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# Wages and productivity growth in a competitive industry

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## Abstract

We describe the evolution of productivity growth in a competitive industry with free entry and exit. The exogenous wage rate determines the firms' engagement in labor productivity enhancing process innovation. There is a unique steady state of the industry dynamics, which is globally asymptotically stable. In the steady state, the number of active firms, their unit labor cost and supply depend on the growth rate but not on the level of the wage rate. In addition to providing comparative statics of the steady state, the paper characterizes the industry's adjustment path.

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## 1. Introduction

How do wages affect the incentives for labor productivity enhancing innovation at the firm and the industry level? We address this question by studying the evolution of productivity growth in a competitive industry in which the last period's best technology is freely available to all competitors. Firms in this industry face an exogenous wage rate, which can be thought of as being determined in the aggregate

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labor market of the underlying economy. This wage affects the innovative performance of the industry as firms seek to capture inframarginal rents by increasing labor productivity. The dynamics of innovation converge to a unique steady state, in which unit labor costs are constant over time. In the steady state, the number of active firms, their supply and unit labor cost turn out not to depend on the level of wages; they only depend on their rate of growth. From any initial configuration the industry characteristics monotonically approach the steady state as time evolves. Along the adjustment path, high but declining productivity growth rates are associated with entry of new firms and a decline in the size of firms. Exit induces an increase in market concentration when productivity growth is relatively low but increasing over time.

Technological innovations as a means to reduce labor costs seem to have been at the heart of economic growth for many decades. The conventional macroeconomic view is that productivity growth drives wage growth. In a competitive equilibrium, the wage rate equals the marginal productivity of labor. Therefore, traditional growth theory has a causality running from productivity growth to wage growth. This view, however, presumes that productivity growth is exogenous and independent of labor market conditions. In contrast, in our analysis productivity growth is endogenously determined by innovation incentives at the firm and industry level. Firms respond to high and growing wages by productivity enhancing innovations to substitute against labor. Our model thus points to a microeconomic causality that runs in the opposite direction to the traditional macroeconomic view.<sup>2</sup> It shows how wage growth, which may reflect technological progress at the economy-wide level, stimulates productivity enhancing innovations at the industry level. Of course, the implication of our partial equilibrium analysis for macroeconomic modelling is that both, wage growth and productivity growth, are jointly endogenously determined (see [15]).

Our theoretical argument is in the same spirit as the empirical findings of Gordon [10] who argues that a substantial component of accelerations and decelerations of productivity growth in Europe, Japan and the US can be attributed to the behavior of the ratio of wages to labor productivity (see also [11]). A number of microeconomic studies have established a positive relationship between wages and the introduction of new technologies. The time series results of Doms et al. [6] suggest that plants with high wage workforces are more likely to adopt new technologies. A possible explanation for this could be some complementarity between technology and skill: Wages are positively related to workforce skills and these skills allow new technologies to be adopted at lower costs. The alternative rationalization, which we model in this paper, is that higher wages will induce firms to substitute away from labor through new technologies. Chennells and Van Reenen [3] conclude from their analysis of British plant data that this substitution effect may indeed be an important factor. In a dynamic factor demand model, Mohnen et al. [25] find that the long-run cross-price elasticity of R&D with respect to the price of

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<sup>2</sup> A similar causality is emphasized in efficiency wage models, where higher wages raise productivity because of adverse selection or incentive effects, see e.g. [30].

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