Modeling of Necessity Entrepreneurship via General Equilibrium Approach*

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Abstract. We construct a structural model of the occupational choice under unemployment, giving a natural definition of necessity entrepreneurs as individuals who fail to find a salaried job, but running business, they are able to earn more than the unemployment benefit. The existence of the necessity entrepreneurs shrinks unemployment in the economy and positively affects the welfare.

Keywords: Necessity Entrepreneurs; Occupational Choice; General Equilibrium Model

1   Introduction

Economists frequently study entrepreneurship in the context of the economic development [1,2]. The relationship between entrepreneurship and economic development is multidimensional [3]. In particular, an innovative entrepreneurship positively affects the economic development. An opposite effect is likely related to necessity entrepreneurs, who prefer paid employment but fail to get a job offer associated with their expectations. The role of necessity entrepreneurs in the economic development is difficult to estimate primary because their definition requires refinement and preciseness [4].

This paper brings a twofold contribution into the analysis of necessity entrepreneurship. On one hand, we propose a simple structural model that defines the necessity entrepreneurs in a natural way. On the other hand, we posit that this definition corresponds to our expectations regarding necessity entrepreneurship in the Russian Federation.

In 1978, Lukas proposed an approach to modelling of necessity entrepreneurship, considered now as canonical [5]. According to this approach, individuals perform the occupational choice between entrepreneurship and a salaried job, choosing the alternative that gives them a larger income. In the equilibrium, more talented individuals run a firm, whereas the other individuals end up with the paid employment. We extend this construction to the economy with unemployed agents. Then a part of indi-

viduals applied for a job are rejected, but, turning to entrepreneurship, earn more than the unemployment benefit. This part forms the set of necessity entrepreneurs.

2 Basic Model

2.1 Economy

We consider a single-sector closed economy. In this sector, single-product firms produce varieties of a differentiated good competing monopolistically. There are L individuals in the economy. Aiming at higher profit, they perform the occupational choice between entrepreneurship and the entrance into the labour market. The labour market choice is risky, since a salaried job is not guaranteed. The application for a job can fail. In this case, the individual secures the unemployment benefit, but switches to entrepreneurship, if the latter is more profitable. The unemployment benefit is fixed by the central planner to a prescribed level by taxing wages and profits in an appropriate way.

Individuals are assumed to be heterogeneous with respect to their entrepreneurial abilities.

2.2 Supply and Demand

We assume that the individuals are homogeneous as consumers. They are endowed by a separable additive utility function with a constant elasticity of substitution between varieties of the differentiated good. Any mechanisms of the money transition between time stages (credits, deposits, et. cetera) are absent; therefore, the consumers spent money completely at each stage.

The supply is also modelled by simple tools. Firms require labour as a single production factor. The production function depends linearly in labour supplied by individuals in inelastic way. The variable costs are inverse to entrepreneurial abilities of the firm manager. Involving into the monopolistic competition, the firm clears the market of its variety by tuning the price.

The free entry and exit conditions regulate the number of firms in the economy.

We show that unemployment is observed in equilibrium. As soon as the wages are agreed, firms lose profits when hiring new workers for arbitrary positive compensation. The origin of this phenomenon is drawn on the assumption regarding a negligible size of each market agent with respect to the market in whole. As usual, we model that every agent is unable to affect market aggregates by individual actions. Then the demand remains unchanged, if some firm hires a new worker. Under stable market aggregates, which, in particular, include wages, this new worker has nothing to produce. Small costs associated with this worker do not play a role at all.

2.3 Occupational Choice and Timing

We assume that the occupational choice is performed in two stages. The maximization of the income underlies the choice at the both stages. The sequential decisions are based on the backward induction. At the first stage, individuals correctly anticipate

the choice of all agents at the second stage. In particular, the individuals optimize their second stage decision for all outcomes of the first stages parameterized by a single quantity. As a result, the second stage decision depends on the first stage decision. It is taken, aiming to maximize the sum of the incomes obtained at each stage, where the future income is discounted by a factor that is less than one.

Evidently, the individuals, who are talented enough to run a firm and earn profit exceeding the wages, decide to become entrepreneurs from the very beginning. On the contrary, the individuals, who as entrepreneurs end up with profits that are lesser than the unemployment benefit, definitely prefer the labour market over entrepreneurship. However, some individuals, choosing entrepreneurship, can earn the profit that is greater than the unemployment benefit, but less than the wages. Their choice requires more detailed consideration.

We assume that the decisions of the individuals are ordered with respect to their entrepreneurial abilities. Namely, if an individual with entrepreneurial abilities φ finds profitable to run a firm, then more talented individuals also prefer to run a firm. Analogously, if an individual with entrepreneurial abilities φ finds reasonable to apply for a job, then less talented entrepreneurs behave in the same manner. Under these assumptions, individuals whose potential income as entrepreneurs only slightly exceeds the unemployment benefit would prefer the labour market over entrepreneurship at the first stage. Their gain from the job offer exceeds the losses from the possible unemployment. If the latter occur, she has time to alter her decision at switch to entrepreneurship at the second stage.

We also believe that at the second stage, the individuals avoid risk and choose entrepreneurship if it allows obtain the income that is greater than the unemployment benefit. With this assumption in mind, we find an individual who is indifferent to the second stage choice. Her entrepreneurial abilities solve the algebraic equation that equalizes the after-tax-wages and the expected income of the labour market candidate. The equation determining an indifferent individual at the first stage involves the same idea but requires a certain generalization: now the discounted sum of the profits equalizes the expected discounted income of the labour market candidate. The abilities of this indifferent entrepreneur indicate the threshold between entrepreneurs and non-entrepreneurs. We note that the abilities of the indifferent entrepreneurs found at the second stage determine only a weak threshold at the first stage. Nobody with lesser abilities chooses entrepreneurship, but some individuals with larger abilities end up as workers. They avoid entrepreneurship at the first stage because fail to secure the profit that exceeds the wages. As labour market candidates, they get the job offer at the first stage and keep it at the second stage. The underlying mathematical computation admits that the threshold abilities decrease from the first to the second stage. In other words, deciding to run a firm at the first stage, the individual repeat her choice at the second stage.

Simplifying the model, we assume that the individuals are homogeneous as workers: they are equally productive. This immediately equalizes the equilibrium wages. However, we assert that the alternative between a former worker and a former unemployed agent is resolved in favour of the worker when a firm chooses its employees at the second stage.
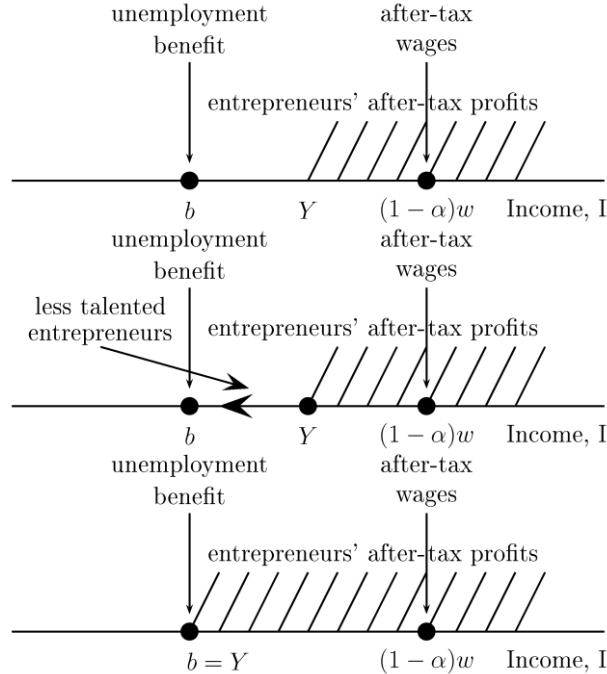
Fig. 1. The income I of entrepreneurs (*I>Y*), workers (*I=(1-α)w*), and the unemployment benefit *b*. After the first stage, *Y>b* (top), but during the second stage new individuals choose entrepreneurship pushing *Y* down (middle), and eventually, *Y=b* in equilibrium; α is the tax rate.

3   Results of Modeling

Equilibrium consists of the set of the demands, the prices, the number of firms, and the threshold abilities arising at the both stages such that each market cannot improve the gain by deviation from the corresponding choice. This is a standard Nash equilibrium used in the monopolistic competition theory. We establish the correctness of the formulated problem, proving the existence and uniqueness of the threshold abilities. This implies the existence and uniqueness of the other equilibrium variables. We also find that, as expected, in equilibrium, a part of entrepreneurs earn the income that lies between the unemployment benefit and the income of the workers. In other words, the model does explain the existence of the necessity entrepreneurship through the occupational choice threaten by unemployment.

The first stage generates an intermediate low boundary I of the income of entrepreneurs. As we discussed above, this boundary is located between the unemployment benefit *b* and the income of workers *(1-α)w*, where α is the tax rate. The individual earning income I is indifferent between two options: entrepreneurship and risky search for job that can be switched to entrepreneurship later. The losses from the un-

successful job application precisely balance the gains from the job offer. The mathematical formulation is delegated into the Appendix.

We posit that necessity entrepreneurs affect positively on economy, decreasing the unemployment rate. If the central planner had the opportunity to prescribe occupational choice, (s)he should motivate managers of the firms to reject the applications from those workers whose entrepreneurial abilities are relatively large. This measure would increase the number of the entrepreneurs in the economy. However, the assumption regarding the homogeneity of workers is considered to simplify the modelling. In reality, the workers are heterogeneous. Moreover, one would expect that more successful entrepreneurs typically demonstrate a better output as workers. Therefore, our model overestimates the number of entrepreneurs in the economy.

Acknowledgement

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Appendix. Mathematical formulation of the equilibrium

Maximization of the demand q_φ by an individual with income Y results in the equation:

$$q_\varphi \int_0^\infty p_\varphi^{1-\sigma} N_e(\varphi) d\varphi = p_\varphi^{-\sigma} Y, \qquad (1)$$

where p_φ is the price charged by a firm that is run by an entrepreneur with abilities φ, and $\sigma \in (1; +\infty)$ characterizes the elasticity of substitution between varieties of the differential good, and $N_e(\varphi)$ is the number of entrepreneurs with abilities φ.

The maximization of the profit leads to the price

$$p_\varphi = \frac{\sigma w}{(\sigma-1)\varphi} \qquad (2)$$

charged by the firm that incurs a relative cost $\frac{w}{\varphi}$ per a unit of output; w is understood as wages of workers.

The balance between workers N_w earned after tax wages $(1-\alpha)w$ and unemployed agents N_u endowed by the benefit b is given by the equation:

$$\frac{N_w}{N_u} = \frac{(\sigma-1)b}{\alpha\sigma w},$$

(3)

where $\alpha \in (0; 1)$ indicates the taxes applied to workers and entrepreneurs.

Let $\Gamma(\varphi)$ be the fraction of individuals whose entrepreneurial abilities are at most φ; t_0 and t_1 be the threshold at stages 0 and 1 respectively. We put

$$I_0 = \int_{t_0}^{\infty} \varphi^{\sigma-1} d\,\Gamma(\varphi)$$

(4)

and

$$I_1 = \left(1 - \frac{(\sigma-1)b}{(\sigma-1)b+\alpha\sigma w} \frac{1-\Gamma(t_1)}{1-\Gamma(t_0)}\right) \int_{t_1}^{t_0} \varphi^{\sigma-1} d\Gamma(\varphi) + \int_{t_0}^{\infty} \varphi^{\sigma-1} d\,\Gamma(\varphi)$$

(5)

Then the profits $\pi_{\varphi,1}$ of the firm run by an individual with the abilities φ at stage 1 are

$$\pi_{\varphi,1} = \frac{\varphi^{(\sigma-1)}}{I_1} \frac{\Gamma(t_0)\Gamma(t_1)bw}{\alpha\sigma w\Gamma(t_0)+(\sigma-1)b\Gamma(t_1)}$$

(6)

The cutoff equation at stage 1 is

$$t_1^{\sigma-1} = \frac{\alpha\sigma w\Gamma(t_0)+(\sigma-1)b\Gamma(t_1)}{(1-\alpha)w\Gamma(t_0)\Gamma(t_1)}$$

(7)

where t_0 is considered as a parameter.

Let $A < 1$ be the factor that discount the second stage profit. Then the cutoff equation at stage 0 is

$$(1 - \alpha)\left(\frac{t_0^{\sigma-1}}{I_0} \frac{\tau_0\Gamma_0 w}{\sigma-1} + \frac{t_0^{\sigma-1}}{I_1} \frac{\tau_1\Gamma_0 wA\tau_1}{\sigma-1}\right) t_1^{\sigma-1}$$
$$= \tau_0(1 - \alpha)w + (1 - \tau_0)b + (1 - \alpha)wA\tau_1$$

(8)

We pose conditions on the model parameters such that given w/b, α, $\Gamma(\varphi)$, and σ, the system of equations (7), (8) has a unique solution (t_0, t_1). This solution determines the equilibrium distribution $N_e(\varphi)$ of entrepreneurs over their abilities, the optimal demands via (1), and the profits $\pi_{\varphi,1}$ gained at stage 1.