

Report on “Modes of Innovation: Identification, Dynamics and Intra-industry Heterogeneity: An Analysis of Swiss Firm-level Data for the Period 1999 to 2008” by Heinz Hollenstein, MS 2549.

### Brief Summary

The paper studies firms’ innovation strategies using rich survey data from four waves of the Swiss Innovation Survey. Its first contribution is to identify five distinct patterns (modes) of innovation by isolating commonalities across firms in a number of innovation-related variables. Next, it provides a characterization of the firms engaging in each mode in terms of size, export orientation and sector of activity. Third, it analyzes the transition of firms across modes of innovation over a 3-year horizon, and it shows that there is a high degree of dynamism in the choice of innovation strategies, since over one half of the firms switch to a different mode in the reference period. In particular, innovation modes 1 (science based) and 2 (investment based) seem to be more appealing than others in that firms are less likely to change mode and firms switching from other patterns are more likely to choose one of these two. Another interesting result presented in the paper is that firms display a certain degree of within-sector heterogeneity in their innovation strategies. In particular, the evidence suggests that there is no clear dominant innovation mode at the 4-digit industry level. Finally, regression analysis is performed to show that, once measures of capital and skill intensity are controlled for, firms tend to benefit in terms of labor productivity only from IT/product-oriented innovation (mode 5).

### General Assessment

The paper aims to contribute to the literature by providing a more detailed analysis than previous works (e.g., Leiponen and Drejer, 2007). Some of the insights it provides, however, are also related to recent and fast-growing literature in macroeconomics studying how firm-level innovation relates to performance at various levels of aggregation, and to sectorial characteristics. Stressing this link would be important to give the manuscript a larger visibility and cross-field exposure. Some revision, however, is needed to achieve this goal. In particular, clarity and precision in the description of variables and of the empirical methodologies should be improved. Moreover, the paper should mention the related macroeconomic literature. More specific comments follow.

### Specific Comments

1. Clarity and precision. The first part of the analysis has a significant “qualitative” components, in that it hinges on the selection of specific elements that may characterize different innovation strategies. It is therefore crucial that Section 3 explains very clearly and precisely the process of cluster analysis. Precision is also necessary when referring to sectors or industries, making sure these are not defined as “branches”, which is usually used for plants or subsidiaries of a firm.
2. Macroeconomic literature  
A recent and expanding literature in macroeconomics studies firms’ innovation and its effects on performance, both at the firm level and on aggregate sectors. Special emphasis has been made on the relationship

between firm heterogeneity and innovation. For instance, recent contributions have shown how innovation strategies vary with firm-level characteristics such as age, size and innovation capacity (Acemoglu et al. 2017), with sector-level characteristics such as competition (Aghion et al. 2005) and with export opportunities (Aghion et al. 2018). Interestingly, Bonfiglioli, Crinò and Gancia (2018a,b) argue that export opportunities induce firms to invest more in high-profile innovation strategies, a result consistent with the evidence in this paper. The manuscript will benefit from a larger exposure and make a broader contribution if it connects to this literature.

3. Empirical analysis

a. Dynamics. Various tables are reported to describe the dynamics of innovation strategies. However, showing just a simple transition matrix (i.e., the conditional probabilities of switching to each innovation mode in the next period) may be a more effective way of describing the dynamics.

b. Innovation and firm performance. Table 9 reports results from regressing a firm-level labor productivity (is it value added per worker?) on a measure capturing how close the firm is to each of the 5 innovation modes, and other controls. Since the ultimate goal of firms is to make profit, an alternative way to assess the effects of the different innovation strategies may be to re-estimate the proposed specifications for firms' market shares.

4. Minor points

Tables should be self contained, specifying a brief definition of variables (e.g., what's the dependent variable in Table 9 and how is it computed? What are the independent variables?), and of methodologies.

Acemoglu Daron, Ufuk Akcigit, Nicholas Bloom and William Kerr (2017). "Innovation, Reallocation and Growth," *American Economic Review*, forthcoming.

Aghion, Philippe, Nick Bloom, Richard Blundell, Rachel Griffith and Peter Howitt (2005). "Competition and Innovation: An Inverted-U Relationship," *Quarterly Journal of Economics*, 120(2), 701-728.

Aghion, Philippe, Antonin Bergeaud, Matthieu Lequien, Marc J. Melitz (2018). "The Impact of Exports on Innovation: Theory and Evidence" NBER Working Paper No. 24600.

Bonfiglioli, Alessandra, Rosario Crinò and Gino Gancia (2018a). "Betting on Exports: Trade and Endogenous Heterogeneity," *Economic Journal*, 128, 612-651.

Bonfiglioli, Alessandra, Rosario Crinò and Gino Gancia (2018b). "Trade, Finance and Endogenous Heterogeneity," *Journal of the European Economic Association*, forthcoming.