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Is Neoclassical Economics still Entrepreneurless?*

by

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Abstract: We review and evaluate some recent contributions on modeling entrepreneurship within a neoclassical framework, analyzing how and to what extent the fundamental ingredients suggested in the social science literature were captured. We show how these approaches are important in stressing the main elements of a complex picture without being able to fully describe it. Each modeling attempt focuses only on one specific feature of entrepreneurship, and the entrepreneurial function broadly perceived eludes analytical tractability. As a consequence, the models can be useful in analyzing the effect of entrepreneurial behavior at an aggregate level, but not at explaining individual choices. From these observations we highlight how a simplistic interpretation of the existing mainstream approaches incorporating entrepreneurship runs the risk of leading to distortionary policy interventions.

JEL Classification: B41; D81; J23; L23; M13; O31.

Keywords: Entrepreneurial Choice; Entrepreneurship; Innovation; Neoclassical Modeling; Uncertainty.

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1. Introduction

”The theoretical firm is entrepreneurless – the Prince of Denmark has been expunged from the discussion of *Hamlet*”.¹ This oft-quoted observation was made by William J. Baumol (1968, p. 68) almost four decades ago in the *American Economic Review*. The article was an urge to the economics profession to start paying serious attention to the role of entrepreneurship in economic development.

A decade or so later entrepreneurship and the entrepreneur began to loom large on the political agenda, and ever since the entrepreneur has from time to time been said to be *the* factor crucial for the furthering of innovation and prosperity. Even as distinguished a social scientist as Ronald Reagan became captivated by these trends, stating ”We have lived through the age of Big Industry and the age of the giant corporation. But I believe this is the age of the entrepreneur.”²

There is also systematic empirical evidence that entrepreneurship is important for economic growth (e.g. Audretsch and Thurik 2000; Carree *et al.* 2002; Wennekers and Thurik 2001) and for job creation and renewal (e.g. Acs 1999). Still, many scholars have pointed out that there has been little room for the entrepreneurial element in theoretical mainstream economics (e.g. Baumol 1993; Kirchoff 1994; Kirzner 1997; Swedberg 2000). As documented by Johansson (2004) the terms entrepreneur and entrepreneurship are virtually nonexistent in the leading graduate textbooks in micro, macro and industrial organization.

The reason for this disregard of entrepreneurship is not a denial of its relevance for economic development and the organization of economic activity. The reasons are methodological: the entrepreneur and the entrepreneurial function largely elude analytical tractability. In recent years, however, several attempts have been made to include entrepreneurship in mainstream economic modeling, not least in growth models.³

The purpose of this paper is to provide a systematic survey of the different mainstream/neoclassical modeling techniques that have been used in order to capture the entrepreneurial function in the economy. Among other things, we will highlight how and to what extent restrictive assumptions

¹ Schumpeter (1942, p. 86) uses a similar formulation: “[A] theoretical construction which neglects this essential element of the case neglects all that is most typically capitalist about it ... it is like *Hamlet* without the Danish prince.”

² Quoted in Brown, Hamilton and Medoff (1990, p. 1).

³ E.g. Romer (1990), Segerstrom, Anant and Dinopoulos (1990), Aghion and Howitt (1992), Helpman (1992) and Acemoglu, Aghion and Zilibotti (2003).

were required in order to attain the equilibrium (as properly defined in the given setting). An important additional purpose is to examine to what extent it may be possible to model the entrepreneurial function more realistically within mainstream economics (“the neoclassical paradigm”).

It turns out that entrepreneurship is invariably defined narrowly and it cannot be said to capture the wide-ranging and complex functions suggested outside mainstream economics. However, from this observation it does not follow that formal modeling of entrepreneurship in mainstream economics is of no value. In fact, while not being able to represent the whole picture, models help highlighting and exploring its main components. Hence, one has to be aware of the limitations of any given approach before drawing policy conclusions.

The paper is organized as follows. In section 2 we briefly characterize the enormous and highly diverse body of research on entrepreneurship in the social sciences. In Section 3 we review some recent and influential approaches in modeling entrepreneurship, highlighting their main ideas, assumptions, results and possible critiques. In section 4 we evaluate these modeling attempts in order to assess to what extent they can be said to capture essential features of entrepreneurship and thereby contribute to our understanding of the workings of a modern market economy. Section 5 concludes, discussing the usefulness of (neoclassical) modeling and related policy issues.

2. Entrepreneurship in the Social Sciences

Considering the whole gamut of approaches to the study of entrepreneurship in the social sciences shows that the diversity of approaches and the number of contributions is extraordinary. It is sufficient to go through the recent handbooks and collections to see this (Acs and Audretsch 2003; Shane 2002; Westhead and Wright 2000; Sexton and Landstrom 2000). In all disciplines from social anthropology to highly abstract economic theory entrepreneurship is studied, and the focus could be on personality, opportunity, ability, motivation, environment, organization, coordination, policy and finance. Hence, there is no way to summarize entrepreneurship research in a few pages. Fortunately, that is not necessary given the purpose of this paper.

Entrepreneurship research by non-economists is in most cases more descriptive in nature, and the theorizing is usually shaped by the empirical research (Swedberg 2000, p. 24). But what does this boil down to? Well, a claim such that “the entrepreneur is the single most important player in a

modern economy” (Lazear 2002, p. 1) must necessarily imply that it is about individuals and organizations (be they new, old, large or small) that actively contribute to renewal and change in the economy. It also implies that it is a function, but a function that is carried by specific individuals – individuals who can by their own volition decide whether to supply this function and, given that they choose to do so, do it in ways that are productive, unproductive or destructive from a social perspective (Baumol 1990; Murphy *et al.* 1991).

Hence, entrepreneurship is not management, but it also involves more than just alertness and boldness. Its importance hinges on the fact that the real world is replete with Knightian uncertainty (uncalculable risk; Knight 1921), knowledge is highly decentralized, particularized, largely noncodifiable (Hayek 1945), human cognitive abilities are severely limited relative to the available information (Martens 2004), and human action is an open-ended process rather than the result of dynamic optimization (Kirzner 1997).

Moreover, as emphasized by Casson (1982/2003, p. 23) the entrepreneur is someone who “specializes in taking judgmental decisions about the coordination of scarce resources”. But because of the characteristics of the real world listed above, entrepreneurs will differ in decisions and actions. The essence of entrepreneurship is therefore about doing things differently. As long as opportunities for improved coordination and innovation exist entrepreneurial services will be socially valuable. However, getting entrepreneurial insights does not ascertain that these insights are translated into entrepreneurial action.

Trying to synthesize all this, we will settle on the following definition of entrepreneurship (partly adapted from Wennekers and Thurik 1999): the ability and willingness of individuals, both on their own and within organizations to: (i) *innovate*, i.e. perceive and create new economic opportunities; (ii) *face uncertainty*, i.e. introduce their ideas in the market, by making decisions on location, form and the use of resources and institutions; and (iii) *manage their business* by competing with others for a share of that market. These three attributes will also accompany us in the next section, where we will analyze in some detail how and to what extent they have been captured in formal modeling.

What is already clear is how formidable is the challenge to model entrepreneurship analytically. As noted, Baumol was very pessimistic in 1968 about the possibility of integrating it within the neoclassical theory of the firm (as developed in the 1930s by scholars like John Hicks and Paul Samuelson): “there is no way in which they [entrepreneurs] can fit into the model”. Some two

decades later Barreto (1989 presented a comprehensive analysis of the exclusion of the entrepreneur from the theory of the firm. He claims that it is indeed an infeasible task (p. 115, 141):

The confrontation between the basic axioms and the entrepreneur leaves two possibilities: to accept the entrepreneur and reject the modern theory of the firm, or to reject the entrepreneur and maintain allegiance to the modern theory of the firm. . . . Simply put, entrepreneurship is above ‘formalization’ – it cannot be neatly packaged within a mechanistic, deterministic model. Importantly, the choice is an ‘either-or’ proposition; there is no happy medium. The corner solution which economic theory has chosen is consistency and for this reason the entrepreneur disappeared from microeconomic theory (Barreto 1989: 115, 141).

However, some significant attempts have been made in recent years to model entrepreneurship in mainstream economics. Are these attempts largely aborted, or do they contribute to our understanding of the real world? This is the question to which we now turn.

3. Modeling Entrepreneurship in “Neoclassical” Economics

If you say mainstream or neoclassical economics basically every academic economist knows what you are referring to, at least as long as you do not ask for a formal definition. Still it is fair to say that the core of the neoclassical research paradigm is characterized by the study of the allocation of scarce resources, optimization, rationality, focus on marginal tradeoffs and relative prices, methodological individualism, the use of calculus and a general equilibrium conception of the economy (e.g., Aspromourgos 1987; Colander 2000), or more colloquially, greed, rationality and equilibrium. However, as recently noted by numerous scholars (e.g. Solow 1997; Colander 2000, 2003; Schiffman 2004), contemporary mainstream (micro) economics is far less dogmatic and is almost wholly defined by its method. It is about building models that are tested or that can at least be tested in principle. Hence, it is no surprise that ideas that cannot be modeled formally tend to be ignored in economics. It is then also logical, given the enormous interest in the entrepreneur and entrepreneurship in the public discussion, that there are a number of recent attempts to model entrepreneurship formally while remaining within the confines of mainstream economics.

In our review, we will not attempt to account for every author that has somehow addressed the issue, but rather to provide a systematic survey of the more representative contributions of a given idea of entrepreneurship⁴. In our survey we have identified three crucial attributes of entrepreneurs that have been stressed in the more substantive modeling efforts: (i) they are (generally speaking) “more talented”, (ii) they have greater tolerance towards risk-bearing and (iii) they are innovators

⁴ A recent and comprehensive survey of the ‘the economics of entrepreneurship’ can be found in Parker (2004).

(either as individuals or as firms involved in R&D activities). Within these broad strands we look more closely at the most influential works, analyzing how and to what extent the entrepreneurial function can be said to be captured in the models, their driving assumptions and main results (with particular focus on the existence and properties of the equilibrium).

The analysis will be conceptual rather than technical in order to stimulate some reflections on the concept of entrepreneurship and on the possibility to model it in a neoclassical framework.

1. Talented entrepreneurs

The model in Lucas (1978) focuses on the coordinating function of the entrepreneur. This basic feature goes back to Say (1845) and commonly characterizes the entrepreneur in economic theory. Each firm, irrespective of the size of its workforce, must have an entrepreneur (or equivalently, in Lucas's terminology, a manager) in order to produce.⁵ He will organize the production employing the optimal level of labor and capital and will be remunerated by residual profits (i.e. by the value of output after having compensated the factors of production).⁶ In the model workers are assumed to be completely homogeneous with respect to their productivity as employees, while they are endowed with different "talents for managing". This variable will play a crucial role in the model, determining the choice between becoming a worker or an entrepreneur and the allocation of the workforce among entrepreneurs.

For a given standard constant return to scale production technology $f(l, k)$ the output actually produced y will depend on the talent x of the manager according to the following formulation:

$$y = x \cdot g[f(l, k)], \text{ where } g[\cdot] \text{ is increasing and concave.}$$

We may already note how "entrepreneurship" is considered as a factor of production, as in Schultz (1980), where entrepreneurship enters the production function as any input whose price is determined by the interaction of supply and demand.

⁵ This indivisibility between output and entrepreneurial labor is typical when the entrepreneur is modeled as a coordinator of production. Technically, the nonconvexities created in this formulation do not constitute a problem for the existence of an equilibrium, since it is usually assumed that the economy is populated by a continuum of individuals (Aumann 1966).

⁶ Notice however that there is no role for uncertainty in this model; everything is deterministic and agents are assumed to be risk neutral. Also, there's no separation between ownership and control.

Although very convenient from an analytical point of view, and thus generally embraced in neoclassical approaches, the formulation is somehow at odds with the message in fundamental contributions in the field such as Knight (1921), Schumpeter (1934) or Kirzner (1997). They in fact rejected the idea of reducing entrepreneurship to a mere factor of production comparable to physical capital or “normal” labor. Instead they insisted on the impossibility to quantify/identify its specific contribution to final output. This is necessary in the neoclassical approach, so that one can solve the maximization problem by using the customary tools (Barreto 1989).

Entering the production function simply as a multiplier, talent has a huge effect on output. The effect is mitigated by the function $g[\cdot]$, which introduces diseconomies of scale in managing. This ensures that there exists an optimal size of the firm for any given x , and hence the most talented individual cannot control everything in equilibrium.

Regarding the first basic occupational choice, the optimal rule will identify a cut-off level x^* (increasing in factor prices and decreasing in $g[\cdot]$) such that everyone given a talent larger than x^* will become an entrepreneur and the others will be employees. The intuition behind the result is straightforward and robust to different specifications of the model; all that is required is that productivity differs among otherwise homogeneous individuals (with respect to a number of relevant parameters like initial wealth or risk aversion) and income for entrepreneurs is more sensitive to individual characteristics than for employees. Laussel and Le Breton (1995), for example, derive the same result in a slightly different general equilibrium model, where imperfect information on the quality of workers creates a “lemon effect” on the labor market and induces the most efficient workers to become entrepreneurs.

Lucas’s contribution also addresses the issue of the optimal distribution of factors of production across managers/entrepreneurs. Adding some more structure to the model, and in particular imposing independence between firm growth, in terms of labor and assets employed, and size (Gibrat’s Law), Lucas is able to derive the competitive equilibrium in the economy, characterized by a famous result: the most talented individual will manage the largest firm and earn the highest profits. This applies keeping fixed the distribution of talent (that intuitively gives an idea of the level of competition in talent required to manage a firm of given size) and factor prices (that determine the minimum threshold x^* needed to become an entrepreneur).⁷

⁷ More testable implications can be derived with further assumptions. In particular, assuming an elasticity of substitution in production less than unity will imply an average firm size increasing in per capita wealth in the country.

As Lucas recognizes, the model does not specify exactly what managers do, but simply assumes that ‘whatever managers do, some do it better than others’. The model thus does not really explain its crucial variable, “talent”, and is incapable of addressing more realistic issues relating for example to the investment in one’s own “talent” or to the dynamics of occupational choice.

The model draws attention to the fundamental issue of the relationship between skills and occupational choice. From an empirical perspective, for the reason just mentioned, its predictions are hardly testable, unless we assume something on what the variable “talent” refers to. Loosely speaking, it is quite unintuitive to think about the topic in such a clear-cut and monotonic way, where entrepreneurs are simply more talented than employed workers. In fact it has been debated in many disciplines whether there is positive or negative self-selection into entrepreneurship, and empirical studies are not conclusive. For example, Evans and Leighton (1989) find that entrepreneurs are more likely to have experienced low wages and unemployment (they are the “misfits”), while Robinson and Sexton (1994) report that entrepreneurs are on average more educated than salary workers and Bates (1995) documents how these results vary greatly across industries.

Hence much depends, on how one defines (or tries to proxy for) entrepreneurial “talent”.

An important contribution towards the understanding of this complex concept was recently made by Lazear (2002). He stresses the point that becoming an entrepreneur (as opposed to a specialist) requires having a more balanced talent that spans a number of different skills. To model the occupational choice in this fashion, it is assumed that, for given skills x_1 and x_2 , a specialist can earn $\max [x_1, x_2]$ while an entrepreneur will earn $\lambda \cdot \min [x_1, x_2]$, where λ denotes the market value of entrepreneurial talent. Then the closer you get to the space where x_1 equals x_2 , the more likely that the agent becomes an entrepreneur. This probability is also affected by the parameter λ , which accounts for a number of technological (e.g. economies of scale or agency costs) and market (supply and demand of entrepreneurs) variables.

The empirical validity of the theory is still quite preliminary, but some support has been given in Lazear (2002) and Wagner (2003). The key factors in promoting entrepreneurship here reside on the possibility to train these “jack-of-all-trades” attitudes and to act on institutional factors comprised in the market return for entrepreneurship λ . The first point is currently being investigated empirically (Baumol 2004 and Silva 2004) and there seems to be little scope for policy intervention on this side:

entrepreneurial talent appears to be mostly innate and difficult to teach. The second aspect is fundamental and it would clearly require further specifications. One interesting connection, that we can just mention here, leads to the recent literature on how different incentives determine the occupational choice of the most talented people in a country, whose growth rate will heavily depend on the choice of these people to devote their talent to productive vs. rent-seeking activities (Baumol 1990; Murphy, Shleifer and Vishny 1991; Holmes and Schmitz 2001).

2. *Risk-bearing entrepreneurs*

The influential work of Kihlstrom and Laffont (1979) adds the element of risk bearing to a neoclassical general equilibrium model. Entrepreneurs not only provide organizational skills, but “take the responsibility of enterprise”, i.e. bear the risk associated with production.

The model is quite similar to that of Lucas (1978), although more refined: Individuals are homogeneous (in particular, they have the same ability in performing entrepreneurial and employee functions) except for their degree of risk aversion. Their basic decision is whether to be an employee or an entrepreneur. The latter foregoes a fixed wage in exchange for risky profits and decides also how many workers to employ.

Each firm is required to have one unit of entrepreneurship in order to operate and production is a function depending on labor input and a stochastic factor with an objective (i.e. known to everybody) and common (i.e. independent of characteristics of the firm or the entrepreneur) probability distribution.⁸ The equilibrium defines the partition of the population (i.e. decides who becomes worker and who is entrepreneur, based on agents’ expected utility maximization) and the resulting prices (wages) so that the labor market clears.

Under standard assumptions on the utility function (everywhere continuous in the degree of risk aversion and strictly concave in income) and the production function (decreasing return to scale in labor), there exists an equilibrium where less risk averse individuals become entrepreneurs. More

⁸ This assumption leaves no room for interactions between individual capacities and final outcome. Thus, situations where more able individuals have more accurate inferences or are less affected by global shocks are ruled out. However, it does not imply that shocks are perfectly correlated across firms, i.e. that the realization of the random variable will be the same for everybody.

precisely there exists a unique cut-off level of risk aversion r^* such that all agents with risk aversion smaller than r^* will be entrepreneurs and the rest will be workers.⁹

In a fashion very similar to Lucas (1978),¹⁰ the less risk averse entrepreneurs will hire more workers in equilibrium, even if each firm faces the same decreasing return to scale production technology (and thus from an efficiency point of view should produce the same amount). This will hold if uncertainty enters the production technology multiplicatively or in general if in good states of the world workers are more productive.¹¹ Intuitively, this guarantees that the expected effect of a shock unambiguously determines the amount of risk to bear in order to run a firm of a given size.

The paper has turned out to be a fundamental contribution in many respects. It was probably the first study to extend the results regarding the existence and stability of equilibrium to a model comprising (some type of) entrepreneurship. Here the comforting point is that no departure from rational choice, well-defined production functions or complete information is required to invoke a need for entrepreneurs. Some heterogeneity in preferences is enough to justify a role for the entrepreneur in equilibrium, *as long as risk cannot be insured*.

Second, it provides a formal treatment of the theory of the entrepreneur as risk bearer, which is definitely one of the most plausible aspects commonly associated with entrepreneurship. At a somewhat deeper level, however, one may question whether bearing risk *per se* is a defining characteristic of entrepreneurs, or whether it emanates from external constraints (e.g. capital market imperfections). We will return to this issue shortly, trying to get some hints from the empirical literature.

Finally, it provides a plausible justification for a positive relationship between initial wealth and entrepreneurship. Differences in risk aversion may arise because individuals with the same utility function differ in initial wealth levels. Under the widely accepted assumption that risk aversion

⁹ It is also unique if we assume that the number of workers hired by an entrepreneur (with a given degree of risk aversion) decreases in the equilibrium wage. Furthermore, (Lyapunov) stability of the equilibrium is shown assuming a particular *tâtonnement* adjustment process and some more assumptions to assure that the utility function is “well-behaved” with respect to risk aversion.

¹⁰ Lucas himself points out (footnote 1) that the spirit of his paper can be replicated substituting the variable “talent for managing” with “attitude towards risk”.

¹¹ Formally, if x is the stochastic factor entering the production function $g(l,x)$, we say that x enters multiplicatively if we can write $g(l,x)=xh(l)$, as in Lucas’s formulation. What is required in the more general case is that $g(l,x)$ and $g_l(l,x)$ are both monotonic in x , i.e. a more favorable realization of x not only increases output but also the marginal product of labor. Under all these conditions it is also shown that a general increase in risk aversion, increasing the supply and decreasing the demand for workers, reduces the equilibrium wage.

decreases in wealth, the model implies that those who are initially wealthier will become entrepreneurs.

However, while there's little to criticize on the formal structure of the model, some concerns remain regarding the last two points. First, to be consistent with Knight's terminology, risk should be distinguished from uncertainty. Risk is a stochastic process with a known distribution, while uncertainty has to be handled with no information. And while Knight defines the entrepreneurial role as assuming responsibilities in an *uncertain* environment, the authors choose to model *risk-bearing*.¹² What (rational) decision making can deal with is in fact only risk, as one always needs an idea at least on some moments of the underlying probability distribution.¹³

Second, from a theoretical point of view, the recent literature on incentives and endogenous matching reveals the inconsistency of this interpretation of the Knightian theory of entrepreneurs as providers of insurance once we relax the assumption that the choice of occupation is the only institutional scheme of risk sharing. The fact that, in Kihlstrom and Laffont's model, there exists some institutional constraint to risk trading (basically the absence of a capital market) is really crucial for the result.

In fact, risk averse entrepreneurs would prefer to purchase some insurance, if a market for that would be opened. On the other hand, because of moral hazard effects perfect insurance would give entrepreneurs incentives not to supply the necessary effort. Moreover, if utility is separable in income and effort, wealthier agents will have to bear more risk in order to satisfy their incentive compatibility constraint for any given effort level. And here is the surprising result in Newman (1999): For a broad class of utility functions, the decrease of risk aversion in wealth is too slow compared to the increase in the level of risk to be borne. So the "increasing risk effect" dominates

¹² The distinction will be also important in order to reconcile Knight's and Schumpeter's theories, usually seen as contrasting (e.g. Evans and Jovanovic 1989). Schumpeter makes a clear distinction between the risk bearer and the entrepreneur (who deals with uncertainty, i.e. directs his actions in new and unpredictable directions). Risk has to be borne by the capitalist, not necessarily by the entrepreneur, who handles uncertainty.

¹³ An interesting avenue in searching for foundations of the entrepreneurial choice might take into account subjective probability theory, where beliefs do not come from an exogenous and objective probability distribution (as in the von Neumann – Morgenstern theory) but where they are rather derived by individual preferences and thus will typically vary across individuals facing the same situation (see Kreps 1988, for an introduction). A direct formalization of Knightian uncertainty can be found in Bewley (1986), where individuals possess a set of subjective probability distributions over states rather than a single (objective) one and make incomplete plans of action, that consider the possible occurrence of unexpected alternatives and state of the world. Unfortunately this literature has not inspired explicit applications to entrepreneurial choice and this seems definitely a worthwhile task.

the “decreasing risk aversion effect” and we obtain the empirically implausible prediction that wealthy agents will choose to be workers while the poor become entrepreneurs.¹⁴

And the positive association between wealth and entrepreneurship can instead find an explanation recalling a basic result in incentive theory: Once the model is purged from risk-sharing considerations (i.e. when entrepreneurs are assumed to be risk neutral), higher wealth actually mitigates moral hazard problems in financial markets. In this setting greater wealth does not increase the likelihood of becoming an entrepreneur because of reduced risk aversion, but thanks to better access to the credit market.

Altogether, this casts some doubt on the view of entrepreneurs as risk bearers once an (imperfect) insurance market is opened. And these two points remain highly controversial also when one moves on to the empirical side. On the role played by risk, for example, Parker (1996) and Ilmakunnas and Kannianen (2001) document that the degree of uninsurable risk that characterizes an economy drives individual occupational choice. Van Praag and Cramer (2001) stress the importance of risk aversion while Rosen and Willen (2001) report evidence that casts doubts on the “Knightian” interpretation that risk attitudes are a major determinant of the decision to become self-employed.

Similar debates can be found on the relationship between personal wealth and entrepreneurship. The crucial role of individual wealth has been largely recognized in many empirical studies, stressing the existence of liquidity constraints that restrict the possibilities for business start ups (e.g. Evans and Jovanovic 1989; Evans and Leighton 1989; Holtz-Eakin *et al.* 1994; Blanchflower and Oswald 1998). On the other hand, recent studies (e.g. Dunn and Holtz-Eakin 2000 and Hurst and Lusuardi 2004) have reported no significant wealth effect and rejected the claim that these constraints play a key role in determining the propensity to enter self employment.

3. *Innovative entrepreneurs*

Important contributions come from the acknowledgement of the centrality of innovation in the process of development. Most notably, recall Schumpeter’s theory of entrepreneurship as the engine of the capitalist economy. *Implementing* innovations (e.g. introducing new goods, new methods of

¹⁴ Technically, the total utility $U(y, e)$ can be written as: $U = u(y) - e$, where y denotes income and e effort. The result requires that $1/u'(y)$ is a strictly convex transformation of $u(y)$. Empirically, the fact that wealthy agents choose safer occupations than poor agents is not so implausible once these agency problems (and thus the endogeneity of matching between principals and agents) is taken into account. Akerberg and Botticini (2002), for example, find that in Medieval Tuscany wealthy farmers grew safer crops (cereals), while the poor peasants were dedicated to wine (riskier).

production, new markets...) is regarded as the key feature of entrepreneurial activities, which are clearly separated from risk bearing or invention. We will review the most important attempts made to comprise this idea in formal models.

More recently, endogenous growth theory has developed some Schumpeterian ideas, focusing in particular on the process of innovation created by R&D activities. While not really consistent with the Schumpeterian idea of entrepreneurship (as we will argue in what follows), this literature has become the most prominent neoclassical attempt to model innovation, obsolescence and “creative destruction”.

3.1 Entrepreneurs responding to recurrent profit opportunities

Several schools of thought, in particular the Austrian School, have described the entrepreneur as somebody who discovers and responds to new economic opportunities. Holmes and Schmitz’s (1990) model refers explicitly to Baumol’s approach on the capacity to ‘respond to the opportunities for creating new products that arise from repeated technological breakthroughs’. This, and not risk bearing, is the crucial feature that defines an entrepreneur.

The model has two key features: individuals are continuously faced with opportunities for developing new products, i.e. the dynamics of growth (technical progress, demographic change) always create “disequilibria” and thus potential profits. Second, individuals differ in their ability to exploit these emerging opportunities. The first feature is modeled assuming an exogenous rate of technical progress and the second one by defining an ability parameter, θ , that mitigates the risk of creating a new business: the more talented agents are less likely to undertake an unsuccessful enterprise.

Specifically, businesses differ in their quality q : a unit of time allocated to managing a business of quality q will result in the production of q units of output. Given technical progress, the average quality of new businesses increases over time by some exogenous and constant parameter. Individual ability mitigates risk in the sense that for a given θ , q_t is a random variable with the cumulative distribution function $F(q, \theta) = \Pr(q_t \leq q/\theta)$ and $F(q, \theta_1) > F(q, \theta_2)$ for $\theta_2 > \theta_1$; the higher the ability the greater the probability of starting up a high quality business.¹⁵

¹⁵ Formally the distribution $F(\cdot, \theta_2)$ is strictly first-order stochastic dominant with respect to $F(\cdot, \theta_1)$, for $\theta_2 > \theta_1$.

In the model the occupational choice of individuals is derived in relation to their abilities and to the quality of the business that they are currently managing. They have to decide whether to manage their current business (and producing deterministically a consumption good) or starting-up a new one with stochastic quality q and incurring the fixed cost of one foregone period of production.¹⁶

Quite intuitively, in the unique competitive equilibrium people with low θ only manage already existing firms, people with high θ only set up new businesses, and people with intermediate θ either manage businesses they started or trade for higher quality businesses (dismissing their current one).

The major contribution consists in the simple and intuitive formalization of an idea that has been the central point of the analysis of authors like Schumpeter, Kirzner and Schultz , i.e. the existence of individuals with special abilities to innovate and capture profit opportunities.

The shortcomings concern the exogeneity of the technological progress and, once again, the focus on risk rather than Knightian uncertainty. The first aspect may not be crucial in a theory of entrepreneurship, once we stick to the Schumpeterian observation that ‘the inventor produces ideas, the entrepreneur gets things done’. In other words the real focal point is not where “new opportunities” come from, but rather how some people respond to them and drive development.¹⁷ On the other hand, the recent and vast literature of endogenous growth and innovation (partly reviewed in the next subsection) may provide this missing ingredient, thus suggesting a possibly interesting combination of the two approaches.

On the second aspect, it seems that focusing solely on uncertainty would not allow the construction of an occupational choice model, where one can explain the motives for becoming an entrepreneur rather than a worker. As already mentioned, modeling individual choice requires either to somehow assign probabilities to different possible outcomes or to dismiss (standard) decision theory.

¹⁶ It is interesting to note that individuals differ in their activities, not necessarily in their status of employee or self-employed. The model would not be different if the same “developing a new opportunity” vs. ”managing an existing one” would be undertaken by an employee. Schumpeter (1934, p. 78) stated that ‘whatever the type, everyone is entrepreneur only when he actually carries out new combinations and loses that character as soon as he has built up his business, when he settles to running it as other people run their business’. The focus is therefore not really on a category of person, but rather on a function.

¹⁷ Formalizing how exactly entrepreneurs create new combinations is not an easy task. A possible approach is suggested in Olsson and Frey (2002). Entrepreneurs create growth through “normal” technological advance, i.e. they innovate by creating convex combinations of existing ideas within a set of technological possibility. The process will obviously terminate when the set will become convex, and we will have stagnation until an exogenous paradigm shift (extraordinary technological breakthrough) will reconfigure the technological possibilities, reintroducing non-convexities, new profit opportunities and ensuring long-run growth. Once again, “extraordinary” technological progress is not explained in the model.

A different approach is proposed by Blanchflower and Oswald (1998). They create a simple and testable model of entrepreneurship, where people with different abilities to innovate act in a world of genuine uncertainty and where information asymmetries create imperfection in the capital market. Here entrepreneurs have not only to be gifted with entrepreneurial vision (in the model it is simply assumed that a fraction of the population is endowed with it), but must have enough capital or be “lucky” enough to receive an unsecured loan (again, there is an exogenous fraction of these “lucky” people in the population). Unsurprisingly, when there is a shortage of “entrepreneurial people” with capital, they will earn a rent, i.e. they enjoy a higher utility than other workers do. The paper has mainly empirical concerns (and indeed finds evidence that liquidity constraints bar some potential entrepreneurs from becoming self-employed, and that self-employed persons report higher levels of satisfaction than employees), but it highlights an important point in our discussion. One can stick to the idea that returns from innovations are impossible to quantify (and thus incorporate uncertainty), but then any ambition to provide an explicit model of individual choice has to be abandoned.

3.2 *Innovation as a product of the R&D sector*

This recent and burgeoning literature builds on the crucial role of technological progress in the explanation of long-run growth. Innovation comes from purposive, profit-seeking investment in knowledge by firms involved in R&D activities, modeled following the patent race literature in industrial organization (see Tirole 1998). Innovations typically emerge according to some stochastic process dependent on the amount of resources devoted to the sector.¹⁸ Moreover, it completely displaces previous products or leaders in an industry, allowing the winner to enjoy some monopolistic power until another innovation arrives. Thus there are winners and losers in the process; the obsolete products leave the market replaced by the new ones, in a Schumpeterian “creative destruction” fashion.¹⁹

¹⁸ The most common assumption is that the arrival of innovations is governed by a Poisson process with intensity proportional to the labor force in the R&D sector. While convenient analytically, the assumption is at odds with some stylized facts. First, the basic assumption underlying the Poisson process (the probability of two arrivals in a short period of time is practically zero) is not so intuitive given the (Schumpeterian) observation that innovations are often lumpy (they come in cycles). Second, the total amount of resources spent may be “adjusted” for by some institutional factor (see e.g. the evidence on Sweden vs. the U.S. presented in Henrekson and Rosenberg 2001).

¹⁹ See for example Segerstrom *et al.* (1990); Aghion and Howitt (1992); Grossman and Helpman (1994); Dinopolous and Segerstrom (1999). We should also mention the pioneering efforts in modeling this kind of Schumpeterian competition by Futia (1980) and Grabowski and Vernon (1987). In many ways they anticipated the flavor of the recent research on the determinants of innovation.

What is not really Schumpeterian, however, is the way innovation takes place. There is no “new man” involved in novel and extraordinary activities, but rather a large scale, routinized, (almost) predictable path of innovation via investments in R&D.

Thus, a quite distinct conception of the innovative entrepreneur emerges. This conception does not find a proper justification in Schumpeter’s theory, but rather in one of his early critics, namely Solo (1951): ‘Innovation is more realistically analyzed as an ordinary business activity than as the extraordinary efforts of new firms and new men; invention and innovation are subject to costs and result in revenues like any other business activity; and both are carried out in competitive struggle by firms which are at once producers and innovators’.

It follows directly that if innovation is based on deliberate inventive efforts on the part of the firm, the resources used in this activity are a form of production factors. And if entrepreneurship becomes a factor of production, it may well be remunerated by the capitalist as other factors. Unsurprisingly then, in these models innovation is carried out by “highly skilled managers”, who receive fixed payments and thus bear no entrepreneurial risk (see e.g. Acemoglu *et al.* 2003).

The models were designed to study issues of growth, trade, technological convergence and there is not really much concern for providing an explicit formalization of entrepreneurship (modeling for example individual occupational choice and entrepreneurial effort). However, we find them relevant in our review since they impose quite strong assumptions on how innovations come about, and thus on the role of entrepreneurs in modern economies.

In particular, this approach challenges the traditional Schumpeterian distinction between inventor and entrepreneur that views R&D activities as mere providers of inventions (and look for the engine of development elsewhere). Indeed, in Schumpeter’s later writings (1942), one of the reasons for the decline of capitalism is its transformation into a “trustified” system, dominated by a small number of large firms, where ‘innovation itself is being reduced to routine. Technological progress is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways’.

Assessing the relative importance of these theories (and thus also testing two different views on the actual “engine of growth”) is ultimately an empirical issue. But, as it has been a recurrent theme in this section, empirical studies are not conclusive. The relationship between innovative capacity and

firm size or age, for example, is ambiguous and strongly relies on the specific definition of innovative activities adopted (as reported e.g. by Acs and Audretsch 1988; Acs and Audretsch 1995; Audretsch and Thurik, 1997).

At an intuitive level one can say that small firms (or individual entrepreneurs) are more likely to introduce path-breaking ideas and “new combinations”, and that large firms will devote their activities (like R&D) to revise, refine and spread the innovation on a larger scale. And instead of struggling within the debate of individual entrepreneurs vs. large firms it seems reasonable to embrace a “complementarity view”, where development requires both research effort to produce innovations and entrepreneurial/managerial skills to implement them, both the independent entrepreneurial innovations and routine R&D processes in large firms (Scherer 1980; Baumol 2002; Michelacci 2003; Acs *et al.* 2004).

4. Summary and assessment of the contributions

In line with the definition of entrepreneurship given in section 2, the previous section has identified three possible justifications for the role of entrepreneurs in the modern neoclassical theory of the firm. In general, they highlight some “special features” that distinguish entrepreneurs from other workers. The major modeling strategies are summarized in *Table 1*.

Table 1 The Major Neoclassical Attempts to Model Entrepreneurship – A Summary

Idea	Main contribution	Pros	Cons
“talent for managing” (<i>coordination role</i>)	Lucas (1978)	1. formalization of a basic idea (J.B. Say) 2. model of occupational choice	1. no precise meaning of talent (not testable) 2. entrepreneurship as factor of production
“tolerance towards risk” (<i>mechanism to allocate risk</i>)	Kihlstrom and Laffont (1979)	1. equilibrium analysis with entrepreneurship 2. formalization of Knight’s idea 3. explanation of how wealth relates with entrepreneurship	1. no distinction between risk and uncertainty 2. not robust to the opening of capital market
“capacity to capture new profit opportunities” (<i>innovation</i>)	Holmes and Schmitz (1990)	1. “disequilibrium” analysis 2. precise idea of entrepreneurial abilities 3. occupational choice	1. exogenous technological progress 2. no uncertainty
“working in the R&D sector” (<i>innovation</i>)	Segerstrom et al. (1990) Aghion and Howitt (1992)	1. endogenous technological progress 2. formalization of “creative destruction”	1. no explicit modeling of entrepreneurs 2. no distinction between entrepreneur and inventor
Contribution	Why entrepreneurs?	Who is the entrepreneur?	
Lucas (1978)	Production requires coordination	Those more talented in managing	
Kihlstrom and Laffont (1979)	Production is risky	The less risk averse	
Holmes and Schmitz (1990)	New profit opportunities always occur	Those talented in capturing opportunities	
Aghion and Howitt (1992)	Growth requires innovation	Firms involved in R&D activities	

In Lucas (1978) the presence of entrepreneurs is explained by assuming that production requires special coordination skills that are embodied in particular individuals. Some people will become entrepreneurs since they are endowed with more “talent for managing”, i.e. they are able to guarantee a higher production for any given level of technology and factor employment. In Kihlstrom and Laffont (1979) production is risky, and the only way to allocate risk among people is through their occupational choice. Entrepreneurs emerge as those with more tolerance towards risk, those willing to provide income insurance to other workers in return for the right to the residual

profits. In Holmes and Schmitz (1990) the world is always in disequilibrium, since technological, demographic and institutional changes continuously create new profit opportunities. Some people, who will be entrepreneurs, have a greater capacity to capture these opportunities, in the sense that they are more likely to start up a “high quality” enterprise. A somewhat different approach is taken in Aghion and Howitt (1992) and in much of the recent growth literature. Here innovation is still the engine of long-run growth, but its source is not the task of “extraordinary individuals”, but rather of firms that devote resources to large scale, routinized R&D activities.

All these contributions highlight and formally analyze *one* particular feature of entrepreneurship. If one wants a theory that captures the essentials of entrepreneurship at the level of the individual entrepreneur, these models are too restrictive, since the entrepreneurial function is far more complex. Rather than providing an exhaustive theory, these contributions should be viewed as pieces of a complex puzzle. In fact, it is not difficult to recognize that being a good coordinator without having an innovative mind, for example, is probably not enough to become a successful entrepreneur. It thus seems pointless to completely dismiss one approach in favor of another; they are both useful but fill different needs.

We have seen how the genuine uncertainty inherent in entrepreneurial activity is always missing. All risks are calculable, i.e. “known to be knowable”, so that the gathering and processing of information can be treated as a regular business cost amenable to optimization. Also, risk bearing does not appear as a fundamental attribute to define entrepreneurship, especially if we consider a more realistic setting with capital markets and agency conflicts.

We have reviewed what we deem to be the most influential papers concerned with innovations, either as a creative product of people with special talents or as a more predictable result of R&D activities. These two different approaches are somehow representative of a deeper debate, which leads directly to the foundation of traditional neoclassical analysis. Either we think of innovation as a perturbation of the system that will soon adapt and reach a new equilibrium. Or, we are willing to develop a more genuine “disequilibrium approach” that recognizes as a central argument of the analysis a world where possibilities of “new combinations” continuously arise and thus people are in fact acting “out of equilibrium”. In our view, a theory of entrepreneurship cannot abstract from this essential issue. If one believes that risk bearing and coordination are not crucial or not sufficient features to define entrepreneurship, then “in equilibrium” a role for entrepreneurs may be hard to find. At the end of the day the “neoclassical” entrepreneur really needs a deep understanding of the

dynamics of disequilibrium to become “really entrepreneurial”. And probably economic theory needs that too.

5. Useful Models and Useful Policies

Can the entrepreneur at all be endogenized in an empirically meaningful way within an equilibrium framework? Or rather, can we model the entrepreneur as we would realistically like to see him or her within that theoretical framework? Rosen (1997), among others, is skeptical. The general equilibrium model is a powerful analytical tool. But analytical tools narrow the range of phenomena that can exist (within the model) and, hence limit understanding to that restricted set of phenomena. And increased realism quickly implies loss of the powerful tools of calculus and game theory, and there may be no well-defined solution to the resource allocation problem. The entrepreneur, even though probably of critical importance for innovation and growth, “lacks operational definition” and is too elusive to ever fit into the neoclassical model.

The complex, serendipitous, open-ended entrepreneur continuously obligated to deal with genuine uncertainty cannot be modeled in neoclassical economics, not even in a probabilistic sense. This presupposes calculable outcomes, while entrepreneurship is a process of discovery where one thing leads to another, and the discovery and exploitation of opportunities in turn create previously unknown opportunities, not even known to be knowable. In this sense, the neoclassical entrepreneur is not entrepreneurial.

But this is not necessarily a devastating blow to neoclassical modeling. While an individual entrepreneur cannot be modeled analytically, at the more aggregated level (the market, the industry) statistical “laws” may apply and expected regularities are likely to exist. A good model may summarize how a large number of economic agents behave, and it can therefore be used to predict the likely change in the system resulting from a change in one of its parameters (a tax rate, a regulatory measure etc.). This could be the case despite the fact that the model is useless in describing an individual entrepreneur.²⁰

One way of understanding this is to start from Baumol (2002), where the capacity of the free-market economy “to produce a stream of applied innovations” and a rapid rate of growth is

²⁰ An analogy can be drawn to molecular physics, where it may be impossible to describe the process by which the individual molecules move, and still one may be able to construct a model that captures very well how the whole system of molecules behaves.

examined. He stresses the combined and highly powerful effect of entrepreneurial innovation and routine/systematic innovation in incumbent firms, in particular the large firms in oligopolized industries. Capitalism is unrivalled when it comes to innovation and economic growth, but this presupposes both individual entrepreneurs and large oligopolistic firms. In most cases major innovations emanate from the ingenuity and serendipity of individual entrepreneurs (Scherer 1980), but routinized step-by-step improvements of the original innovation by large (or rapidly growing) firms is then required to reap the full benefits of the capitalist organization of the economy.

Neoclassical modeling efforts of entrepreneurship capture important characteristics of these latter activities, even if they do not provide a useful description of the behavior of individual entrepreneurs. These models may adequately capture the dynamics of the whole population of entrepreneurial firms conditional upon the institutional framework within which they operate. The number of firms in mature industries is small, the operations of each firm is highly predictable; and despite the creative destruction of entrepreneurs, economic systems do not explode or implode, and no individual firm ever becomes infinitely large. At the same time, there is an enormous amount of churning and disequilibrium at lower levels of aggregation (Davis, Haltiwanger and Schuh 1996; Kirchoff 1994), but in a well-designed economy there exist entrepreneurs that equilibrate rather than disequilibrate. Or if somebody disequilibrates by introducing a new technology there will, given favorable circumstances, be many entrepreneurs ready to exploit the new opportunities arising when the structure of the economy is adjusted to the new technology.

Equilibrium could still be relevant, although not in the traditional sense of a system that is stable or changing in the same way period after period. Economic systems are complex, humanly devised systems continuously evolving and adapting both to changing external circumstances and to internal changes and disruptions brought about in unpredictable ways by entrepreneurs (Colander 2003; Pelikan 2004). The “equilibrium” of a certain economy is in many ways unique in terms of rate of turnover of firms, industry structure, aggregate growth rate, rate of employment, degree of entrepreneurial activity etc. This can be expected to be largely a function of the institutional setup.²¹ Sometimes a great deal of entrepreneurship is needed to overcome the detrimental effects of dysfunctional institutions, sometimes favorable institutions spur a great deal of productive entrepreneurship that exploits opportunities that arise. In other, less propitious, circumstances what

²¹ See Rodrik *et al.* (2004) for a recent and authoritative empirical study highlighting the crucial importance of institutional factors as determinants of economic growth.

is profitable entrepreneurship from an individual perspective is wasteful rent-seeking from a social perspective (Acemoglu *et al.* 2004).²²

Few observers question the importance of entrepreneurial effort for economic development and increased prosperity. But given the alleged importance it is probably still true that net wealth accumulation by entrepreneurs is not that large. Although one can always point to enormously wealthy entrepreneurs *ex post*, most of them fail or operate on a small scale. In fact, as recently estimated by Nordhaus (2004) the bulk of the social surplus from (Schumpeterian) entrepreneurial activity – a stunning 97.8 percent according to his calculations – flows to consumers in the form of cheaper and better products (in the U.S.).

Nordhaus's calculations suggest that the expected average return from entrepreneurship need not be so high to induce individual entrepreneurial effort, but the flip side of this suggestion is that misdirected policies inadvertently encouraging rent-seeking entrepreneurship are likely to be very costly. So, attempts to derive concrete policy recommendations based narrowly on any of the modeling efforts is hazardous, since the new opportunities for entrepreneurship arising from a policy change must be tied to activities that yield economic growth. Any attempt to *create* entrepreneurship, by trying to act directly on individual motives and behaviors, becomes extremely difficult and risky.

Acknowledging the fact that the different modeling efforts can pick up the effects of entrepreneurship at the aggregate level, they may still be very rough guides for policy design. Heeding the risk that the models are taken too literally is particularly important. For example, policymakers may think they have no meaningful role, if entrepreneurship is driven simply by “ability” or “attitudes toward risk”. Or, which is even worse, they may be inclined to adopt policies that promote the wrong actors (e.g. subsidizing R&D activities in large incumbent firms), or they may consider strategies for picking winners.²³ But given that entrepreneurship is a generic trait in human societies, all programs of this kind are changing entrepreneurial incentives on one or several dimensions: making rent seeking relatively more profitable, expanding opportunities for political entrepreneurship, shifting the focus of limited entrepreneurial attention towards satisfying policymakers and bureaucrats rather than customers in the market place, and so forth. In a real

²² Entrepreneurial self-employment may be partly pursued in search for independence, and fraudulent rent seeking may also be entrepreneurial (Baumol 1990). It may also be noted that most self-employment is likely to be non-entrepreneurial (Henrekson 2004).

²³ Perhaps the most common example is support to existing entrepreneurs by artificially lowering the cost of capital for “entrepreneurial” firms, e.g. by providing seed capital or soft loans to firms selected through a bureaucratic procedure.

economy where genuine uncertainty and path dependence play large roles, this is likely to have negative effects that tend to be ignored in standard neoclassical models even when an element of entrepreneurship is highlighted in the model.²⁴

We conclude that an individual real-world entrepreneur, even if highly stylized, cannot at present be modeled in mainstream economics, since he or she *does* elude analytical tractability. In this sense, the neoclassical entrepreneur is (still) not entrepreneurial. This is not to say that efforts to introduce certain analytically tractable facets of entrepreneurship in economic models are in vain. After all, any predictions about effects of policy proposals and institutional reforms changing the incentive structure vis-à-vis productive entrepreneurship presuppose a specific economic model. The introduction of entrepreneurship in a model, while abstracting from the political economy aspects, is likely to be particularly hazardous when the models are used as a guide for policy advice.

²⁴ Bergström (2000) finds that in the long-run firms that received government support performed worse than other comparable firms. See also Secrieru and Vigneault (2004) for a recent example.

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