E C O N O M I C S B U L L E T I N

The dynamics of structural change under risk influence

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Abstract

The paper is concerned with structural change in the growth process and the role of uncertainty. Uncertainty is conceived as the means of removing the obstacles of growth through the activation of knightian entrepreneurship. A dynamic stochastic model of continuous−time growth is proposed. The paper concludes that uncertainty affects economic growth and the rate of returns, and causes structural changes in portfolio shares of the two types of entrepreneurial events. Structural change depends mainly on intertemporal rate of substitution, productivity ratios, and finally intersectoral difference in return and risk.

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1. Introduction

This paper is concerned with the analysis of the growth process in relation to risk through structural change. The analysis of structural change will come through the examination of growth as it is related to entrepreneurship and uncertainty. Uncertainty is conceived as the means of removing the obstacles of growth through the activation of Knightian entrepreneurship.

We assume that growth is the result of equilibrating and creative entrepreneurial events. Equilibrating entrepreneurial events (adaptive behaviour) are recognised as being the most common entrepreneurial events that take place and those that match demand and supply (Petrakis 1997). On the other hand, creative entrepreneurial events (innovative Schumpeterian behaviour) are those that result in the production of new (innovative) products and services.

Regarding structural change issues, the paper deals with the basic question of 'why industries grow at different rates and which industries come to have an increasing weight in the total output while others decline and eventually wane (Montobbio 2002). In searching for an answer, reference is usually made to different income elasticities of domestic demand or to supply side productivity differences or to differentiable productivity growth which is the result of selection mechanisms within the general evolutionary process (Baumol 1967, and Baumol *et al* 1985, and Kuznets 1971, 1988, and Metcalfe 1998, 1999, and Montobbio 2002, and Passineti 1981, 1993). This paper proposes to look at the role of uncertainty and risk, since it is very probable that when the intersectoral conditions of the risk and return relationship alter, then forces are liberated which will start the structural change process and affect growth. Thus while it is very logical to expect that uncertainty can cause structural change, until now the issue has not been analysed within a growth structural change model.

A dynamic stochastic model of continuous-time growth is proposed, based on the work of Turnovsky (2000) which includes the two basic types of entrepreneurial events. It also includes three distinct 'crucial' individual concepts: growth rates, portfolio shares and rates of return. Thus our analysis includes the performance indexes (growth rates), 'incentives' (rates of returns) and 'results' (portfolio shares) of entrepreneurial behaviour. Thus the paper contributes to the analytics of uncertainty, entrepreneurship and risk. It also contributes to the analytics of the structural change pattern as far as the role of risk is concerned.

In section 2 of the paper the growth model is presented. In section 3 the analytic of growth and risk in relation to structural change are presented. Finally in section 4 conclusions will be drawn.

2. The model of growth, creative equilibrating events and the role of uncertainty

We will develop a model for the representative agent that includes three fundamental concepts: the growth of the economy and its two types of entrepreneurial events and their basic characteristics. Obviously this refers to a stochastic growth model which will include stochastic capital accumulation and capital return specification and consumer utility maximisation procedure. The model is based on Turnovsky's (2000) growth stochastic model with a unified entrepreneurial event. Turnovsky's model has been used in a number of spheres with the latest application (Gong and Zou 2002) to direct preferences for wealth, risk and growth.

We consider a real economy in which the household and production sectors are consolidated. The representative agent consumes output over the period $(t, t+dt)$ at the non-stochastic rate Cdt.

The agent distributes his resources between the two types of entrepreneurial events. This means that he functions within an environment of perfect information, with no costs or limitations regarding the initiation of a creative or equilibrating event.
The differences in the contribution of these two types of entrepreneurial events to an economy's growth rate are detected in the following:

(a) The role of creative events vs equilibrating events, as far as the accumulated flow of output over the period $(t, t+dt)$ is concerned, is rather different.
(b) The two types of entrepreneurial events face different technological conditions as far as the productivity of production is concerned. However, their effect on total production flow is simply additive.

The objective of the agent is to maximise the expected value of lifetime utility as measured by the utility function:

$$\max_{C} E_0 \int_0^{+\infty} \frac{1}{\gamma} C^{\gamma} e^{-bt} dt \,, \quad -\infty < \gamma < 1 \qquad (1)$$

subject to the stochastic accumulation equation,

$$dK = dY - Cdt \qquad (2)$$

Where: $K = K^c + K^e$ and

K^c = stock of physical capital devoted to creative entrepreneurial events at time *t*;
K^e = stock of physical capital devoted to equilibrating events at time *t*;

The initial stocks of capital are given by K_0^c and K_0^e.

The corresponding portfolio shares being:
$n_e \equiv \frac{K^e}{K}, n_c \equiv \frac{K^c}{K} = 1 - n_e$

$dY = dY^c + dY^e$: the flow of output (from both entrepreneurial events) over the instant $(t, t+dt)$.

Furthermore,

- Capital (K), follows the continuous time stochastic process:

$$dK = \psi K dt + K dk, \quad \psi \in \Re \qquad (3)$$

with ψ as the rate of growth of capital and dk as a stochastic component with $E(dk) = 0$ and $Var(dk) = \sigma_K^2 dt$.

- Stochastic real rate of return on capital devoted to equilibrating events, is described through the stochastic process:

$$dR_e = r_e dt + du_e \quad (4)$$

The variance of the stochastic part of "(4)" is given by $Var(du_e) = \sigma_e^2 dt$

Stochastic real rate of return on capital devoted to creative events, is described through the stochastic process:

$$dR_c = r_c dt + du_c \quad (5)$$

with variance of the stochastic part equal to $Var(du_c) = \sigma_c^2 dt$.

The deterministic parts $r_e dt$ and $r_c dt$ indicates the rate of return on capital. The stochastic parts are normally distributed with $E(du) = 0$ and $Var(du) = \sigma_u^2 dt$. They represent the risks that the agent undertakes when he employs capital on equilibrating and creative entrepreneurship.

3. The analytics of growth, risk and structural change

Besides the basic assumptions, which are:

(a) risk averse individual behaviour, which implies that $\gamma - 1 < 0$, that is the elasticity of international substitution is relatively large.

the model adopts the following two additional hypotheses:

(b) $r_c > r_e$ which implies that the rate of return on creative entrepreneurial events is larger than that of equilibrating events;

(c) $\sigma_e^2 > \sigma_{ce}$, and $\sigma_c^2 > \sigma_{ce}$ which is the risk of equilibrating and creative entrepreneurial events is greater than the covariance of risk between the two types of events. This hypothesis, is based on the fundamental principle of portfolio structuring according to which, risk of each portfolio component is greater than the total portfolio risk. In other words, since the agent is risk averse, it always makes sense to reduce risk to compose portfolios that include both equilibrating and creative entrepreneurial events.

(d) We suppose that the production functions are linear, that is $Y_e = \theta_e K^e$ and $Y_c = \theta_c K^c$, θ_e, θ_c are the productivity ratios. There is no a priori reason to assume that $\theta_e \neq \theta_c$; thus the model does not necessarily assume the heterogeneity of the sectors (firms) in terms of productivity. However for presentation purposes we will mark the two productivity ratios differently and will examine the consequences of identical intersectoral productivity later.

Table 1 presents the findings from the analysis. Proofs are available on request.

Table 1 Summary of the model's results

Propositions	*Variables*	*Risk*	
		σ_e^2	σ_c^2
(1)	ψ	$-\frac{1}{2}\left(\frac{1}{\theta_e}\right)^2(\gamma-1)>0$	$-\frac{1}{2}\left(\frac{1}{\theta_c}\right)^2(\gamma-1)>0$
(2)	n_e	$-\frac{(\gamma-1)n_e^2}{2(r_c-r_e)}>0$	$-\frac{(\gamma-1)n_c^2}{2(r_c-r_e)}>0$
(3)	n_c	$-\frac{(\gamma-1)n_e^2}{2(r_c-r_e)}<0$	$-\frac{(\gamma-1)n_c^2}{2(r_c-r_e)}>0$
(4)	r_e	$-(\gamma-1)n_e+\frac{(\gamma-1)^2n_e^2(\sigma_e^2-\sigma_{ce})}{2(r_c-r_e)}>0$	$\frac{(\gamma-1)^2n_c^2(\sigma_e^2-\sigma_{ce})}{2(r_c-r_e)}>0$
(5)	r_c	$\frac{(\gamma-1)^2n_e^2(\sigma_{ce}-\sigma_c^2)}{2(r_c-r_e)}<0$	$-(\gamma-1)n_c+\frac{(\gamma-1)^2n_c^2(\sigma_{ce}-\sigma_c^2)}{2(r_c-r_e)}?0$
(6)	$\frac{\partial\psi}{\partial\sigma_K^2}=-\frac{1}{2}(\gamma-1)>0$		

According to the proposition 1 in both cases the effect of entrepreneurial risk on growth rate is directly analogous to the capital stock of the economy and reciprocal to the productivity ratio of the economy. The larger the stock of capital, the larger the effect of risk on growth. In other words the greater the average ratio in the economy the greater is the risk influence as the financial theory supports. On the other hand the larger the productivity in the economy, the smaller the effect of risk on growth. Different sectoral productivity implies differentiable effect on growth. Thus, if $\theta_e > \theta_c$, that is the productivity ratio in the equilibrating sector is greater than the productivity ratio in the creative sector, then the same increase (decrease) in risk for both sectors means that will produce a smaller (greater) influence on growth through equilibrating events than the creative ones.

Analytically results:

(a) The effect of a change in equilibrate risk: An increase (decrease) in the risk of an equilibrating entrepreneurial event will direct increase (decrease), as it is expected, the corresponding rate of return and will decrease (increase) the rate of return of a creative event. At the same time the portfolio share of equilibrating events will increase (decrease) against the portfolio share of creative events. Eventually the total rate of growth will increase (decrease).

(b) The effect of a change in creative risk: An increase (decrease) in the risk of a creative entrepreneurial vent will increase (decrease) corresponding rate of return while having the opposite effect on the rate of return of an equilibrating event. However the increase (decrease) in the risk of a creative event will shrink the corresponding portfolio share and will increase (decrease) the portfolio share of equilibrating events. Eventually the total rate of growth will increase (decrease). The above comments hold when the creative risk influences positively the rate of return of creative events.

(c) How the portfolio share of creative entrepreneurial events could be increased: From the above it is obvious that any kind of increase in risk will increase the portfolio share of equilibrating events. Then the question arises regarding in what conditions could the portfolio share of creative events be increased. There are two mutual exclusive conditions for the creative portfolio share to be increased. The first is when the rate of return of creative events is less than the rate of return of equilibrating events. In other words, the creative sector expands when the risk becomes smaller than the level of the risk of equilibrating events. The second refers to the intertemporal elasticity of substitution. When it becomes smaller, then the creative portfolio share could be increased. This last result should be evaluated in the light of the fact that the model pinpoints the direction in the change of the basic variables as we depart from the equilibrium point and for very small changes. Therefore when we infer that an increase in the creative risk affects the portfolio share of equilibrating events positively and the portfolio share of creative events negatively in essence we mean that an increase in the high (by definition) risk of creative events reduces their portfolio share.

(d) The question of possible uniformity of growth: The propositions 2 and 3 reveal that uniform growth cannot be the case unless the existing portfolios of the two entrepreneurial events are equal. Since this is a rare condition we may conclude that risk will exercise non-uniform influences on the portfolio shares.

4. Conclusions

The paper deals with the fundamental growth question of which forces and under which conditions the obstacles of sustainable growth can be removed. Our answer is focused on the role of uncertainty. The outcome of the analysis pinpoints the fact that uncertainty affects growth and structural change and structural change is connected with growth.

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