Comments on the paper
"On the Co-Evolution of Innovation and Demand" by P. P. Saviotti and A. Pyka

Fabrizio Patriarca
Sapienza University of Rome

The paper presents an extension of the TEVECON model in Saviotti and Pyka (2004) and following papers. This model exploits the Schumpeterian approach to growth conceived as a process of sectoral life cycles and sequential structural changes. In this version, the demand function takes into account two dimensions of sectoral production: differentiation and quality. Thus, besides the quantity path along which new sectors spread over the economy, the sectoral life cycle is also characterized by a path of differentiation and qualitative change occurring within each sector. Such process of sectoral change is driven by the search activities induced by the "accumulated demand". The goal of the paper is to derive some policy implications from the analysis of the interactions between demand and innovation along a process of growth having the correspondent three dimensions (defined as the "the three trajectories"): productivity, variety and quality. The dynamics analyzed consider different scenarios concerning the three trajectories. First, on the supply side, different effectiveness of the process of qualitative change (Low-quality versus High-quality scenarios) are considered, then, on the demand side, the differences concern the consumers' propensity to novelties.

Consumer propensity to novelties is shown to have a non linear relationship with growth. Indeed, while conservative preferences harms the emersion of new sectors, highly progressive preferences harm the complete expansion of more mature sectors. Also the LQ and HQ scenarios analysis confirms such trade-off between the rate of new sectors creation and the duration of the industry life cycle. Furthermore, the LQ scenarios is better performing in the short term but brings to a worse result on the long term. All such effects are reinforced in case of very dynamic economies, that in TEVECON are related to higher wages and faster human capital accumulation. A deeper insight or a further extension stems from a less intuitive trade-

off emerging from the simulations: the one between quality and employment. Indeed, lower quality scenarios display higher employment growth rates. A similar dualism between alternative models of growth with slow sectoral cycles, high labour intensity on one side, high pace of innovations and growth on the other side, may bring to complex policy issues, in particular when, as in present times, the quest for growth recovery cannot be detached by the need to tackle high unemployment rates.

The paper also attempts to position TEVECON into the wide growth models literature. The authors state that one of the main differences with "orthodox" models is the lack of "complete closure conditions such as general equilibrium". This feature, together with the strong non-linearities of the equations, is also used to justify the use of simulation methods. At the same time, I would suggest the authors to couple simulation analyses with a deeper anaylitical description of the properties of the model. For sure, the model can't be solved since it is impossible to find a set of dynamic equations fully characterizing the dynamic of the main variables. However, it is probably possible to check whether the model is compatible with stable dynamic configurations such as steady states, steady growth trends, cycles or other well detectable although more complex underlying dynamics. This type of study can be very helpful when, as in this case, the main conclusions of the papers are based on the analysis of the long run dynamics and not (as instead in the cited "out-of-equilibrium" literature) on the short run traverse issues. As an example, in the present paper, the dynamic paths that emerge in the medium and long-run from by simulating the model do not seem to be significantly different from paths characterized by stable growth trends, with a cyclical steady increase in the number of sectors and cyclical components corresponding to the life cycle of the youngest sector. In this perspective, if equilibrium is defined as both the partial equilibrium in each market and the attainment of a stable configuration at aggregate level, the dynamics displayed in the long-run mainly result into "equilibrium" configurations. Such "compatibility" features of the model could have been partially investigated by looking at the structure of the equations (among which, in particular, the bounded, symmetric and convergent nature of most functions) before running the simulations.

Another argument on computational models methodology in general concerns the role of initial conditions. I see a tendency to run simulations and analyze the results of the model without a preliminary theoretical analysis of the hypotheses underlying the specific

initial conditions and of their heuristic implications (a feature which is shared by many computational models which are "self-initialized"). In my opinion, this approach is not suitable when the dynamics is characterized by path dependency.

References

Amendola M., J.L. Gaffard, 1998. *Out-of-equilibrium*. Clarendon Press, .

Saviotti P.P., Pyka A. (2004), "Economic development by the creation of new sectors", *Journal of Evolutionary Economics,* Springer, vol. 14(1): 1-35, January.

Hicks, J., 1987. *Methods of Dynamic Economics*, Oxford University Press,

Reply to Comments

Pier Paolo Saviotti
INRA-GAEL, Université Pierre Mendès-France - GREDEG CNRS, Sophia Antipolis, Valbonne
Andreas Pyka
University of Hohenheim, Economics Institute, Germany

For what concerns the relationship between the Low Quality (LQ) and High Quality (HQ) scenarios, it must be pointed out that the LQ scenario leads (i) always to a higher rate of growth of employment, but at the price of stagnant wages, demand and human capital, and (ii) to a higher rate of growth of income only in the early part of the development process. These results can be compared to the observed real development paths which show that for successful economic systems the HQ scenario started to dominate at times variable between the early and the late 20th century for different countries. Thus, it seems that a transition occurred between an LQ scenario, which dominated during the 19th century, and the HQ scenario which emerged during the 20th century and subsequently became dominant. Our model predicts that such a transition had to take place if the economic system was mainly driven by income generation rather than by employment generation.

The policy implications can be complex because the patterns detected for the long run do not automatically provide us with the best policy guidance for the short run. Fig. 8 shows that the timing of the transition between the LQ and the HQ scenarios depends on the combination of different model parameters. This implies that a pattern which applied generally to the relationship between some variables, such as wages and growth, can take different forms in each short run period. For example, while growing wages were an important component of the observed economic development path, we cannot assume that raising wages at any given time will affect positively growth.

The suggestion to provide a deeper analytical description of the properties of the model is welcome. We are working on it. TEVECON is constituted by a general core, common to all extensions, and by exten-

sions which explore particular aspects of the economic system. We have given a complete description of the core in Pyka and Saviotti (2011) and refrain from it in journal papers mostly for reasons of space. However, we accept the referee's suggestion and we are working on a 'compact' as well as graphical description which can be used in different papers.

To test the stability of TEVECON we have carried out several explorations of parameter space, in addition to those which have been published to make sure that TEVECON's results were not too sensitive to small changes of parameter values. These explorations showed that a) in general TEVECON is not unduly sensitive to such variables and that b) depending on the region of parameter space TEVECON can give rise to self-sustaining development or to the collapse of the economic system, which would then loose the capacity to create new sectors and to support the existing ones. For the stability and robustness tests we compile so-called corridors which describe parameter spaces with stable qualitative development paths (e.g. Saviotti and Pyka, 2004, Appendix). Furthermore, we differentiate the steady states that we can find from a general equilibrium. A general equilibrium is not compatible with an economic system characterized by endogenous innovation and changing composition. We have local equilibrium between demand and supply at the sector level.

TEVECON has some parameters based on initial conditions and we explored their impact on economic development. In some cases their impact on predicted growth patterns is limited, in others more noticeable, but never as large as to completely change economic development patterns. A sensitivity of development paths in dependence of small deviations from starting values cannot be observed. However, we agree with the referee that further work in this direction would be useful.

References

Saviotti, P.P., A. Pyka, 2004. Economic Development, Variety and Employment, *Revue Économique*, Vol. 55 (6), 1023-1051.

Pyka, A., P.P. Saviotti, 2011. Economic Growth through the Emergence of new Sectors, in: Mann, S. (ed.), Sectors matter – *Exploring Mesoeconomics*, Springer, Heidelberg, Dordrecht, London, New York, 55-102.