Response to Reviewer 1

"A New Keynesian Model with Unemployment: The Effect of On-the-job Search" by Z. Kantur and K. Keskin (Discussion Paper No. 2017-99)

We would like to thank the reviewer for his careful reading, comments, and suggestions. We understand that the reviewer's main concern is about the motivation of the paper, because apparently, we were not sufficiently clear in explaining what we are trying to achieve in our paper. Thus, here we first explain this issue.

Among the choices provided by the reviewer, the answer is "c) both". However, we should clarify some differences. Our aim is not to create a "sign" difference between the models with and without on-the-job (OTJ) search. In the current literature, there already are New Keynesian models with labor market frictions reporting an increase in unemployment and a decrease in labor market tightness in response to a positive technology shock. What we emphasize is that the volatilities of these variables are not as high as their empirical counterparts; hence, we introduce a new dimension (namely, OTJ search) showing that the volatilities of unemployment and labor market tightness would be amplified. For example, in the baseline model without OTJ search, the increase in unemployment is 5%; and the same response jumps to 9%, when only 10% of the workers at aggressive firms start searching on-the-job.

In his conclusion, the reviewer writes "It is not clear why your approach is better than others"; "Given only the impulse response functions, it is difficult to evaluate whether OTJ is a sufficient extension to account for the problem noted by Shimer (2005)"; and "[Significance of the results] depends on whether or not the improvement of the model is such that it matches the data as opposed to only slightly amplifying the variables movements over the business cycle".

In response to these comments, we should state that we do not claim to have a better approach. OTJ search is proposed as a candidate to amplify the volatilities of unemployment and labor market tightness. As we emphasize in several places within our paper, this is a *theoretical* study, which finds that the model with OTJ search induces a *higher* volatility in unemployment and labor market tightness in response to a positive technology shock. We believe that the result that the volatilities of other variables are almost unaffected also adds a value to the paper. A data analysis has never been our intention. That being said, even when a data analysis is carried out to reveal that the model predictions match the data well enough, we believe that it would still be a matter of debate that this is "sufficient" to conclude that our model is better than the other models in the literature. Instead of following such a path, we choose to stay in the theory side and propose OTJ search as a realistic extension to the model, which is revealed to be a forward step in the right direction.

We also believe that it would be underrating to state that OTJ search only slightly amplified the responses of unemployment and labor market tightness. For instance, the response of unemployment is almost *doubled* when $\varphi = 0.1$, i.e., when only 5% of the whole population is allowed to search on-the-job. This issue will be further discussed in our response to the reviewer's *specific comment 9*.

On a related note, also seeing from the reviewer's *specific comments* 1-3, we understand that we have caused some sort of confusion, and we agree to make the necessary changes in the relevant parts of the paper to clarify these issues. As a whole, all these will be taken care of in the revised version of the manuscript. In particular, we will restructure the "Motivation" section of the paper, clarify the aim of our analysis, and enrich the literature review part.

As for the other comments of the reviewer:

Reviewer: What specification of Gali's (2010) model exactly do you refer to? Gali's model embeds labour market frictions, price rigidities as well as wage stickiness. In his analysis, he shuts down some of the features to discuss particular matters.

Response: Our model builds on the specification with sticky prices, labor market frictions, and flexible wages. Additionally, we assume full participation, so that our baseline model corresponds to the setup provided by Blanchard and Gali (2010). Then, we introduce OTJ search into this baseline model.

Reviewer: The solution strategy could be explained in more detail. The reader is left with a succession of equations, little explanation and intuition of the procedure is provided.

Response: Our solution strategy is that we log-linearize the system of equations around their steady state values, and we analyze the effect of an AR(1) technology shock on the model variables using these log-linearized equations. We might have misinterpreted this comment; in such a case, we kindly ask the reviewer to clarify.

Reviewer: A careful differentiation regarding the nature of a technology shock (transitory vs. permanent) is important. The authors begin their summary of the employment-technology shock literature with a permanent shock, but use a transitory shock in their numerical exercise. It should also be stressed whether the focus is on the dynamic response of employment/unemployment rate or on the level of these variables reacting to changes in technology.

Response: In our paper, we only deal with an AR(1) technology shock with a high persistence level (i.e., $\rho = 0.9$). This is close to a permanent shock. We understand that mentioning some of the existing results on the effects of a permanent technology shock was misleading, and accordingly, we will be more careful in the revised version.

Reviewer: There are some repetitions, e.g. footnote on page 2 and on page 11.

Response: The footnote provides information about some terms used by Barnichon (2010), whereas on page 11, it is stated that we also use those terms interchangeably, as Barnichon (2010) does. We believe that it is safer to keep both of these, as they are to prevent a possible confusion for the reader. Furthermore, we have scanned the manuscript for other examples of

repetitions, but we could not detect any. In case we have overlooked something, please specify other cases of repetitions.

Reviewer: I suggest sticking to the term labor market tightness and avoiding "average" job finding rate as you already defined rates for both types of searchers.

Response: We agree with the reviewer.

Reviewer: The hiring cost could be explained in more detail. I understand that $Pool_t$ is a predetermined variable. The two types of firms share the same pool of workers, but their hiring cost only depend on their own hirings. Hence, if the aggressive firm hires a lot of workers, the hiring cost of the passive firm are unaffected. Is that a reasonable assumption?

Response: Regarding hiring by aggressive firms (not) affecting hiring cost of passive firms, we believe that both assumptions are reasonable to some extent. Intuitively, if there is abundance of job searchers in an economy, then an increase in aggressive firm hirings should not affect the hiring cost of passive firms, because each passive firm should be able to find enough workers easily. If, on the other hand, there is scarcity of job searchers, then aggressive firm hirings could affect hiring cost of passive firms. This would be a modeling choice.¹

Reviewer: It would be useful to explain at least one of the value function, especially V_t^{NA} is not straightforward to interpret. It seems to me that workers could loose their job and search a new job in the same period. Is that reasonable? Usually, workers loose their job and move into unemployment. Once unemployed, they start searching.

Response: We believe that the reviewer got confused regarding job search after separation. In the model, separation takes place at the end of a period t, and after becoming unemployed, a separated worker can search for a new job in the next period t + 1.

Moreover, V_t^{NA} is written below. The first term is the real wage level for the aggressive firm, the second term is the marginal rate of substitution between consumption and labor market effort, and the third term is the expected value of future earnings (under three possible states of the future: U, NA, and NP).

$$\begin{aligned} V_t^{NA} &= \frac{W_t^A}{P_t} - \chi C_t N_t^{\phi} + E_t \bigg\{ \Lambda_{t,t+1} \bigg[\delta(1 - q_{t+1}) V_{t+1}^U \\ &+ \bigg(\delta q_{t+1} \tau_{t+1} + (1 - \delta) (\varphi(p_{t+1} \tau_{t+1} + (1 - p_{t+1})) + (1 - \varphi)) \bigg) V_{t+1}^{NA} \\ &+ \bigg(\delta q_{t+1} (1 - \tau_{t+1}) + (1 - \delta) \varphi p_{t+1} (1 - \tau_{t+1}) \bigg) V_{t+1}^{NP} \bigg] \bigg\}. \end{aligned}$$

¹Note that our hiring cost assumption has the same flavor with Gali (2010)'s assumption. In his paper, Gali (2010) related hiring costs with labor market tightness. Similarly, once can argue that we separate our labor market tightness x_t into two parts, for aggressive and passive firms, and then define hiring cost for each type of firm using the respective labor market tightness.

The interpretations for the other value functions follow similarly. The interpretation above will be added to the revised version.

Reviewer: The calibration strategy partially seems arbitrary (e.g. "having no evidence ..., we set γ to 0.5."). Are your results robust to different values of γ ?

Response: We support the calibration values either by referring to the related empirical observations or to the calibration values used in similar studies. When this is not possible, such as for the number of aggressive firms (N^A) or for the productivity parameter (γ) , we acknowledge this and opt for symmetry, setting $N^A = 0.475$ and $\gamma = 0.5$. We believe that other values of these parameters would raise bigger concerns.

Be that as it may, we understand the reviewer's concern about this issue. We can safely report that some asymmetric values for these parameters are also controlled for and that our results are qualitatively robust to such asymmetric values. A footnote will be added to the revised version regarding this issue.

Reviewer: Shimer's puzzle: How well does the improvement of the model fit the data? Is the difference quantitatively sufficient to match the data? As argued by Shimer, the model generated volatility of tightness is less than 10% compared to the data. However, the impulse response functions in Fig.1 only compare the model with and without OTJ. A comparison of the models performance with the data seems necessary. The intuition why OTJ search helps to amplify the volatilities could be explained in more detail.

Response: As mentioned above, our study is meant to be a theoretical paper showing that OTJ search would amplify the responses of unemployment and labor market tightness. In Figure 1, we show that the response of unemployment to a positive technology shock is almost doubled when 10% of the workers at aggressive firms start searching on the job. The analysis of whether this is "quantitatively sufficient" and whether further extensions would be necessary are not in the scope of this paper. As a matter of fact, such an analysis would require data-supported calibration values for some of the model parameters, such as the ratio of aggressive firms, the bargaining powers, and the productivity levels. And to achieve this, one would need firm-level data including the relevant information. Otherwise, we believe that a data-fitting analysis would not be sufficiently well-practiced. That is the reason why we are being cautious about such a data analysis.

Finally, we can say that the intuition why OTJ search helps to amplify the volatilities will be explained in more detail in the revised version.

We thank the reviewer once again for his comments and suggestions. We hope that we have managed to address all the issues in his report.