



Preface: Special issue of Dynamic Games and Applications in Memory of Professor Ngo Van Long

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Ngo Van Long peacefully passed away on January 15, 2022, in Montreal, his home for the past 33 years. The announcement of his passing came as a shock to many in the scientific community, given his sustained scientific activity until the very end. This special issue aims to honor Long's remarkable spirit, inquisitive mind, and sharp intellect by compiling contributions from former co-authors and colleagues who found inspiration in his academic writings.

1. Ngo Van Long: a brief bio



Ngo Van Long, born in Vietnam in 1948, adopted the family name Long in the English-speaking world, where he spent the majority of his life, although his original Vietnamese family name was Ngo. In 1967, he embarked on his academic journey in Melbourne, enrolling in economics at La Trobe University. Following the completion of his BA, he transitioned to Australian National University (ANU) in Canberra to pursue his Master's and PhD studies. Long's tenure at ANU evolved from Lecturer to Senior Lecturer, Reader, and culminated in his appointment as a full Professor before he assumed the role of Professor at McGill University in 1989. Concurrently, he served as a research fellow at CIREQ and CIRANO in Montreal.

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Long's prolific academic career spanned methodological and theoretical advancements, applied research, surveys, and textbooks. He made significant contributions to environmental and resource economics, international trade, dynamic optimization, dynamic game theory, and industrial organization. His extensive body of work encompasses approximately 250 articles in refereed journals, 8 books, and numerous contributions to edited volumes. Long held editorial roles in over a dozen academic journals, including the *Canadian Journal of Economics*, the *European Journal of Political Economy*, the *Journal of Environmental Economics and Management*, the *Journal of Public Economic Theory*, and, notably, *Dynamic Games and Applications*.

The list of Long's students and co-authors is extensive, a testament to his enthusiasm for sharing ideas and questions with others, and his enjoyment of scientific collaborations. Those fortunate enough to collaborate with him undoubtedly benefited from his impressive mathematical skills and broad knowledge of the economics literature. Despite his accomplishments, Long remained a humble, kind, and generous colleague.

For more comprehensive details about Long's scientific career, readers are encouraged to explore obituaries available at

<https://www.cesifo.org/en/network-member/long-ngo-van>

or

https://cireqmontreal.com/wp-content/uploads/2022/02/In-Memoriam-Ngo-Van-Long_anglais.pdf.

2. Contributions to the special issue

The economics of natural resources was a central research theme of Long. Already in the early 1980s he and Murray C. Kemp edited and contributed to two volumes of essays on topics related to exhaustible resources [8, 9]. His later books Dockner et al. [6] and Long [14] each contain chapters on resource models. In addition, he has written many academic papers on this topic, including the survey article Long [15]. One of Long's very first academic papers was Long [13]. It deals with the question of how the threat of nationalization at a random time affects the optimal extraction path for a non-renewable resource. Long showed in particular that this kind of uncertainty increases the rate of extraction and leads to earlier extinction. According to Google Scholar, this paper is Long's second most cited journal publication and, until today, it continues to inspire researchers to new ideas. The current special issue contains two papers which discuss extensions or modifications of Long's early classic.

Salant and Keller [20] provide a detailed account of the relevant research activity which took place around the time when Long [13] was published and continue by discussing a variant of Long's model in which the uncertain event does not reduce the value or price of the asset under consideration (e.g., the resource stock) but rather increases it. They illustrate their results by means of three examples: the permission to carry out an investment project, the abandonment of restrictions for land use, or an anticipated but uncertain currency appreciation. For each of these cases, they derive the implications of uncertainty for the competitive asset price path.

Van der Ploeg [21] also takes Long's [13] paper as starting point but replaces the threat of nationalization by a conflict between two rival political factions. In a first step, the paper demonstrates how rent sharing rules can reinforce the effects of expropriation risk. Then, the author moves on to consider ongoing conflict cycles, in which the power switches back and forth between the two parties at exogenously given rates. The final step then treats these rates as endogenous and therefore builds a differential game model of resource wars. The overall conclusion is that political uncertainty triggers voracious behavior and depresses exploration investment.

Even if most of Long's papers on the economics of natural resources deal with exhaustible ones, he was also interested in studying optimal harvesting strategies for renewable resources such as fisheries. One example is Long et al. [17], in which fishing effort affects the stock of fish but also the carrying capacity of the habitat. The authors were primarily interested in tax schemes that support optimal solutions but restricted their analysis to a large extent to the steady state of the model. The contribution by Jean-Marie and Tidball [7] in the present special issue, on the other hand, considers a somewhat simpler model of the joint evolution of the resource stock and the habitat under fishing and succeeds in characterizing the optimal dynamic solution path. This is accomplished by generalizing Clark's most rapid approach path method to the two-state dynamical system at the heart of the model. To illustrate the theoretical analysis, the authors also provide a few numerical simulations.

Koulovatianos [10] presents an application of differential game theory to another problem of renewable resource extraction with two state variables. More specifically, the author considers an ecosystem with two populations, a predator and a prey, which is harvested by finitely many non-cooperative players. The system is subject to stochastic shocks to the natural death rates of the two interacting species. The focus of the analysis is on the question of how changes of the means and variances of the death rates affect the optimal harvesting rates and the severeness of the tragedy of the commons. In order to ensure analytical tractability, the author assumes that only one of the two species is harvested (but not both) and imposes specific parametric assumptions on the preferences of the players and on the natural growth rates of the two species.

Colombo and Labrecciosa [3] employ a renewable resource framework to examine the impact of resource mobility on resource extraction and market performance. They consider a duopoly exploiting two distinct stocks of a renewable resource, each located in a specific area. After characterizing the equilibrium in a benchmark case where there is no mobility of the resource, they allow for the possibility for the resource to migrate from the more densely populated region to the less populated region, an extension of the mobility of oil between two reservoirs (à la Kemp and Long [8]). They show that consumer surplus and social welfare increase in the short run but decrease in the long run. The industry's profits increase in the long run but may decrease in the short run. The discounted sum of profits of the industry increases, whereas the discounted sum of welfare decreases.

The above contribution is an illustration of the influence of Long's work in the modeling of markets characterized by imperfect competition and intertemporal constraints and more generally in the analysis of competition versus cooperation in industrial organization and applied microeconomic theory. The following four contributions also deal with market structure, industry dynamics, and cooperation vs. competition.

Yanase and Long [22] examine the impact of market structure on the dynamics of research and development, captured by the accumulation of a stock of knowledge. The model allows for large firms that have market power and a mass of small firms that are price takers. R&D is conducted by large firms and results in the accumulation of a stock of knowledge from which all firms benefit. The accumulated knowledge becomes a public good accessible by all firms. The authors establish that an increase in the number of large firms may result in an increase in profits of all the firms in the long run. When firms can commit to an investment path in R&D an increase in the number of large firms may result in a decrease in the steady state stock of knowledge.

Mason [18] considers an empirical model of cooperation between two firms where two approaches to cooperation are examined: accumulation of a stock of goodwill (as in Benchekroun and Long [2]) and the use of trigger strategies under which a punishment phase

starts as soon as a deviation from cooperation is detected. The data from two-person experimental games give statistically significant support for the social goodwill model in the case of symmetric games. For the case of asymmetric games there is statistically significant support for larger players only.

Boucekkine et al. [23] examine the sustainability of cooperation in a transboundary stock pollution game. An agreement assigns (i) a pollution path to each country such that the sum of the discounted sum of welfare of all countries is maximized and (ii) a share of that welfare to each country. The authors then determine, given a country's share of the total surplus, a date at which this country would unilaterally choose to leave the coalition: the splitting date is endogenous. In a framework à la Dockner and Long [5], the authors show that the splitting date chosen by a country may be a decreasing function of that country's share of welfare under cooperation. When the initial stock of pollution is small enough, the authors characterize an interval of sharing-rule values such that no country has a unilateral incentive to split. When the initial stock of pollution is large enough, the authors show that no country should have a share of payoff larger than half and that all shares should be small enough for cooperation to last forever.

Martin-Herran and Rubio [19] examine a dynamic oligopoly. The source of the dynamics is the accumulation of pollution generated by firms' production. The authors generalize Benchekroun and Long [1] to allow for an abatement technology. A regulator chooses a tax on production and a subsidy for abatement. Firms take these policies as given and choose their production and abatement strategies. The regulator is modeled as a stage wise Stackelberg leader. The authors consider two tax-subsidy schemes that induce the socially efficient outcome: a tax on production accompanied with a subsidy on the quantity of pollution abated, and a tax on production with a subsidy of abatement costs. Numerical simulations indicate that the latter policy achieves efficiency with a smaller deficit at the steady state than under the former policy. This paper belongs to a large literature inspired by the seminal paper of transboundary pollution Dockner and Long [5].

Laussel [11] examines the evolution of market structure in a dynamic infinite horizon game of mergers. The author considers a Cournot symmetric triopoly where, in each period, one of the firms announces a bid price to the other two firms. The sellers respond by choosing a mixed strategy: a probability of accepting a bid (as in Long [14, 16]). Two equilibria may potentially exist: no merger equilibrium and immediate monopolization equilibrium. The paper shows that there is a third potential equilibrium that features a 'war of attrition': monopolization occurs but after a finite period of time. The delayed monopolization occurs because the firm that sells last gets a larger bid. The author fully characterizes, for all sets of parameters, the equilibria in the case of a linear demand and in the case of a demand with constant price elasticity.

Long has also contributed significantly to the development of mathematical methods of economics. His textbooks on optimization and control theory [12] and differential games [6] have become standard works of the literature and are now Long's two most frequently cited publications (according to Google Scholar). The contribution by de Zeeuw [4] fits into this research direction as it is primarily a methodological one. The author studies three different ecological or economic models, in which tipping points occur with a constant or state-dependent hazard rate. The contribution of the paper consists of analyzing these models consistently with a common method, which is based on the use of the appropriate HJB equations. The three models under consideration are a pollution control model in which the damage may suddenly rise, a fishery model in which the carrying capacity may drop, and the Ramsey growth model in which total factor productivity may collapse. In all cases, extensions to differential games are also discussed.

3. Personal remembrances

We conclude this preface with personal remembrances by the editor of this journal and the two associate editors in charge of the special issue.

Hassan Benchekroun (associate editor): I was introduced to Long by Gérard Gaudet who was my doctoral advisor. Long used to visit Gérard frequently at Université Laval. My dissertation was on resource games and of course Long's papers and textbooks were at the top of my reading list, so meeting him for the first time was very intimidating. His kindness and humility immediately put me at ease during our meetings. Since then, his generosity and encouragements were crucial at each step of my academic life. This is true for many colleagues around the world, who, like me, were very fortunate to have Long as a mentor.

I was lucky enough to also become his colleague and friend. Having Long close by was fantastic. My questions on any aspect of the research projects I work on had an immediate answer from the expert in the field. He always listened to my questions with a big smile, a short pause and then inevitably gave me the answer. We rarely had a meeting or a chat without a good laugh and, me feeling uplifted.

Rest in peace Long, I miss you very much.

Gerhard Sorger (associate editor): I believe I first met Long during one of the Viennese Workshops on optimal control theory and economic dynamics organized by Gustav Feichtinger in the late 1980s and early 1990s. During one of his visits to Vienna in that period, Long extended an invitation to Engelbert Dockner and me for an extensive research stay at the Australian National University (ANU). Enthusiastically, we accepted the invitation and spent seven weeks at ANU in 1993, relishing Long's hospitality and soaking in the inspiring atmosphere at ANU's economics department. Throughout our visit, Long, Engelbert, and I came up with the plan to write a textbook on differential games in economics and management. This plan came to fruition in the year 2000, with Steffen Jørgensen joining as the fourth co-author. In 1996, I secured a scholarship from the Austrian Science Fund, enabling me to spend an entire year as a guest researcher in Montreal. Long had thoughtfully organized office spaces for me at McGill University and CIRANO during my stay. From that point onward, our connection remained strong. Long and I stayed in frequent contact, and I always regarded him as a role model. He stands out among the scholars who have profoundly influenced my academic career. Beyond his brilliant mind, Long left a lasting impression with his kind and humble personality. I will forever cherish his memory.

Georges Zaccour (editor): I do not remember when we met the first time, I had the impression that I have known Long forever. Because of his legendary kindness, bright mind, and efficiency, Long was always on my short list of people to whom I could often ask a favor with a certainty of responding yes such as reviewing a paper (of course with a very tight deadline), commenting on a model I was working on, joining the editorial board of *Dynamic Games and Applications*, being on a Ph.D. student committee, and giving a plenary/invited talk at several of the workshops I co-organized in my career. On one occasion, and after the usual thanks for the invitation, he said that a lot of people asked him how come we never wrote a joint paper despite sharing common research interests and living in the same city. Interestingly, I was asked the same question infinitely many times! Thanks to Mabel Tidball, we finally made it, and I am very proud of our joint paper that got an award, but most importantly because it constitutes a piece of memory. I enjoyed every minute working with Long, especially during our meeting at my preferred sushi restaurant.

Rest in peace my friend.

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