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Efficiency of two sided investments in an equilibrium unemployment framework☆

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ABSTRACT

This paper investigates the efficiency of investments by firms and workers in a matching model with high- and low-productivity jobs. Search is sector specific and random within sectors. Search frictions and ex-post bargaining imply that wage inequality arises as a result of the difference in investment costs between the sectors. The efficiency properties of the equilibrium are analyzed under the particular division in bargaining proposed by Hosios (1990). The conclusion is that the equilibrium is inefficient, with a too low fraction of workers and a too high vacancy-unemployment ratio in the high-productivity sector. The opposite happens in the low-productivity sector.

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1. Introduction

This paper analyzes the efficiency of two sided investments in a labor market model with search frictions. It presents a model where firms and workers make ex-ante investments, search for suitable partners and once they match they bargain over the surplus that results from their investments.

Typically, ex-ante investments and ex-post bargaining imply under-investments. When two parties commit to invest in advance to make production possible, investments are sunk at the bargaining stage and then the parties do not get the full marginal benefits of their investments. It is essential for this result that rents arise because of the presence of asset specificity. In the extreme case, investments are only productive within the relationship and the outside options are zero.

In a labor market there are a lot of agents on each side of the market taking investments decisions simultaneously and intuitively the degree of asset specificity is significantly reduced. Indeed, Cole et al. (2001a,b) and also Felli and Roberts (2002) analyze matching models where competition for partners can prevent holdup problems. From this perspective, under-investment problems are mitigated in a frictionless labor market. However, in a labor market with search frictions rents from matching take place and they bring back some degree of asset specificity to the productive relationship creating again incentives to under-investments (Acemoglu and Shimer, 1999).

This paper analyzes the efficiency properties of a standard two-sector search and matching model with two-sided investments. There exist a high- and a low-productivity sector where firms and workers participate as a result of their ex-ante allocation decisions. The model generates a sectorial distribution of firms and workers. Heterogeneity arises because workers have to pay for a cost to become high skilled and firms, correspondingly, need to make higher investments in order to open a vacancy in the high-productivity sector. It is assumed that a high-productivity vacancy can only be filled by a high-skill worker and low-skill workers can only be productive in the low-productivity sector.[1] Also, any filled vacancy employs one worker to produce one unit of a good. The number of vacancies in each sector is determined by two free-entry conditions which drive expected profits from job creation to zero. The distribution of the workforce is the one that equalizes the expected net income of high- and low-skill workers. The model is related to the two sector models of Acemoglu (2001) and Albrecht and Vroman (2002) with the main difference being that the skill composition of the workforce is endogenous.[2]

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[1] It is not considered the possibility of mismatch between high-skill workers and low-productivity firms previously analyzed in the literature (McKenna, 1996; Gautier, 2000; Albrecht and Vroman, 2002; Uren 2006; Dolado et al., 2009). Notwithstanding, the conclusions of the paper are robust to this potential extension for high enough investment costs in the high-productivity sector. See Blázquez and Jansen (2008) for an efficiency analysis of Albrecht and Vroman (2002).

[2] Aricò (2009) presents a model with endogenous types in both sides of the market and analyzes the effect of subsidies to education and innovation on output and unemployment. Apart from not analyzing the efficiency properties of his model, the treatment of frictions is quite different from this paper.

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The general conclusion of previous research studying two-sided investment in matching models is that with search frictions both workers and firms under-invest in human and physical capital, respectively.[3] This is not necessarily what happens in the model presented here. In fact, it is shown that under the particular division in bargaining satisfying the Hosios condition with costly investments workers under-invest and firms tend to over-invest in the high-productivity sector. This result is explained by the interaction of investment externalities with their general equilibrium effects. Of particular importance is the endogenous price assumption introduced to the model. Each sector requires capital and labor to produce an intermediate good that is sold in a perfectly competitive market and used with the other sector's output to produce a final consumption good (Acemoglu, 2001). As prices depend on the relative supply of the intermediate goods, and therefore the number of agents in each sector, a higher investment cost of any good reduces its supply and increases its price, which is the value of output in each productive relationship (i.e. the match surplus). Given that wages are determined by Nash Bargaining over the match surplus, the sectorial price difference resulting from different investment costs explains wage inequality in the model. These price effects have important implications for the efficiency properties of the equilibrium. Even when search frictions and rent sharing give incentives to under-investments by firms and workers, the relative scarcity of goods produced by the high-productivity sector implies that the sectorial price difference is higher than it should be. This incentive to invest in the high-productivity sector mitigates under-investment problems. With endogenous prices there is also more interdependence in the investments decisions in the economy because they do not only rely on investment costs and matching probabilities but also on their effect on prices.[4]

It is assumed that search is sector specific but random within sectors. That is, given the matching requirements, agents only search for the partners with whom production is possible. This leads to a labor market with two separate matching functions, one for each sector. Equilibrium in standard matching models involves trading externalities: a firm posting a vacancy makes it more difficult for the other vacancies to meet an unemployed worker (congestion externality) and easier for the unemployed workers to meet an unfilled vacancy (thick market externality). These externalities cancel out only when the measure of workers' bargaining power β is equal to the elasticity of the matching function with respect to unemployment (Hosios, 1990; Pissarides, 2000). The efficiency analysis of this paper is done assuming the Hosios condition holds. This makes it possible to identify the efficiency effects of investments not related to the standard ones in this type of models. As previously shown by Acemoglu and Shimer (1999), under the sector specific matching assumption the Hosios condition makes firms internalize the externalities associated to vacancy creation. An interesting result of the paper is that there is an externality in the determination of the skill composition that is not related to the matching assumption. This arises because when workers take their skill decision they do not consider how a better skill composition increases the average value of matches in the economy. These investment externalities together with the general equilibrium effects of the model (in particular the price effects) determine the final efficiency properties of the model.

The paper is structured as follows: The next section describes the general environment. Section 3 presents the equilibrium and Section 4 analyzes the efficiency properties of the equilibrium. Section 5 concludes.

[3] Acemoglu (1996, 1997), Masters (1998) and Davis (2001).

[4] Additionally, in line with some empirical literature (Autor et al., 2005, 2008) the model with endogenous prices is consistent with a net supply of skills explanation of wage inequality.

2. Model

2.1. Basic assumptions

Consider a continuous-time economy populated by a unit mass of workers producing a final consumption good Y with two intermediate inputs Y_b and Y_g according to a CES technology,

$$Y = \left(\alpha Y_b^{\rho} + (1-\alpha)Y_g^{\rho}\right)^{1/\rho}. \tag{1}$$

Following Acemoglu (2001), b and g refer to a bad-job and a good-job sector, respectively. Good Y is sold in a competitive market at a normalized price of 1. It is assumed that $\rho<1$ and α measures the share of Y_b in the final good production function. The first order conditions of the aggregate economy problem lead to the following equilibrium prices for the two intermediate goods,

$$p_b = \alpha Y_b^{\rho-1} Y^{1-\rho} \tag{2}$$

$$p_g = (1-\alpha)Y_g^{\rho-1} Y^{1-\rho}. \tag{3}$$

These two intermediate goods are produced via a Leontieff technology using capital and labor. That is, production of one unit of an intermediate good $i=b,g$ takes place when a firm with a vacancy meets a suitable unemployed worker. Then, Y_i measures not only aggregate production but also aggregate employment in sector i.

Firms can only produce in one of the two sectors and need to make ex-ante investments before production takes place. Denoted by k_i the firm investment cost in sector i and assume that investments are generally more costly in the g sector, that is $k_g \geq k_b$. Similarly, workers can only participate in one of the two sectors. Workers producing in sector g must have acquired the necessary skills at a cost c. It is assumed that having incurred the cost c precludes workers from being able to produce in sector b.[5] As a result of the allocation of workers across the sectors there is a fraction π of workers who can only work in sector b. As long as it is more costly for either firms or workers to participate in sector g than in sector b, $Y_b > Y_g$ and therefore $p_g > p_b$.

2.2. Search and meeting process

At any moment in time, a job is either filled or vacant and a worker is either employed or unemployed. Unemployed workers and firms offering vacancies have to spend resources in order to meet each other. When a vacant job is filled with a qualifying unemployed worker, production takes place and the job generates a rent. As standard in this literature workers and firms meet according to a matching function $M(u,v)$ where u is unemployment and v vacancies. This matching function is twice differentiable, increasing in both arguments and has constant returns to scale.

Given that different jobs have different matching requirements firms and workers could only search for their potential partners with whom production is possible. This leads to the sector specific search assumption adopted in this section. There are then two matching functions, one for bad jobs and another for good jobs.

The constant returns to scale assumption implies that $M(u_i,v_i)/v_i = q(\theta_i)$, where $\theta_i = v_i/u_i$ is defined as the tightness of the labor market in sector i. The function $q(\theta_i)$ represents the flow rate at which vacancies meet unemployed workers and is decreasing in θ_i. In addition, $M(u_i,v_i)/u_i = \theta_i q(\theta_i)$ is the flow rate at which unemployed workers meet unfilled vacancies and is increasing in θ_i .

[5] We can relax this assumption to allow for high-skill workers to be productive in both sectors. However, even under a more general assumption about the skill requirements of the different jobs, it can be shown that for a high enough price difference between the sectors high-skill workers would never find it worthwhile to accept a b sector offer.

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