An ESRC Research Centre
CCP CENTRE FOR COMPETITION POLICY

Understanding Perpetual R&D Races

November 2008

CCP Executive Summary

BACKGROUND

- In a number of industries, firms compete by innovation in 'perpetual races'. These are races without finishing lines: when a firm is ahead in the race, it earns higher rewards than lagging firms; but then it earns lower rewards when overtaken. Examples include the pharmaceutical, disk drive and semiconductor industries.
- A characteristic of these industries is that innovations are typically gradual: technology progresses in incremental steps rather than leaps, thereby rendering patents less crucial in defining relative market positions. Also, innovations affecting relative market positions can occur in terms of production processes rather than the product *per se*.
- Equilibrium behaviour in R&D races is well understood theoretically; but predictions are highly sensitive to the context in which the race takes place: small changes determine whether technological competition is sustained, or converges into a market structure with entrenched leadership and lower aggregate R&D.

METHODOLOGY

- The paper aims to improve the understanding of perpetual R&D races by presenting the results of an experiment and through the development of theory. Theoretical predictions are derived against which the results of an experiment are compared.
- The experiment was conducted with 90 subjects and generated 7,920 observations.

EXPERIMENTAL RESULTS

- Experimental results fail to display the theoretically predicted sensitivity of technological competition to even small changes in context.
- The greatest R&D effort is found when competition is neck-to-neck, regardless of context.
- In three out of four experimental variations, technological competition tended to evolve into a R&D leadership monopoly: a market structure with an entrenched leadership and lower aggregate investment than if competitors remained neck-and-neck.

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- Experimental findings can largely be explained by relaxing the assumption of rationality and assuming that instead of playing best responses, agents play 'quantal' responses. These are responses in which the higher the payoff to a given strategy, the higher the probability of it being chosen, and where all strategies have a positive probability of being chosen. Moreover, agents make mistakes and know that others do, too, and take these mistakes into account in choosing their strategies.
- The results suggest that further research is warranted, for example, varying the number of R&D competitors, reconsidering theoretical assumptions, and analysing welfare and policy implications.

THE CCP

The ESRC Centre for Competition Policy (CCP), at the University of East Anglia, undertakes competition policy research, incorporating economic, legal, management and political science perspectives, that has real-world policy relevance without compromising academic rigour.

FOR MORE INFORMATION

The full working paper (CCP Working Paper 08-22) and more information about CCP and its research is available from our website: www.ccp.uea.ac.uk

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