dixit and Pindyck (1994, p. 315) for the computation of expected present values.

[16] So far we have implicitly assumed that $T^N > T^I$ ($\pi_I < \pi_N$). This is clearly the only case where bargaining makes economic sense . Otherwise, as we will show later, once undertaken the investment would be simultaneously expropriated.

[17] The basic situation behind a Nash bargaining is very simple. Two agents want to share a pie of size 1. Each of them simultaneously and without knowing the other agent's proposal presents to a referee her request. If the two requests are feasible, an agreement is reached and the pie is divided accordingly. Otherwise, the game ends and the two agents obtain the disagreement pay-off.

[18] This is not in conflict with previously assumed risk neutrality. In fact, the parties may be neutral when assessing a more general and differentiated set of ventures opportunities. On the contrary, when involved in the bilateral setting HC-MNC, due to the specificity of the bargaining, the parties may show risk adversity.

[19] See Breccia and Salgado-Banda (2005) and Moretto and Rossini (1995,1996) for bargaining games over a Nash product driven by a geometric Brownian motion.

[20] Both parties have a positive share and their sum is equal to 1. This implies that only internal solutions are considered.

3.1 The Host Country

Once the investment is undertaken, HC holds the option to nationalize and earns the share $1-\theta$ if the option is kept open. HC must decide when it is optimal to exercise such option. This is an optimal stopping problem where $G(\pi,\theta)$ must be maximized with respect to T^N.[21]

Let $V(\pi)$ be the expected present value of total revenues from extraction once the project has been activated. That is[22]

$$\begin{aligned} V(\pi) &= E\left[\int_0^\infty \pi_t e^{-\rho t}dt \mid \pi_0 = \pi\right] \\ &= E\left[\int_0^\infty \pi e^{-(\rho-\alpha)t}dt\right] \\ &= \frac{\pi}{\rho-\alpha} \end{aligned} \tag{5}$$

Being π_N the critical trigger for nationalization, over the continuation region, $\pi < \pi_N$, the option to nationalize is unexercised. In this region, the Bellman equation for $G(\pi,\theta)$ is[23]

$$\rho G(\pi,\theta) = E\left[dG(\pi,\theta)\right] + (1-\theta)\pi \tag{6}$$

By applying Ito's lemma on the RHS and rearranging

$$\frac{1}{2}\sigma^2\pi^2 G''(\pi,\theta) + \alpha\pi G'(\pi,\theta) - \rho G(\pi,\theta) = -(1-\theta)\pi \tag{7}$$

The solution for the differential equation in (7) is[24]

$$G(\pi,\theta) = A_N\pi^\beta + (1-\theta)V(\pi) \tag{8}$$

where $1 < \beta < \frac{r}{\alpha}$ is the positive root of $\Psi(\beta) = \frac{1}{2}\sigma^2\beta(\beta-1) + \alpha\beta - \rho$.

The constant A_H and π_N can be determined attaching to (7) the following value-matching and smooth-pasting conditions

$$G(\pi_N,\theta) = V(\pi_N) - N \tag{9}$$

$$G'(\pi_N,\theta) = V'(\pi_N) \tag{10}$$

Note that (9) can be rearranged as follows:

$$A_N\pi_N^\beta = V(\pi_N) - \left[(1-\theta)V(\pi_N) + N\right]$$

That is, at π_N the value of keeping the option (LHS) must be equal to the net benefit of nationalization (RHS). The first term on RHS is the expected present value of the entire

[21] This is equivalent to the maximization of (2). However, since T^I is determined by MNC we can reduce the problem to the maximization of $G(\pi,\theta)$.

[22] See Harrison (1985, p. 44).

[23] If a market for trading options to expropriate existed, the return from keeping the option, namely expected capital gain plus dividend, must be equal to what the holder would receive selling the option and keeping the proceeds on a bank account paying ρ as interest rate.

[24] See Dixit and Pindyck (1994, p. 143, p. 180).

flow of profits while the term into square brackets stands for the cost associated to the expropriation. Such cost is given by the expected present value of the share on the joint project revenues implicitly given up nationalizing plus the nationalization cost.

Solving (9) and (10) for π_N and A_H yields

$$\pi_N = \frac{\beta}{\beta-1}\frac{(\rho-\alpha)}{\theta}N \tag{11}$$

$$A_N = [\theta V(\pi_N) - N]\,\pi_N^{-\beta} \tag{12}$$

Note that π_N is decreasing in θ. This implies that as $\theta \to 1$, the expropriation becomes in expected terms more likely.

Finally, plugging (12) into (8) gives

$$G(\pi,\theta) = \begin{cases} [\theta V(\pi_N) - N]\left(\frac{\pi}{\pi_N}\right)^{\beta} + (1-\theta)V(\pi) & for\ \pi < \pi_N \\ V(\pi) - N \quad for\ \pi \geq \pi_N \end{cases} \tag{13}$$

In (13) on the first line, the first term represents the value of the option to expropriate while the second is the perpetuity paid if the option is never exercised. On the second line the discounted net pay-off of nationalization.

3.2 The Multinational Corporation

MNC maximizes (3) with respect to T^I taking T^N as given. Let $F(\pi,\theta)$ represent the expected present value of the stream of profits gained by MNC once invested[25]

$$\begin{aligned} F(\pi,\theta) &= E\left[\int_0^{T^N} \theta\pi_t e^{-\rho t}dt \mid \pi_0 = \pi\right] \\ &= \frac{\theta}{\rho-\alpha}\left[\pi - \pi_N\left(\frac{\pi}{\pi_N}\right)^{\beta}\right] \\ &= \theta\left[V(\pi) - V(\pi_N)\left(\frac{\pi}{\pi_N}\right)^{\beta}\right] \end{aligned} \tag{14}$$

From (14) one can easily see that MNC is accounting for a flow of profits stopping at T^N due to nationalization.[26]

In the continuation region, $\pi < \pi_I$, the Bellman equation for $M(\pi,\theta)$ is:

$$\rho M(\pi,\theta) = E[dM(\pi,\theta)] \tag{15}$$

Expanding the RHS in (15) it follows

$$\frac{1}{2}\sigma^2\pi^2 M''(\pi,\theta) + \alpha\pi M'(\pi,\theta) - \rho M(\pi,\theta) = 0 \tag{16}$$

[25] See Dixit and Pindyck (1994, p. 315) for the computation of expected present values.

[26] From MNC's perspective π_N represents an absorbing barrier for (1).

The guessed form for the solution to (16) is

$$M(\pi,\theta) = A_I \pi^{\beta} \tag{17}$$

Imposing the value-matching and smooth-pasting conditions

$$\begin{aligned} M(\pi_I,\theta) &= F(\pi_I,\theta) - I \\ M'(\pi_I,\theta) &= F'(\pi,\theta) \end{aligned}$$

and solving for π_I and A_I we obtain

$$\pi_I = \frac{\beta}{\beta - 1}\frac{(\rho-\alpha)}{\theta} I \tag{20}$$

$$A_I = \left\{\theta\left[V(\pi_I) - V(\pi_N)\left(\frac{\pi_I}{\pi_N}\right)^{\beta}\right] - I\right\}\pi_I^{-\beta} \tag{21}$$

Note that π_I is not affected by π_N.[27] This means that with or without threat of nationalization the expected investment timing is the same. This result is consistent with the dynamic programming principle of optimality used to solve the problem: if π_I is the optimal investment trigger at $t = 0$ then it should remain optimal for every $t > 0$. In other words, any possible event occurring after π_I has been hit has no impact on the optimal trigger.[28]

Substituting (21) into (17) gives

$$M(\pi,\theta) = \begin{cases} \left\{\theta\left[V(\pi_I) - V(\pi_N)\left(\frac{\pi_I}{\pi_N}\right)^{\beta}\right] - I\right\}\left(\frac{\pi}{\pi_I}\right)^{\beta} & for\ \pi < \pi_I \\ \theta\left[V(\pi) - V(\pi_N)\left(\frac{\pi}{\pi_N}\right)^{\beta}\right] - I \quad for\ \pi_I \le \pi < \pi_N \\ -I \quad for\ \pi \ge \pi_N \end{cases} \tag{22}$$

MNC is aware that investment implicitly provides HC with the option to expropriate. This is accounted in (22) through the term $\theta V(\pi_N)\left(\frac{\pi_I}{\pi_N}\right)^{\beta} = \theta V(\pi_N) \cdot E[e^{-\rho T^N}|\pi_0 = \pi_I]$. This term discounts the profits expropriated for the random time period $T^N - T^I$ and corrects the perpetuity $\theta V(\pi_I)$. From (22) follows that the only case to matter in our analysis is $\pi_I < \pi_N$. Otherwise, for $\pi_I \ge \pi_N$, investment makes no sense in that HC nationalizes it as soon as it is undertaken.

Finally, $\frac{\partial \pi_I}{\partial \theta} < 0$: the higher is MNC's share the earlier the investment occurs. More interestingly, note that $\frac{\partial(\pi_N - \pi_I)}{\partial \theta} = -\frac{\pi_N - \pi_I}{\theta} < 0$. This result implies that to induce earlier investment an higher share must be paid to compensate for the option value given up and for the rising threat of nationalization ($\frac{\partial \pi_N}{\partial \theta} < 0$).

4 Nash Bargaining and Cooperative Equilibrium

The bargaining on the profit sharing rule θ must occur before the project activation ($\pi < \pi_I < \pi_N$). In this region MNC's and HC's value functions are respectively given by (22) and (2).

[27] This can be easily seen solving the MNC's problem with $\pi_N \to \infty$.

[28] See chapters 8 and 9 in Dixit and Pindyck (1994) discussing a similar result.

Proposition 1 *If the investment is undertaken then the following inequality must hold*

$$\gamma^{\beta-1} > \beta \tag{23}$$

where $\frac{\pi_N}{\pi_I} = \frac{N}{I} = \gamma$.

Proof. See section A.1 in the appendix for the proof ■

The inequality in (23) is a necessary but not sufficient condition for investment. It must hold for the bargaining to make economic sense. In fact, it requires that $M(\pi, \theta) > 0$ for $\pi < \pi_I$. Note that this in turn implies $M(\pi_I, \theta) > 0$. The parameter γ represents the magnitude of the punishment with respect to the scale of the investment expropriated. By γ we can capture the impact that international sanctions, loss of reputation and other costs have on the likelihood of nationalization and implicitly on investment decision. In particular, note from (23) that $\gamma > 1$. This means that the punishment must be greater than the investment cost. As γ increases the distance between the two thresholds, $\pi_N - \pi_I$, becomes larger, and in expected terms the flow of MNC's profits has a longer duration. In figure 1, we analyse some possible scenarios. It is interesting comparing plots (a) and (b) that condition (23) does not hold for some γ in (a) while it may hold for the same γ over some range of σ in (b). This is due to the profit growth rate, α. In fact, if $\alpha > 0$, profits increases at a faster rate and in expected terms the threshold π_N is met earlier. This in turn reduces MNC's gain from joining HC. In (b) for $\gamma = 1.5$, the zero growth effect holds for levels of volatility up to $\sigma = 0.3$. Above this value, the punishment is too mild and γ must increase for condition (23) to hold.

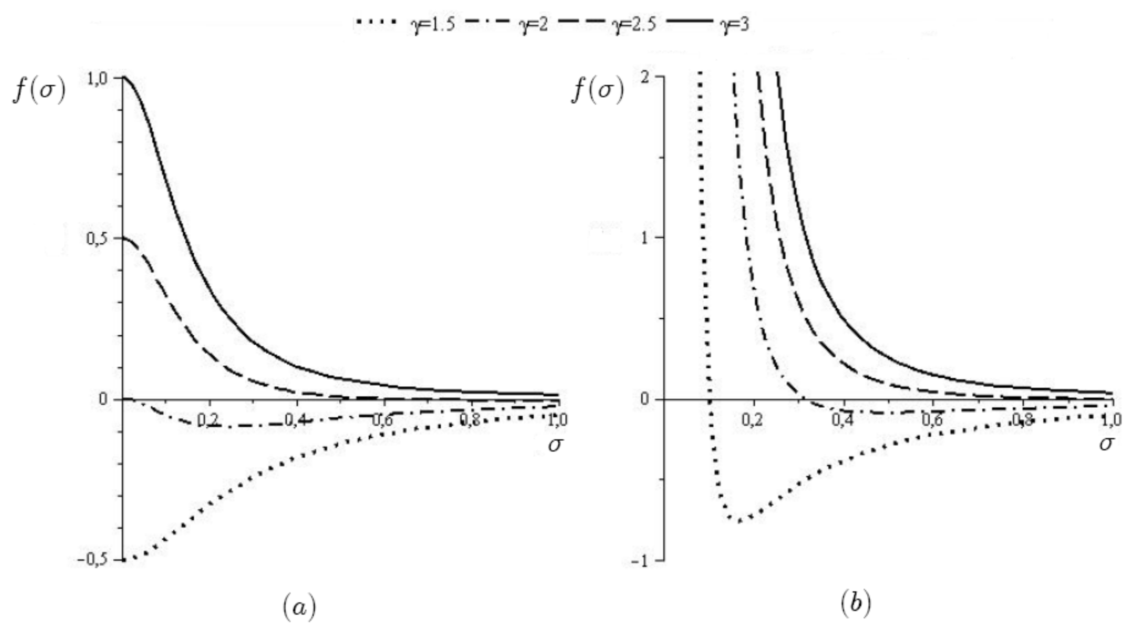

FIGURE 1: $f(\sigma) = \gamma^{\beta-1} - \beta$ for $\rho = 0.1$, (a) $\alpha = 0.05$, (b) $\alpha = 0$

Finally, note that if condition (23) holds then both derivatives, $\frac{dH(\pi,\theta)}{d\pi}$ and $\frac{dM(\pi,\theta)}{d\pi}$, are positive for $\pi < \pi_I$. This means that the bargaining should occur just a "while" before the investment trigger has been hit. By the continuity of the two value functions, it follows that the objective function in (4) must be maximized at π_I.[29] Waiting up to π_I both parties are better off in that they may collect more information on future prospects.

4.1 Cooperative Equilibrium

Denote respectively by $W(H) = H^{1-p}$ and $U(M) = M^q$ HC's and MNC's utility functions. Their degree of relative risk aversion is measured by $0 \leq p < 1$ and $0 < q \leq 1$. Let the two parties play the cooperative game at T^I. The equilibrium agreement will be represented by the level of θ^* maximizing (4).

Differentiating (4) with respect to θ, the following condition must hold in equilibrium:[30]

$$(1-p)\frac{\frac{dH(\pi_I,\theta^*)}{d\theta}}{H(\pi_I,\theta^*)} + q\frac{\frac{dM(\pi_I,\theta^*)}{d\theta}}{M(\pi_I,\theta^*)} = 0 \tag{24}$$

Rearranging (24) we get

$$-\frac{\beta - \theta^*\left(\beta - \gamma^{1-\beta}\right)}{\beta - \theta^*\left(\beta - \gamma^{1-\beta}\right) - 1} = \eta \tag{25}$$

where $\eta = \frac{1-p}{q}$.

Proposition 2 *Under the threat of nationalization the optimal sharing rule is given by*

$$\theta^* = \frac{\beta - \frac{\eta}{\eta+1}}{\beta - \gamma^{1-\beta}} \tag{26}$$

The problem in (25) makes sense if $\theta^* > \frac{\beta-1}{\beta-\gamma^{1-\beta}}$. By proposition (1) and since $\beta > 1$, it follows that $\beta - 1 < \beta - \gamma^{1-\beta}$. This means that over $\frac{\beta-1}{\beta-\gamma^{1-\beta}} < \theta^* < 1$ a feasible bargaining outcome can be reached. Note that as $\gamma \to \infty$ ($\pi_N \to \infty$), the lower bound tends to $1 - \frac{1}{\beta} < \frac{\beta-1}{\beta-\gamma^{1-\beta}}$ and the set enlarges. In other words, the threat of nationalization, restricting the set of feasible bargaining outcomes, makes more difficult to attain a mutually convenient agreement. Finally, while $\theta^* > \frac{\beta-1}{\beta-\gamma^{1-\beta}}$ can be easily shown, to have $\theta^* < 1$ a restriction is needed. That is

$$\eta > \frac{\gamma^{1-\beta}}{1-\gamma^{1-\beta}} \tag{27}$$

5 Some comparative statics and a numerical solution

In this section we derive and discuss some properties of the cooperative agreement. We will show how profit growth, α, and volatility, σ, interacting through β with the magnitude of nationalization cost, γ, and the relative risk aversion ratio, η, may impact on the bargaining outcome.[31]

[29] More realistically, MNC and HC may agree before on a sharing rule conditional on π_I.

[30] The second order condition holds always. See appendix A.2.

[31] See section A.3 in the appendix for the derivatives.

5.1 On the impact of profit growth, volatility and risk aversion

Taking the derivative of (25) with respect to β we obtain (see figure 2)

$$\begin{cases} \frac{\partial\theta^*}{\partial\beta} > 0 \text{ for } \theta^* < \widetilde{\theta} \\ \frac{\partial\theta^*}{\partial\beta} \leq 0 \text{ for } \theta^* \geq \widetilde{\theta} \end{cases} \tag{28}$$

where $\widetilde{\theta} = \frac{1}{1+\ln\gamma\cdot\gamma^{1-\beta}}$.

Since $\frac{\partial\beta}{\partial\sigma} < 0$, by (11) and (20), an increase in σ implies both investment and nationalization occurring later in expected terms. By (28) an interior $\widetilde{\theta}$ allows to distinguish between two possible scenarios. This duality reflects how the parties may differently trade off option value and profit share. If $\theta^* < \widetilde{\theta}$, as volatility soars up, MNC prefers to invest later when profits are high enough and may accept a lower share. This in turn lightens the nationalization threat. In this case, HC is compensated with a larger share for the postponed investment and a less valuable option to expropriate. Instead, when $\theta^* \geq \widetilde{\theta}$ to encourage earlier investment the local government agree on a larger θ^* to MNC. However, note that a larger share makes more tempting the option to nationalize and lowers the time trigger for its exercise.

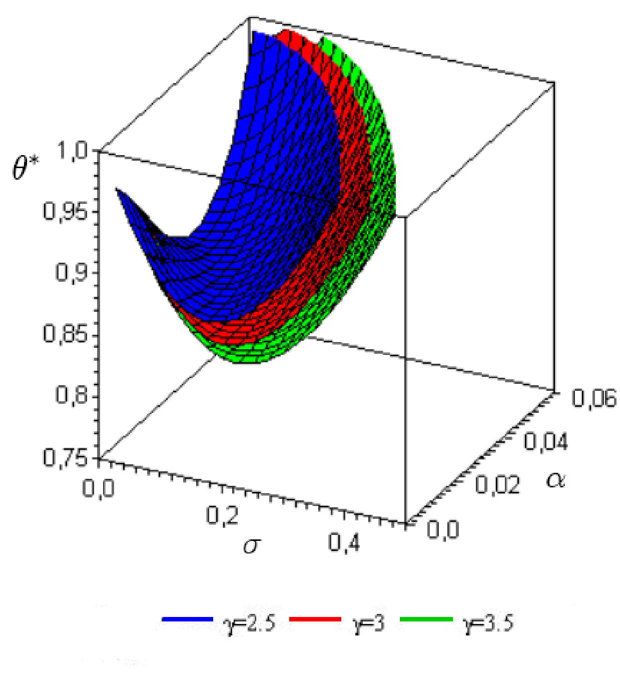

FIGURE 2: $\rho = 0.1, \ \eta = 1$

On the contrary, as α rises both π_N and π_I decrease implying respectively earlier nationalization and investment. In the bargaining room the parties may have different deals. Since $\frac{\partial\beta}{\partial\alpha} < 0$, if $\theta^* < \widetilde{\theta}$, MNC relying on robust profit growth prefers to wait and agree on taking a smaller share. Here, the analysis above applies. Instead, if $\theta^* \geq \widetilde{\theta}$ HC wants to push the investment and would accept a lower share to induce it. This is balanced by high profit growth and a more valuable option to nationalize. However, HC must leave a higher share to MNC to compensate the option value given up and for a more severe threat of nationalization.

Studying (26) subject to (27):

(a) as $\sigma \to \infty$, $\beta \to 1$ and both $\pi_N \to \infty$ and $\pi_I \to \infty$. Due to high uncertainty on future profit prospects the threat of nationalization vanishes. However, high uncertainty affects also the timing of investment which is never undertaken.

(b) if $\alpha > 0$ as $\sigma \to 0$ then $\beta \to \rho/\alpha$, $\pi_I \to \frac{\rho}{\theta} I$, $\pi_N \to \frac{\rho}{\theta} N$ and

$$\theta^* = 1 - \alpha \frac{\frac{\eta}{\eta+1} + \gamma^{-\frac{\rho-\alpha}{\alpha}}}{\rho - \alpha\gamma^{-\frac{\rho-\alpha}{\alpha}}}$$

(c) if $\alpha = 0$ as $\sigma \to 0$ then $\beta \to \infty$, $\pi_I \to \frac{\rho-\alpha}{\theta} I$, $\pi_N \to \frac{\rho-\alpha}{\theta} N$ and $\theta^* = 1$. Since as $\beta \to \infty$ then $\gamma^{1-\beta} \to 0$, the feasible domain, $\frac{\beta-1}{\beta-\gamma^{1-\beta}} < \theta^* < 1$, collapses and the bargaining fails.[32]

Finally, since $\frac{\partial\theta^*}{\partial\eta} < 0$ then $\frac{\partial\theta^*}{\partial p} > 0$ and $\frac{\partial\theta^*}{\partial q} > 0$.This result can be explained by the disadvantage that the more risk adverse party has in bargaining (Roth, 1989). In fact, keeping q constant and letting $p \to 0$, HC becomes less risk averse and an higher share $1-\theta^*$ is required to have a deal. The same effect applies as $q \to 1$. See figure 3.

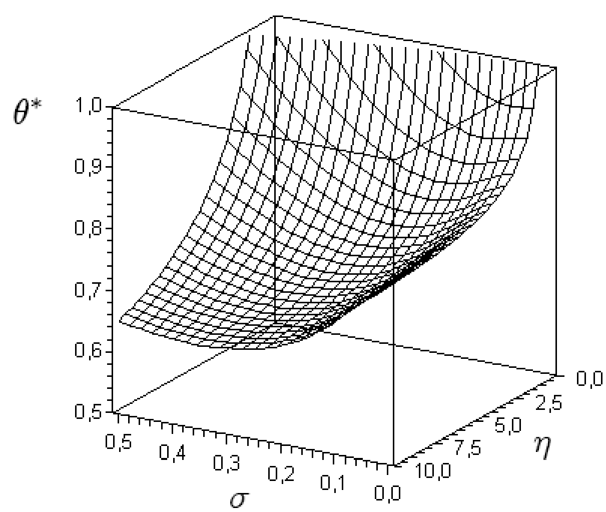

FIGURE 3: $\rho = 0.1,\ \gamma = 3,\ \alpha = 0.025$

5.2 On the impact of nationalization cost

An increase in γ makes nationalization more costly in relative terms and as expected the derivative of θ^* with respect to γ is negative (See Figures 2 and 4). Hence, being the threat of nationalization less severe MNC accept a lower share.

[32]The two value functions in (13) and (22) become linear and this implies that MNC and HC propose only not conciliable requests.

Taking the limit for $\gamma \to \infty$, θ^* decreases and tends to

$$\widehat{\theta} = 1 - \frac{1}{\beta}\frac{\eta}{\eta + 1} \tag{28}$$

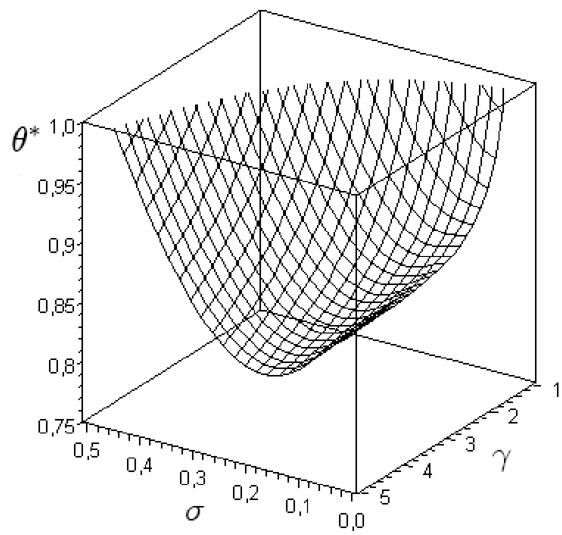

FIGURE 4: $\rho = 0.1,\ \eta = 1,\ \alpha = 0.025$

Comparing (28) with (26), we note

$$\theta^* - \widehat{\theta} = \frac{\gamma^{1-\beta}}{\beta - \gamma^{1-\beta}}\widehat{\theta} > 0 \tag{29}$$

and we can state that

Proposition 3 *Under the threat of nationalization the share of profits accruing to MNC is always higher than under no threat.*

HC must pay a premium to induce investment under the threat of nationalization. However, changing perspective another interesting explanation could be given to the wedge in (29). MNC is aware that by investing an option to expropriate is open. This is kept into account during the bargaining process. Once agreed on the shares the two parties have implicitly priced the option to expropriate. Hence, one can view such option as a part of the compensation paid to HC in addition to the share $1 - \theta^*$. In figure 5, we show that the wedge increases as volatility soars up. This can be explained by a more valuable option to expropriate held by HC at the investment timing.[33] The wedge reduces as η increases. As anticipated above, this is due to the advantage that less risk adverse parties have in bargaining.

Finally, restricting by (27) the limit result in (28) we may draw some implications on the role that α and σ play under no threat of nationalization:[34]

[33] See appendix A.4.

[34] Note that the bargaining outcome would lead to $\widehat{\theta}$ in other two cases. First, if the local government was able to credibly commit not to nationalize, second if HC totally compensates MNC for the value expropriated.

(i) as $\sigma \to \infty$, $\beta \to 1$ and $\pi_I \to \infty$. The investment is not undertaken due to high uncertainty on π_t .

(ii) if $\alpha > 0$ as $\sigma \to 0$ then $\beta \to \frac{\rho}{\alpha}$, $\pi_I \to \frac{\rho}{\theta} I$. This implies that

$$\widehat{\theta} = 1 - \frac{\alpha}{\rho} \frac{\eta}{\eta + 1}$$

If $\sigma \to 0$ and the threat of expropriation is absent then the frame is deterministic. The sharing rule is shaped by the profit drift rate, α, the discount rate, ρ, and by relative risk aversions. In this case, the following results hold

$$\frac{\partial \widehat{\theta}}{\partial \alpha} < 0, \; \frac{\partial \widehat{\theta}}{\partial \rho} > 0, \; \frac{\partial \widehat{\theta}}{\partial p} > 0, \; \frac{\partial \widehat{\theta}}{\partial q} > 0$$

(iii) if $\alpha \leq 0$ as $\sigma \to 0$ then $\beta \to \infty$, $\pi_I \to \frac{\rho - \alpha}{\theta} I$ and $\widehat{\theta} = 1$. Here, the same argument used in (c) applies.

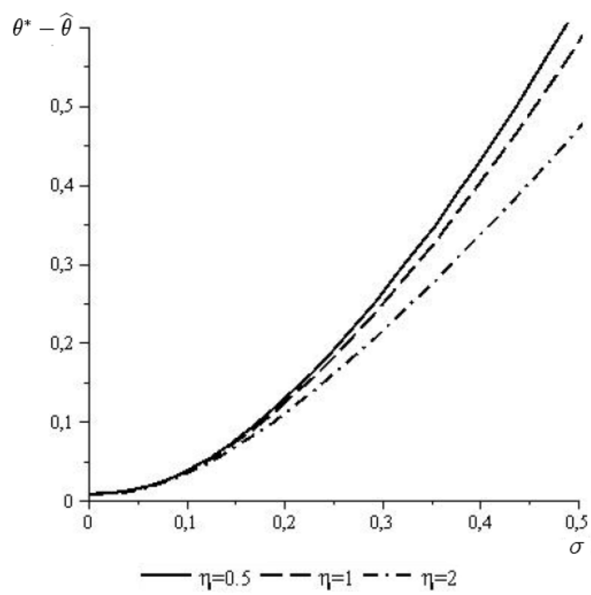

FIGURE 5: $\rho = 0.1, \; \gamma = 3, \; \alpha = 0.025$

5.3 Numerical solution

We illustrate the results above through a numerical solution. Let normalize the investment cost $I = 1$, and set the cost of nationalization $N = 3$, and the discount rate $\rho = 0.1$. In figures 6a and 6b, for profit growth rates $\alpha = 0.025$ and $\alpha = 0$, we plot the optimal sharing rule θ^* for different values of profit volatility (σ). In addition, to stress again on the role of relative risk aversion in bargaining, we show its impact on θ^* for three different scenarios. As η increases HC, becoming less risk averse than MNC, is entitled to larger shares, $1 - \theta^*$, on profit flow. Note, that for $\eta = 1$, any asymmetry is present being both parties equally risk averse or both risk neutral. In this case the profit share is only affected by the asymmetrical charge in terms of risk-taking. Focusing on σ, the duality marked in (28) is straightforward.

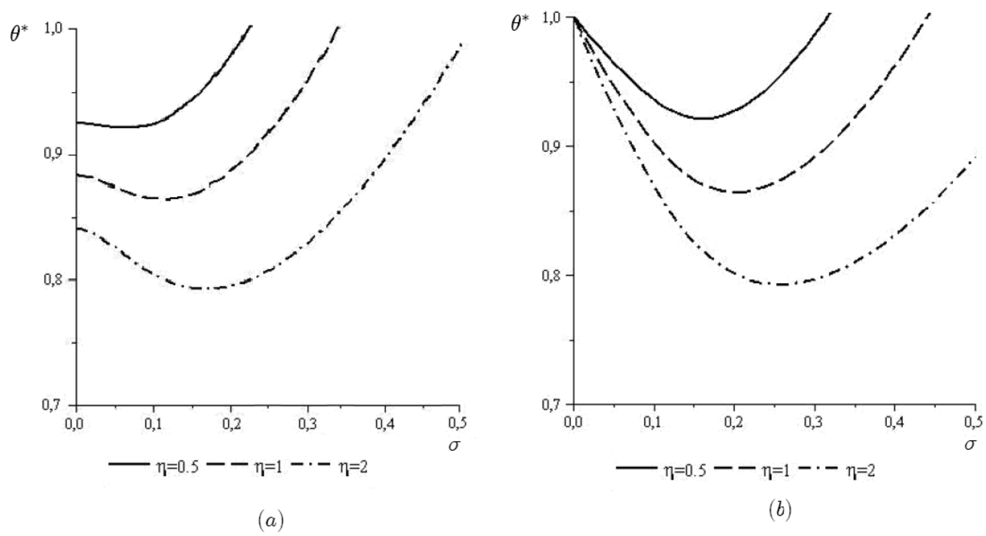

FIGURE 6: $\rho = 0.1,\ \gamma = 3,\ (a)\ \alpha = 0.025,\ (b)\ \alpha = 0$

Let run (26) for $\alpha = 0.025$, $\sigma = 0.2$ and $\eta = 1$. Under these assumptions, MNC takes approximately the $88,68\%$ of each unit of profit ($\theta^* = 0.8868060187$) and leave the rest to HC. Plugging the assumed parameters into (11) and (20) we respectively determine the time triggers for investment, $\pi_I = 0.1604535594$, and nationalization, $\pi_N = 0.4269609891$.

In figure 7, the value function, $H(\pi, \theta^*)$, and the net present value of nationalization, $NPV(\pi, \theta^*) = V(\pi) - N$, are plotted. Holding the option to nationalize up to π_N is valuable as shown by the gap between the two functions. Note also that even if continuous, $H(\pi, \theta^*)$ is not differentiable at π_I. This is due to the option to nationalize being conditional on the investment.

To complete our illustration we draw in figure 8 the value function, $M(\pi, \theta^*)$, and the net present value of investment, $NPV(\pi, \theta^*) = \theta \left[V(\pi) - V(\pi_N) \left(\frac{\pi}{\pi_N} \right)^{\beta} \right] - I$. Again, to keep the option open up to π_I is valuable. Let analyse the impact of nationalization on the net present value. This impact is absolutely clear for $\pi \geq \pi_N$ where the investment would be instantaneously expropriated and result in a loss equal to -1. Now, note that under no threat $NPV(\pi, \theta^*) = \theta V(\pi) - I$ which is linear and increasing in π. The effect of the threat of nationalization is then shown by the curvature of $NPV(\pi, \theta^*)$. As π approaches π_N, a more likely nationalization lowers the net present value from investment. This reduction is so drastic that $NPV(\pi, \theta^*)$ is negative for some $\pi_I < \pi < \pi_N$.

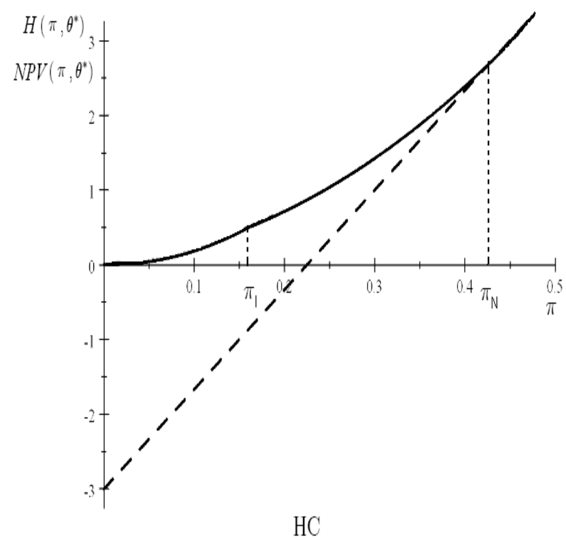

FIGURE 7: $\theta^* = 0.8868060187,\ \pi_I = 0.1604535594,\ \pi_N = 0.4269609891$
$\rho = 0.1,\ \alpha = 0.025,\ \gamma = 3,\ \eta = 1,\ \sigma = 0.2,\ I = 1$

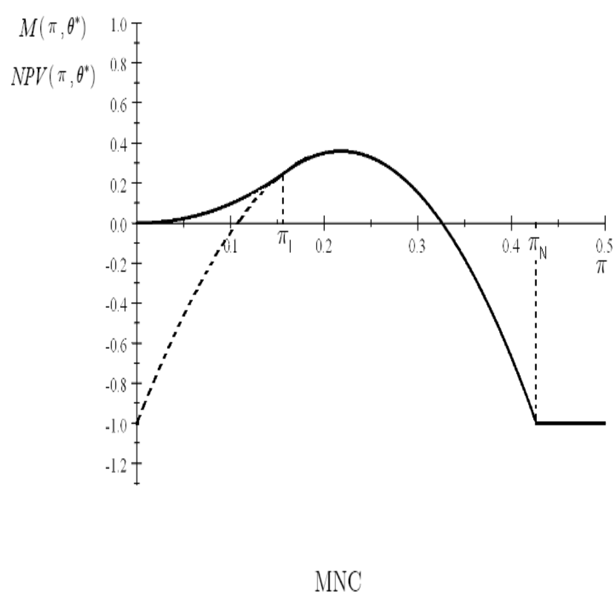

FIGURE 8: $\theta^* = 0.8868060187,\ \pi_I = 0.1604535594,\ \pi_N = 0.4269609891$
$\rho = 0.1,\ \alpha = 0.025,\ \gamma = 3,\ \eta = 1,\ \sigma = 0.2,\ I = 1$

6 Conclusions

The exploitation of natural resources in developing countries can support their economic growth and fund social welfare improvements. Often, in the presence of funding constraints and lack of technological skills the activation of extractive projects may be problematic. In this case, local governments can benefit from joint ventures with multinational corporations offering capital and technology.

Unfortunately, high political hazard may limit joint venture formation. The abuse of national sovereignty concept to support the existence of a right to expropriate or nationalize foreign investment weakens the legal frame regulating contractual agreements (Mahajan, 1990). In the lack of a credible commitment, expropriation and nationalization may be a temptation hard to resist when profits are high and local governments are under populist pressure for profit redistribution. International sanctions and the fall of future FDI may limit but not deter this opportunistic behaviour.

In this paper these conflicting and mutual economic interests have been considered. We have proposed a model where cooperative bargaining meets the real option approach. Both parties holds an option, respectively on investment and nationalization. Both decisions are characterized by uncertain pay-offs and irreversibility. Hence, accounting for market uncertainty and additional political risk we shape and fully characterize a feasible agreement inducing foreign investment.

We believe that this framework should be extended at least in two respects. First, we have considered only the case where the government takes all the "cake". It would be interesting to apply our frame to analyse the more subtle threat of "creeping expropriation" (Schnitzer, 1999, 2002). That is, the increasingly common practice by which, after an agreement has been signed, governments violate its terms imposing a change in MNC's profit taxation, import or export duties, stricter environmental and labour regulations. As one can easily see, the main issue with creeping expropriation is to distinguish between the legitimate exercise of government prerogatives and a clear act of expropriation.

Second, the analysis can be extended to account for government time inconsistency. Time inconsistency may be due to changing time preferences (Strotz, 1956). This can be a consequence of short political cycles for democratic governments. Each government in power to magnify the probability of re-election needs to please the currently living political body. This consideration modifies the time preferences which may show a certain bias for the present and induce rush on decisions which entails present benefits in front of future costs. A similar issue may arise also when dictatorship are considered. In this case the point becomes to maximize the probability of conserving the power feeding populism to deter political opposition.

A Appendix

A.1 Proposition 1

For the bargaining to occur $M(\pi, \theta)$ must be positive. From (22) follows $\beta < \gamma^{\beta-1}$. Taking the logarithm on both sides:

$$\ln \beta + (1-\beta) \ln \gamma < 0$$

Being $\beta > 1$ it is easy to show that if such condition holds then $\gamma > 1$. Finally, note that for $\beta \to 1$, the condition does not hold at the limit.

A.2 Optimal θ^*

The second order condition for the optimality of θ^* requires $\frac{\partial^2 \nabla}{\partial \theta^2} \mid_{\theta^*=\theta} < 0$. Using (25) and rearranging this is equivalent to

$$-\left[\frac{\left(\frac{dH(\pi_I,\theta^*)}{d\theta}\right)^2}{H(\pi_I,\theta^*)} - \frac{dH^2(\pi_I,\theta^*)}{d\theta^2}\right] < -\frac{\frac{dH(\pi_I,\theta^*)}{d\theta}}{\frac{dM(\pi_I,\theta^*)}{d\theta}}\left[\frac{\left(\frac{dM(\pi_I,\theta^*)}{d\theta}\right)^2}{M(\pi_I,\theta^*)} - \frac{dM^2(\pi_I,\theta^*)}{d\theta^2}\right] \quad \text{(A.2.1)}$$

Being $\theta^* > \frac{\beta-1}{\beta-\gamma^{1-\beta}}$ it follows

$$\frac{\frac{dH(\pi_I,\theta^*)}{d\theta}}{\frac{dM(\pi_I,\theta^*)}{d\theta}} = \frac{\beta - \theta^*\left(\beta-\gamma^{1-\beta}\right) - 1}{\theta^*\left(\beta-\gamma^{1-\beta}\right)} < 0$$

Finally, to prove that (A.2.1) holds it is sufficient to show that

$$\frac{dH^2(\pi_I,\theta^*)}{d\theta^2} < 0 \text{ and } \left(\frac{dM(\pi_I,\theta^*)}{d\theta}\right)^2 > M(\pi_I,\theta^*)\frac{dM^2(\pi_I,\theta^*)}{d\theta^2}$$

Proposition (1) implies $1-\theta^*\gamma^{1-\beta} > 0$. In addition, since $\theta^* > 1-\frac{1}{\beta}$ then $\beta(1-\theta^*)-1 < 0$. Using these results the first inequality is verified being

$$\frac{\beta}{I}\left(\frac{\pi}{\pi_N}\right)^\beta \left[\frac{\beta(1-\theta^*)-1}{\theta^*} - \left(\frac{1}{\theta^*} - \gamma^{1-\beta}\right)\right]\left(\frac{1}{\theta^*}\right)^2 < 0$$

Rearranging on both sides the second inequality it follows

$$\begin{aligned}\left(\frac{\beta}{\beta-1}\right)^2 \frac{1-\beta\gamma^{1-\beta}}{I} &> \frac{\beta}{\beta-1}\frac{1-\beta\gamma^{1-\beta}}{I} \\ \frac{\beta}{\beta-1} &> 1\end{aligned}$$

A.3 Properties of θ^*

In this section we present the derivatives of θ^* with respect to the main parameters:

- γ

$$\frac{\partial\theta^*}{\partial\gamma} = -\theta^* \frac{\beta-1}{\beta-\gamma^{1-\beta}}\gamma^{-\beta} < 0$$

- η, p and q

$$\frac{\partial\theta^*}{\partial\eta} = -\frac{1}{(\beta-\gamma^{1-\beta})(\eta+1)^2} < 0$$

$$\frac{\partial\theta^*}{\partial p} = -\frac{1}{q}\frac{\partial\theta^*}{\partial\eta} > 0; \quad \frac{\partial\theta^*}{\partial q} = -\frac{\eta}{q}\frac{\partial\theta^*}{\partial\eta} > 0;$$

$$\frac{\partial^2\theta^*}{\partial p\partial q} = \frac{2(1-p)+1}{q^2}\frac{\partial\theta^*}{\partial\eta} < 0$$

$$\frac{\partial^2\theta^*}{\partial q\partial p} = \frac{1-2\eta}{q^2}\frac{\partial\theta^*}{\partial\eta} \gtreqless 0 \text{ for } \eta \lesseqgtr \frac{1}{2}$$

- β

$$\frac{\partial\theta^*}{\partial\beta} = \frac{1-\theta^*(1+\ln\gamma\cdot\gamma^{1-\beta})}{\beta-\gamma^{1-\beta}} \gtreqless 0 \text{ for } \theta^* \lesseqgtr \widetilde{\theta}$$

where $\widetilde{\theta} = \frac{1}{1+\ln\gamma\cdot\gamma^{1-\beta}}$.

A.4 Impact of volatility on the option to nationalize

According to (13) the option to nationalize at $\pi = \pi_I$ is worth $[\theta V(\pi_N) - N]\left(\frac{\pi_I}{\pi_N}\right)^\beta = \frac{N}{\beta-1}\left(\frac{I}{N}\right)^\beta$. The derivative of its value with respect to σ is given by

$$\frac{\partial\left[\frac{N}{\beta-1}\left(\frac{I}{N}\right)^\beta\right]}{\partial\sigma} = -\frac{N\left[1-\frac{\ln\left(\frac{I}{N}\right)}{\beta-1}\right]\left(\frac{I}{N}\right)^\beta}{(\beta-1)^2}\frac{\partial\beta}{\partial\sigma} > 0$$

References

[1] Barham, B. L., Chavas, J. P., Coomes, O. T., 1998. Sunk costs and the natural resource extraction sector: analytical models and historical examples of hysteresis and strategic behavior in the Americas. Land Economics, 74, 4, 429-448.

[2] Breccia, A., Salgado-Banda, H., 2005. Competing or colluding in a stochastic framework. Birkbeck Working Papers in Economics and Finance 0504, Birkbeck, School of Economics, Mathematics & Statistics.

[3] Brennan M., Schwartz, E., 1985. Evaluating natural resource investments. Journal of Business, 58, 135-157.

[4] Brunnschweiler, C. N., Bulte, E. H., 2008. The natural resource curse revisited and revised: a tale of paradoxes and red herrings. Journal of Environmental Economics and Management, forthcoming.

[5] Clark, E., 2003. Pricing the cost of expropriation risk. Review of International Economics, 11, 412-422.

[6] Clark, E., 1997. Valuing political risk. Journal of International Money and Finance, 16, 477-490.

[7] Cox, J.C., Ross, S.A., 1976. The valuation of options for alternative stochastic processes. Journal of Financial Economics, 3, 145-166.

[8] Dixit, A.K., Pindyck, R.S., 1994. Investment under uncertainty. Princeton University Press, Princeton, NJ.

[9] Duncan R., 2006. Price or Politics: an investigation of the causes of expropriation. Australian Journal of Agricultural and Resource Economics, 50, 85-101.

[10] Engel, E., Fischer, R., 2008. Optimal resource extraction contracts under threat of expropriation. NBER Working Paper No. W13742. Available at SSRN: http://ssrn.com/abstract=1086993.

[11] Guasch, J.L., Laffont, J.J., Straub, S., 2003. Renegotiation of concession contracts in Latin America. Policy Research Working Paper Series 3011, The World Bank, revised.

[12] Hajzler, C., 2007. Expropriation of foreign direct investments, 1990-2006. Unpublished Paper, University of Western Ontario.

[13] Harrison, M. J., 1985. Brownian motion and stochastic flow systems. New York: Wiley.

[14] Harsany, J., 1977. Rational behaviour and bargaining equilibrium in games and social situations. Cambridge, Cambridge University Press.

[15] Kobrin, S. J., 1987. Testing the bargaining hypothesis in the manufacturing sector in developing countries. International Organization, vol. 41, 4, 609-638.

[16] Kobrin, S. J., 1984. Expropriations as an attempt to control foreign firms in LDCs: trends from 1960 to 1979. International Studies Quarterly, vol. 28, 3, 329-348.

[17] Long, N. V., 1975. Resource extraction under uncertainty about possible nationalization. Journal of Economic Theory, 10, 42-53.

[18] Mahajan, A., 1990. Pricing expropriation risk. Financial Management, 19, 77-86.

[19] Minor, M. S., 1994. The demise of expropriation as an Instrument of LDC Policy, 1980-1992. Journal of International Business Studies, vol. 25, 1, 177-188.

[20] Moretto, M., Rossini, G., 1996. Profit sharing regulation and repeated bargaining with a shut-down option. Review of Economic Design, 2, 1, 339-368.

[21] Moretto, M., Rossini, G., 1995. The shut-down option and profit sharing. Journal of Comparative Economics 21, 154-186.

[22] Nash, J., 1950. The bargaining problem. Econometrica, vol. 18, 2, 155-162.

[23] Roth, A.E., 1989. Risk aversion and the relationship between Nash's solution and subgame perfect equilibria of sequential bargaining. Journal of Risk and Uncertainty, 2, 353-365.

[24] Schnitzer, M., 2002. Debt v. Foreign Direct Investment: the impact of sovereign risk on the structure of international capital flows. Economica, vol. 69, 273, 41-67.

[25] Schnitzer, M., 1999. Expropriation and control rights: a dynamic model of foreign direct investment. International Journal of Industrial Organization, vol. 17, 8, 1119-1137.

[26] Strotz, R.H., 1956. Myopia and inconsistency in dynamic utility maximization. Review of Economic Studies, 23, 165-80.

[27] Tomz, M., Wright, M., 2008. Sovereign theft: theory and evidence about sovereign default and expropriation. Available at SSRN: http://ssrn.com/abstract=1392540.

[28] Vernon, R., 1993. The raw material ventures. In McKern, B., ed., Transnational Corporations and the Exploitation of Natural Resources. Routledge: London.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:
http://www.feem.it/getpage.aspx?id=73&sez=Publications&padre=20&tab=1
http://papers.ssrn.com/sol3/JELJOUR_Results.cfm?form_name=journalbrowse&journal_id=266659
http://ideas.repec.org/s/fem/femwpa.html
http://www.econis.eu/LNG=EN/FAM?PPN=505954494
http://ageconsearch.umn.edu/handle/35978
http://www.bepress.com/feem/

NOTE DI LAVORO PUBLISHED IN 2010

GC	1.2010	Cristina Cattaneo: Migrants' International Transfers and Educational Expenditure: Empirical Evidence from Albania
SD	2.2010	Fabio Antoniou, Panos Hatzipanayotou and Phoebe Koundouri: Tradable Permits vs Ecological Dumping
SD	3.2010	Fabio Antoniou, Panos Hatzipanayotou and Phoebe Koundouri: Second Best Environmental Policies under Uncertainty
SD	4.2010	Carlo Carraro, Enrica De Cian and Lea Nicita: Modeling Biased Technical Change. Implications for Climate Policy
IM	5.2010	Luca Di Corato: Profit Sharing under the threat of Nationalization