

Wages and productivity growth in a dynamic monopoly

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Received 26 October 2001; received in revised form 4 November 2002; accepted 10 April 2003

Abstract

This paper studies the intertemporal problem of a monopolistic firm that engages in productivity enhancing innovations to reduce labor costs. The optimal innovation policy is not monotone and the rate of productivity growth is the highest when the firm's size is in some intermediate range. As long as its initial productivity is not too low, the firm eventually reaches a steady state where the rate of productivity growth is identical to the rate of wage growth. Productivity dependent wage differentials do not affect productivity growth in the steady state; they increase, however, the firm's long-run equilibrium cost level.

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JEL classification: D24; D42; D92; J30; J51

Keywords: Innovation; Labor productivity; Wages; Wage differentials; Dynamic programming; Monopoly

1. Introduction

This paper studies the impact of labor costs on the incentives for process innovations. It considers the intertemporal problem of a firm that engages in productivity enhancing innovations to reduce its labor costs. While the firm acts as a monopoly in the output market, it takes the current competitive wage in the labor market as given. At each point in time, the wage rate and the firm's productivity determine its unit labor cost. Through

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investments in process innovations it can raise productivity and thus reduce its cost at subsequent dates. This generates a dynamic optimization problem because innovation affects future labor costs and the incentives for innovation depend on the evolution of these costs.

We formulate this problem as an infinite horizon optimization program. In this way we can study the long-run evolution of productivity growth. At each point in time, the optimal innovation policy is determined by the firm's current unit labor cost. We show that this policy is not monotone but has an inverted U-shape: the optimal innovation rate is higher for intermediate values of the firm's unit labor cost than for low or high values. Since the firm's output and employment decrease with its cost, the empirical implication is that the relation between innovation and the firm's size, as measured by its output or employment, is not monotone. In fact, on an optimal path with output increasing over time, there may be an initial phase of accelerating productivity growth, which is followed by a phase of decelerating productivity growth.

The long-run prediction of our analysis is that productivity growth converges towards the rate of wage growth in all firms that survive in the long-run. Indeed, we show that increasing wages will not drive the firm out of the market as long as the initial level of its labor cost is not too high. In this case the rate of productivity growth approaches the rate of wage growth under the optimal innovation policy. Eventually, the firm reaches a steady state where these two rates coincide so that its unit labor cost remains constant over time. Interestingly, this steady state is independent of the level of wages; it only depends on their growth rate. The level of wages determines only whether the optimal policy tends towards the steady state or whether the firm will go extinct in the long-run.

In our model it is the evolution of wages that stimulates productivity enhancing innovations at the firm level. Our cost-push argument addresses the interaction between labor market conditions and the innovative performance of industries and countries. This interaction is the subject of a number of empirical studies both at the macroeconomic (see e.g. [Gordon, 1987](#)) and the microeconomic level (see e.g. [Doms et al., 1997](#); [Chennells and van Reenen, 1997](#); [Mohnen et al., 1986](#); [Van Reenen, 1996](#)). An important issue in this context is the relation between unionization and firms' R&D investment and innovation activities, which has been the subject of a relatively small number of theoretical and empirical studies. Theoretical studies by [Baldwin \(1983\)](#), [Grout \(1984\)](#) and [van der Ploeg \(1987\)](#) show that unionization is associated with underinvestment. In the absence of legally binding contracts, once a firm has incurred the sunk costs of investment, its union pushes for higher wages in order to capture a share of the quasi-rents created by the firm's innovation. Due to the union's hold-up behavior, the firm's incentives to innovate are decreasing with the union's bargaining power¹. This underinvestment result may, however, not hold if unionized firms are competing in the market and invest strategically to increase their market shares and profits: [Tauman and Weiss \(1987\)](#) show that a unionized firm, competing with a non-unionized rival, may overinvest in R&D under plausible conditions. [Ulph and Ulph \(1994, 1998, 2001\)](#) show that overinvestment may be observed in a

¹ For an excellent discussion of the hold-up problem in labor markets see [Malcomson \(1997\)](#).

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