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Wim Naudé

Maastricht Economic and social Research institute on Innovation and Technology (UNU-MERIT)
email: **info@merit.unu.edu** | website: **http://www.merit.unu.edu**

Boschstraat 24, 6211 AX Maastricht, The Netherlands
Tel: (31) (43) 388 44 00

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The Decline in Entrepreneurship in the West: Is Complexity Ossifying the Economy?

Wim Naudé[*]

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Abstract

Entrepreneurship in most advanced economies is in decline. This comes as a surprise: many scholars have expected an upsurge in entrepreneurship. What are the reasons for the decline? In this paper I first document the extent of the decline in terms of entrepreneurial entry rates; the share of young and small firms; and in terms of labor market mobility and in innovativeness. I then critically discuss the explanations that have been offered in the literature: slow population growth, market concentration, zombie-firm congestion, slower diffusion of knowledge, and burdensome business regulations. While having merit, these explanations are largely supply-side oriented and moreover fail to explain why the decline in entrepreneurship is associated with high levels of economic complexity. I argue that we need to consider the potential of negative scale effects and evolutionary pressures from rising complexity, as well as long-run changes in aggregate demand and energy costs. Whether the decline in entrepreneurship and the *ossification* of the economy is undesirable, is a point for debate, calling for more research and more attention to entrepreneurship in growth theories.

JEL classifications: O47, O33, J24, E21, E25
Keywords: Entrepreneurship, start-ups, development, economic complexity, growth theory

[*]UNU-MERIT and Maastricht University, Maastricht, The Netherlands; RWTH Aachen University, Aachen, and IZA Institute of Labor Economics, Bonn, Germany. Email: w.naude@maastrichtuniversity.nl

1 Introduction

Entrepreneurship, in particular what we can call Schumpeterian entrepreneurship[1] is in decline in advanced economies. Entrepreneurship is strongly associated with "business dynamics", which refers to the entry, expansion, decline and exiting of firms (Decker et al., 2014a). On all accounts, entrepreneurship is less dynamic than before. Entry and exit rates are in decline, growth rates of incumbent firms are slowing down, job creation and destruction rates are falling, and innovative activities are in decline too.

This decline in entrepreneurship constitutes a puzzle because scholars have been predicting a rise in entrepreneurship, not a decline (EIG, 2017). For example Stangler and Spulber (2013) predicted a rise in entrepreneurship in the USA based on the increase in the USA population in the peak age group for entrepreneurship (30 to 40 years), continued immigration, and growing business opportunities in the health and education sectors. More fundamentally, Thurik et al. (2013) have argued that recent years have seen a structural shift in advanced economies away from the "managed" towards the"entrepreneurial economy", described as "dynamic capitalism" (p. 302). They describe this emerging entrepreneurial economy as being characterized by the downsizing of large firms, the entry of many new small firms, employment shifts from larger to smaller firms, a rise in R&D amongst new and small firms, a shift in employment away from low to high skilled labor.

As will be shown in this paper, the decline in entrepreneurship that have been well documented in recent years is in sharp contrast with **all** of these expectations. Entry has declined, employment has shifted from small to larger firms, employment has been document in some instances shifting from high to lower skilled labor, concentration and market power is rising, and R&D is declining. If anything, advanced economies are experiencing a very *un-dynamic* form of capitalism, a move from the "entrepreneurial" to the "ossified" economy, to borrow an adjective from Cowan (2017).

The decline in entrepreneurship has taken place over the same period of time as a secular decline in labor productivity growth in advanced economies, from around the 1970s (Syverson, 2016). It has also occurred fairly simultaneously with significant increases in income inequality (Atkinson et al., 2011). Hence it is no surprise that declining entrepreneurship has been implicated in both. It is seen as a cause of the productivity slowdown, because the entry and exit of businesses are an important mechanism to improve allocative efficiency in the economy[2] (Bartelsman et al., 2013; Bijnens and Konings, 2018; Decker et al., 2017; OECD, 2017). It is associated with rising inequality, due to the decline in competitiveness that has boosted the bargaining power and concentration of large incumbent firms and driven inter-firm wage inequality (Konczal and Steinbaum, 2016; Mueller et al., 2015; Furman and Orszag, 2015; Song et al., 2015).

The productivity slowdown and the rise in income inequality are problematic for sustaining growth, moreover socially sustainable growth. This is because as productivity declines, so does

[1] See Henrekson and Sanandaji (2014) who discuss Schumpeterian entrepreneurship as innovative entrepreneurship that drives growth, and moreover who points out that the "overwhelming majority of self-employed persons are not entrepreneurial in this sense". Thus in this paper, entrepreneurship will not refer to self-employment, but rather to new business creation, high-growth enterprises, and innovative business activities.

[2] Decker et al. (2017) presents evidence that the decline in productivity growth is due to reduced allocative efficiency between firms, amongst others because fewer inefficient firms exit the market, as well as declining entrepreneurial entry.

the potential growth in GDP per capita[3]. For instance, in the OECD potential growth in GDP per capita has declined from 2,1 percent in 1998 to 1,0 percent in 2015 (McGowan et al., 2017, p.9). And as income inequality rises, trust and social and political stability is threatened. In most advanced economies, all indicators of the latter have deteriorated over the past three decades. Public trust[4] in government in the USA have for instance fallen from 73 percent in 1950 to 19 percent in 2015, the lowest ever. Concern about the decline in entrepreneurship is therefore justified, making an understanding of why entrepreneurship is declining and what can be done about it, important. Unfortunately, there is no full and entirely satisfactory explanations at present. It remains as Decker et al. (2014b, p.19) put it "We do not yet fully understand the causes of the decline in indicators of business dynamism and entrepreneurship, nor in turn, their consequences".

The contribution of this paper is to argue that there are complexity brakes on entrepreneurship that may constitute an ultimate cause for declining business dynamism. Most of the current literature dealing with explaining the decline in business dynamism tend to be concerned with a myriad of proximate causes, such as regulations, lack of scarce inputs, and increasing concentration, which also tend to be largely supply-side causes. None has yet, to the best of my knowledge, pointed to the potential role of negative scale effects associated with rising complexity and entropy[5] . I concur with Konczal and Steinbaum (2016) that if the causes of declining entrepreneurship were only supply-driven, then one would see incomes and earnings of workers and entrepreneurs that are in business to be rising, but it is however generally not. Moreover, what all countries where business dynamism is declining in fact have in common, are high levels of GDP per capita and economic complexity (Goldschlag and Tabarrok, 2018). The proximate causes of the decline in business dynamism in these countries that are discussed in the literature, are also prevalent in less developed countries - perhaps even more so; nevertheless they do not (yet) show evidence of declining business dynamics.

Intuitively, greater GDP per capita should be associated with the "entrepreneurial economy" expected by e.g. Thurik et al. (2013); Audretsch and Thurik (2000). That fact that it does not suggests that as the economy increases in scale and complexity[6] that negative scale effects and spillovers may start to hamper entrepreneurial entry and growth of smaller, younger firms it becomes for instance more difficult to innovate[7] as the stock of knowledge and the degree of firm-specific, specialized knowledge becomes sufficiently large (Bloom et al., 2018; Jones, 2009; Peretto and Smulders, 2002). The comparison in the quote from West (2017) at the top of this section between a mouse and an elephant is an apt metaphor: smaller and less complex economies are like a mouse, much more agile and dynamic in terms of entrepreneurship and innovation; larger economies may be more efficient and productive, enjoying scale benefits[8] but are slower and less dynamic.

[3] Gourio et al. (2014) estimates that a 1 percent decline in the entrepreneurship entry rate in the USA between 2006 and 2010 to be associated with a 0,5 percent to 1,2 percent reduction in GDP growth.

[4] See `https://www.people-press.org/2015/11/23/1-trust-in-government-1958-2015/`

[5] Entropy refers to "the degree of disorder or lack of predictability of a system" (Sequeira et al., 2018, p.102).

[6] Hidalgo and Hausmann (2009) derive an economic complexity index using data on products being exported the complexity of a country's export basket. They recognise that most measures of economic complexity are correlated with GDP and that population growth allows more specialization with leads to greater complexity.

[7] It is likely also the case that the diffusion from what has been called the super-radical innovations in the form of general-purpose technologies (GPTs) like the internal combustion engine (ICE) and electricity in the 19th century has reached the end of their diffusion and efficiency impacts, and that with no comparable innovations to impact on the economy and with rising energy prices, that opportunities for growth and entrepreneurship will inevitably decline (Foster, 2011; Court, 2018).

[8] Elephants use energy so much more efficient than mice that it implies a 25 percent increase in energy efficiency with each doubling in size in the animal world (West, 2017, p.27).

The rest of this paper is structured as follows. In section 2 I document the decline in entrepreneurship, and in section 3 review the explanations offered in the literature. In section 4 I discuss energy prices and aggregate demand as fundamental causes that have so far bee neglected. Section 5 concludes.

2 The Decline in Entrepreneurship

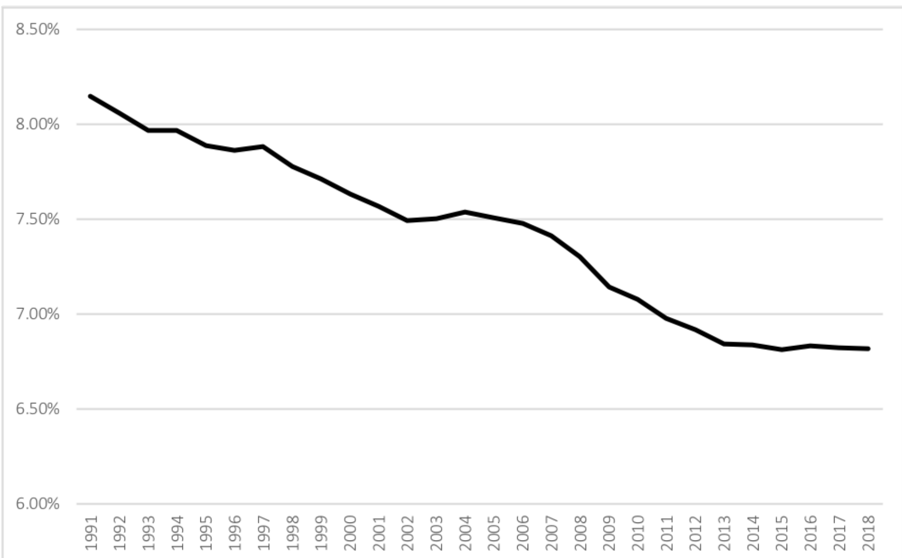
The decline in entrepreneurship is reflected in declines in entrepreneurial entry and exit rates, declines in the shares of young and small firms, and in decreased labor market mobility and innovativeness. These are elaborated in the following sub-sections.

2.1 Declining entrepreneurial entry and exit rates

In terms of entry, if we measure the rate of entrepreneurship rate as the ratio of new firms (being less than one year old) to total firms, then entrepreneurship in the USA has declined by around 50 percent between 1978 and 2011 (Hopenhayn et al., 2018; Hathaway and Litan, 2014). If we measure entrepreneurship as the share of entrepreneurs in the working population, then in the USA the share has declined from 7,8 percent in 1985 to 3,9 percent in 2014 (Salgado, 2018).

While these declines are most noted the USA, it is similar in many other high-income countries. Bijnens and Konings (2018) use a dataset on businesses in Belgium covering the period 1985 to 2014 to find that "start-up rates rapidly decline from the 1990s". They present data that shows that the growth rate of business formation the country declined between 1986 and 2014 from 12 to -1 percent. Ugur et al. (2016) finds that in the UK firm entry rates declined between 1998 and 2012 from 6,5 percent to 0,8 percent. Calvino et al. (2015) presents evidence of declining entrepreneurship for all OECD countries. More broadly, according to ILO data (see Figure 1), the population share of entrepreneurship in all high-income countries declined from an average of 8,15 percent in 1991 to 6,8 percent in 2018.

Figure 1: Entrepreneurship rate (own account workers plus employers in self-employment as proportion of working population) in High-Income countries, 1991-2018



Data source: ILO Stats Online.

We should also note it is not only firm entry rates that have declined: there is also evidence that firm exit rates have declined. For instance the aggregate exit rate in the USA declined from 9,5 percent to 7,5 percent between 1980 and 2015 (Hopenhayn et al., 2018). In Canada, the firm exit rate declined between 1983 and 2011 from 16,5 percent to 11,6 percent (Mcdonald, 2014).

2.2 Declining share of young and small firms

Audretsch and Thurik (2000) and Thurik et al. (2013) expected that the entrepreneurial economy would see a rise in the share of young and small firms in the economy. In contrast, the decline in entrepreneurship and the move towards the "Ossified Economy" is characterised by a decline in both the share of young and small firms in advanced economies, in particular the USA. For instance, in the USA the share of young firms (those less than 5 years old) declined from 47 percent in the late 1980s to 39 percent in 2006. Moreover, the share of young firms in providing employment has declined by 30 percent since the 1980s (Decker et al., 2014a). Smaller firms account now for a lower share of employment (the share of employment with firms with more than 250 employees rose from 51 percent to 57 percent) and the average firm size has increased from 20 to 24 (Decker et al., 2014a).

Evidence from outside the US is more scarce and more mixed, but the picture that is emerging tends to suggest that the dynamics of young and small firms may be decreasing. E.g. in the case of Belgium, (Bijnens and Konings, 2018) finds that after 2000, the number of small businesses that experienced high-growth[9] (measured in terms of employment) started to decline.

2.3 Declining labor market mobility

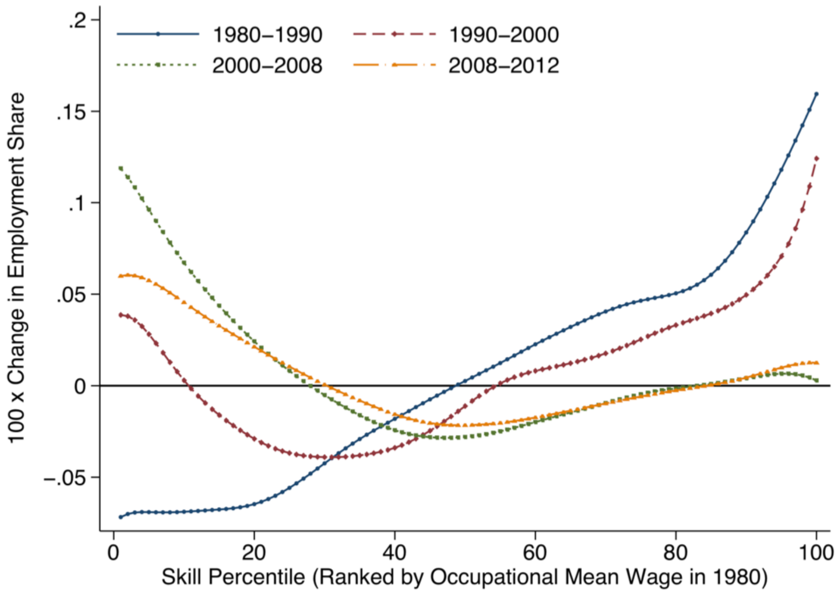
Labor market mobility refer to job-to-job mobility, within job mobility (the "job ladder") and geographical mobility of labor. It is an indirect measure of entrepreneurship in the sense that entrepreneurial entry, exit and growth dynamics (churning) would be reflected in greater churning in labor markets. Schumpeterian disruption would destroy and create jobs, and as Thurik et al. (2013) expected, in the "entrepreneurial economy" more and more highly skilled individuals would make an occupational choice to become an entrepreneur.

The evidence however shows that on all accounts, labor mobility is declining. Konczal and Steinbaum (2016, p.14) show that labor market mobility in the USA, measured as (Quits+Hires from non-employment/Total employment), declined from almost 14 percent in 2000 to around 10,5 percent by 2011 and that geographic mobility, measured as the percentage of laborers that migrated between USA states during a year, declined from almost 3,5 percent in 1990 to around 1,5 percent in 2011.

Evidence of declines in job-to-job mobility and in the job ladder, are presented by respectively Hyatt and Spletzer (2013) and Cairo et al. (2015). The latter show (see Figure 2) that after 2000 job creation in the USA shifted from creation of high-paying jobs to low-wage (low-skilled) jobs.

[9] High-growth firms are defined as "firms which grows in terms of employment by more than 25 percent per year" (Decker et al., 2014a, p.8).

Figure 2: Shifting of Job Creation from High to Low Skill Jobs in the US



Data source: Cairo et al. (2015, p.8).

The shift towards low-skilled jobs reflected in Figure 2 is paralleled in entrepreneurial occupational choices with the share of entrepreneurs with higher education declining from 12,2 percent in 1985 to 5,3 percent in 2014 (Salgado, 2018). As Kozeniauskas (2018, p.2) concludes, "the decline in entrepreneurship is concentrated amongst the smart".

2.4 Declining innovativeness

According to Thurik et al. (2013, p.303) "the entrepreneurial economy is defined as an economy where economic performance is related to distributed innovation and the emergence and growth of innovative ventures". Innovativeness and innovative ventures are however in decline in the "Ossified Economy". Evidence of a decline in innovativeness is reflected in wide variety of measures.

For instance, the ratio of patents to GDP in the USA is declining (Ha and Howitt, 2007). The cost of patenting has been increasing constantly (Griliches, 1990). "The United States today only generates two non-health and non-IT patents for every $ billions of GDP; in the 1980s the figure was over four" (EIG, 2017, p.27).

Furthermore, Bloom et al. (2018, p.3) find using Compustat data that "research productivity for the aggregate U.S. economy has declined by a factor of 41 since the 1930s, an average decrease of more than 5 per cent per year". Jones (2009) reports that the rise in the age of inventors when they registered their first patent, as well as the average size of research teams, have increased significantly. This reflects that innovation is getting more difficult and that ideas are indeed "getting more difficult to find" (Bloom et al., 2018).

3 Literature Review: Why?

What explains the (surprising) decline in entrepreneurship documented in the previous section?

According to the "Knowledge Spillover Theory of Entrepreneurship" (Ács et al., 2009) entrepreneurship entry rates will depend on (i) the stock of knowledge, (ii) the efficiency with which incumbents exploit knowledge, and (iii) regulatory measures. In the remainder of this section, I will use these lenses to explore the explanations offered in the literature [10].

3.1 The stock of knowledge

The stock of knowledge is for purposes of understanding the rate of entrepreneurial entry the result of demographic shifts and the interaction of such demographic shifts with technology. Population growth drives innovation, entrepreneurship and growth. Strulik et al. (2013, p.415) recognise that "a larger population meant a larger number of tinkerers producing more ideas", and Kremer (1993a) provides a growth model wherein more people generate more ideas, and ideas diffuse faster.

Population growth itself is the result of higher fertility and declining mortality. Higher fertility raises the number of ideas and knowledge in circulation, and a decline in mortality raises the incentives to invest in human capital (Bucci, 2015; Boucekkine et al., 2003). Together, a larger and better skilled population promotes specialization in production and raises the return to innovation (Peretto and Smulders, 2002). This drives technological innovation and trade. As Galor and Weil (2000, p.807) concludes "changes in the size of population can be taken as a direct measure of technological improvement". Technology in turn result in positive feedback effects, as it magnifies the returns on investment in human capital (Galor and Weil, 2000). These feedback effects have been the engine of the remarkable take-off in economic growth and entrepreneurship in the West since the early 19th century.

Hence, the slowing down of population growth in the West has been identified as a potential cause of the decline in entrepreneurship (Hopenhayn et al., 2018; Karahan et al., 2018; Kopecky, 2017). This is especially pertinent given that the decline in entrepreneurship have set in in advanced economies concomitant with the decline in population growth and ageing in these economies. In most advanced economies, fertility rates started to drop below replacement rates[11] in the 1970's[12]. Hopenhayn et al. (2018) finds that the major reason for the decline in the USA population growth rate was due to changes in birth rates. Karahan et al. (2018) calculated that the 1 percent decline in the growth of the US labor force between 180 and 2000 explains 66 percent of the decline in the start-up rate from 13 percent to 10 percent over this period.

It is not only a slower growing population that can reduce entrepreneurship rates. The ageing of the population in advanced countries can also lead to a reduction in business dynamism, as the "pool of potential entrepreneurs" age (Kopecky, 2017). Liang et al. (2018) using GEM

[10] For a review of the "Knowledge Spillover Theory of Entrepreneurship", see Ghio et al. (2015) and for a critical discussion see Tsvetkova and Partridge (2019).

[11] What this means for example is that with a fertility rate of 1,6 on average, as in Europe at present, each generation will be 20 percent smaller than the previous generation (Liang et al., 2018, p.S141).

[12] Strulik et al. (2013) finds from historical data on population and total factor productivity growth (TFP) in the case of the G-7 countries that TFP growth started to decline during the 1970's, which was also the period when fertility rates in these countries, for the first time in history, fell below replacement levels.

data found that countries with an older population also have fewer entrepreneurs, and moreover fewer entrepreneurs at every age group. Also, they find that middle-aged individuals in ageing countries become less inclined to become entrepreneurs. They ascribe their findings to the likelihood that in an older society economic growth prospects and returns to entrepreneurship may be lower. Pugsley and Sahin (2015) find some evidence as this may be the case, as countries with fewer young entrepreneurs are less resilient in the face of recessions and tend to grow slower after such growth shocks. Whether however population ageing is implicated in the decline of entrepreneurship in the USA is doubted, because the country's population has not aged as for instance in Europe. The prime age group from which entrepreneurs emerge tend to be between 35 and 54 years, and this age group has not declined in the USA (Karahan et al., 2018).

If population growth is associated with more ideas and hence innovation and innovative entrepreneurship, then one could surmise that ideas may have become harder to find and hence that the growth in innovativeness may have declined. This is indeed what is found in the data, as section 2.4 indicated. Innovation does seem to be getting harder.

The literature do not appreciate that the decline in population growth may also have effects on entrepreneurship via the demand side. For instance, when facing a potentially decline growth in aggregate consumer demand as a result of a slower growing (and ageing) population, incumbent firms, facing declining demand and aiming to protect and profit as much as possible from their existing market are likely to attempt to stifle competition through new entry, and as such engage in merger and acquisition activity as well as R&D and patenting to keep competitors out, in what has been termed as "defensive innovation" (Dinopoulos and Syropoulos, 2007). Merger and acquisition activity has been on the increase, for instance one manifestation is that innovative young small firms tend increasingly to be bought by large incumbent firms. As (EIG, 2017, p.36) note, "the annual number of initial public offerings fell by three-quarters from the late 1990s to 2015. Instead of going public, promising young companies are more likely than ever to opt for acquisition instead". This leads to less competition, higher mark-ups for existing firms, entrench vested interested, and reduces entrepreneurial entry.

3.2 The exploitation of the stock of knowledge

Entrepreneurial entry rates are driven not only on the level of the stock of knowledge (the potential ideas or business plans out there) but also on whether and how these ideas are being exploited (Ács et al., 2009). In the literature on the decline in business dynamism a weaker exploitation of the stock of knowledge is ascribed to three reasons: (i) growing market concentration; (ii) zombie-firm congestion and (iii) slower diffusion of knowledge.

3.2.1 Growing market concentration

Grullon et al. (2017) calculate, using a Herfindahl-Hirschmann index that concentration in the USA has increased in over 75 percent of industries and that the average increase in concentration levels has been around 90 percent. They also find that this concentration has led to higher profits. These higher profits, however, are not due to concentration leading to more effective firms (as in the superstar firms of Autor et al. (2017)) but rather due to higher market power of incumbents allowing then to raise mark-ups.

Chatterjee and Eyigungor (2018) presents a growth model wherein a decline in the interest rates (as we have seen over the past decade) benefits larger, more monopolistic incumbent firms more, because they can leverage larger amounts of finance. Larger firms tend to have a greater variety of products, which means that their likely future profits streams are safer than that of a smaller firm with a smaller variety of products, given that individual varieties may go out of the market. The larger firms can therefore borrow more against these larger future streams of revenue. They can use this funding to invest in new ideas that arise within the firm, and moreover with a decline in interest rates, would be more likely to do so. Thus, "more ideas get implemented in existing firms" (p. 3) rather than in new start-ups. Thus, the entry rate will decline, concentration will increase, and productivity growth can decline as a result of potential mis-allocation of capital and output losses to the extent that the success of a new idea being commercialized may be more probable in a new start-up than in an incumbent firm (Chatterjee and Eyigungor, 2018, p.3). Exploiting more knowledge within existing firms due to growing market power of incumbents is thus one cause and manifestation of the decline in entrepreneurship.

3.2.2 Zombie-firm congestion

"Zombie firms" are old firms (10 years old) that have "persistent problems meeting their interest payments" (McGowan et al., 2017, p.3). These are unproductive firms on the margins of exit, but who nevertheless remain in business. In the OECD between 2 percent and 10 percent of firms are classified as zombies. They tend to be old (> 40 years) and large firms (> 250 employees) and take a significant share of investment in capital stock up to 19 percent in Italy and 14 percent in Belgium (McGowan et al., 2017).

A growing number of firms in the OECD are relatively unproductive zombie firms. In the UK alone it has been estimated that there is at least 100,000 zombie firms (Cooke, 2019). As McGowan et al. (2017, p.9) conclude, this means that "it has become relatively easier for weak firms that do not adopt the latest technologies to remain in the market". They reduce entrepreneurial entry rates, and growth rates of new entrants, because they are "congesting" markets. This congestion takes the form of zombie firms paying wages that exceeds productivity and offering depressed market prices (McGowan et al., 2017).

Entrepreneurial entry rates will as consequence fall because the combination of high wages (exceeding productivity) and depressed market prices raises the productivity hurdle that potential new entrants have to cross on entry in order tom compete against zombie firms. We see evidence for this in the growing "gap" in productivity between zombie and non-zombie firms McGowan et al. (2017). Hence, the growth in zombie firms are implicated in both the productivity slowdown and the decline in entrepreneurship ((McGowan et al., 2017).

3.2.3 Slower diffusion of knowledge

Slower knowledge diffusion has been identified as a very likely contributor to the decline in entrepreneurship and more generally in declining business dynamism. This is consistent with the "Knowledge Spillover Theory of Entrepreneurship" of Ács et al. (2009) in that slower diffusion of new knowledge amongst incumbent firms would reduce their own knowledge accumulation and hence reduce spillovers of un-utilized opportunities by new firms. Moreover, slower knowledge diffusion could lead incumbents to better exploit their existing knowledge, again reducing new start-ups through knowledge spillovers.

Akcigit and Ates (2019b), using a general equilibrium to identify "one single mechanism" behind declining business dynamism and the productivity slowdown in the USA, finds that the single most important factor to be an increase in concentration and market power of incumbent firms. Leading incumbent firms use mechanisms, such as patenting and IP laws, to build up a large and unassailable technological lead over potential rivals. In essence, they stifle the diffusion of knowledge. This discourages new firms from entering, and existing, laggard firms from investing in innovation. "When knowledge diffusion slows down, market leaders are shielded from being copied, which helps establish stronger market power" (Akcigit and Ates, 2019b, p.3). As a result, not only do entrepreneurial entry decline, but mark-up rise, profits increase, and growth slows down. The slower knowledge diffusion is perhaps most apparent in the widening dispersion of productivity growth between leading and laggard firms, also known as "best vs the rest" dynamics (Andrews et al., 2016).

According to Akcigit and Ates (2019a) the slowing down of knowledge diffusion is the single most important determinant of the increase in market power of incumbent firms over the past three decades. Why does knowledge diffusion slow down? Akcigit and Ates (2019a) identify three reasons: changing technology, such as digital technologies that have data-network effects which places a premium on big data and hence benefits firms with large data (see also Calligaris et al. (2018)); weak antitrust regulations and weak enforcement of competition legislation; and the "use and abuse" of patents for defensive innovation. In the latter regard, Akcigit and Ates (2019a) document an increase in the concentration of patenting, finding that the share of patents registered by the top 1 percent of firms in terms of their patent stock holdings, have increase their share of patents from 35 percent in 1980 to around 50 percent in 2015. They also find that the share of patenting by firms that register a patent for the first time has declined by more than 50 percent in 25 years. Moreover, using the length of text of patent claims and patent citations they conclude that since 2000 patents have been "getting narrower in scope and also less original" (p. 47) and that patenting is increasingly being used by incumbents to construct "thickets" around their IP.

3.3 Burdensome regulations

Many scholars argue that an increase in business regulations and a more complex tax code have been creating barriers to entry for entrepreneurs. The possibility that regulations can depress the incentives to enter are a clear result from theoretical models - see e.g. Hopenhayn and Rogerson (1993). The extent of such regulations in advanced economies have indeed become extensive and perhaps even excessive (a certain level of regulations is however important and good for entrepreneurs and consumers). For example, according to Davis (2015, p.0) "The U.S. regulatory system has grown increasingly expansive, intrusive and complex in recent decades, its tax system has become ridiculously complicated, and its economic policies have become less predictable". It is worthwhile to quote Davis (2015, p.3,1) more extensively on the Byzantine complexity that characterizes the USA's business regulations:

"As of 2011, it takes 70,000 pages of instructions to explain the federal tax [it] has about four million words and 67,000 sections, subsections and cross-references. It's all crystal clear if you read the instructions carefully. However, you will need to reread every year to stay current. There were about 4,400 changes to the tax code from 2000 to 2010, 579 changes in 2010 alone [...] the Code of Federal Regulations (CFR) [...] grew nearly eight-fold over the past 55 years, reflecting tremendous growth in the scale and complexity of federal regulations. At 175,000

pages, the CFR contains as many words as 130 copies of the King James Bible".

A number of specific regulatory changes that have been examined in the context of declining entrepreneurship include occupational licensing (Kleiner, 2015; Davis et al., 2014), tighter zoning restrictions (Hsieh and Moretti, 2019), weakening of anti-trust legislation and its enforcement (de Loecker and Eeckhout, 2017) and stronger employment protection (Liebregts and Stam, 2019).

As far as the empirical evidence that a growing complex regulatory environment has been the cause of the decline in entrepreneurs is concerned, there is less certainty. (Goldschlag and Tabarrok, 2018) for instance argue that the increased regulatory complexity in the USA has not been a major cause of declining entrepreneurship. (Salgado, 2018) concurs, finding that a 7-fold increase in entry costs would be required to generate the observed decline in the entrepreneurship rate in the USA between 1985 and 2014.

3.4 Discussion

The explanations discussed in the previous section tend to take a supply-side view. As such, entrepreneurial entry rates decline, and less productive firms stay in business because they face constraints such as not enough ideas, not enough innovation, higher regulatory burdens, lack of contestable markets and concentration, and technological changes which affect their need for skilled labor and response to productivity shocks.

While the supply-side is undoubtedly important, I am of the view that these explanations are not wholly satisfactory. This is because, as Konczal and Steinbaum (2016) pointed out, that if the causes of declining entrepreneurship were only supply-driven, then one would see incomes and earnings of workers and entrepreneurs that are in business to be rising, but it is however generally not.

Furthermore, what all countries where business dynamism is declining have in common, are high levels of GDP per capita and high economic complexity (Goldschlag and Tabarrok, 2018). Higher GDP per capita, the result of economic growth, which causes the world economy to scale up, leads to greater complexity; economic growth is a "scaling phenomenon" (West, 2017, p.27). Such scaling brings with it scale advantages, but also disadvantages. The entrepreneurship literature has generally been oblivious[13] to the possibility of negative scale effects.

What is needed, is to complement the supply-side explanations surveyed here, with explanations that considers the complexity and scale effects of advanced levels of development on entrepreneurship, as well as considerations from the demand side. These "brakes" on entrepreneurship and their core components can schematically presented as in Figure 3

[13] The partial exception is the small and recent literature on sustainable entrepreneurship and on entrepreneurship and ecological constraints, e.g. Potts et al. (2010).

Figure 3: Brakes on entrepreneurial entry in high GDP contexts

Brake on entrepreneurial entry in high GDP contexts	Description
Complexity brakes	1. Negative scale effects 2. Widening technological distances 3. "Ideas are getting harder to find"
Demand constraints	1. Population decline and ageing (since 1970s) 2. Inequality / declining labor share (since 1970s) 3. Energy prices rising (since 1970s)

Source: author's compilation.

In the remainder of this paper, the elements in Figure 3 will be discussed.

4 The End of Entrepreneurship? Complexity Brakes and Demand Constraints

4.1 Complexity Brakes

As was mentioned in the introduction, intuitively, higher GDP per capita should foster entrepreneurship: the advantages of scale are that more people that are better connected and generate more non-rival ideas and knowledge, which are the factors recognised to drive economic growth endogenously. That fact that entrepreneurship is decline, however suggests that decreasing returns have kicked in. It suggest that as economies increase in scale and complexity that negative scale effects and spillovers will hamper entrepreneurial entry and growth of smaller, younger firms. As indicated in Figure 3 there are three interrelated complexity brakes on entrepreneurship in such contexts : (i) negative scale effects , (ii) widening technological distance between firms, and the phenomeon that (iii) "ideas are getting harder to find".

4.1.1 Negative scale effects

Let us consider first negative scale effects. That there are positive aspects related to larger scale is obvious. This is also visible in the biological sphere, where for example larger animals make more efficient use of energy than smaller animals. West (2017, p.28) uses a metaphor of a mouse compared to an elephant to explain : "Large mammals live longer, take longer to mature, have slower heart rates, and cells that don't work as hard as those of small mammals, all to the same predictable degree. Small creatures live life in the fast lane while large ones move ponderously ... think of a scurrying mouse relative to a sauntering elephant".

Moreover, staying within the living organism metaphor, West (2017) argues that the same sigmoid growth curve that characterises living organisms also apply to the growth of cities, economies and firms. As such, after growing beyond a certain threshold, size and complexity would stabilize and growth level off. From a study of 28,853 publicly traded USA firms West (2017, p.393) reports that "All large mature companies have stopped growing. Their growth curves when corrected for both inflation and the expansion of the market now look just like typical sigmoidal growth curves of organisms in which growth ceases at maturity".

Maturity comes from growing complexity. The growth in complexity is seen within the relatively recent field of Complexity Economics as the outcome of the co-evolution of technology and entrepreneurship (Arthur, 1999; Beinhocker, 2006). According to Foxon et al. (2013, p.190) it arises as "an ongoing process of coevolution of physical technologies, social technologies (i.e. institutions or ways of coordinating human activities) and business plans".

In this view, Sequeira et al. (2018) proposes an endogenous growth model wherein this co-evolution is reflected by an "operator", akin to an "entrepreneur" which they proxy by compiling a complexity index. As a result of entropy, they show in their model that the complexity index (i.e. Schumpeterian entrepreneurship) "levels off despite the continuous increase in the stock of available knowledge" (p. 101). Their entrepreneur interacts with knowledge accumulation and population growth (i.e. physical and social technologies) to generate either positive or negative scale effects. When scale effects are positive, the result is innovation-driven growth; when scale effects become negative, economic stagnation results. Their model predicts declining entrepreneurship and eventual economic stagnation in the long-run, despite technological innovations and growing population.

An interesting feature of the model of Sequeira et al. (2018) is that although population growth is generally a positive determinant of entrepreneurship (a slowing down of population is seen as a reason for the recent decline in entrepreneurship, see section 3) they show that in a more general and longer-term sense, after a certain size, population growth can also start to reduce entrepreneurship. To understand this, it has to be borne in mind that as the population increase, so does knowledge and ideas. Thus technological innovation is a function of population size (more "tinkerers" are around). At first, this creates positive scale effects, given that innovation through R&D is subject to fixed costs, and therefore, the returns to R&D improves with a larger market the successful innovator thus may expect larger profits as the market expands.

The issue however is that over time as the more ideas and knowledge that already exist, the more difficult it is to create and use new valuable knowledge. It becomes more difficult in other words to innovate. Sequeira et al. (2018, p.103) explains that "the difficulty of introducing new products and replacing old ones is proportional to the market size [.....] the larger the market size, the larger the costs necessary to discover, develop and market the associated technology, e.g. costs pertaining to the construction of prototypes and samples, new assembly lines and training of workers, and generic coordination, organizational, marketing and transportation costs".

Indeed, empirical evidence seem to be bearing this out. Bloom et al. (2018, p.46) find that in the USA at present "just to sustain constant growth in GDP per person, the U.S. must double the amount of research effort searching for new ideas every 13 years to offset the difficulty of finding new ideas". As technological progress - new ideas - slows down, the number of ideas to be profitable exploited by entrepreneurs would decline, and hence the number of new start-ups would decline (Goldschlag and Tabarrok, 2018). This touches on the issue of the greater difficulty of innovation, which I will address more thoroughly below.

Finally, the case for rising complexity resulting in negative scale effects that causes a decline in entrepreneurship is consistent with evolutionary / natural selection models, e.g. as in Galor and Michalopoulos (2012) wherein individuals with risk-tolerant traits (good for entrepreneurship) have an evolutionary advantage at early stages of development (they leave more offspring) whereas at higher levels of development and complexity it will be individuals with risk-averse traits that have the evolutionary advantage [14].

[14] They assume that entrepreneurial traits are heritable, which may be subject to criticism.

4.1.2 Widening technological distance

One of the characteristics of greater complexity is that the diversity of products and services increase (Hidalgo and Hausmann, 2009). It has been termed "product proliferation" in the economic growth literature, and while it is associated with higher GDP (Du and O'Connor, 2019) it is not always appreciated that product proliferation could reduce entrepreneurship.

Peretto and Smulders (2002) shows, using an an endogenous growth model, how product proliferation in a large, complex economy would result in negative scale effects. The essence of their approach is to show how the impact of knowledge spillovers on innovation will decline as the economy becomes larger. A larger economy will allow firms to specialize more and more. The growing uniqueness of firms and their products and services results in what they describe as an increasing "technological distance" to other firms. This means that the R&D of one firm will have less benefits for other firms as the economy becomes more complex. The rates of return to innovation thus declines.

Overall, Peretto and Smulders (2002) illustrate that entrepreneurial entry can decline over time can be because the (i) R&D that is necessary for firms on entry rises, because they need more specialization and uniqueness; that (ii) knowledge spillovers decline, because of growing technological distance; and because (iii) R&D overall grows slower because of the decline returns to innovation. All three of these effects becomes more significant the larger the complexity and scale of the economy. This is because as the economy first grows larger, more businesses firms will enter due to the scale advantages to innovation. This has three consequences: first, many small firms will result in the average R&D effort per firm declining as small firms engage less in R&D than larger firms; two, that firms specialize to such an extent that their firm specific knowledge is so unique so that firms can learn less from one another - in other words, the technological distance between firms increases ; and three, that the new entrepreneurial firms will offer new products in the market that introduces new knowledge spillovers which increases the returns to innovation.

The above implies that the growth in ideas would decline due to the complexity effects of product proliferation, unless countered by increases in the growth in R&D so that R&D per worker do not decline. Hence population growth and large scale will have an ambiguous relationship with economic growth - due to negative scale effects from complexity that "spreads R&D more thinly" over increased number of product varieties, which counters advantages from specialization (Madsen, 2008; Strulik et al., 2013). Ang and Madsen (2015) estimated an "ideas production function" using a dataset covering 26 countries between 1870 and 2010. Their estimates suggests constant returns to scale to existing knowledge as well as the presence of significant product proliferation effects (negative complexity effects). They conclude that "population-induced expansions in R&D were neutralized by a proportional increase in product variety" (Ang and Madsen, 2015, p.105).

Finally, in the model of Peretto and Smulders (2002) the negative effects on the return to innovation is "never fully offset by stronger spillovers" (p. 616). The extent of the dispersion of labor productivity that we are current observing within industries Decker et al. (2017) may be a reflection of the increase in technological distance between businesses, as a result of the increase in scale and complexity.

4.1.3 “Ideas are getting harder to find”

In subsection 4.1.1 above I mentioned the conclusion from Sequeira et al. (2018) that over time, as ideas and knowledge accumulate, it becomes more difficult to create and use new valuable knowledge. The implication, that innovation will be getting more and more difficult over time, is an idea that has been gaining in traction in recent years. In this sub-section I will explore how this is one of the underlying causes, due to rising complexity, that is now beginning to constraint entrepreneurial entry.

It is useful to do this by continuing to use the concept of the “ideas production function” mention above. The ideas production function is elaboration of the first neoclassicial production functions which related GDP to inputs such as capital (K) and labor (L). In the first generation of neoclassical growth models, such as the Solow (1956) model, scale as measured by population growth, had a negative impact on GDP growth due to diluting capital per worker (Bucci, 2015). The negative relationship between population and per capita GDP growth in early neoclassical growth models reflected the Malthusian concern that population growth, unless offset by technological innovation, would lead to stagnation and incomes at subsistence level (Galor and Weil, 2000).

In subsequent models capital (K) and labor (L) were augmented by knowledge (A), which became to be seen in time as the prime driver of economic growth. As has been emphasised in this paper, knowledge expansion depends on population growth. More people generate more ideas, and faster diffusion of ideas (Kremer, 1993b). The take-off in modern economic growth, during the earlier 19th century, is strongly correlated with rapid growth in the world population. For Galor and Weil (2000, p.807) this even means that “changes in the size of population can be taken as a direct measure of technological improvement”.

The ideas production function is a function that sets out how knowledge accumulates: (A) (Ang and Madsen, 2015, p.82):

$$A = \lambda(\frac{X}{Q^B})^{\sigma} A^{\phi}$$

with

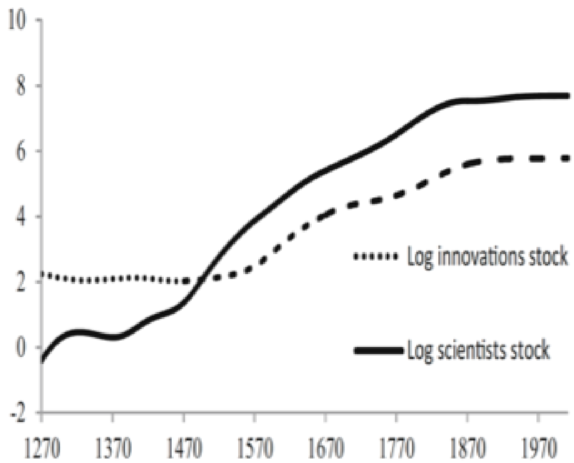
$$0 < \sigma \leq 1; \phi \leq 1 \tag{1}$$

Here A denotes “new ideas”; λ is a parameter denoting the productivity of research effort (R&D); X is R&D, Q stands for product variety, often measured by population (Madsen, 2008); σ is a “duplication parameter ”which $= 0$ if innovations are duplications (not original) and $= 1$ if not; ϕ is a parameter of the returns to scale in knowledge, and B a parameter of “product proliferation”. The ratio X/Q measures research intensity (Madsen, 2008, p.3).

The essence of (1) for present purposes is that is shows that with constant R&D effort and research effectiveness, an increase in product variety and product proliferation (economic complexity) would lead to a decline in new ideas. As Bucci (2015, p.173) points out, “an individual researcher becomes less and less productive as the number of existing ideas grows, so in the long run, it is possible to keep on innovating at a constant pace only by allowing for a rise in the aggregate stock of researchers [.....] this is ultimately possible only through an increase of population”.

What this would result in though is a decline in average researcher productivity- precisely what Bloom et al. (2018) finds for the USA - they found that "Research productivity for the aggregate U.S. economy has declined by a factor of 41 since the 1930s, an average decrease of more than 5 percent per year" (p.3) . It also predicts that as product variety (economic complexity) increases, generation of new ideas would require progressively higher research effort and attempts to raise the effectiveness of research, so as to be able to enter the market with a new idea or novel innovation (Bucci, 2015; Porter and Stern, 2000). As Gordon (2016) argues, all the "low hanging fruits" of ideas for innovations have been taken. Figure 4 reflects the idea of innovations getting harder over time, plotting data on British scientists and innovations over a 700 - year period. It is clear that over the last century or so, that the growth in these have been approaching zero.

Figure 4: Innovation getting harder through the centuries: Stock of British Scientists and Innovations, 1270-1970



Source: (Madsen and Murtin, 2017, p.242).

The production complexity effect on decreasing growth in the research productivity, as well as the concept of widening technological distance discussed in the previous subsection, both has resonance in Kremers O-Ring theory, which, with reference to the Space Shuttle Challenger's O-Ring faults that caused the disaster, basically implies that more can go wrong the more complex production is (Kremer, 1993a).

4.2 Demand Constraints

As indicated in Figure 3 there are three factors contributing to a demand constraint on entrepreneurship entry rates: (i) the decline in population and ageing in the West; (ii) growing inequality and the declining share of labor in GDP and (iii) the rise in energy price. All of these factors started to decline / decrease from around the 1970s / 1980s, the same time that the structural break in business dynamism in the West occured.

Much has already been discussed in this paper about the role of population growth in economic growth, the ideas production function, innovation, and entrepreneurial entry. Therefore, the remainder of this section will focus on the rise in income inequality and energy prices.

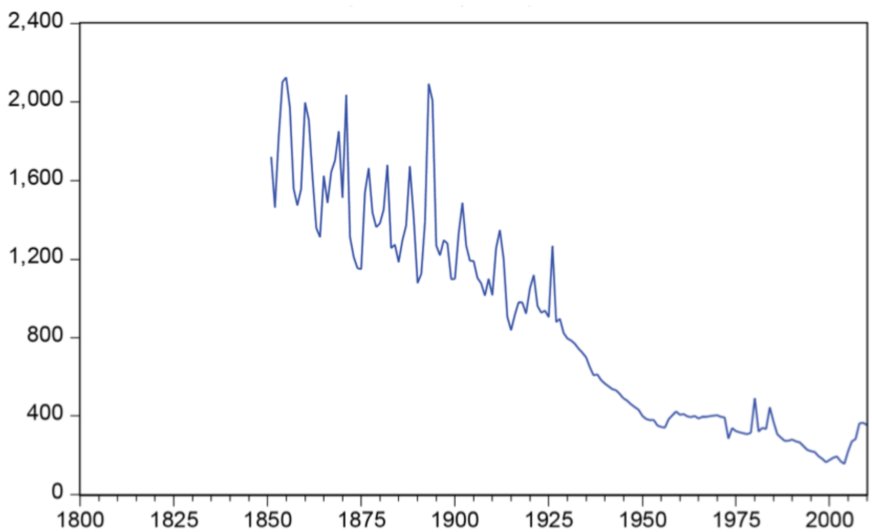
4.2.1 Energy

As economies and their populations grow and become more complex, they need in adherence to the Second Law of Thermodynamics to "pay" for their increased complexity (and order) by giving entropy back to the system in terms of increased heat, CO2 emissions, waste, and pollution (Beinhocker, 2006). As put by Foxon et al. (2013, p.193) "Economic systems transform energy inputs, typically in the form of fossil fuels and calories from agricultural production, into useful goods and services, which have high local order, at the expense of an overall increase in disorder or entropy, in the form of waste products, heat and greenhouse gases".

The importance of energy inputs in development and complexity is still relatively neglected in economic and specifically endogenous growth theory (Court, 2018; Foster, 2012). It is remarkable that unified growth models and various generations of endogenous growth models explain the rise of modern economics, and the industrial revolution, "without appealing to the role of energy in particular the associated energy transition towards fossil fuels" (Court, 2018, p.2). This is a notable omission given the fact, as described by Foster (2012, p.13), that the take-off of modern economic growth in the 19th century was due to "a super-radical innovation diffusion process that became possible because the availability of very cheap fossil fuel energy". The important General Purpose Technologies (GPTs) that made the industrial revolution possible were the internal combustion engine (ICE) and electricity. Both of these depended significantly on fossil fuel energy.

Fossil fuel energy has been the cheapest mass source of energy used by humanity. As is always the case with revolutionary technologies, the diffusion of fossil fuels was enabled by the significant decline in fossil fuel prices over time. For example, in the UK (where long time series data is available) energy costs in 2009 was **one ninth** that is was in 1830 (Foster, 2012).

Figure 5: British Average Real Energy Prices, 1851-2018



Data source: Foster, 2012 :17.

If energy is defined as the "ability of a system to cause change" (Court, 2018, p.3) then it is clear that the generation of ideas, the growth in the knowledge stock and the impact of knowledge in the form of capital and technology requires efficient flows of energy. Court (2018) discusses how the use of fossil fuels enabled the transition from farming to industry, and the accumulation of capital, which allowed huge growth in labor productivity as well as helped to displace labor from heavy manual labor towards the knowledge-intensive services sector. This energy transition has determined modern transport and city infrastructure, which had opened up huge opportunities for entrepreneurship.

From this perspective, Court (2018) argues that complexity has reached such a state that current energy is only sufficient for maintenance of the system but not further growth a position consistent with that of Gordon (2016, 2018) and Bloom et al. (2018) who argues that the low hanging fruits of innovation has been taken and that it is getting harder. To increase the rates and impact of innovation, more energy may be needed. It seems however that energy demand per capita is decreasing - see (Court, 2018, p.20). One could argue that this reflects more efficient use of energy; while no doubt energy efficiency has increased substantially, some authors take a sceptical view whether further significant gains can be obtained, adding to this the rise in energy prices (Court, 2018; Foster, 2012).

The decline in energy consumption and rise in energy prices, together with the need to deal with the entropy (pollution) from the rising complexity that the burst of energy flowing into the global economy since the mid 19th century has allowed, will slow down GDP and productivity growth, as well as business dynamism. In a sense, greater economic complexity can be seen as the necessary outcome of having to deal with stressed ecological systems (Potts et al., 2010, p.377). However, as the complexity itself starts to put brakes on entrepreneurship and economic growth, complexity may itself not expand fast enough given the stresses on ecological systems. As a result of which, “we may be producing so much entropy that the resulting pollution become insurmountable” (West, 2017, p.423).

Growing ecological stress and hitting against the limits of energy efficiency and energy cost declines are not surprising, especially in light of Johansen and Sornette (2001, p.1) who pointed out that “both the Earth human population as well as its economic output have grown faster that exponential for most of the known history and most strikingly so in the last centuries” has raised the likelihood of a “finite-time singularity” which refers to the fact that the “acceleration of the growth rate contains endogenously its own limit in the shape of a finite-time singularity to be interpreted as a transition to a qualitatively new behaviour”.

Given that they predict this singularity around 2052 plus or minus 10 years, it may well be that the planetary economy is in a transition towards stagnation, which is characterized by amongst others the decline in innovative entrepreneurship.

4.2.2 Aggregate demand

Mainstream economists tend to be of the view that business dynamism is declining because ultimately labor productivity growth is stalling[15]. Their explanations of why productivity growth is stalling, tend to be twofold: one explanation is that the productivity growth boost will come, but only after an implementation lags. The second explanation is that innovation has become more difficult. These explanation are supply-side oriented, imply that we need more supply of complementary infrastructure and inventions to diffuse technology, and more inputs

[15] For example “in the USA average labour productivity growth per decade since the 1950 was 2,3 percent (in the 1950s), 2,5 percent (1960s), 1,03 percent (1970s), 1,8 percent (1980s), 2,5 percent (1990s), 1,8 percent (2000s) and since 2010 it was on average 1,8 percent per annum. In European countries such as the UK, Germany and France it was even more sluggish since 2010, at respectively 0,43 percent, 0,44 and 0.54” (Gries and Naudé, 2018, p.4).

into innovation.

Recently, Gries and Naudé (2018) added a third explanation for the slowdown in productivity growth, which also explains partly the decline in entrepreneurship: they illustrate mathematically that slow growing aggregate demand constitutes an additional constraint on entrepreneurship, and moreover show that slow aggregate demand growth will reinforce the basic supply-side constraints that characterises current mainstream explanations.

One contributing factor to the decline in aggregate demand is the rise in within-country income inequality - a rise that started not coincidentally, in the 1970s/1980s. A particularly strong trend, which also poses a challenge for mainstream economics, is the decline in the relative share of labor in GDP (Karabarbounis and Neiman, 2014). It is argued in the literature that there may be four interrelated reasons for this decline: one is technology, as the ICT revolution started in the 1970s/1980s (Autor, 2014). A second is globalization and (digital) technology which accelerated from the 1970s(Autor et al., 2017). A third is changes in labor market regulations and the power of labor unions, which were progressively undermined since the 1970s and 1980s under the free market philosophies associated with *Reaganomics* and the Thatcher era (Naudé and Nagler, 2018). And a fourth reason is the noted decline in population growth since the 1970s : Hopenhayn et al. (2018) calculates using a general equilibrium model that the fall in the share of labor may be a result of slower growing population.

Gries and Naudé (2018) argue that because of the declining growth in aggregate demand, business dynamism is declining. This in turn leads to slower diffusion of technology, fewer radical innovations, rising profit shares and a further decline in the labor share (higher inequality). This again in turn leads to further declines in aggregate demand growth and in the incentives for entrepreneurship. Their explanation of declining aggregate demand growth therefore consistent with both the view that there are implementation lags as far as technology is concerned, and the view that the power of innovation is declining. Moreover, as Konczal and Steinbaum (2016) have argued, a decline in aggregate demand may also restrict the demand for labor, which will depress entrepreneurial entry rates due to the fact that a depressed labor market provides less "social insurance" for entrepreneurs. Hence, workers will be less likely to start a new firm or join a new start-up, when they consider the chances of getting back into the labor market at a later stage to be too low.

The demand-constrained model [16] of Gries and Naudé (2018) is based on but extends the seminal theoretical growth models of Romer (1990) and Aghion (2009). Where it differs is in using a "nested" human capital function, which specifies the production of final goods to be the result of a "human service good" H and a number of innovative intermediate goods x. The human service is generated by labor augmented by technology which can partly also substitute for labor. Final good producing business firms sell their products in a competitive final goods market. Entrepreneurs each provide a unique intermediate goods, requiring them to innovate to deliver these. They do not always succeed, because despite significant innovation effort, their product may not find ready buyers.

In the initial steady state Gries and Naudé (2018) assume that "all factors of production share symmetrically in the gains from product innovations". They then relax this assumption by reversing the typical direction of causality between investment and savings. This allows for the possibility that as a result of random shocks and the consequences of rising complexity, such as rising energy prices or a reduction in population growth, that actual sales of final goods may be lower than anticipated or potential sales. With this possibility, they show that the consequences

[16] The follow three paragraphs are adapted from Gries and Naudé (2018)

will be actual GDP below potential GDP, and actual productivity growth less than potential productivity growth.

Moreover, Gries and Naudé (2018) illustrate that if GDP can be demand constrained then supply-side policies to boost technological progress (for instance to support artificial intelligence) could lead to a replacement of labor and a fall in real wages - these declines will be larger the larger the elasticity of substitution in production. Wage growth will slow down and the labor's share will drop. In contrast, capitalists, who provide the capital to finance innovation can gain in terms of productivity and increase their share of GDP. This may be called a "Silicon Valley" model of innovation-led growth, wherein inequality increases. Because wealthy capitalists consume less than workers, aggregate demand will slow down, also reducing potential and real GDP growth. The conclusion is that if supply-side policies aiming to stimulate tech innovation fails to raise the share of labor in GDP then the slow growth in aggregate demand will impact negatively on total economic growth.

5 Concluding Remarks

"These days Americans are less likely to switch jobs, less likely to move around the country, and, on a given day, less likely to go outside the house at all [...] the economy is more ossified, more controlled, and growing at lower rates" - (Cowan, 2017, pp.6-7).

Entrepreneurship and business dynamism are in decline throughout most advanced Western economies. This is evident in declining entrepreneurial entry and exit rates, slower growth and lower employment shares of young, high-growth business firms, reduced labor market mobility within and between jobs, and weaker innovation. These declines can be associated with the productivity slowdown and rising income inequality, and with a general "ossification" of the economy.

In this paper I first documented the decline in entrepreneurship, after which I discussed the current explanations for it. I noted that these explanations tend to be supply-side oriented and fails to account for the fact that the declines in entrepreneurship and business dynamisms tend largely to be confined to advanced, highly complex economies. Hence the contribution of this paper was to associate entrepreneurship with complexity and scale in economic development. Higher costs associated with complexity and entropy, such as higher energy costs and slower growing aggregate demand, eventually reduces business dynamism in the economy, with entrepreneurial entry rates, productivity and GDP growth declining - and even vanishing over the long-run.

Haltiwanger (2015, p.9) is not far off the mark that the decline in entrepreneurship is the outcome of the combination of many different factors, akin to "a death by a thousand cuts". However, whereas a "death by a thousand cuts" (and mainly supply-side cuts) may until now have seen to be a thousand unrelated cuts, it was showed in this paper how these "cuts" are related, also from the demand-side and moreover that some of these cuts are of a fundamental long-run nature. The level of complexity that the world economy has achieved in the past thirty years is unprecedented in the history of humanity. We do not completely understand nor appreciate fully the conditions which allowed this to happen, nor do we know whether it is a once-off fluke or sustainable. The decline in entrepreneurship and business dynamism therefore calls up many intriguing questions and concerns.

If the basics of the processes of life, organization complexity, and hence economic growth is in the realm of information, as many scientists are arguing, e.g. Hidalgo (2015); Davies (2019); Hoffman (2019), then the role of entrepreneurs, as exploiters and generators of information deserves more attention in economic growth theory. In this respect the challenge is one of escaping ultimately from the Red Queen phenomenon: "[...] unbounded growth cannot be sustained without having either infinite resources or inducing major paradigm shifts that reset the clock before potential collapse [...] such discoveries must occur at an increasingly accelerating pace; the time between successive innovations must systematically and inextricable get shorter and shorter [...] we must innovate at a faster and faster rate. " (West, 2017, p.32,424). Escaping from the Red Queen phenomenon will entail a new qualitative growth regime, and the decline in entrepreneurship may be part of a long-run transition to such a new qualitative growth regime - one that will be characterized by greater stability and stagnation.

What are the implications of the findings and speculations? The first is whether the noted declines calls for efforts to resist it and to try to increase entrepreneurial entry and resuscitate the entrepreneurial economy. In this respect, even though it may not be feasible over the longer term, it may also not be desirable. For instance, a number of scholars have questioned whether the decline in entrepreneurship is necessarily undesirable. Goldschlag and Tabarrok (2018) for example point out that this decline has resulted in less self-employment, more job stability and better job matching, and asks whether this is not a better situation than one of higher uncertainty, high job turnover and fewer employment opportunities? The ICT revolution may have increased the ability, especially of larger businesses, to "adapt to shocks" and "allow creative destruction to be internalized to the firm". And Bijnens and Konings (2018) conclude from their study of business dynamism in Belgium that it is partly due to less dynamism amongst smaller, high-growth firms, and as such may not be all negative for overall productivity growth because it may mean that "resources are already allocated to the most productive (larger) firms" (p. 19). Similarly, if the decline in entrepreneurial entry is mainly driven due to efficient occupational choices in the light of technological change, then less concern may be warranted (Salgado, 2018; Karahan et al., 2018). Also, Decker et al. (2014b, p.22) have found that the decline business dynamics is reflected in that "the process of building careers through job switching has slowed down", and raised the question whether less frequent job switching may not be due to better matching between firms and their workers?

If indeed it is the case that the decline in Schumpeterian entrepreneurship brings more stability, certainty and efficiency, the downside may be that complex *ossified* modern economies will be less flexible, less adaptable to external change, and hence more vulnerable to shocks - a point variously made by amongst others Beck (2009), Bostrom and Ćircović (2008), Decker et al. (2014b) and West (2017).

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References

Ács, Z., Braunjerhjelm, P., Audretsch, D., and Carlsson, B. (2009). The Knowledge Spillover Theory of Entrepreneurship. *Small Business Economics*, (32):15–30.

Aghion, P. (2009). Some Thoughts on Industrial Policy and Growth. *OFCE Working Paper no 2009-09, April.*

Akcigit, U. and Ates, S. (2019a). Ten Facts on Declining Business Dynamism and Lessons from Endogenous Growth Theory. *CEPR Discussion Paper no. 13668, Centre for Economic Policy Research.*

Akcigit, U. and Ates, S. (2019b). What Happened to U.S. Business Dynamics? *CEPR Discussion Paper no. 13669. Centre for Economic Policy Research.*

Andrews, D., C.Criscuolo, and Gal, P. (2016). The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy. *OECD Productivity Working Papers no. 5, Paris: OECD.*

Ang, J. and Madsen, J. (2015). What Drives Ideas Production Across the World? *Macroeconomic Dynamics*, 19:79–115.

Arthur, W. (1999). Complexity and the Economy. *Science*, 284(5411):107–109.

Atkinson, A., Piketty, T., and Saez, E. (2011). Top Incomes in the Long Run of History. *Journal of Economic Literature*, 49(1):3–71.

Audretsch, D. and Thurik, A. (2000). Capitalism and Democracy in the 21st Century: From the Managed to the Entrepreneurial Economy. *Journal of Evolutionary Economics*, 10(1-2):17–34.

Autor, D. (2014). Skills, Education, and the Rise of Earnings Inequality Among the Other 99 Percent. *Science*, 344(6186):843–851.

Autor, D., Dorn, D., Katz, L., Patterson, C., and van Reenen, J. (2017). The Fall of the Labor Share and the Rise of Superstar Firms. *Working Paper no. 23396, National Bureau for Economic Research.*

Bartelsman, E., Haltiwanger, J., and Scarpetta, S. (2013). Cross-Country Differences in Productivity: The Role of Allocation Efficiency and Selection. *American Economic Review*, 103(1):305–334.

Beck, U. (2009). World at Risk. *London: Policy Press.*

Beinhocker, E. (2006). The Origin of Wealth: Evolution, Complexity and the Radical Remaking of Economics. *London: Random House.*

Bijnens, G. and Konings, J. (2018). Declining Business Dynamism in Belgium. *Small Business Economics*, pages 1–39.

Bloom, N., Jones, C., Van Reenen, J., and Webb, M. (2018). Are Ideas Getting Harder to Find? *Working Paper no. 23782, National Bureau for Economic Research.*

Bostrom, N. and Ćircović, M. (2008). Global Catastropic Risks. *Oxford : Oxford University Press.*

Boucekkine, R., de le Croix, D., and Licandro, O. (2003). Early Mortality Declines at the Dawn of Modern Growth. *Scandinavian Journal of Economics*, 105:(3):401–418.

Bucci, A. (2015). Product Proliferation, Population, and Economic Growth. *Journal of Human Capital*, 9(2):170–197.

Cairo, I., Hyatt, H., and Zhao, N. (2015). The US Job Ladder in the New Millennium. *Meeting Papers 893, Society for Economic Dynamics.*

Calligaris, S., Criscuolo, C., and Marcolin, L. (2018). Mark-Ups in the Digital Era. *OECD Working Paper no. 2018-10. Paris: OECD.*

Calvino, F., Criscuolo, C., and Menon, C. (2015). Cross-Country Evidence on Start-Up Dynamics. *OECD Science, Technology and Industry Working Paper 2015/6, Paris: OECD.*

Chatterjee, S. and Eyigungor, B. (2018). Declining Interest Rates and Firm Dynamics: Falling Startups and Rising Concentration. *Working Paper no. 19-18, Federal Reserve Bank of Philadelphia.*

Cooke, P. (2019). World Turned Upside Down: Entrepreneurial Decline, Its Reluctant Myths and Troubling Realities. *Journal of Open Innovation: Technology, Markets and Complexity*, 5(22):1–16.

Court, V. (2018). Energy Capture, Technological Change, and Economic Growth: An Evolutionary Perspective. *BioPhysical Economics and Resource Quality*, 3(12):1–27.

Cowan, T. (2017). The Complacent Class: The Self-Defeating Quest for the American Dream. *New York: Picador.*

Davies, P. (2019). The Demon in the Machine: How Hidden Webs of Information Are Finally Solving the Mystery of Life. *London: Allen Lane.*

Davis, B., DiGiuseppe, S., and Zezza, A. (2014). Income Diversification Patterns in Rural Sub-Saharan Africa: Reassessing the Evidence. *Policy Research Working Paper no. 7108. Washington DC: The World Bank.*

Davis, S. (2015). Regulatory Complexity and Policy Uncertainty: Headwinds of our Own Making. *Economics Working Paper 15118, Hoover Institution.*

de Loecker, J. and Eeckhout, J. (2017). The Rise of Market Power and the Macroeconomic Implications. *Working Paper no. 23687, National Bureau of Economic Research.*

Decker, R., Haltiwanger, J., Jarmin, R., and Miranda, J. (2014a). The Role of Entrepreneurship in US Job Creation and Dynamics. *Journal of Economic Perspectives*, (28):324.

Decker, R., Haltiwanger, J., Jarmin, R., and Miranda, J. (2014b). The Role of Entrepreneurship in US Job Creation and Dynamics. *Journal of Economic Perspectives*, 28(3):3–24.

Decker, R., Haltiwanger, J., Jarmin, R., and Miranda, J. (2017). Declining Dynamism, Allocative Efficiency, and the Productivity Slowdown. *American Economic Review, Papers and Proceedings*, 107(5):322–326.

Dinopoulos, E. and Syropoulos, C. (2007). Rent Protection as a Barrier to Innovation and Growth. *Economic Theory*, 32(2):309–332.

Du, K. and O'Connor, A. (2019). Examining Economic Complexity as a Holistic Innovation System Effect. *Small Business Economics Journal*, published online 26 July.

EIG (2017). Dynamism in Retreat: Consequences for Regions, Markets and Workers. *EIG.org. Feb.*

Foster, J. (2011). Energy, Aesthetics and Knowledge in Complex Economic Systems. *Journal of Economic Behavior and Organization*, 80(1):88–100.

Foster, J. (2012). Energy, Knowledge and Economic Growth. *Papers on Economics and Evolution no. 1301, Max Planck Gesellschaft.*

Foxon, T., Koehler, J., Michie, J., and Oughton, C. (2013). Towards a New Complexity Economics for Sustainability. *Cambridge Journal of Economics*, 37:(1):187–208.

Furman, J. and Orszag, P. (2015). A Firm-Level Perspective on the Role of Rents in the Rise in Inequality. *Washington DC: Council of Economic Advisors.*

Galor, O. and Michalopoulos, S. (2012). Evolution and the Growth Process: Natural Selection of Entrepreneurial Traits. *Journal of Economic Theory*, 147:759–780.

Galor, O. and Weil, D. (2000). Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond. *American Economic Review*, 90:(4):806–828.

Ghio, N., Guerini, M., Lehmann, E., and Rossi-Lamastra, C. (2015). The Emergence of the Knowledge Spillover Theory of Entrepreneurship. *Small Business Economics*, 44(1):1–18.

Goldschlag, N. and Tabarrok, A. (2018). Is Regulation to Blame for the Decline in American Entrepreneurship? *Economic Policy*, pages 5–44.

Gordon, R. (2016). The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War. *Princeton: Princeton University Press.*

Gordon, R. (2018). Why Has Economic Growth Slowed When Innovation Appears to be Accelerating? *NBER Working Paper 24554. National Bureau for Economic Research.*

Gourio, F., Messer, T., and Siemer, M. (2014). A Missing Generation of Firms? Aggregate Effects of the Decline in New Business Formation. *CESIfo Conference on Macroeconomic and Survey Data, 5-6 Dec.*

Gries, T. and Naudé, W. (2018). Artificial Intelligence, Jobs, Inequality and Productivity: Does Aggregate Demand Matter? *IZA Discussion Paper 12005, IZA Institute of Labor Economics, Bonn.*

Griliches, Z. (1990). Patent Statistics as Economic Indicators: A Survey. *Journal of Economic Literature*, 27:1661–1707.

Grullon, G., Larkin, Y., and Michaely, R. (2017). Are US Industries Becoming More Concentrated? *Mimeo.*

Ha, J. and Howitt, P. (2007). Accounting for Trends in Productivity and R&D: A Schumpeterian Critique of Semi-Endogenous Growth theory. *Journal of Money, Credit and Banking*, 39:733–774.

Haltiwanger, J. (2015). Top Ten Signs of Declining Business Dynamism and Entrepreneurship in the U.S. *Kaufmann Foundation New Entrepreneurial Growth Conference*, June.

Hathaway, J. and Litan, R. (2014). Declining Business Dynamism in the United States: A Look at States and Metros. *Economic Studies at Brookings*, May.

Henrekson, M. and Sanandaji, T. (2014). Small Business Activity Does Not Measure Entrepreneurship. *Proceedings of the National Academy of Science*, 111(5):1760–1765.

Hidalgo, C. (2015). Why Information Grows. *London: Penguin Books.*

Hidalgo, C. and Hausmann, R. (2009). The Building Blocks of Economic Complexity. *PNAS*, 106.(26):10570–10575.

Hoffman, D. (2019). The Case Against Reality. *London: Penguin Books.*

Hopenhayn, H., Neira, J., and Singhania, R. (2018). From Population Growth to Firm Demographics: Implications from Concentration, Entrepreneurship and the Labor Share. *NBER Working Paper no. 25382.*

Hopenhayn, H. and Rogerson, R. (1993). Job Turnover and Policy Evaluation: A General Equilibrium Analysis. *Journal of Political Economy*, 101:915–938.

Hsieh, C. and Moretti, E. (2019). Housing Constraints and Spatial Misallocation. *American Economic Journal: Macroeconomics.*

Hyatt, H. and Spletzer, J. (2013). The Recent Decline in Employment Dynamics. *IZA Journal of Labor Economics*, 2(5):1–21.

Johansen, A. and Sornette, D. (2001). Finite-time singularity in the dynamics of the world population: Economic and financial indices. *Physica A*, 294(3-4):465–502.

Jones, B. (2009). The Burden of Knowledge and the Death of Renaissance Man: Is Innovation Getting Harder? *Review of Economic Studies*, 76(1):283–317.

Karabarbounis, L. and Neiman, B. (2014). The Global Decline of the Labor Share. *Quarterly Journal of Economics*, 129(1):61103.

Karahan, F., Pugsley, B., and Sahin, A. (2018). Demographic Origins of the Startup Deficit. *Mimeo, Federal Reserve Bank of New York and University of Notre Dame.*

Kleiner, M. (2015). Guild-Ridden Labor Markets: The Curious Case of Occupational Licensing. *Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.*

Konczal, M. and Steinbaum, M. (2016). Declining Entrepreneurship, Labor Mobility and Business Dynamism. *Roosevelt Institute, New York.*

Kopecky, J. (2017). An Ageing Dynamo: Demographic Change and the Decline of Entrepreneurial Activity in the United States. *Mimeo.*

Kozeniauskas, N. (2018). Whats Driving the Decline in Entrepreneurship? *Mimeo.*

Kremer, M. (1993a). The O-Ring Theory of Economic Development. *Quarterly Journal of Economics*, 108(3):551–575.

Kremer, M. (1993b). Population Growth and Technological Change: One Million BC to 1990. *Quarterly Journal of Economics*, 108(3):681–716.

Liang, J., Wang, H., and Lazear, E. (2018). Demographics and Entrepreneurship. *Journal of Political Economy*, 126(51):S140–S196.

Liebregts, W. and Stam, E. (2019). Employment Protection Legislation and Entrepreneurial Activity. *International Small Business Journal : Researching Entrepreneurship*, 37(6):581–603.

Madsen, J. (2008). Economic Growth, TFP Convergence and the World Export of Ideas: A Century of Evidence. *Scandinavian Journal of Economics*, 110(1):145167.

Madsen, J. and Murtin, F. (2017). British Economic Growth Since 1270: The Role of Education. *Journal of Economic Growth*, 22:229–272.

Mcdonald, R. (2014). Business Entry and Exit Rates in Canada: A 30-year Perspective. *Economic Insights, Statistics Canada*, 38.

McGowan, M., Andrews, D., and Millot, V. (2017). The Walking Dead? Zombie Firms and Productivity Performance in OECD Countries. *Working Paper no. 1372, Paris: OECD.*

Mueller, H., Quimet, P., and Simintzi, E. (2015). Wage Inequality and Firm Growth. *Working Paper no. 20876, National Bureau of Economic Research.*

Naudé, W. and Nagler, P. (2018). Technological Innovation, Entrepreneurship and Productivity in Germany, 1871-2015. *SPRU Working Paper Series (SWPS), 2018-02. Science Policy Research Unit, University of Sussex.*

OECD (2017). Business Dynamics and Productivity.

Peretto, P. and Smulders, S. (2002). Technological Distance, Growth and Scale Effects. *Economic Journal*, 112:603–624.

Porter, M. and Stern, S. (2000). Measuring the Ideas Production Function: Evidence from International Patent Output. *Working Paper no. 7891, National Bureau of Economic Research.*

Potts, J., Foster, J., and Straton, A. (2010). An Entrepreneurial Model of Economic and Environmental Co-evolution. *Ecological Economics*, 70:375–383.

Pugsley, B. and Sahin, A. (2015). Grown-Up Business Cycles. *Center for Economic Studies Working Paper no. CES-WP-15-33. US Census Bureau.*

Romer, P. (1990). Endogenous Technical Change. *World Development*, (5):S71–S102.

Salgado, S. (2018). Technical Change and Entrepreneurship. *Mimeo, University of Minnesota.*

Sequeira, T., Gil, P., and Alfonso, O. (2018). Endogenous Growth and Entropy. *Journal of Economic Behavior and Organization*, 15:100–120.

Solow, R. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, 1:65–94.

Song, J., Price, D., F.Guneven, Bloom, N., and Von Wachter, T. (2015). Firming Up Inequality. *Working Paper no. 21199, National Bureau of Economic Research.*

Stangler, D. and Spulber, D. (2013). The Age of the Entrepreneur: Demographics and Entrepreneurship. *IIIJ Innovation and Communication*, March.

Strulik, H., K.Prettner, and Prskawetz, A. (2013). The Past and Future of Knowledge-Based Growth. *Journal of Economic Growth*, 18:411–437.

Syverson, C. (2016). Challenges to Mismeasurement Explanations for the US Productivity Slowdown. *NBER Working Paper Series NBER21974.*

Thurik, A., Stam, E., and Audretsch, D. (2013). The Rise of the Entrepreneurial Economy and the Future of Dynamic Capitalism. *Technovation*, 33(8-9):302–310.

Tsvetkova, A. and Partridge, M. (2019). Knowledge-Based Service Economy and Firm Entry: An Alternative to the Knowledge Spillover Theory of Entrepreneurship. *Small Business Economics Journal*, early online.

Ugur, M., Trushin, E., and Solomon, E. (2016). A Firm-Level Dataset for Analyzing Entry, Exit, Employment and R&D Expenditures in the UK: 1997-2012. *Data in Brief*, 8:153–157.

West, G. (2017). Scale: The Universal Laws of Life and Death in Organisms, Cities and Companies. *London: Weidenfeld and Nicolson.*

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