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JOB CREATION, JOB DESTRUCTION AND GROWTH: A COMMENT

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Abstract
Studies investigating the sign of the relationship between growth and unemployment have generated opposite results. In this paper we provide a simple theoretical model where the net effect of growth on unemployment is ambiguous both in steady state and out-of steady-state.

Keywords: Unemployment, Growth, Matching models

JEL classification: J64, O4, O40

1. Introduction

According to Mortensen (2005), the net effect of growth on unemployment is unclear. From an empirical point of view, in fact, there is no clear prediction about how the unemployment rate and the aggregate growth rate should be correlated across countries or across time.[1] This issue has been effectively synthesised by Mortensen (2005), who shows that the correlation between average growth and average unemployment over the past ten years across 29 European countries is essentially zero.[2]

This ambiguity has been explained on the basis of theoretical assumptions about technological progress. Precisely, if the technological progress is *disembodied*, the higher the technological progress, the lower is the discount rate. Hence, the present-discounted profits are higher and firms open more vacancies. This is the so-called "capitalization effect" which implies both higher growth and a lower steady-state unemployment rate (Pissarides, 2000). Instead, in the case of *embodied technological progress*, the rate of job destruction is endogenous and it is higher at faster rates of growth (the Schumpeter's notion of "creative destruction"). Hence, faster technological progress is associated with a higher

[1] This topic is very important since it involves the discussion about the effect of an increase in the gross domestic product on the social welfare.
[2] It is beyond the scope of this paper to review the literature. See Mortensen (2005) and the references therein.

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steady-state unemployment rate (Aghion and Howitt, 1994, 1998).[3] According to Mortensen and Pissarides (1998), these opposite results found in the literature can be interpreted within a more general model in which the net effect of productivity growth on unemployment depends only on the size of the updating cost.[4]
The main contribution of this work is that the opposite results found in the literature are interpreted within a basic labour market matching model where the net effect of productivity growth on unemployment depends only on the key variables of these models: namely, the level of matching frictions and the share of (un)employed workers. Precisely, if market tightness is very low, the effect of growth on employment is negative; whereas, in the case that market tightness is very high, the effect is positive if the share of unemployed workers is higher than the share of employed workers, vice versa if the share of unemployed workers is lower than the share of employed workers the effect remains negative. Furthermore, in this model the net effect of growth on unemployment is ambiguous both in steady state and out-of steady-state.

The rest of the paper is organised as follows: section 2 presents a baseline labour market matching model; while section 3 extends the model to the technological progress, thus finding the growth rate of the economy; finally, section 4 concludes the work.

2. (Un)employment

We consider a basic matching model with a continuum of homogeneous workers of measure one and free-entry of one-job firms (see Pissarides, 2000).

In matching models, the creation of employment is characterised by trading frictions due to costly and time-consuming matching of individuals (workers and firms) and an aggregate matching function is used to summarise these frictions (Petrongolo and Pissarides, 2001). Precisely, the number of job matches formed per unit of time is $m = m(u, v)$, where u is the number of unemployed workers and v is the number of vacancies. The matching function is strictly increasing but concave in both arguments and displays constant returns to scale. This common assumption allows us to introduce the key variable of the model, $\theta \equiv v/u$, more commonly known as 'market tightness'. It follows that $q(\theta) \equiv m\{v, u\}/v = m\{1, \theta^{-1}\}$ and $g(\theta) \equiv m\{v, u\}/u = m\{\theta, 1\}$ are the probability of filling a vacancy and of finding a job, respectively.[5] For the sake of simplicity, we express the matching function by the functional form commonly used in matching models, i.e. the *Cobb-Douglas function,* $m = m(v, u) = v^{1-a} \cdot u^{a}$, where $0 < a < 1$ is the (constant) elasticity of the matching function with

[3] Technological progress is disembodied in the sense that both old and new jobs benefit from higher labour productivity without it being necessary to replace their capital stock. This is the only form of technological progress that is consistent with a balanced-growth path. Instead, technological progress is embodied in the sense that growth can come about through job destruction and the creation of new and more productive jobs.
[4] In short, Mortensen and Pissarides (1998) find a threshold value of renovation cost such that faster growth decreases (increases) unemployment if the updating cost is below (above) this critical value.
[5] Standard technical assumptions are assumed: $lim_{\theta \to 0} q(\theta) = lim_{\theta \to \infty} g(\theta) = \infty$, and $lim_{\theta \to 0} g(\theta) = lim_{\theta \to \infty} q(\theta) = 0$.

respect to the share of unemployed workers. To ensure that unemployment exists in steady state, it is assumed that job destruction occurs at the rate δ. Therefore, given that the labour force is normalised to the unit, the matching and job destruction rates allow us to obtain both the evolution of employment over the course of time ($\dot{N}$) and the steady state employment rate (N):

$$\begin{cases} \dot{N} = \theta^{1-a} \cdot (1-N) - \delta \cdot N \\ \Rightarrow N = \dfrac{\theta^{1-a}}{\delta + \theta^{1-a}} \end{cases} \tag{1}$$

where $(1-N) \equiv u$ is the share of unemployed workers. Since each firm has only one job, N also represents the number of firms/jobs of this economy.

As usual, market tightness is endogenised by equalising the expected cost of a vacancy and the present-discounted value of a filled job, since profit maximisation requires that the profit from one more vacancy should be zero in equilibrium (see Pissarides, 2000, chapter 1):[6]

$$\begin{cases} \dfrac{c}{\theta^{-a}} = \dfrac{p-w}{(r+\delta)} \\ \Rightarrow \theta = \left[\dfrac{p-w}{c \cdot (r+\delta)} \right]^{\frac{1}{a}} \end{cases} \tag{2}$$

Thus, market tightness depends positively on job productivity (*p*) and negatively on wage (*w*), start-up cost (*c*) and discount rates of profits (i.e. job destruction rate δ and interest rate *r*).

3. Productivity and growth

Growth can be introduced into search and matching models in two ways (see Pissarides, 2000; Aghion and Howitt, 1994):

- By assuming that the productivity of labour is a function of time and grows at the constant rate *g* (exogenous labour-augmenting technological progress). Precisely, in terms of Pissarides's specification, the labour productivity of one-job firms is the following: $p_t = p_0 \cdot e^{g \cdot t}$, where $p_0 > 0$ is some initial level of productivity.
- By assuming that the rate of job destruction is higher at faster rates of technological progress, i.e. $\delta = \delta(g)$, with $\delta'(g) > 0$.

[6] The inverse function of the probability of filling a vacancy is the expected duration of a vacancy.

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We introduce into the basic matching model developed in the previous section both forms of technological progress.[7]
Since the productivity is described by a parameter (a common assumption in matching models), it represents both the marginal productivity and the average productivity. Hence, the overall production (Y) and the growth rate (y) of this economy can be calculated as follows:[8]

$$\begin{cases} Y = N \cdot p_0 \cdot e^{g \cdot t} \\ \Rightarrow lnY = lnN + lnp_0 + g \cdot t \\ \Rightarrow y = n + g \end{cases} \tag{3}$$

where $y \equiv \frac{\dot{Y}}{Y}$ and $n \equiv \frac{\dot{N}}{N}$.

Therefore, in steady state (where the values of the variables are not subject to further changes over time):

- The economy grows at the rate of technological progress (g);
- An increase in g has an ambiguous effect on market tightness and thus on unemployment, since the technological progress increases both firms' productivity and job destruction. If wage and productivity grow at the same rate g, in fact, the discounted value of a filled job becomes $\int_0^\infty e^{-(r+\delta(g))\cdot t} \cdot (p-w) \cdot e^{g \cdot t}\, dt \Rightarrow \frac{(p-w)}{r+\delta(g)-g}$, with $r+\delta(g) > g$ (present values finite);

Furthermore, out-of-steady-state dynamics:

- The economic growth rate also depends on the growth rate of jobs, $n \equiv \frac{\dot{N}}{N}$. The economic growth is thus an endogenous process since it depends on market tightness;
- The growth rate of jobs depends positively on market tightness, $\partial n/\partial\theta > 0$, but its relationship with the job destruction rate, $\partial n/\partial\delta$, is *a priori* ambiguous. Hence, although the technological progress increases the job destruction rate, the final effect of g on employment growth remains ambiguous.

Precisely,

- If market tightness is very low ($lim_{\theta \to 0}$), the effect of job destruction rate on jobs growth rate is negative;

[7] In order to make non-trivial the dynamics of growth and destruction of jobs, we could assume that the initial level of productivity (p_0) is different within the firms and the job destruction rate δ is higher for firms with a lower initial level of productivity, *ceteris paribus*. In this case, all jobs grow at the rate of technological progress but the level of productivity remains different within the firms and the probability of destroying remains higher for less productive jobs. However, this case would not change the qualitative results of the analysis.
[8] Formally, with different initial levels of productivity (p_i) and job destruction rate (δ_i), we get different shares of employment (n_i) for each firm i, since different market frictions are obtained. Thus, in order to get the overall production of the economy, we can determine the aggregate productivity as a weighted average of the productivity of firms (i.e. weighted by their respective shares of employment). Again, the qualitative results of the analysis do not change.

o Whereas, in the case that market tightness is very high ($lim_{\theta \to \infty}$), the effect is positive if the share of unemployed workers is higher than the share of employed workers ($u > N$), vice versa if the share of unemployed workers is lower than the share of employed workers ($u < N$) the effect remains negative.

4. Conclusions

In this paper we provide a simple theoretical model where the net effect of growth on unemployment is ambiguous both in steady state and out-of steady-state. As a result, this model is consistent with the opposite results found in the literature about the sign of the relationship between growth and unemployment. Precisely, the net effect of growth on unemployment depends on both the level of matching frictions and the share of (un)employed workers present in the market.

The model used is rather general (and the growth equation rather simple), so that it can be applied to a number of cases. In short, the net effect of growth on unemployment can be different in some countries/regions, although they share the same institutional set-up (start-up cost, for example) or the same discount rates of profits. Hence, policy makers should focus their attention on the firms' productivity, by encouraging job creation and the development of small and medium-sized enterprises; in this way, the productivity effect can prevail on the job destruction effect, thus making positive the (net) effect of growth on market tightness and employment.

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