

Modeling the Effects of Financial Constraints on Firm's Investment

Reply to referee report #1

The main indication of this report was to strengthen the exposition in the paper, in order to clarify what its contribution is in relation to the existing literature.

The background of the paper, as correctly identified in the report, is the macroeconomic literature on the investment function. The new version of the paper therefore provides a more exhaustive set of references to this literature. The selection of both theoretical and empirical works reflect the more recent developments of the subject, where the main concern is with non convex costs of adjustment and financing constraints. Since the subject of the analysis is the effect of financing constraints on investment, references to the asymmetric information literature that can help provide a foundation for the assumption in the model, are also provided.

The reading suggestions made in the report were also very helpful. In particular, the work of Gomes (2001), that was not in the first version of the paper, is included in the new version. References to the empirical literature on investment have also been extended, on the subjects of non convexities and irreversibilities and of finance and investment.

Turning to the more specific comments:

1. Both the model statement in section 2 and the analysis of the model presented in sections 3 to 6 are relatively original in view of the present author. The proposed model and analysis draw of course on previous work. Most of the results presented in the paper however are relatively new. In particular, the results in section 3 and in sections 5 and 6 where the analysis is made of the shadow price of capital and the shadow price of firm's debt. The references provided in the new version of the paper should clarify that this is a subject that has so far not been entirely addressed in the literature on investment. There is actually a debate in the empirical literature on the effects of financing constraints on investment, regarding the soundness of the results that have been obtained so far in the empirical works on this subject, for instance Kaplan and Zingales (1997) and Gomes (2001). The paper proposes a review of the theory that may contribute in resolving this dispute. The additional references suggested in the report are certainly complementary and could be usefully considered for further work in this subject. In order to keep the analysis in the logical field of the first version and of the literature that is in the main concern of the paper, some of the suggestions

made have been left out of the present version. The originality of the contribution can in this way be assessed by comparing this result with related work.

2. The model in the paper could be certainly extended in order to take into account of firm's policies to manage internal cash funds. In order to address this concern the following changes have been made to the exposition in the first version. In the present version the firm is allowed to accumulate assets, the stock of outstanding debt B_t is not constrained to be nonnegative. While this modification does not change the main results, the formal structure of the model in this way should address the indication of the report and allow for further analysis of the subject. In the presentation of the structure of the firm's financial choices and of the assumptions regarding the firm's financing constraints, some references have been moreover made to works in the finance literature where this subject is analyzed in more depth. A more extensive justification for the financing assumptions is provided in this way and the literature on asymmetric information and agency is also cited in this context. Further analysis of this subject however would be out of the scope of the paper.

3. The assumption that $\rho \geq r$ is the most difficult to justify. This assumption is certainly required for the logical consistency of the model and it has the economic interpretation that the firm's cash-flow is discounted with a premium on the interest rate that must be paid on the firm's debt stock.

In order to interpret this result we could consider for instance, that the assumption that returns on risky activity are characterized by a risk premium on returns of safe assets is a standard feature of asset pricing models. While this is suggestive of a possible contingency claim interpretation it is however not formally correct, since conventional asset pricing model are based on the assumption of complete markets. The model in the paper instead is an example of an incomplete market model.

From a different perspective, returns on risky activity are also usually greater than returns on safe bonds also in models of asymmetric information, a result that reflects the limited liability features of the firm's financial structure in this models.

The perspective of the model presented in the paper is more likely to be interpretable in the context of the analysis of asset pricing in incomplete markets. Since this is again a subject that would take the analysis far away from the scope of the paper, the statement that $\rho \geq r$ has been left as consistency requirement without commenting on its economic content. This is however indeed a feature of the model that may be subject to further study.

4. Finally, following also the advice of the invited reader, in the appendix a more rigorous derivation of equations (3.3) and (3.4) is provided. The firm's optimization problem, the Lagrange multipliers and the optimality and complementary slackness conditions that lead to these equations are now stated in an appropriate way in the appendix. The analysis of the Lagrange multipliers that was proposed in the first version of the paper has been also maintained. In order to keep the presentation in the text to the features of the model that are strictly required for the analysis of the main results, this part has been however left in the appendix.