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RAPPORT DE SOUTENANCE

Nom et prénom du doctorant : MAVROYIANNIS Diomides
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Titre de la thèse : « Choix d'innovation »
Président du Jury : Mme Claire Chambolle
Avis du Jury sur le Prix de thèse (Chancellerie et Fondation Dauphine). (oui) non

UNIVERSITÉ - PARIS - DAUPHINE
École Doctorale de Dauphine ED-543

Les membres du jury :

Prénom et Nom	Signature	Prénom et Nom	Signature
David ETTINGER		**Olivier BOS**	
Sara BIANCINI		**Claire CHAMBOLLE**	
Frédéric LOSS			

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PhD defense of Diomiodes Mavroyiannis on Innovation and Choice

held at Université Paris Dauphine
on December 12th 2019

Diomides Mavroyiannis' PhD thesis presentation

The candidate presents his work in a concise and clear way. Follows the sequence of questions and comments.

Sara Biancini

Sara Biancini congratulates the candidate for the work accomplished with three chapters, each one constituting an original research contribution, interesting and rich in practical applications.

First chapter

- Practical context. The paper applies in particular to the audiovisual market. It could therefore be enriched with stylized facts or empirical evidence that justifies the chosen modeling. The introduction also cites the software market, but in this case, it seems that the model should be enriched to describe the behavior of companies.
- From a technical point of view, I was wondering what the key elements to describe the effects under consideration are and whether the model could be simplified.
- Another important hypothesis is the form of asymmetry in the utility of buyers of legal and pirated copies (difference captured by two different parameters). It might be interesting to rely on existing empirical analyses or anecdotal evidence in support of the hypotheses chosen.
- The result that piracy may be desirable for business when the network effect is large seems quite intuitive and not specific to this model. It would be interesting to put this result in a more precise relationship with the literature on network effects and better explain its originality.

Second chapter

- The paper presents a large number of proposals. However, some are intermediate results, which could probably be less detailed in the body of the paper to focus on the more significant results.
- The paper could also benefit from a more in-depth discussion of the hypotheses retained and their comparison with other frameworks common in the literature.

- Similarly, the role of the size of the periods before successive innovations in the case of sequential innovation (t1 and t2) could be explored in more detail. Indeed, in end-of-paper applications (Cournot and Bertrand competition), the model is simplified (t1 and t2).
- What would the case of non-drastic innovation in Cournot/Bertrand applications bring?
- An interesting result is that the incumbent would be willing to pay to prevent itself from buying out the entrant. This is interpreted in practice as a willingness on the part of the company to influence the regulator to prohibit takeovers. However, other forms of commitment could be discussed.
- It would also be interesting to further develop the intuition as to why the entrant more often chooses sequential innovation in the presence of a buyout possibility and to provide some examples or stylized facts. Indeed, there is sometimes the opposite intuition, that innovative market entrants (IT startups, etc.) would tend to undertake risky projects, with the aim of reselling the activity to a large company in case of success. In the model, the results depend on the role of the entrant's bargaining power.
- Some extensions could also be discussed, such as the possibility that the incumbent innovates as well.
- A limitation of the model in my view is the lack of a complete welfare analysis, which would indicate the optimal choice of technology as well as the optimal choice of entry and merger, to compare them with the equilibrium obtained in the model. Some elements are given in the Appendix of the paper, but I think it would be good to further clarify the issues of total welfare.

Third chapter

This subject is further from my expertise and I can only make a very general comment. I find that the discussion of axiomatization is not very developed in the text. It would be interesting to further develop the justification of the theoretical framework to bring out the originality of the contribution.
In conclusion, each of the three chapters of the thesis presents a distinct research question and original findings. Congratulations again to the candidate for his work.

The candidate answers the questions.
For the first chapter, he explains that some of the results of the model also apply to the software market, taking as an example scientific software such as Stata, where collaboration between users increases the value of the good. Other applications could be explored.
In terms of the functional forms used, others were tested, but the analysis was often even more complicated. In the context of the model it is difficult to obtain a closed form.
For the alpha and beta parameters, the candidate explains that this assumption seems natural. Taking into account the effect of laws could be explored. To put the effects of network size into perspective, he would like to consider a more general model afterwards.
For the second chapter, he explains that the analysis of well-being is difficult in the context studied in this chapter. It might be possible to develop a little more specific cases and examples to illustrate what is happening. He also explains the role of t1 and t2 periods in some results, since the length of the periods in the model influences the difference between the two types of innovation. In response to the other questions he briefly returned to the role of the other assumptions of the model and mentioned possible future developments.

Olivier Bos

Olivier Bos starts by congratulating the PhD candidate for the quality of his works that he enjoyed very much to read.

This PhD thesis investigates ambitious and difficult research questions. Indeed, this thesis consists in three chapters: one with a IO static model, a second with a dynamic setting, which is always challenging given the difficulties raised by the analysis, and a third chapter about decision theory, a complete different field. This research requires to have a high understanding and a high command of a broad and hard literature. This ambitious research leads to original results in every chapter, which are the evidence of the high abilities and skills developed by the Diomides Mavroyiannis as an economist.
Olivier Bos comments then the results on the first chapter. In the analysis it is supposed that the network parameters are exogenous. Yet it seems empirically reasonable to consider that for intermediate piracy cost values, the network parameters depend from the piracy cost value. Therefore, how robust are the results to non-exogenous network parameters, when there is a mapping between the piracy cost values and the network parameters? A general comment is added about the thresholds of the piracy cost. While they are used to establish some results, they are not explicitly determined. That could lead to a static comparative analysis given the other parameters, which might interest the regulator and other policy authorities.

Beyond the interesting results developed in chapter 2, Olivier Bos discusses the general methodology. The question investigated and the model could be looked as a sequential game with complete information. Therefore, why not use the usual game theory concepts to solve it? A larger structure might be provided, and the takeover could be considered as a strategic action. That would turn to be a two-decision investment problem, the entry and costly technology by the entrant and the takeover by the incumbent, which could happen at any period. This approach might also be helpful to understand how the incentives are affected by the time periods between the two innovations in the two-stage technology.
A last question is about the robustness of the results for infinite or large enough number of periods. That might be empirically relevant.

On the last chapter, Olivier Bos reminds that Diomides Mavroyiannis developed a very interesting new approach to determine the micro-foundations of discounting rate. The results could be better exposed thanks to a discussion through the literature. There is indeed a large literature in economics on this topic. A significant part is about uncertainty, which can explain why it is not discussed here. Yet other papers investigate, through axioms on preferences, the same research question and find in some case similar results. For example, as noticed in this chapter, the exponential discounting rate determined is consistent with the prediction of Samuelson (1937). So why not to compare this result and the methodology adopted with the axiomatic characterization of Samuelson proposed by Koopmans (Econometrica, 1960)? There are also recent works on this topic. Among them, Montiel and Strzalzcki

(Quartely Journal of Economics, 2014) characterized axiomatically preferences leading to a family of hyperbolic discounting rates, and then provide theoretical and experimental evidence. These comparisons will not weaken the contribution of this chapter. They will instead highlight the relevance of the methodology developed and the robustness of the results. Results established here could either be complements of previous ones, or even better provide a new look on this topic. Not citing the related literature might also be risky as a publication strategy.

The candidate answers to the questions raised.
He believes, that in a way, the first model does tackle the link between the piracy cost and the network parameters although it is not a link directly between the parameters but rather an indirect link. Indeed, when the piracy cost increases, piracy activities decrease. Therefore, the network effect applies on a lower population, which decreases the network effect. He further mentions that he cannot determine the threshold of piracy cost because of computational issues, but he agrees he should work on it in the future. Regarding chapter 2, the candidate is convinced that it would be indeed very interesting to take into account the strategic behaviour of the incumbent by solving the model as a game. He would like to work on that in the future. He also mentions that the difference between the sequential and radical innovation projects decreases when the horizon increases but he does not believe that firms make their plan with such a long-time horizon. He believes that the analysis in the third chapter is quite different from the existing literature, and that somehow, they are studying within agent variations rather than between agent variations as done in this literature. They try to explain the consistency of the agents' behaviour throughout time, which therefore leads them to not consider relevant the standard axiomatic characterization.

Claire Chambolle

Claire Chambolle congratulates Diomides for his interesting work. She thinks that the thesis contains a lot of ideas. When reading from chapter 1 to chapter 3, chapters becomes more and more polished. She will focus her remarks on the two first chapters which are more applied and less polished.

An important result in Chapter 1 is that the profit made under piracy can be higher than without when the network effect, represented by the parameter α is large enough. This only happens when $\alpha>1+k$. She wonders how realistic that assumption is? It means that the social network effect must bring a higher utility than the objective private utility you can withdraw from having the good and the additional services. Are there empirical marketing studies assessing the relative utility derived from social network effect as compared to private utility?
In the same vein, she questions the assumption $\alpha > \beta$, i.e. that the socialization effect is stronger when the consumer buys the product.

She also would have enjoyed more discussion on alternative mechanisms. For instance, a total control over piracy but the possibility for the firm to offer one song for free that generate the network effect and serve as attraction for consumers to buy the rest. She also wonders if instead of one product, there were two products differentiated in terms of basic utility but also in terms social network effect (strong vs high)! Which product should you protect from piracy? is it better to have product-targeted policy or the same for all.

Diomides answers. He believes that indeed some cultural products might generate large network effects that bring more utility than the good in itself but agrees that some marketing studies might exist and that it could be interesting to look for it. He justifies the network effect to be higher when the firm does not buy the good than in case of piracy by a social stigma that people could affect to pirates. He also justifies it by the need to go through a pirate website rather than netflix which is costlier.
He acknowledges that sampling may be useful for the firm and can only be better than not doing so.
He also thinks that a targeted policy targeting people who are going to switch from buying to pirating would be more efficient.

Claire Chambolle then proceeds with her comments about Chapter 2. She thinks that the paper contains typos that makes it difficult to read and that the choice of notations is sometimes misleading, but she thinks it is a promising paper. She appreciates that the model explains well the buy-out of start-ups by Google for instance. One of the main results is that when the entrant can be bought out by the incumbent, it increases the probability that he chooses the Sequential innovation path (incremental innovation not risky) with respect to radical innovation (but risky). Diomides finds this in Proposition 12 and this is explained in the discussion at the end of the paper, a bit far to her taste. She understood that when opting for the sequential path, it hurts the outside option profit of firm I absent any buying out which increases the total surplus of this buying out, and because the entrant is able to get a share of this surplus, it makes this option more profitable.
She wonders, as was previously pointed out by Sarah Biancini, whether Diomides can obtain this result with a simple model with two periods like presented in the end and in that case, she would be in favor of presenting the result in a two period model first and then explain the effect of time by increasing the time horizon. Another important result of Diomides is that when the possibility to be bought out makes the entrant enters (decides to innovate in a sequential path with buy out while he wouldn't otherwise), the incumbent might lobby to prevent any buying out.
She mentions that Diomides should be careful when relating this result to merger control because in the model, after the incumbent observes the innovation path chosen by the entrant, he can decide to buy it. At that moment the entrant has no market share yet, he does not exist basically so she does not understand how a competition authority would prevent such a merger from happening. It is quite different from a duopoly merging to monopoly. Finally, she regrets that the analogy between complementarity or substituability of the innovation project with existing technology and radical vs sequential innovation is not well explained. She thinks only substitution among technologies is

considered in the model and that it is likely that some result would not hold with complementarity as the entrant would loose any ability to hurt the rival in the sequential path?

Diomides answers. He believes that indeed there is no existing competition policy for such buy-out and this is why it is an important debate to bring forward. He also acknowledges that more work should be put into the chapter to improve the writing and better explain the link with complementarity and substituability. He believes the results would also apply with complementariy technologies, but he is not completely sure about it.

Frédéric Loss

First of all, I would to thank the candidate and his adviser, for giving me the opportunity to be here in this committee. It's a great honor, and what is best than defending on the 12th of December (I did that also a long time ago now). I'm going to be swift, in particular because everything has almost already been said.
I really appreciated reading the Introduction. I think it is well written, many papers/ideas are presented, and I found it clear.

First Chapter
I enjoyed reading it. I've got some comments.
Firstly, we talked already about Nicolas Curien and François Moreau who have worked on this question. I was a little bit surprised not to have seen any of their paper quoted. In particular, the following paper "the music industry in the digital era: toward new contracts, 2009, The journal of Media Economics". Indeed, this article proposes a model of the music industry under piracy.
I find interesting the intuitive result that piracy can be desirable for the firm when the network effect is important, since it allows widening the user base among the consumers having a weak disposition to pay and at the same time increases the willingness to pay of buyers, because of the positive network effect. As an advice, I would say to publish it as soon as possible, because otherwise, someone else is going to make it.
When you look at whether the firm prefers the high product degradation case or the no product degradation case, you could also try to determine the optimal product degradation level for (maximizing the profit of) the firm (Page 55).

Second chapter
I think that the question which is studied is definitely interesting: "the choice of technological innovation in the presence of buyouts. A first comment: When you consider buying out a substitute project in order to shut it down. I understand the theoretical result, but I am wondering whether a Competition Authority would accept it.
Page 82 you write "It is known that in most standard competitive frameworks, firms will want to merge because merger profits are higher than the sum of profit". Are you sure of that? (in Cournot oligopoly framework, are profits of merged firms higher than those of non-merged firms"...?).

Then, I've got rather advices about the form. In order to publish this chapter in an academic journal, you should transfer to the appendix almost all the proofs and provide in the text much more intuition of the results. As an example, Proposition 12, Page 89, which says that "if the entrant has bargaining power, a switch from the no-buyout to the buyout regimes, weakly increases the incentive for the entrant to pursue the sequential innovation". There is almost no intuition of this important result.

Third Chapter

Providing microfundations about discounting is a very good project. However, I am not a specialist at all of this question, only a user of either exponential or hyperbolic discounting. There also, if you want to publish this paper, you should spend times improving the redaction. For instance, you've got a subsection named Results (Page 119), but not a single proposition.

To conclude, you have three original articles. You demonstrated the ability to read and make bridges between different literatures. Moreover, you are able to work alone or in team with international people. Your English is excellent (your French too, and your Greek even better). So, to sum up, I am happy with this thesis and I wish you all the best for the future.

The candidate answers the questions. He will try to integrate Curien and Moreau's literature. He recognizes that his representation of Competition Authorities is too passive. He will take into account the observations regarding competition and concentration and reorganize the writing of the paper presented in the second chapter.

David Ettinger

David Ettinger congratulates Diomides Mavroyiannis for the quality of its work. These four years were an extremely rich experience, on the scientific side and the human side. For both the candidate and his adviser. He thanks Diomides Mavroyiannis for the intellectual stimulation and wishes him a lot of other major accomplishments in his future career.

Deliberation

The jury considers the high quality of the thesis and unanimously grants Diomides Mavroyiannis with the degree of Doctor in Economics from PSL University prepared at Université Paris-Dauphine.

The jury also allows him to apply for the classical thesis prizes.

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