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Competition, cooperation, and the neighboring farmer effect

Serguey Braguinsky[a,1], David C. Rose[b,*]

[a] Department of Social and Decision Sciences, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, United States
[b] Department of Economics, University of Missouri-St. Louis, 1000 University Drive, St. Louis, MO 62131, United States

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ABSTRACT

In this paper we propose a model that explains how cooperation can emerge spontaneously between firms in a highly competitive market environment. The basic idea is that the more competitive is the market, the less costly it is for firms to help each other like good neighbors. Cooperation takes the form of sharing technical know-how, which speeds up the adoption of new technologies (normally developed elsewhere) that spur industrial development. The model comports with the development history of Japan's first example of successful industrial development – its cotton spinning industry – whose conditions match those of firms in small open economies today.

> Competition is essential to the innovation process and to capitalist economic development more generally. But so is cooperation. The challenge. . .is to find the right balance of competition and cooperation, and the appropriate institutional structures within which competition and cooperation ought to take place. [Teece, 1992, p. 1]

1. Introduction

It is natural to view competition as inimical to cooperation. Even economists, who readily appreciate the benefits of competition, expect the benefits of competition to come at the cost of cooperation – hence the need to "find the right balance." A well-known exception is cooperation within firms that is spurred by competition between firms. Experimental evidence has consistently shown that cooperation *within* groups (in the form of overcoming free-riding in the provision of a public good) is enhanced by competition between groups (Kugler et al., 2006; Bornstein, 2003; Bornstein and Ben-Yossef, 1994). But to date no models predict and no experimental evidence suggests that competition improves cooperation *between* competing individuals, groups, or firms.

* Corresponding author. Tel.: +1 314 516 5550; fax: +1 314 516 5352.
E-mail addresses: sbrag@andrew.cmu.edu (S. Braguinsky), rose@umsl.edu (D.C. Rose).
[1] Tel.: +1 412 268 3009; fax: +1 412 268 6938.

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In this paper we propose a simple model that explains how cooperation can actually emerge spontaneously between firms in a highly competitive market environment. The basic idea behind this simple, surprising, and counterintuitive result is that the more competitive is the market structure, the less costly it is to help each other like good neighbors.[2] In short, among neighboring firms price taking in the output market takes much of the rivalry out of the relationship between ostensibly competing firms.[3] Unlike existing models of inter-firm cooperation, in the model presented here incentives for cooperation are stronger the more competitive the output market is. This model is therefore relevant to the conditions that face firms in many small open economies today, especially those in less developed countries.

In the model cooperation is not merely an exercise in collusion between rivals. Instead, cooperation is socially beneficial, taking the form of firms sharing technical know-how required for adopting new machines and production techniques typically developed by firms in more advanced countries.[4] Parente and Prescott (1994) and Parente (2000) have argued that the purchase of new machines that take advantage of recent technological advances is the key to spurring economic growth in less developed countries and therefore the development puzzle largely rests on the question of why firms in less developed countries do not buy these machines. Allen (1983) argued that in the latter half of the 19th century it was common for firms to share information about technological improvements through the process of collective invention, which he argued was "...probably the most important source of inventions" at that time (Allen, 1983, p. 21). Although Allen's paper focused on the Cleveland Steel District, the concept of collective invention has proven to be a rich idea indeed.[5]

Here we extend Parente and Prescott's and Allen's arguments by considering the role played by technical know-how stressed by Teece (2007). We posit that the key to spurring industrial development in less developed countries is for firms to accelerate the adoption of new machines and production techniques by sharing technical know-how. Ideally, this will result in the industry finding a niche in the form of a new kind of machine or production technique for which firms in the local industry possess a comparative advantage in use.[6]

An important difference between the approach taken here and the process of collective invention described by Allen (1983) is that he envisioned invention occurring through a process analogous to biological exaptation. In short, a problem presents itself that can be solved in a rather straightforward way (e.g., the need to produce more steel is solved by building larger furnaces). This leads to an unanticipated discovery (lower energy cost per ton of steel produced) that then leads to a new line of experimentation (even larger furnaces being built in the hope of increasing energy savings). A key aspect of Allen's argument is that collective invention does not involve costly investment because it is a form of learning-by-doing that proceeds via marginal experimentation. In the model presented here, however, the story focuses on the investment of resources into acquiring the necessary technical know-how.

This paper proposes a model that is more applicable to what firms were doing between the era of collective invention and the rise of dedicated investment into R&D and, we will argue later, is also more applicable to small open economies today.[7] In the model presented here, firms are aware that other firms (often foreign firms) are doing new things and they believe it is beneficial to determine as soon as possible whether imitation will be profitable under their local conditions. Although this is principally a story of imitation, adapting new machines and production techniques to local conditions often requires some innovation as well. Both the process of discovery and the process of adaptation are costly. Unlike Allen's theory of collective invention, an important part of the model presented here is the decision by firms to invest resources into the acquisition of such technical know-how in a timely fashion.

As is often the case with neighborhoods, some take advantage of the neighborly generosity of others. Those who care most about the appearance of a subdivision's common ground, for example, can be counted on by others to take care of it. In the model developed here we will find that the smaller is the local industry relative to the world market (the more competitive the world market and, hence, the more "infant industry like" the local industry is) the more likely that sharing technical know-how will be the dominant strategy for firms. But this inevitably gives rise to free-riding in the form of firms conserving their resources because they know that other firms will find it in their best interest to share what they learn. This leads to sub-optimal investment of resources into the acquisition of technical know-how for the local industry as a whole and therefore a slower rate of industrial development.

[2] The idea behind the neighboring farmer effect was originally inspired by a model presented in Ohyama et al. (2004). We benefited greatly from numerous conversations with Atsushi Ohyama and Salavat Gabdrakhmanov.

[3] In this paper the word *competition* refers to the idea that the world market constitutes a competitive market structure. As such, the level of competition does not vary with the number of firms in the local industry (in other words, the number of "neighbors"). As long as the local industry is sufficiently small relative to the world market, the number of firms in the local industry is irrelevant to the model presented here.

[4] It will become clear later that the main results apply to cooperation more generally. We focus on the sharing of newly acquired technical know-how because of the relevance this particular form of inter-firm cooperation has for industrial development.

[5] Other examples from the literature on collective invention include improvements to the steam engine (Nuvolari, 2004), open source software development (Meyer, 2002; Osteloh and Rota, 2007), flat panel displays (Spencer, 2003), the Homebrew computer club (Meyer, 2003), U.S. minimill steel producers (von Hippel, 1987, 1988). Cowan and Jonard (2003) proposed an interesting model of how producer networks affect the dynamics of collective invention.

[6] The form of inter-firm cooperation that has been most closely examined is industry-wide cooperative research agreements and joint ventures (Katz, 1986; Kamien et al., 1992). Two important findings of this literature are that: (1) with sufficiently large spillovers firms may cooperatively conduct R&D even if they compete in output markets, and (2) such cooperation improves welfare (see e.g., D'Aspermont and Jacquemin, 1988, pp. 1134–1135; Kamien et al., 1992, Proposition 1). But while there are competing firms in these models, the output market itself is never competitive.

[7] In their "private-collective" model, von Hippel and Krogh (2003) examine a scenario that comports with this historical era and the circumstances faced by many infant industries in developing countries today.