Action Taken Report

For the thesis titled,

“Love for Variety”, Outside Option, and Platforms

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Action Taken Report

Response to the External Examiner's Comments

I thank the external examiner for the set of comments on my Ph.D. thesis. The comments have helped me to improve the quality of the thesis.

Chapter 2:
"Love for Variety", Outside Option, and Extensive Margin of Demand

Comment 1

Page 29, the line after equation (4): When differentiating v with respect to μ, you are differentiating $\phi\mu$ with respect to qj. Hence, do you need to have the term $-\sum_{j=1}^{N_S}\left[\frac{\partial\emptyset_\mu}{\partial q_j}\right]\frac{\partial q_j}{\partial\mu}$. May be I am missing something, but please have a look at it. *Please adjust if required.*

Response:

I thank the external examiner for the comment. To clarify the query raised, let me start with equation (4). When v is differentiated with respect to μ, there are two effects. The first term is an indirect effect, and the second term is a direct effect. The direct effect is very clearly understood. However, for understanding the first term, one needs to go back to equation 3, which is the first-order condition.

The μ type consumer's demand for the j^{th} variety is derived as $q_j(p_1, \dots p_j \dots, p_{N_S}, \mu, \rho, \beta)$. Hence, I have mentioned in the thesis that "$v(\mu)$ is nothing but the value of $\emptyset_\mu$ at $q_j(p_1, \dots p_j \dots, p_{N_S}, \mu, \rho, \beta)$." This is how the indirect effect works, but eventually, through the first-order condition, it becomes zero.

Also, the use of the summation sign is attributable to the fact that the chain rule should apply to all j starting from 1 through Ns, as μ affects all such varieties. Hence, the FOC in equation (3) should be invoked not once but Ns times. I hope my explanation will justify the query raised.

Comment 2

When you are deriving results and considering the effects of different results, it might be useful to mention that they satisfied second order conditions and the stability conditions (if appropriate). For example, it would be useful to mention that results like Proposition 4 satisfied those conditions. If I didn't miss anything, I think you didn't mention explicitly that those conditions are satisfied. I am assuming that you have considered those conditions, but it would be useful to mention them explicitly in your work. If you want to mention them in the thesis, please do so. *Otherwise, you can ignore this comment for the thesis, but can consider it for your future work.*

Response:

All the results and propositions that follow from the results have been derived considering the second-order conditions. In the detailed derivations of the Lemmas and the Propositions in Appendix A.2, I have explicitly used the second-order conditions, and this has been accordingly mentioned explicitly wherever necessary.

The second-order condition for the consumer's problem is already mentioned in the first paragraph on Page 29 of the thesis (Section 2.2.1), while for the seller's optimization problem, it is mentioned on Page 33 (Section 2.2.2).

Comment 3

When mentioning the empirical evidences, it might be more useful if the evidences are linked closely to your theoretical structure. For example , you have mentioned Amazon as an agent in the e-commerce market and also has the "brick-and-mortar" segment. In your theoretical analysis, the outside option of the buyers is exogenous, while the Amazon example gives the impression of an endogenous outside option. Hence, the theoretical structure (and, therefore, the implications) might not be exactly similar to the empirical evidence. *You can ignore this comment for the thesis, but you can consider this comment for your future work.*

Response:

The external examiner is correct, and this issue remains a part of my future research agenda.

Chapter 3:
"Love for Variety" and Monopoly Platform

Comment 1

Page 64, Last paragraph: It is not clear from the description of that paragraph whether you have considered the option that the buyers may not want to join the platform. Since the producers of the differentiated products can sell their products without joining the platform, I assume that a buyer can also buy the product without joining the platform and avoid paying the platform fee. Please check it and adjust the description/model *if required.*

Response:

I thank the external examiner for the comment. I will provide clarification for the same.

The model assumes that the N_B fraction of the buyers will enter the differentiated product market given their strong preference for variety. If they enter the differentiated product market, given their "love for variety" preferences, they will buy from every seller present in the market, independent of whether they are members of the platform or not. Sellers have the option of either joining the platform inside the differentiated product market or staying off the platform but remaining inside the differentiated product market or not joining the differentiated product market at all.

The catch here is that since the model emphasizes on buyers having a strong "love for variety" preference, the buyers who enter the differentiated product market in our model also join the platform if some sellers of the differentiated product operate on the platform (already mentioned on Page 64 (Section 3.2.1) of the thesis). Here, the implicit assumption is that for the platform's existence, there has to be at least one differentiated product seller on the platform. Given this, since buyers have a strong "love for variety" preference, as mentioned, they must buy from the platform as well by paying the fee.

There is no question of buying the differentiated product without joining the platform and avoiding paying the platform fee. The buyers who do not enter the differentiated product market participate in an alternative consumption program with no "love for variety".

I completely understand that the "love for variety" assumption of buyers buying every product available in the differentiated product market is a strong assumption, but it allows one to determine the number of varieties in such a market, which is otherwise treated as exogenous in the platform literature. I hope my argument has convinced him/her.

Comment 2

Given the above comment, which suggests that a consumer has three options - buying differentiated products from platform, buying differentiated products from outside platform, buying the outside option - the intuitions provided (and maybe the calculations), e.g., for Lemma 7 on page 76, might be different. Please check them and adjust if required.

Response:

This follows from my response to the previous comment. As advised by the external examiner, I have also rechecked the calculations. It is fine.

Comment 3

Page 67, 2nd line after equation 5: This is similar to my comment 1 for Chapter 2. When differentiating v with respect *to* μ, you are differentiating $\phi\mu$ with respect to qj. Hence, do you need to have the term $\sum_{j=1}^{N_S}\left[\frac{\partial\phi_\mu}{\partial q_j}\right]\frac{\partial q_j}{\partial\mu}$? Maybe I am missing something, but please have a look at it. *Please adjust if required.*

Response:

This follows from my response to Comment 1 of Chapter 2.

Comment 4

Page 71, middle of the page: The expressions π_j^{PL} and π_j^{O} consider the same expression *Qj*. However, I am a bit confused here. I think if a producer does not pay the platform fee, it will not be able to supply the product to the buyers purchasing from the platform. If my understanding is correct, will it not have different demand for these two expressions? *Please check it and adjust if required.*

Response:

I will clarify the matter.

On Page 68 of the thesis, I have shown how the aggregate demand (see equation 6) for a j^{th} variety of the differentiated product is derived. Now, this aggregate demand is an aggregation of the individual demand of all the μ type buyers who have entered the differentiated product market. The buyers in my model have a "love for variety" preference, as mentioned in my response to the first comment. Given their "love for variety", the buyers in the differentiated product market will buy this j^{th} variety irrespective of whether the seller is on the platform or off it. Thus, every variety of the differentiated product enters symmetrically in the utility function specified in equation (2), and therefore, every seller faces the same demand function. Hence, π_j^{PL} and π_j^{O} consider the same expression *Qj*.

I have already discussed this in my thesis on Page 72 (Section 3.2.3) in the paragraph just before Lemma 6. Also, the details of symmetry of prices in the Bertrand price-setting game have been discussed in the same paragraph.

Comment 5

Page 75, two lines above equation (15): I think you mean probability of Pr [.]. I understand what you want to say here. Since there is no uncertainty in the model, would it be better not to say probability and to use a different notation to express the fraction/percentage of consumers. This comment is applicable for other chapter(s) also. *Please check them and adjust if required.*

Response:

I thank the external examiner for this comment. My clarification is the following.

It is mentioned in the first paragraph of section 3.2.1 on Page 64 of the thesis, "We assume T_j is uniformly distributed among sellers in the interval $[0, 1]$." Since uniform distribution has been used, following the conventional literature, I have used Pr [.] to denote the fraction of sellers on the platform and outside of it. This nomenclature has been followed throughout the thesis.

Comment 6

Page 78: It would be better to mention that the second order conditions are satisfied. I think you didn't mention it explicitly. *Please check it and adjust if required.*

Response:

The second-order condition for the consumer's optimization problem is already mentioned on Page 67 (Section 3.2.2) of the thesis in the last line of the first paragraph, for the sellers' optimization problem it is mentioned on Page 72 (Section 3.2.3) of the thesis right after equation 10 and the second-order condition for the platform's profit maximization problem is mentioned on Page 79 (Section 3.2.4) of the thesis just before Lemma 8.

Comment 7

Page 83, Proposition 3: Perhaps the most interesting result of this chapter is Proposition 3. However, I find this result confusing. Let me explain it here.

Let's assume that the equilibrium profit of the platform is $\pi = (F_S - C_S)\widetilde{N}_S + (F_B - C_B)N_B$

for a given C_B. If C_B falls and the platform takes no action, i.e., does not change F_B* and *Fs**, the platform's profit will increase. Hence, a lower C_B cannot reduce the profit of the platform, since the platform can always do better by not changing the fees. *So, I think you need to adjust this result and similar results in the next chapter (also mentioned below), and need to double-check other results also.*

I think the problem is the way you did the optimisation. Let's consider your argument. If C_B falls, it reduces F_B, attracts more buyers, and increases *To*. Call the reason up to this point as effect A. I think the profit of the platform increases due to effect A.

Then you say that the platform will increase *Fs* to match T_o, which will reduce the number of producers on the platform and therefore, will reduce the profit of the platform. Call this effect created by a higher *Fs* as effect B.

If I understand you correctly, you are suggesting that if C_B falls, the platform's profit tends to increase due to effect A but it tends to fall due to effect B and eventually, the platform is worse off.

Since the effect A increases the profit of the platform, it may not want to increase *Fs* to match T_o but it can increase *Fs* up to a point that creates maximum profit gain and the new *Fs* will be less than *To*.

I think your result is due to the fact that you impose $Fs = T_o$ in the optimisation problem. It will be better to consider the constraint as $Fs \leq T_o$ and use the Kuhn-Tucker condition. You can then find that this constraint might not be binding in equilibrium. *Please adjust the calculations accordingly.*

Please check other results also with the new optimisation problem.

Response:

I thank the external examiner for this critical comment.

I will try to explain the issue raised. It follows from the discussions on Pages 74 and 75 and from Figure 3.1 that $Fs \leq T_o$ is required for the existence of the platform. **On Page 77, last line after Assumption 6, I have added a footnote that reads, "The change in results on violation of Assumption 6 is discussed later." (see Addendum Point No. 1)**

As suggested by the external examiner, I have also added footnotes to Propositions 2 and 3 (Pages 82 and 83, Section 3.3), mentioning what would happen if assumption 6 is violated in the context of Propositions 2 and 3 (see Addendum Point Nos. 2 and 3).

The footnotes have been recorded in the addendum submitted as follows,

Page 82, after Proposition 2: A footnote is added that reads, "If Assumption 6 is violated, the platform chooses $\boldsymbol{F_S = \frac{(1+C_S)}{2}}$ under unconstrained profit maximization, and $\boldsymbol{F_B}$ solves $\boldsymbol{(F_B - C_B)\frac{\partial N_B(.)}{\partial F_B} + N_B(.) = 0}$. A lower $\boldsymbol{C_S}$ implies a lower $\boldsymbol{F_S}$. However, $\boldsymbol{F_B}$ and $\boldsymbol{N_B}$ do not change. The number of varieties on the platform rises. $\boldsymbol{\frac{\partial \pi}{\partial C_S} = \frac{\partial[(F_S - C_S)(1 - F_S)]}{\partial C_S} = \frac{C_S - 1}{2} \gtreqless 0 \;\; iff \;\; C_S \gtreqless 1}$."

Page 83, after Proposition 3: A footnote is added that reads, "If Assumption 6 is violated, $\boldsymbol{F_S = \frac{(1+C_S)}{2}}$, and $\boldsymbol{F_B}$ solves $\boldsymbol{(F_B - C_B)\frac{\partial N_B(.)}{\partial F_B} + N_B(.) = 0}$. A lower $\boldsymbol{C_S}$ implies a lower $\boldsymbol{F_B}$. However, $\boldsymbol{F_S}$ does not change. The number of varieties on the platform remains unchanged, but $\boldsymbol{N_B}$ rises. $\boldsymbol{\frac{\partial \pi}{\partial C_B} = \frac{\partial[(F_B - C_B)N_B]}{\partial C_B} = (F_B - C_B)\frac{\partial N_B(.)}{\partial F_B} < 0}$."

Second, the comment you have made, "If C_B falls and the platform takes no action, i.e., does not change F_B* and Fs*, the platform's profit will increase." is not fully correct and hence, this confusion. A change in C_B does not mean that the platform will not take any action, and the optimal values of F_B* and Fs* remain unchanged. You are missing out on the fact that given the construction of our model and $F_S = T_0$, F_B and Fs are actually functions of C_B and C_S.

If you refer to equations 21 and 22 on Pages 78 and 79 of the thesis, it would be clear that that the way we have defined the net marginal revenues for the platform on the buyer side and the seller side as functions of C_B and C_S allows for changes in these parameters to actually result in changes in F_B* and Fs*. Lemmas 8 and 9 explain how the platforms' net marginal revenues on the buyer side and the seller side respond to changes in C_B and C_S, and consequently, Propositions 2 and 3 explain how the equilibrium values of F_B and Fs change with a change in C_S and C_B.

Chapter 4:
"Love for Variety" and Location Choice

Comment 1

For this chapter, I have comments similar to comment 6 made under Chapter 2. For example, I find Propositions 2 and 3 confusing. If the platform does not take any action (i.e., does not change fee and the location) following a lower Cs or a lower C_B, the platform will experience higher profits. Hence, lower costs of the platform cannot reduce its profits. I think the reason for your result is due to the fact that you impose the condition *Fs* = *To* in the optimisation problem. It will be better to consider the constraint as *Fs* ≤ *To* and use the Kuhn-Tucker condition. You can then find that this constraint might not be binding in equilibrium. *Please adjust the calculations and the results accordingly.*

Response:

Similar to my response to Comment 7 in Chapter 3, I have added footnotes to Propositions 2 and 3 (Pages 132 and 133, Section 4.1), mentioning what would happen if the assumption $T_0 < \frac{(1+C_S)}{2}$ is violated in the context of Propositions 2 and 3 (see Addendum Point Nos. 5 and 6).

The footnotes have been recorded in the addendum submitted as follows,

Page 132, after Proposition 2: A footnote is added that reads, "If the assumption of $T_0 < \frac{(1+C_S)}{2}$ is violated, the platform chooses $F_S = \frac{(1+C_S)}{2}$ under unconstrained profit maximization. The mall chooses to locate at $a = 0$, the opposite extreme of the city, which is farthest away from where the homogeneous product market is located (i.e., $a = 1$). A lower C_S implies a lower F_S. However, a and N_B do not change. The number of varieties in the shopping mall rises. $\frac{\partial \pi}{\partial C_S} = \frac{\partial[(F_S - C_S)(1 - F_S)]}{\partial C_S} = \frac{C_S - 1}{2} \gtreqless 0 \;\; iff \;\; C_S \gtreqless 1$."

Page 133, after Proposition 3: A footnote is added that reads, "A similar corner solution as discussed in Proposition 2 will occur if the assumption of $T_0 < \frac{(1+C_S)}{2}$ is violated. A lower C_B implies a lower F_B. However, F_S does not change. The number of varieties in the mall remains unchanged, but N_B rises. The effect on profit will be, $\frac{\partial \pi}{\partial C_B} = -N_B - C_B \frac{\partial N_B(.)}{\partial C_B} \gtreqless 0 \;\; iff \;\; C_B \frac{\partial N_B(.)}{\partial C_B} \gtreqless N_B$."

Comment 2

Please check other results also with the new optimisation problem.

Response:

It follows from my response to Comment 1 above.

Comment 3

Page 114, first paragraph: You mentioned that if the sellers are not members of the mall, they will sell outside the mall at the same location. Why can't those sellers locate to a different point? *Please adjust this assumption or provide a justification.*

Response:

I thank the external examiner for the comment.

I have added the justification in the addendum on page 107 at the start of the footnote, as: "The location of the sellers at far-off places from the mall would increase the buyers' cost of accessing the differentiated product because of the transport costs. Therefore, the buyers' indirect utility would fall, and the marginal buyer exits from the market for the differentiated product, adversely affecting the intensive margin of all the sellers in the market. Therefore, the sellers who do not enter the mall locate themselves just outside it." (see Addendum Point No. 4)

Comment 4

Some propositions, such as Propositions 2 and 3, are not written very clearly. For example, it is not clear which results are related to "rises" mentioned in the first line. *Please write these propositions and the following propositions clearly.*

Response:

It follows from my response to Comment 1 above.

Signature of the Candidate

Sovik Mukherjee

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Sovik Mukherjee

Dated: 07.05.2025

Forwarded by the Supervisors

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