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RESEARCH ARTICLE

Neo-Schumpeterian growth theory: missing entrepreneurs results in incomplete policy advice

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Abstract The neo-Schumpeterian growth models, which appeared in the early 1990s, have ostensibly reintroduced the entrepreneur into mainstream growth theory. However, we show that by ignoring genuine uncertainty and by assuming that profits follow an objectively true and *ex ante* known probability distribution, the entrepreneur is made redundant. Thus, the theory fails to exhaustively explain innovation, the role of ownership competence, profits, the function of financial markets, wealth and income distribution, and, ultimately, economic growth. These shortcomings risk leading to erroneous or overly narrow policy conclusions by overestimating the importance of supporting R&D investments. Rather, the presence of genuine uncertainty forms a fundamental theoretical basis for the importance of new venture creation as a source of innovation-driven growth; entrepreneurs must establish and expand firms to capture the subjectively perceived profit opportunities. Therefore, tax policy is decisive for the commercialization and dissemination of innovations by providing incentives to uncertainty-bearing, not only for entrepreneurs, but also for intrapreneurs and financiers taking an active part in the governance and development of firms based on innovations characterized by genuine uncertainty. Furthermore, taxation can distort the evolutionary selection of innovations and firms, for instance, by taxing owners and firms differently.

Plain English Summary The neo-Schumpeterian growth models, introduced in the early 1990s, aimed to integrate creative destruction into mainstream economic theories of growth. However, the models fall short because they do not account for genuine uncertainty, instead assuming that profits can be predicted based on known probabilities. This oversight effectively sidelines the entrepreneur's unique role and does not satisfactorily explain economic phenomena critical to economic growth such as innovation, ownership, profits, and the role of financial markets. These limitations could lead to flawed or narrow policy recommendations, especially those that overemphasize the importance of research and development (R&D) investments. To address these issues, economic policies should focus more on enhancing the commercialization and dissemination of innovations. This includes providing incentives not just for entrepreneurs, but also for intrapreneurs and financiers who actively engage in and support the entrepreneurial ventures, bearing uncertainty and contributing to their governance and growth. In this context, tax policy is of major importance as it greatly influences incentives to uncertainty-bearing, not only for

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entrepreneurs, but also for intrapreneurs and financiers taking an active part in the governance and development of firms based on innovations characterized by genuine uncertainty. Furthermore, an inappropriately designed tax code will distort the evolutionary selection of innovations and firms, for example, by taxing owners and firms differently.

Keywords Creative destruction · Economic growth · Entrepreneur · Entrepreneurship policy · Innovation · Judgment · Knightian uncertainty

JEL Classification B40 · O10 · O30

1 Introduction

The entrepreneur has largely been excluded from mainstream economics since the interwar period. It proved too difficult to incorporate the economic function of the entrepreneur when the theory was increasingly based on general equilibrium and formal mathematical analysis (Barreto, 1989; Baumol, 1968; Bianchi & Henrekson, 2005; Hébert & Link, 2007). However, in the most recent development of mainstream growth theory, neo-Schumpeterian growth theory, the concept of "entrepreneur" has been reintroduced. Or so it appears.[1]

The theory is called "neo-Schumpeterian" because it models economic growth as resulting from the economic process described by Schumpeter (1942) as "creative destruction". In this book he predicted that the development and commercialization of innovations would become a routine process with large firms, by virtue of economies of scale in both production and research and development (R&D), taking over the role of the entrepreneur as the main engine of growth. This view stands in stark contrast to Schumpeter's earlier view (Schumpeter, 1934) where incumbent firms are constantly challenged by individual entrepreneurs who introduce new innovations, which leads to the elimination of the least efficient firms, thus making the entrepreneur the *primus motor* of economic growth. The crucial role of new entrepreneurial firms for radical innovation and renewal has been confirmed in more recent research (e.g., Baumol, 2002; Christensen, 1997).

Thus, a description of the role of the entrepreneur in innovation, creative destruction, and economic growth along the lines of Schumpeter's ideas straddles two opposing poles. The conclusions regarding how an economy works and how economic policy should be conducted differ markedly depending on the approach taken. For example, the early Schumpeter is more supportive of a decentralized market economy, while the later Schumpeter is more supportive of central planning and political interventions. Neo-Schumpeterian growth theory is customarily invoked to motivate policy proposals, which implies that how growth is modeled largely determines the policy space. Our first objective of this article is therefore to examine the extent to which neo-Schumpeterian growth theory leans towards Schumpeter (1934) or Schumpeter (1942).

Apart from Schumpeter, Knight (1921) and Kirzner (1973) have the greatest influence on current research in entrepreneurship economics (Hébert & Link, 2007). While Knight argues that the entrepreneur only fulfils a function if innovations are characterized by genuine uncertainty, i.e., the expected value of an innovation *cannot* be calculated *ex ante*, Kirzner argues that entrepreneurs fulfil an equilibrating function by exploiting arbitrage opportunities. Our second objective is therefore to discuss the extent to which neo-Schumpeterian growth theory incorporates insights from Knight and Kirzner.

We show that neo-Schumpeterian growth theory disregards genuine uncertainty. Instead, the expected value of innovations is assumed to be calculable *ex ante*, as the value is assumed to follow an objectively true and known probability distribution. Hence, the entrepreneur has no function; the theory is in line with Schumpeter (1942). This shortcoming of neo-Schumpeterian growth theory is explained by the fact that it is based on models that cannot incorporate genuine uncertainty (e.g., Baumol, 1993).[2]

[1] Becker (1976, p. 5) defines mainstream economics as the "unflinching application of the combined postulates of maximizing behavior, stable preferences, and market equilibrium." Contemporary mainstream economics is less dogmatic and is almost wholly defined by its method: building models that are tested or that can at least be tested in principle (Colander, 2000; Schiffman, 2004). As a result, ideas that cannot be modeled formally tend to be ignored.

[2] This was also pointed out about the same time by the pioneer of mainstream economics growth theory, Robert Solow (1994,

Innovations drive economic growth and create new economic value for the various actors in the economy.[3] However, innovations do not fall like "manna from heaven" but are the result of human creativity and action, with entrepreneurs playing a key role. Without a theory of entrepreneurship and its economic function, it is therefore not possible to fully explain innovation, and hence the importance of ownership competence, profits, financial markets, wealth and income distribution, and, ultimately, economic growth.

Taking genuine uncertainty into account also has implications for economic policy. Most importantly, entrepreneurship displaces R&D investment as the main source of creative destruction. As a consequence, ownership and the scarcity and uneven distribution of owner competence come to the fore. Owners ultimately control the use of resources and bear genuine uncertainty as residual claimants, and their decisions are decisive for the profits, or losses, of the venture.

Furthermore, the presence of genuine uncertainty establishes a theoretical link between entrepreneurship and new entry, which is absent in neo-Schumpeterian growth theory. Entrepreneurs judge *ex ante* that a certain use of resources has a higher expected value than external investors believe. This leaves the entrepreneurs with the option to commercialize innovations in new firms to capture the subjectively perceived economic potential.[4]

When firms expand, entrepreneurs need to delegate decision rights to intrapreneurs (Elert & Stenkula, 2022; Pinchot, 1985).[5] External financiers who take an active part in the governance of firms may also fulfill part of the entrepreneurial function (Gompers & Lerner, 2001). This leads to the conclusion that tax policy rather than R&D investments is critical for creative destruction because it determines the after-tax payoff on different actors' entrepreneurial effort; there will be little effect of R&D investments if taxation provides poor incentives to commercialize and disseminate innovations through the establishment and growth of entrepreneurial firms. It also makes it possible to clarify in what form these actors receive their monetary compensation, and thereby to pinpoint which taxes that affect them. In line with Knight, the remuneration to entrepreneurial activities shows up as residual income because genuine uncertainty makes it impossible to price them *ex ante*. This implies that entrepreneurial activities are affected by corporate income, personal capital income, and wealth taxation. Inheritance and gift taxation matters when economic actors have preference for transferring their firms or wealth to descendants. Other details in the tax code also play a role, notably the relative taxation of debt and new share issues because entrepreneurial firms are more reliant on equity finance, especially in the early phase of their life cycle. It follows that taxation can distort the experimental selection of entrepreneurial ventures in several ways, for instance, by taxing firms, owners and sources of finance differently.

Hence, although neo-Schumpeterian growth theory advances mainstream economics' understanding of economic growth, the analysis is hampered by the absence of genuine uncertainty and entrepreneurship. This risks resulting in inaccurate and imprecise policy advice. An important task for future research is therefore to further investigate the theoretical and

Footnote 2 (continued)
p. 52): "If 'Knightian uncertainty' shows up …, then appropriate analytical techniques are lacking.".

[3] We have decided to use the term "actor" rather than "agent" throughout. Although both terms may be used to describe someone who has an active role in leading a process forward, they have slightly different connotations. Agent may also refer to someone acting on behalf of another person or organization. As we want to emphasize persons' active role in the innovation/entrepreneurial process, we deem that actor is a better choice.

[4] Genuine uncertainty means that neither the entrepreneur nor others can know the return from an investment in the development and commercialization of an innovation *ex ante*. Subjectivity, in turn, means that the entrepreneur makes a different assessment—"guess"—of the return than others. In the case when the entrepreneur has a more positive view than others, the entrepreneur must therefore carry out the investment him-/herself to reap the perceived profits. Over time, uncertainty will turn into certainty when the result from the investment is revealed.

[5] Pinchot (1985), who coined the term, described intrapreneurs as "[t]hose who take hands-on responsibility for creating innovation of any kind, within a business." We use the term "intrapreneur" for an employee carrying out innovative activities. A major difference between "entrepreneur" and "intrapreneur" is that the entrepreneur hires (and fires) the intrapreneur and that intrapreneurs act within boundaries laid down by the entrepreneur. The entrepreneur thus has the ultimate decision-making rights about the development and commercialization of innovations.

policy implications of taking the uncertainty-bearing entrepreneurial function into consideration.

The next section presents the views of Schumpeter, Knight, and Kirzner on the entrepreneur. In the third section, this is contrasted to the role of the entrepreneur in neo-Schumpeterian growth theory. In Sect. 4, we discuss the effects of disregarding genuine uncertainty in neo-Schumpeterian growth theory. This is followed by a section where we examine why neo-Schumpeterians abstract from genuine uncertainty. The sixth section considers policy implications following from a more general analysis that incorporates genuine uncertainty and entrepreneurs. The main conclusions are presented in the final section.

2 Schumpeter, Knight, and Kirzner

Schumpeter (1934) aims to explain long-term economic growth as an *endogenous* process. He notes that growth requires change, i.e., the use of society's scarce resources in new and more efficient ways. He further argues that this is the result of human creativity and action. The concept of "new combinations"—combining the factors of production in a novel way—forms the basis for Schumpeter's definition of concepts and actors according to their economic function. A new combination is referred to as an invention and its commercialization as an innovation, while those who conceive, commercialize, and finance the new combinations are referred to as inventors, entrepreneurs, and financiers, respectively. The entrepreneur is the most important economic actor, as economic growth only results if the new combinations are put to practical use with the purpose of satisfying market demand. Growth also benefits from the rapid diffusion of innovations, and competitors, referred to as "imitators," are seen as central to the diffusion phase in their effort to share the profits by imitating and further developing original innovations.[6] Moreover, innovations do not have to originate from R&D and that the concept encompasses more than products and technologies. Five main types are distinguished: a new product, production method, market, organization, or input.

Although the term "creative destruction" was coined in Schumpeter (1942) to describe the struggle between new and old economic solutions and structures, the book primarily analyzes socialism as an economic and political system. Three predictions are made: (i) innovative activity will become a routine process best carried out by large firms; (ii) entrepreneurs as individuals will therefore become redundant and disappear as a "social class"; and (iii) socialism and the planned economy will work.

Knight (1921) wants to explain entrepreneurial profits—why and how entrepreneurs make money. Like Schumpeter, he assumes that profits arise from the more efficient use of scarce resources. Unlike Schumpeter, he makes a distinction between *risk* and *uncertainty*. Risk refers to events that follow an objectively true and known probability distribution whereas events characterized by uncertainty do not. Risk, but not uncertainty, is thus calculable *ex ante*. However, the terms are often used synonymously in the literature, in the sense of computable risk. The entrepreneurship literature therefore often uses the terms Knightian uncertainty, genuine uncertainty, or radical uncertainty to mark the difference.

A central conclusion of Knight's analysis is that neither entrepreneurship nor supernormal profits can be explained by risk-taking. If the expected outcome of an investment is known when the investment is made, competition and forward-looking expectations should lead to the disappearance of profit opportunities as economic actors adjust their prices and behavior to the known information. Anyone—wage earners, a central planner, or even a computer—could make the investment decisions. The entrepreneur is not needed.

Therefore, according to Knight, entrepreneurial profits[7] can only be explained by entrepreneurs

[6] Spurred by observing the profits of an innovative entrepreneur, "imitative entrepreneurs" (Baumol 2010) challenge the original entrepreneur through imitation and further improvement of the innovation. These imitators may very well end up making the largest profits. Over time, however, replication in a free market tends to erode any rents, shifting the innovation's benefit into a consumer surplus in the form of lower prices and products of higher quality (Nordhaus, 2005).

[7] Alternatively, such profit could be named an entrepreneurial rent as it arises as a result of an entrepreneurial activity that requires a resource whose supply is fixed (unique competence, organizational advantage that cannot be imitated, copyright, locational advantage, etc.), or as a result of an entrepreneurial activity that requires a resource whose supply is fixed or highly constrained for some significant period of time (organizational superiority, patent protection of limited duration, creation of a strong brand name, etc.) (Lewin & Phelan, 2002).

investing in innovations characterized by uncertainty. Since their value cannot be objectively determined *ex ante,* actors' investment decisions must be based on subjective evaluations of business opportunities. An additional criterion for explaining entrepreneurial profits is therefore that entrepreneurs must make more accurate assessments of the value of innovations *ex ante* than other actors.

Another conclusion, according to Knight, is that entrepreneurship and ownership are intertwined. As residual income earners, owners bear the financial uncertainty and thus receive the profit or absorb the loss of an investment. Ultimately, the owners also decide whether to invest in the development and commercialization of an innovation.

That the relevant actors should be capable of calculating an objectively true value of expected profits is perceived as a very strong assumption by contemporary entrepreneurship scholars (Hébert & Link, 2007). At best, it applies to incremental innovations, i.e., marginal innovations with limited economic potential. However, it is not a reasonable assumption for breakthrough innovations. The distinction between risk and uncertainty is therefore fundamental to understanding innovation and entrepreneurship.

While Schumpeter and Knight share the view that the entrepreneur breaks an existing equilibrium, Kirzner (1973) argues that the entrepreneur must be included in general equilibrium theory to explain the existence of equilibrium. Kirzner's entrepreneurs push the economy toward equilibrium because the potential, though never attained, equilibrium is constantly changing. Many factors may explain this constant change, including changes in the composition of the population, in preferences (tastes), and in world market prices for inputs as well as new competitors. The equilibrium also changes when Schumpeterian entrepreneurs introduce innovations. Thus, the two approaches are complementary. The entrepreneur disequilibrates the economy by introducing innovations. The resulting disequilibrium gives rise to new opportunities for other entrepreneurs to exploit, which will once again move the economy closer to a new equilibrium (Baumol, 2010; Holcombe, 2007). Thus, Kirzner's entrepreneur is an alert arbitrageur who brings markets towards equilibrium by exploiting arbitrage opportunities until assets are paid the same across markets.

3 Neo-Schumpeterian growth theory

Neo-Schumpeterian growth theory was established as a research field in the early 1990s pioneered by Segerstrom et al. (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992). It is a continuation of endogenous growth theory, e.g., Romer (1986, 1990) and Lucas (1988), and thus the latest development in mainstream growth theory; see, e.g., Aghion et al. (2015) and Aghion et al. (2021). As with endogenous growth theory, growth is seen as resulting from the discovery and use of new knowledge, in this case in the form of innovations. In endogenous growth models knowledge accumulation, human capital development, spillovers, and increasing returns to scale are the main drivers of growth. In neo-Schumpeterian models, growth is driven by the process of "creative destruction," where old technologies and products are replaced by newer, more efficient ones. This leads to a focus on R&D investments, innovations, and the institutional environment that facilitates the process of creative destruction.

One case in point is the influential work of Mazzucato (2013, 2021). She not only maintains that R&D is the driver of innovation but also fails to recognize the entrepreneur's critical role in commercializing the results of R&D. Her work has become a major inspiration for new large-scale industrial policies, so-called missions, launched as a response to "grand challenges." Rather than finding solutions through a bottom-up process of experimentation, selection, and diffusion, mission-oriented policymaking means that the state not only identifies the problem but also assumes an entrepreneurial role by directly selecting technologies and partnering with private companies.[8]

In order to analyze how the entrepreneur and the entrepreneur's function are described in neo-Schumpeterian growth theory, Henrekson et al. (2024a) identify the scientific literature in the research field in the form of English-language scientific articles. Using data mining and machine learning, the databases

[8] For critical evaluations the reader is referred to McCloskey & Mingardi (2020), Muldoon & Yonai (2023), and the contributions in Wennberg & Sandström (2022), and Henrekson, Sandström & Stenkula (2024b).

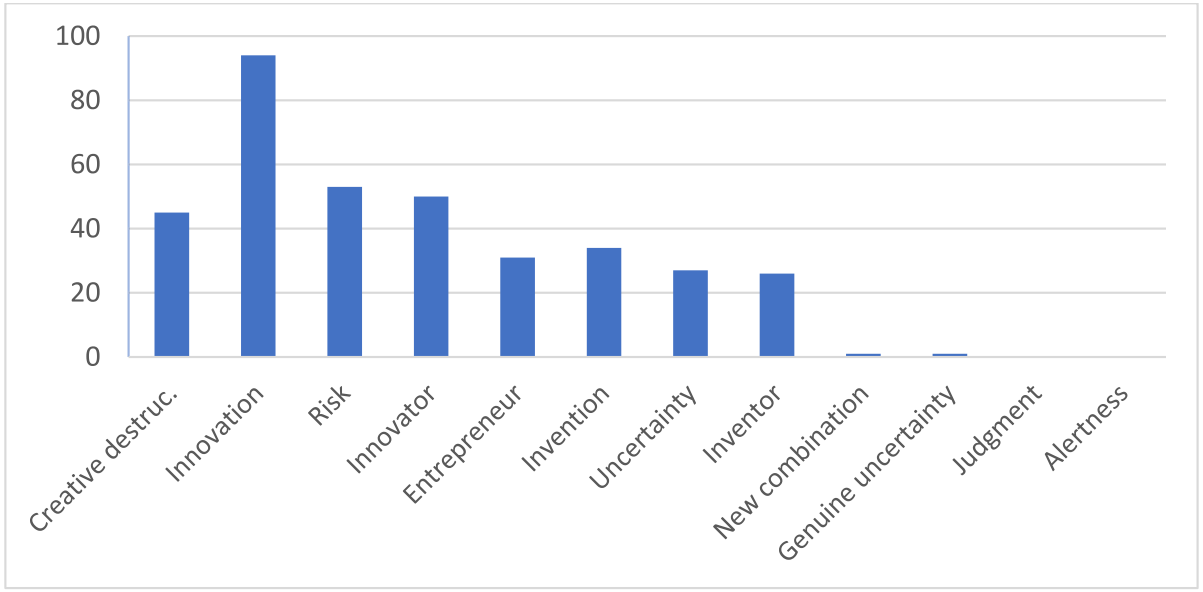

Fig. 1 The share (%) of peer-reviewed articles on neo-Schumpeterian growth theory that include direct citations and terminology related to Schumpeter (1934, 1942), Knight (1921), and Kirzner (1973), 1990–2020. *Source*: Henrekson et al., (2024a, b)

Google Scholar, *Scopus,* and the *Web of Science* were searched. After supplementing with a manual review, 712 articles were classified as neo-Schumpeterian.[9]

A quantitative text analysis is then conducted, where the occurrence of key concepts such as "entrepreneur" is studied. In addition, it is also examined to what extent the identified literature refers to Schumpeter (1934), Schumpeter (1942), Knight (1921) and Kirzner (1973). Finally, a qualitative analysis of the conceptual meaning of the entrepreneurial concept is made.

As Fig. 1 shows, the concept of "new combinations," fundamental to Schumpeter (1934), is hardly mentioned at all (in a mere one percent of the articles). The few times the concept is mentioned, it is not used for analytical purposes but only to position one's own article in relation to Schumpeter's terminology. Therefore, unlike Schumpeter, "new combinations" are not used to define the concepts of "entrepreneur" and "innovation" either, making the concepts theoretically unclear. Consequently, no clear distinction is made between "inventor" and "entrepreneur," or "invention" and "innovation."

"Entrepreneur" appears in about one-third of the articles, although not in the original articles that established neo-Schumpeterian growth theory as a research field, e.g., Segerstrom et al. (1990) and Aghion and Howitt (1992). Grossman and Helpman (1991) include "entrepreneur," but then as a synonym for innovation-based firms. It was not until the early 2000s that the term "entrepreneur" began to appear more frequently although still in just a minority of the papers. Instead, the term "innovator" is often used in a general sense to refer to actors carrying out "innovative activities." "Innovator" appears in about half of the articles.

The examination also shows that there are few references to Schumpeter (1934), who is cited in less than one twentieth of the articles, and Schumpeter (1942), who is cited in slightly more than one tenth of the articles. This reflects that neo-Schumpeterian growth theory has its origins in endogenous growth theory rather than in Schumpeterian theory. Furthermore, it is an indication that neo-Schumpeterian growth theory is closer to Schumpeter (1942) than Schumpeter (1934) in its view of the entrepreneur.

[9] In addition, the two textbooks Aghion and Howitt (2009) and Acemoglu (2009) are included in the analysis. The textbooks are written by perhaps the foremost authorities in the field and are used at top-ranked U.S. universities (Johansson & Malm, 2017).

This notion is reinforced by the large difference in the use of "innovation" compared to "entrepreneur." "Innovation" is the most commonly used term and is used in almost all articles, indicating that the theory tends to focus on innovations per se and not on the actor, or actors, who *actually* implement the innovations. The absence of Schumpeter's (1934) key concept of "new combinations" provides further evidence for this conclusion.

The term "risk" is relatively common and is mentioned in about half of the articles. "Uncertainty" is also used relatively often, in about a quarter of the articles. However, the terms are used as synonyms rather than denoting two different theoretical concepts, and there are virtually no references to "genuine uncertainty" (only mentioned in one percent of the articles). There are even fewer references to the concept of "judgment," which is only mentioned in three articles. Moreover, Knight (1921) is only referenced in two articles, Kirzner (1973) is referenced in one article, and "alertness" is not even mentioned once. Overall, this gives a clear indication that insights from neither Knight (1921) nor Kirzner (1973) are incorporated into neo-Schumpeterian growth theory.

By reading what is written about the entrepreneur in the places where the concept is mentioned, the qualitative analysis shows that the neo-Schumpeterian growth literature rests on two fundamental assumptions. First, the entrepreneur is assumed to be a decision maker in a firm that can either invest in continued production or in R&D. Successful R&D investments lead to innovations that create temporary monopoly profits that exceed the return on investment in continued production. Second, the profits from innovations are assumed to follow an objectively true and known probability distribution, which means that the expected value of the profit is calculable *ex ante*, i.e., at the time of investment. Innovations are thus characterized by risk.[10] The qualitative analysis thus confirms the result in the quantitative analysis that genuine uncertainty is excluded from neo-Schumpeterian growth theory. As previously noted, this implies that the theory may have a bearing on incremental innovations, but hardly on groundbreaking ones.

As profits are assumed in the literature to follow an objectively true and known probability distribution, no special skills are required to make decisions on investments in innovative activities—if the expected risk-adjusted profit is positive, the investment should be made. Like in Schumpeter (1942), this renders the entrepreneurial function redundant. The assumption also undermines the importance of the role of the financier and financial markets in allocating capital by assessing the economic potential of innovations and the ability of entrepreneurs to realize that potential.

This assumption also explains why the neo-Schumpeterian growth literature does not make much of a distinction between the different phases of the innovative process of invention, innovation and diffusion, or the actors and their complementary roles in the different phases, in addition to entrepreneurs, inventors and competitors.[11] This contrasts with the case of breakthrough innovations characterized by uncertainty, where the process and the function and competence of the various actors to perform the functions become central to economic development (cf. Elert & Henrekson, 2021; Foss & Klein, 2012; Henrekson & Johansson, 2009).

4 Effects of disregarding genuine uncertainty: profits, organization, and competence

Following Knight, profits beyond expected risk-adjusted returns, and hence the concept of profits becomes difficult to explain. Forward-looking

[10] See, for instance. Chapter 4 in Aghion and Howitt (2009) for a presentation of the basic neo-Schumpeterian growth model.

[11] Acs et al. (2009) and Braunerhjelm et al. (2010) are partial exceptions. They model entrepreneurs as individuals who have the ability to draw on previous R&D investment and use that knowledge to launch new goods and services. In this way, the entrepreneur becomes an instrument for disseminating knowledge; he or she contributes a mechanism for knowledge to be commercialized. Acs et al., (2009, p. 16) explicitly note that "[w]hile the new growth theory enhances our understanding of the growth process, the essence of the Schumpeterian (1934) entrepreneur is missed. As a result, endogenous growth models fail to incorporate a crucial element in the process of economic growth: Transmission of knowledge spillovers through entrepreneurship.".

expectations combined with competition should cause prices and behavior to change so that profit opportunities are eliminated as soon as information about them becomes available. The exception would be the Kirznerian entrepreneur who makes a profit by responding more quickly to new information. However, this explanation is not highlighted in the literature as Kirzner and alertness are excluded from neo-Schumpeterian theory.

Neo-Schumpeterian growth theory sidesteps this critique through the assumption of temporary monopoly profits resulting from innovations that give the innovating firms a short-term monopoly. But even this assumption is empirically questionable. Most markets are characterized by competition. It also contradicts, for example, the fact that companies that once started as new and small entrants in some of the world's most competitive markets have grown large and remained profitable for decades, such as IKEA (furniture), Toyota (automobiles) and Wal-Mart (retail).

In the spirit of the early Schumpeter and Knight, researchers outside the neo-Schumpeterian tradition explain sustainable profits by the fact that entrepreneurs succeed in recruiting and organizing competent employees in such a way that competitive firms successfully develop and commercialize innovations over time.[12] For instance, in management research, the resource-based view (Barney, 1991; Penrose, 1959) suggests that organizations must develop unique, firm-specific core competencies that will allow them to outperform competitors over time by doing things differently, sometimes called "dynamic capabilities" (Eisenhardt & Martin, 2000; Makadok, 2001). Similar to entrepreneurship traditions in economics, the entrepreneur is identified as a "resource" that coordinates, or organizes, other resources (Alvarez & Busenitz, 2001) and thus is critical for creating a "sustained competitive advantage" (Barney, 1991).

Based on this approach, it becomes reasonable to assume that how people organize themselves—and thus organizational innovation—is crucial to the innovative capacity of both firms and societies. This conclusion differs from neo-Schumpeterian theory, which largely ignores organizational innovations. The assumption of *ex ante* calculable (expected) profits combined with the fact that innovations originate from R&D investments makes it theoretically less interesting to discuss different types of innovation and their relative importance.

This leads us to the view of the relationship between the entrepreneurial and ownership functions, which is unclear in neo-Schumpeterian growth theory. However, the owners ultimately decide how a firm is organized, who are employed, how the firm's resources are used, and whether and to what extent an innovation is implemented. The owners are also the residual claimants receiving the profit or bearing the loss. This suggests that the entrepreneurial and ownership functions are inseparable in the sense that all entrepreneurs are owners, but not all owners are entrepreneurs.

It also provides a theoretical explanation for the empirical observation that some entrepreneurs have managed to make huge fortunes through their entrepreneurship. As *active* owners, they have possessed the ability to recruit and organize teams of competent employees who over time successfully develop and commercialize profitable innovations despite being subject to uncertainty.[13] The persistence of profits is in turn explained by the fact that the active owners' entrepreneurial competence is an exceedingly scarce resource (a large supply of entrepreneurial competence would lead to a lower rate of return on entrepreneurial competence) that is unevenly distributed in the population (explains the large concentration of enormous entrepreneurial wealth to such a few individuals).[14]

This scarcity indicates that critical parts of entrepreneurial competence are tacit (Polanyi, 1967), i.e., non-codifiable, and therefore difficult to transfer to others through teaching (Alvarez & Barney, 2010; Foss et al., 2021; Murtinu et al., 2022; Pelikan, 1993). Ownership competence can therefore be described

[12] See, e.g., Eliasson (1990), who describes a successful firm as a team of competent employees governed by an owner-entrepreneur.

[13] This does not preclude the possibility that serendipity or even sheer luck is involved in some instances of entrepreneurial success, i.e., being in the right place at the right time. However, benefitting from serendipitous luck is only possible for individuals who act entrepreneurially (Busch & Grimes, 2023).

[14] This is not to deny that big tech companies such as Apple, Google and Microsoft, which were originally highly entrepreneurial startups, have been able to create high or possibly impregnable barriers to entry (Cioffi et al., 2022).

as a tacit organizational competence leveraging the productivity of all other factors by skillfully selecting and organizing competent people, thus earning supernormal profits in the capital market (e.g., Eliasson, 1996; Henrekson & Sanandaji, 2016). The assumption of objectively true and *ex ante* calculable profit opportunities implies that neo-Schumpeterian growth theory abstracts from uncertainty-bearing entrepreneurship and ownership competence. Hence, the theory is unable to provide an exhaustive explanation of profits and wealth and income distribution. Nor does it recognize the importance of selection and allocation of entrepreneurial competence across productive, unproductive, and destructive activities (Baumol, 1990).

5 Why does Neo-Schumpeterian growth theory exclude genuine uncertainty?

The above analysis suggests that the absence of genuine uncertainty in neo-Schumpeterian growth theory prevents the theory from truly incorporating the entrepreneurial function as a key driver in the growth process.

So why hasn't genuine uncertainty already been incorporated into neo-Schumpeterian theory? After all, more than 100 years has elapsed since Knight (1921) formulated his theory of entrepreneurship as uncertainty-bearing. The answer, highlighted by, e.g., Hébert and Link (2007), is that neo-Schumpeterian growth theory is based on general equilibrium theory and mathematical modeling. For example, Acemoglu (2009, p. 23) writes in his textbook:

> Our next task is to systematically develop a series of models to understand the mechanics of economic growth. I present a detailed exposition of the *mathematical* structure of a number of dynamic general *equilibrium* models that are useful for thinking about economic growth and related macroeconomic phenomena … *Only* by understanding these mechanics can we develop a useful framework for thinking about the *causes* of economic growth and income disparities. [Emphasis added.]

In their textbook, Aghion and Howitt (2009, p. xvii) also emphasize the need for formal mathematical analysis:

> To learn about economic growth you need *formal* theory, for organizing the facts, clarifying *causal* relationships, and drawing out hidden implications. In growth economics, as in other areas of economics, an argument that is not disciplined by a clear theoretical framework is rarely enlightening. [Emphasis added.]

However, the formal mathematical analysis that neo-Schumpeterian growth theory relies on assumes known probabilities. But since these are unknown in the presence of genuine uncertainty, it is not possible to rely solely on mathematical methods and formal analysis.

Moreover, it seems contradictory to apply equilibrium theory to analyze disequilibrium as the very notion of equilibrium suggests a state of balance or stasis, while innovation-driven economic growth implies change, dynamics, and evolution. As a corollary, it becomes odd to argue that formal theory is needed for clarifying *causal* relationships when fundamental factors such as genuine uncertainty are excluded and without clearly defining central concepts such as "entrepreneur" and "innovation." Lacking clear definitions of key concepts may have the opposite effect and lead to confusion.

In an alternative view, innovations characterized by uncertainty can be seen as business experiments and the only way to determine whether the experiments will succeed is by testing them in the market. The economy can thus be described as an experimentally organized trial-and-error process (Johansson, 2010; Braunerhjelm & Henrekson, 2024, Chapter 2). There are traditions other than mainstream economics using this perspective, such as the Austrian school and evolutionary economics, which operate in the spirit of Schumpeter (1934) and Knight (1921). One salient example is the lean startup model (Ries, 2011), where the core idea is to build a sustainable business by creating a minimum viable product, testing assumptions, and using feedback to continuously iterate and improve.

6 Implications for policy

It is beyond the scope of this paper to map out all policy implications of taking genuine uncertainty and the entrepreneur into account. Instead, we provide

some examples to illustrate our point.[15] In this context, a word of caution is warranted. National institutions are path-dependent and complementary (Dilli et al., 2018; Hall & Soskice, 2001); institutional complementarities give rise to persistence of institutional differences across market economies. Thus, policy reforms aimed at increasing incentives for uncertainty-bearing need to be tailored to the historical preconditions of the region or country in question (Elert et al., 2019; Sanders et al., 2020).

6.1 Entrepreneurs vs. R&D

Most importantly, we identify the entrepreneur rather than R&D investments as the main driving force of innovations and therefore of creative destruction. R&D investments are costs that may result in inventions or costs incurred by entrepreneurial actions to perfect an innovation, making it ready for commercialization and dissemination. As pointed out by Schumpeter (1934), but largely overlooked in neo-Schumpeterian theory, inventions do not automatically turn into innovations. It is not until the entrepreneur commercializes the invention that economic value is created. As already pointed out by Schumpeter (1934), innovation is not restricted to being R&D- or technology-based. Various studies of high-growth firms identify success based on business model innovation and on incremental innovation (e.g., Mason et al., 2015; Satterthwaite & Hamilton, 2017). Policies aimed at supporting R&D investment may therefore have little effect on innovation, creative destruction, and growth if the incentives for entrepreneurship are weak and business conditions are poor.

Including entrepreneurship and genuine uncertainty in the analysis also establishes a causal mechanism pointing to the importance of personal wealth (Fairlie & Krashinsky, 2012; Hurst & Lusardi, 2004) and new firm entry for radical innovations. This is so because there is an inherent conflict in the pricing of potential innovations characterized by genuine uncertainty: Entrepreneurs assess the value of these innovations to be higher than other investors do. Therefore, raising external funding for the development and commercialization of innovations at a cost that entrepreneurs find acceptable becomes difficult.

The only way for entrepreneurs to capture the innovation's assessed potential is thus to commercialize the innovation in a new firm (at least predominantly) owned by themselves, which requires sufficient personal wealth to be used as equity. This is in line with the empirical observation that incumbent firms regularly overlook or dismiss the potential of disruptive innovations and that new technologies are often developed, implemented, commercialized, and diffused in the form of new entrepreneurial firms (Baumol, 2002; Christensen, 1997). Hence, it is more likely that entrepreneurial equity investments in uncertain ventures are made in markets that leave more savings and capital in private (as opposed to institutionalized and governmental) hands. There are no such links in neo-Schumpeterian growth theory, which results in an underestimation of the importance of policy measures encouraging individual saving and wealth accumulation as well as entrepreneurial entry through new firm formation.

It is often beneficial that entrepreneurial firms develop innovations, and incumbent firms commercialize them (Rothwell, 1989). Incumbent firms that develop new products risk competing with themselves, whereas entrepreneurial firms may take advantage of the incumbent firms' desire to protect their market positions by selling their innovations to one of them.[16] This increases an innovation's value, thereby increasing the incentive for new firms to innovate (Norbäck & Persson, 2009). Furthermore, in terms of the commercialization of ideas, incumbent firms are likely to be more efficient than smaller entrepreneurial firms since they

[15] Concerns regarding the implications of excluding uncertainty from neo-Schumpeterian growth theory have previously been voiced by, e.g., Solow (1994), Bianchi and Henrekson (2005), and Hébert and Link (2007). However, policy implications of this exclusion have not been developed to any great extent in the previous literature. A likely reason for this lacuna is that it was not established until very recently that uncertainty is abstracted from in neo-Schumpeterian growth models.

[16] Cunningham et al. (2021) talk about "killer acquisitions," where incumbents purchase a firm with the sole intention of terminating its operations to pre-empt competition. However, killer acquisitions seem to be rare. In pharmaceuticals, where the risk is arguably the highest, the likelihood is estimated to be between 5.3% and 7.4% (Cunningham et al., 2021), and in digital markets, the rate is closer to 1 in 175 (Gautier & Lamesch, 2021).

can draw on already existing firm-specific assets such as marketing knowledge, distribution networks and complementary patents (Barba Navaretti & Venables, 2004).

There is also a connection between entrepreneurship and family businesses, the most common form of business ownership (Fernandez, 2023). Family businesses are of interest because they have been shown to be crucial for employment and growth (Andersson et al., 2018; Miroshnychenko et al., 2021) and because they tend to be governed by philosophies that differ from those usually assumed in economic theory (Goel et al., 2014). Instead of profit maximization, priority is often given to control, long-term survival, and the possibility of transferring ownership to the next generation of family members.[17] Although the vast majority of family firms are small and dislike uncertainty, many of the world's largest and most successful companies are family controlled—and these firms have been shown to be important for innovation.[18] Again, the assumptions regarding the function of the entrepreneur and that profits follow an objectively true and known probability distribution mean that this is neglected in neo-Schumpeterian growth theory (cf. Johansson et al., 2020).

However, it should be noted that most firms—new, small, family or other firms—are not entrepreneurial, they lack innovation drive and growth ambitions (e.g., Henrekson & Sanandaji, 2014; Hurst & Pugsley, 2011). Instead, a small share of high-growth firms contributes a disproportionately large share to employment and growth. These firms are found in all industries and are of different ages, sizes and so on, although they tend to be younger on average than other firms (Coad et al., 2014; Haltiwanger et al., 2013; Henrekson & Johansson, 2010).[19] Entrepreneurs are also quite heterogenous (Baron, 1998; Unger et al., 2011; Walter & Heinrichs, 2015). These empirical observations are in line with a theory including genuine uncertainty and recognizing the scarcity of entrepreneurial competence. Importantly, it also points to a *vulnerability* in the economic system overlooked in neo-Schumpeterian growth theory; if a few entrepreneurial firms drive most of the creative destruction, an economic policy that hinders their growth or enable incumbents to block such growth will have a large negative effect on economic growth and renewal.[20] Uncertainty also makes it impossible to know *ex ante* which firms will be (or are most likely to become) successful. Therefore, successful firms can only be selected through an evolutionary process of creative destruction where profit and the return to entrepreneurs and other actors are decisive for survival and expansion; no "picking-winners" strategy can substitute for a well-functioning selection process. This is likely to be favored by a level institutional playing field for new entrants and entrepreneurs.

6.2 Delegated entrepreneurship and uncertainty-bearing actors

When firms grow large, entrepreneurs must delegate rights to take entrepreneurial decisions to designated employees (Casson, 1982; Knight, 1921), notably to CEOs but possibly also to other key employees, who then become intrapreneurs. This raises the question how their services should be priced? A fixed salary would imply that the value of the innovation is calculable *ex ante* (theoretically a salary is fixed because the future value of the employees' work can be estimated *ex ante*), which is not possible when innovations are characterized by genuine uncertainty.

By taking genuine uncertainty into account, we can give a theoretical explanation to why this pricing problem is solved by contractual arrangements, where intrapreneurs share the eventual profits at the same time as they bear some of the uncertainty. Employee

[17] In fact, it is well established in the entrepreneurship literature that entrepreneurs are often motivated by non-pecuniary incentives such as founding "a private kingdom," independence (being one's own boss) and pure passion (e.g., de Mol et al., 2020; Schumpeter, 1934).

[18] This is also true for several of the globally dominant platform companies such as Meta (formerly Facebook) and Google. Mark Zuckerberg owns less than 13 percent of Meta but controls more than 50 percent of the voting rights. The Google Founders Sergey Brin and Larry Page control 51% of Alphabet's voting shares despite owning less than six percent of the equity.

[19] The definition of high-growth firms is in terms of relative growth, which makes it easier for smaller and younger firms to be categorized as high growth.

[20] This point has previously been made and modelled without reference to uncertainty (Acs & Sanders, 2012).

stock options have been shown to be perhaps the most efficient solution for employees to be incentivized to take entrepreneurial decisions (Bengtsson & Hand, 2013). This is particularly true for new entrepreneurial firms where uncertainty is larger and the need to share ownership with employees who make entrepreneurial decisions is greater. A lesson for policymakers may thus be to institute a regulatory framework that allows this type of contract to further innovation-driven growth. This policy conclusion cannot be inferred from neo-Schumpeterian growth theory since it abstracts from genuine uncertainty.[21]

Specialized external financiers, such as business angels and general partners in venture capital and buyout firms, carry out part of the entrepreneurial function by taking active part in the governance and development of firms.[22] Normally, they have acquired wealth as well as entrepreneurial competence by entrepreneurship and/or intrapreneurship, which is in line with the argument that large part of the entrepreneurial competence is tacit, scarce, unevenly distributed, and developed by exercising entrepreneurship. The purpose of bringing in this type of external investors as active owners is to scale up the business—and thus profits—faster. Besides financial capital used for investments in machinery, marketing, hiring (key) personnel et cetera, they contribute complementary competencies such as management skills, networks and industrial knowledge enabling a faster scaling up. A number of contractual arrangements have been developed to handle uncertainty and risk associated with these investments, for instance, validation, due diligence, intellectual property protection, and milestones to be met before committing more equity (Kaplan & Strömberg, 2003).

Most of the specialized external equity financiers probably invest in risky rather than uncertain ventures. At least partially, uncertainty turns into risk over time when business ideas are tested in the market and investors thus gain increased knowledge about their viability. Nevertheless, specialized external financiers have empirically been shown to be crucial for the development and dissemination of innovations characterized by uncertainty (Lerner & Leamon, 2023). It is difficult, or even impossible, for an "outsider" to judge to what extent individual specialized external financiers invest in uncertain ventures and how successful they will become. Also in this case, it is therefore important that the selection process is efficient; in this respect, profits and economic return to the owners are key. One important reason is that taxation tilts the selection process by withdrawing financial resources from owners who have "proved" to be competent, which hampers firm growth and the dissemination of successful innovations.

6.3 Taxation as a critical policy tool

Neo-Schumpeterian growth theorists acknowledge taxation as a critical policy instrument based on the premise that post-tax rather than pre-tax compensation determines the incentives for economic actors (e.g., Akcigit et al., 2022). An analysis recognizing genuine uncertainty and entrepreneurship can therefore complement and strengthen the neo-Schumpeterian analysis by identifying entrepreneurs, intrapreneurs and specific types of financiers as key actors for innovations, and the taxes that affect them. Society's structure of payoffs, i.e., the after-tax rate of return on different activities, determine whether entrepreneurship is channeled to socially productive, unproductive or destructive activities (Baumol, 1990).

As residual claimants, entrepreneurs and specialized financiers are affected by the total effect of different taxes on capital income: personal capital income taxation (as it pertains to dividends and capital gains), corporate income taxation, and wealth taxation. Inheritance taxation may be important because it matters for the possibility to transfer ownership and control of firms to the next generation, which is a concern for many entrepreneurs (Umans et al., 2021). Intrapreneurs are mainly affected by taxes related to the compensation tied to firm performance, notably the taxation of stock option gains.

[21] Of course, stock options and similar contractual arrangements can be used for other purposes such as risk-bearing and reducing principal-agent problems, or for income shifting and tax avoidance activities converting more highly taxed labor income to capital income taxed at a lower rate.

[22] Although our discussion of the financial motive for starting a business focuses on profitability, it should be noted that for many entrepreneurs—and critically their investors—the financial incentive is linked to the exit event, i.e., selling a successful business to a large incumbent firm that has the requisite resources and competencies to expand the business to the next level (Botelho et al., 2021; Cumming, 2008; Norbäck & Persson, 2009).

In this context, it should be noted that it is difficult—arguably impossible—to separate income from bearing genuine uncertainty from other types of residual income such as risk compensation. This is so because it is generally difficult to distinguish such income from other residual incomes such as risk compensation, especially since residual income from uncertainty-bearing over time gradually becomes residual income emanating from risk-bearing when ventures mature. Therefore, income from entrepreneurial activities must necessarily be taxed jointly with other residual income. This is one likely reason why tax codes never recognize entrepreneurial income as a distinct type of income.

It should also be noted that high effective taxation will discourage key actors from entrepreneurial activities and that entrepreneurial activities seem to be characterized by high tax elasticity (Chetty & Saez, 2005; Harju & Kosonen, 2012; Henrekson et al., 2010). However, low taxation on its own is in general insufficient to drive their activities. Non-pecuniary motives, such as passion and striving for independence, are often needed as well. As a result, the influence of taxation may be weakened by non-financial motives. Nevertheless, even if entrepreneurs are not personally motivated by after-tax returns, high effective taxation means that they will accumulate less or have less funds available for their venture.[23] After all, financial resources in the form of equity are a necessary means for materializing any entrepreneurial vision. This is in line with other theoretical and empirical research which suggests that firm-specific proprietary inputs in the form of founders' capital and founders' labor supply matter most for the success of new venture creation under genuine uncertainty. This stands in contrast to imitable resources that can be acquired in the market; see Estrin et al. (2024) for further analysis and references.

In addition, the tax system may introduce distortions that result in a less efficient process of evolutionary selection, and hence dampened creative destruction. The distortions can affect both the corporate and the owner level. For instance, tax systems typically tend to favor debt finance, and to a lesser extent retained earnings, relative to new equity finance. This hampers new entrepreneurial firms, which rely more on new share issues than mature firms as they have fewer assets that can be used as collateral for loans and limited or no access to retained earnings (Gompers & Lerner, 2001; Henrekson & Sanandaji, 2016). Likewise, taxation often differs across owner types, e.g., owner-entrepreneurs and industrial foundations, with substantial effect on the control of the business sector and on the entry and growth of entrepreneurial firms (e.g., Henrekson et al., 2020). Tax systems also change over time providing radically different incentives for entrepreneurs, with significant effects on entrepreneurship and creative destruction (Elert et al., 2023).

Entrepreneurs, intrapreneurs and specialized financiers provide a bundle of competencies conducive to creating economic value through innovation, business enterprising and creative destruction.[24] A growth-promoting tax system must therefore incentivize (or at least not disincentivize) *all* uncertainty-bearing actors. If the tax code penalizes one important uncertainty-bearing category, that may have highly detrimental effects on growth and renewal. The emergence of the modern VC industry in the United States, which has been critical for the IT-revolution, is a striking example. Arguably, it could not have evolved if the tax system had not been reformed in key respects. Sharp reductions in the capital gains tax and stock option legislation in 1981 allowed tax liabilities to be deferred to the point at which stocks were sold rather than when the options were exercised (Gilson & Schizer, 2003). In addition, new legislation in 1979 allowed pension funds to invest in high-risk securities that were issued by small or new companies and VC funds (Fenn et al., 1995; Misher, 1984).[25]

Finally, taking Schumpeter's concept of new combinations and Knightian uncertainty as a starting

[23] Smaller exits also reduce the scale of entrepreneurial recycling processes that entrepreneurs undertake following their exits (Mason & Harrison, 2006).

[24] The idea that successful commercialization requires a number of actors with different but complementary competencies has been developed in later research, for example, in the theories of collaborative innovation blocs and entrepreneurial ecosystems (Elert & Henrekson, 2021; Johansson, 2010; Wurth et al., 2022).

[25] The importance of venture capital markets is widely recognized. Governments have therefore tried to improve their workings, e.g., by adopting angel tax credits to subsidize early-stage investors by providing personal income tax credits equal to a certain percentage of their investment irrespective of the

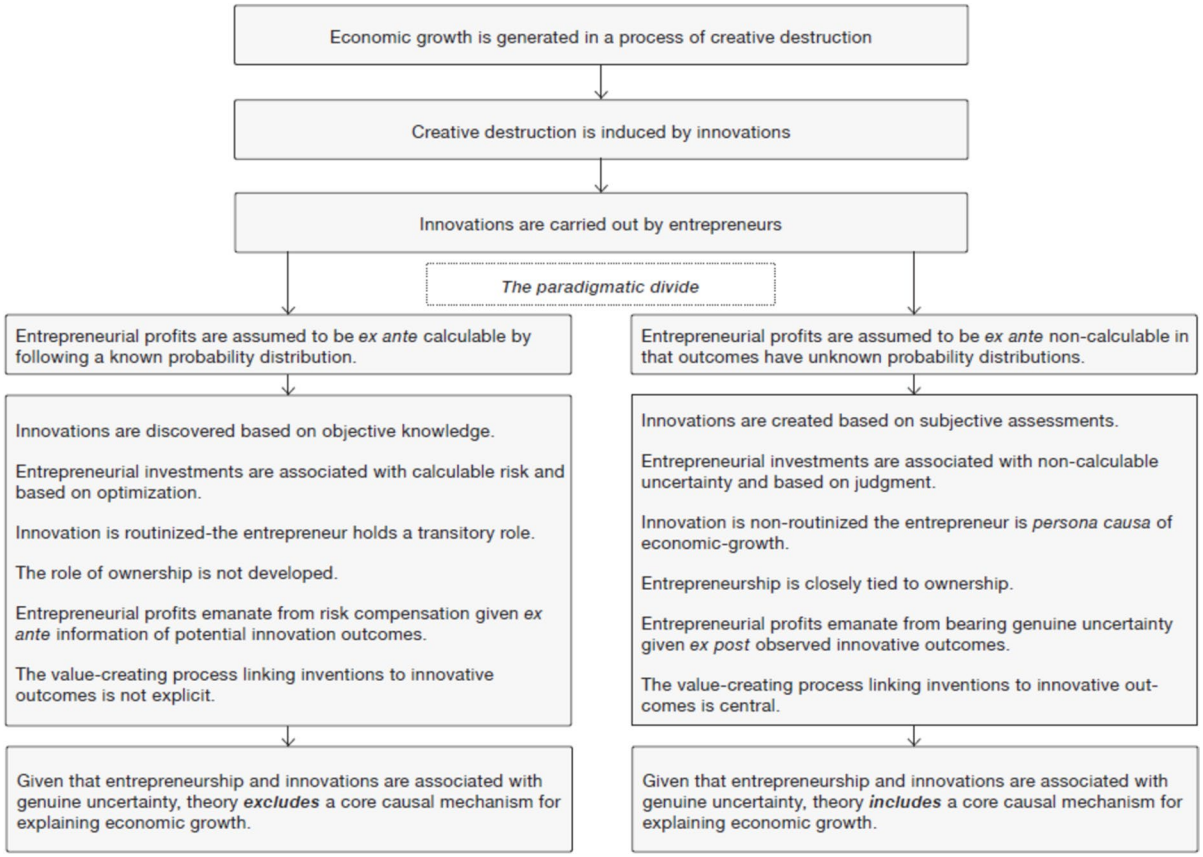

Fig. 2 The neo-Schumpeterian view vs. a view incorporating Knightian uncertainty

point for theoretical and economic analyses creates a bridge to other traditions and disciplines, particularly the resource-based view pioneered by Penrose (1959). Penrose has had a much greater influence on management research despite being an economist inspired by Schumpeter and Knight. It is seldom observed that she uses the term "resources" synonymously to "factors of production" (Penrose, 1959, p. 22). Thus, strands of literature in economics and management have a common theoretical basis, which fertilizes theoretical development and provides new insights about economic processes. By disregarding Schumpeter's concept "new combinations of factors of production" and abstracting from Knightian uncertainty, neo-Schumpeterian theory does not connect to other traditions such as the resource-based view.

In sum, we argue that research in the vein of the early Schumpeter's and Knight's thinking is more fruitful and provides better guidance for policy. It highlights the conditions and opportunities at the micro level, i.e., how individuals and firms facing genuine uncertainty exploit new and existing knowledge for innovation, but also the heterogeneity and variety of these environments. Knowledge and competencies are decentralized across markets and spread over a large number of individuals and firms. This requires appropriate institutions that harmonize the incentives of the different types of actors with complementary competencies. We identify taxation as such a key institution because it determines incentives to expend entrepreneurial effort and affects the selection of entrepreneurial ventures. We can also conclude that the remuneration of entrepreneurial activities will be in the form of residual income since

Footnote 25 (continued)
investment outcome. However, this may introduce new disincentives and distortions (Harrison et al., 2020).

entrepreneurial services cannot be priced *ex ante* in the presence of uncertainty.

The key differences between the neo-Schumpeterian growth models and the view we advocate are summarized in Fig. 2.

7 Concluding remarks

Entrepreneurs are theoretically elusive actors, so elusive that they were excluded from and became invisible in mainstream economic theory. The entrepreneur has ostensibly reappeared in neo-Schumpeterian growth theory, the most recent development in mainstream growth theory. This has made it difficult to disregard the entrepreneur once more from mainstream theorizing. Therefore, mainstream economics will sooner or later have to address long-eschewed fundamental questions. In this article, genuine uncertainty is highlighted as a key issue. If one abstracts from genuine uncertainty, it becomes impossible to fully understand fundamental economic phenomena such as entrepreneurship, innovation, ownership competence, and persistent profits.

Still, the inclusion of the concept of creative destruction into neo-Schumpeterian growth theory increases mainstream economics' understanding of economic growth and the wealth of nations. Neo-Schumpeterian growth theory's greater openness towards and integration of insights from other traditions, such as economic history and institutional economics (e.g., Acemoglu & Robinson, 2012), also contributes to the progress of mainstream economics.

While innovation is closely linked to genuine uncertainty, current neo-Schumpeterian growth models fall short in offering comprehensive guidance for policymakers aiming to boost economic growth. We highlight a few instances where this issue could arise. One possible counterargument to our critique is that neo-Schumpeterian growth models are designed to explain and forecast the macroeconomic evolution of the economy, and, at an aggregate level, it might be justifiable to overlook the inherent uncertainty in innovation-driven entrepreneurship at the micro level. Although the validity of this claim is itself debatable (Frydman et al., 2019), this argument could prove controversial in this context for two key reasons. First, given that economics seeks to explain the *causes* of economic growth, a more thorough causal understanding is essential. Second, economists strive to offer dependable policy recommendations, and the accuracy and relevance of such policy insights hinge on a robust causal grasp of the growth process and its microeconomic underpinnings.

Combining new and existing knowledge into an innovation whose value becomes materialized through commercialization, large-scale production and dissemination is an exceedingly complex process that involves economic actors with complementary competencies who must cooperate towards a common goal. The role of policy is then to institute measures that facilitate such cooperation while giving strong incentives to uncertainty-bearing not only for entrepreneurs but also for intrapreneurs and financiers taking active part in the governance and development of entrepreneurial firms. This also includes measures that prevent incumbents from blocking challengers. The net payoff of the affected actors' entrepreneurial effort and the concomitant uncertainty-bearing is affected by taxation. Moreover, taxation affects the evolutionary selection of ventures with uncertain prospects. Hence, we identify the taxation of income emanating from entrepreneurship and uncertainty-bearing as a critical policy tool. By contrast, policies targeting R&D investment become of secondary importance, especially since many innovations do not originate from R&D.

Since the early 1990s, neo-Schumpeterian growth theory has been developed to such an extent that it is fair to say that it constitutes the cutting-edge explanation of economic growth in mainstream economics. Innovation policy is heavily inspired by endogenous growth theory in general and neo-Schumpeterian growth theory in particular. Therefore, the policy implications of these theories deserve particular attention. These theories stress R&D-based knowledge creation as the key driver of growth while overlooking the key role of uncertainty-bearing entrepreneurship. If the latter, as we claim, is the most important bottleneck in innovation, a policy promoting innovation should lean more towards incentivizing commercialization and dissemination. Our analysis is a step forward in examining how these policy implications are augmented by taking genuine uncertainty and entrepreneurship into account; further research on this issue would be of great potential value for both theory and policy.

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Declarations

Conflicts of interests We hereby certify that we have no conflicts of interest or competing interests.

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