

Naudé, Wim

**Working Paper**

## From the Entrepreneurial to the Ossified Economy: Evidence, Explanations and a New Perspective

GLO Discussion Paper, No. 539

**Provided in Cooperation with:**

Global Labor Organization (GLO)

*Suggested Citation:* Naudé, Wim (2020) : From the Entrepreneurial to the Ossified Economy: Evidence, Explanations and a New Perspective, GLO Discussion Paper, No. 539, Global Labor Organization (GLO), Essen

This Version is available at:

<https://hdl.handle.net/10419/216899>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# From the Entrepreneurial to the Ossified Economy: Evidence, Explanations and a New Perspective

Wim Naudé\*

April 17, 2020

## Abstract

Entrepreneurship in advanced economies is in decline. This comes as a surprise: many scholars have anticipated an upsurge in entrepreneurship, and expected an “entrepreneurial economy” to replace the post-WW2 “managed” economy. Instead of the “entrepreneurial economy” what has come into being may perhaps better be labelled the “ossified economy.” This paper starts by document the decline. It then critically presents the current explanations offered in the literature. While having merit, these explanations are proximate and supply-side oriented. Given these shortcomings, this paper contributes a new perspective: it argues that negative scale effects from rising complexity, as well as long-run changes in aggregate demand due to inequality and rising energy costs, are also responsible. Implications for entrepreneurship scholarship are drawn.

*JEL classifications:* O47, O33, J24, E21, E25

*Keywords:* Entrepreneurship, start-ups, development,  
economic complexity, growth theory

---

\*Maastricht School of Management, Maastricht, The Netherlands; RWTH Aachen University, Aachen, and IZA Institute of Labor Economics, Bonn, Germany. Email: [naude@time.rwth-aachen.de](mailto:naude@time.rwth-aachen.de)

# 1 Introduction

Buoyed by optimism at the end of the Cold War and the emergence of the digital economy, entrepreneurship scholars in the early 1990s anticipated a golden age of entrepreneurship, e.g. [Ács \(1992\)](#) and [Kirchhoff \(1994\)](#). A widely popular narrative described the coming of an “entrepreneurial economy” ([Thurik, 2011](#)). [Audretsch and Thurik \(2000, 2001, 2010\)](#) and [Thurik et al. \(2013\)](#) described this as being due to a structural shift in advanced economies, away from the post-World War II “managed” economy, towards what would be the “entrepreneurial economy”. The entrepreneurial economy is labelled “dynamic capitalism” ([Thurik et al., 2013](#), p.302) after [Kirchhoff \(1994\)](#). According to [Kirchhoff \(1994, p.3\)](#) “dynamic capitalism” refers to “an economic system characterised by the dynamics of new, small firms growing, and old, large firms declining and failing”. The entrepreneurial economy, or “dynamic capitalism”, was expected to be accompanied 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, and a shift in employment away from low to high skilled labor.

The “entrepreneurial economy” never happened. As will be shown in this paper, the secular decline in entrepreneurship and innovation, trends that have been well documented in recent years, is in sharp contrast with all of these expectations. In fact, entrepreneurial entry has declined, employment has shifted from small to larger firms, concentration and market power has been rising, and employment has even been document in some instances shifting from high to lower skilled labor. If anything, advanced economies are experiencing a very *un-dynamic* form of capitalism, a move from the “entrepreneurial” to the “ossified” economy<sup>1</sup>, 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 ([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](#)). Whereas entrepreneurship has traditionally been seen as a vehicle for social mobility and income equality, it certainly seems not to be the case anymore, as [Marinoni and Voorheis \(2019, p.24\)](#) finds no mobility effects of entrepreneurship in the USA, but rather that “if anything, entrepreneurship makes the rich richer and the poor poorer”.

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 the (potential) growth in GDP per capita. [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. 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

---

<sup>1</sup> According to [Cowan \(2017, pp.6-7\)](#) “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.”

advanced economies, all indicators of the latter have deteriorated over the past three decades. Public trust<sup>2</sup> 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, current explanations are not entirely satisfactory. According to [Decker et al. \(2014, p.19\)](#) “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 review current explanations for the decline in entrepreneurship, note their shortcomings, and offer new perspectives. In particular, it is argued here that there the bulk of the current literature is concerned with a myriad of possible causes, such as regulations, lack of scarce inputs, and increasing concentration, which also tend to be largely supply-side causes. [Konczal and Steinbaum \(2016\)](#) has made the good point that if the causes of declining entrepreneurship were only supply-driven, then one would see real incomes and earnings of incumbent workers and entrepreneurs rise, which however it is generally not. Therefore, this paper will identify demand-side causes of the entrepreneurship decline.

A second shortcoming of current explanations is that they tend to be proximate, not giving sufficient due to possible long-term factors. In this regard [Goldschlag and Tabarrok \(2018\)](#) has pointed out that what all countries where entrepreneurship is declining have in common, are high levels of GDP per capita. The proximate causes of the decline in entrepreneurship in these countries that have been mentioned, are also prevalent in less developed countries - perhaps even more so; nevertheless they do not (yet) show evidence of declining entrepreneurship. Therefore, this paper will identify possible long-term, ultimate causes of the entrepreneurship decline.

The rest of the paper is structured as follows. Section 2 surveys the evidence of the decline in entrepreneurship. Section 3 review the explanations offered in the literature. Section 4 discuss demand-side and long-run causes: explanations that have so far been neglected. Section 5 concludes.

## 2 The Decline in Entrepreneurship: Evidence

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. These are elaborated in the following sub-sections.

### 2.1 Declining entrepreneurial entry and exit rates

In terms of entry, if the rate of entrepreneurship is measured 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 entrepreneurship is measured 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

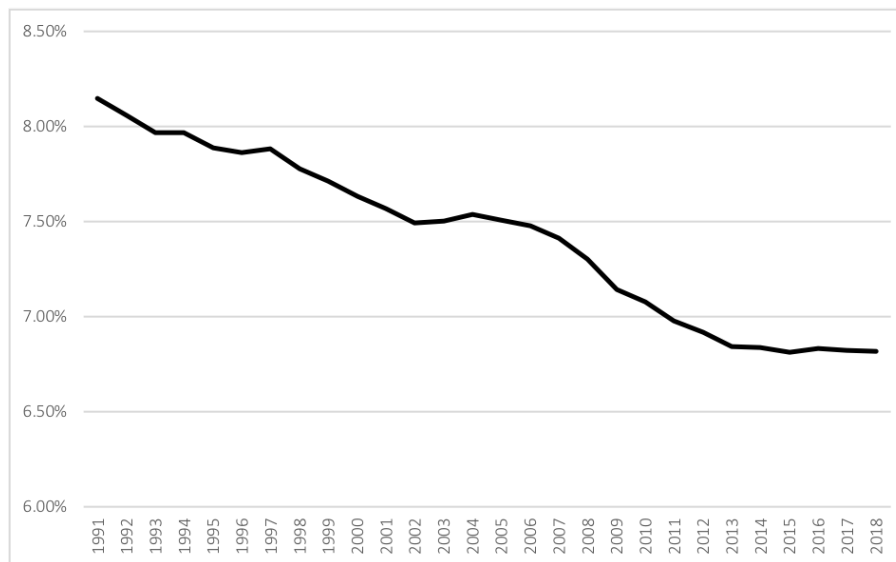
---

<sup>2</sup> See <https://www.people-press.org/2015/11/23/1-trust-in-government-1958-2015/>

for which data is available. [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. [Naudé and Nagler \(2018, p.24\)](#) report that data from the Mannheim Enterprise Panel show that the index of start-up activity (measuring the proportion of new firm entry) in Germany fell from 120 to 60 between 1990 and 2013, a 50 percent decline. [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 high-income countries in aggregate 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.*

While most of the evidence for declining entrepreneurial entry rates comes from high-income countries, it is not exclusively the case, and some recent work has noted declines apparently also setting in in emerging economies. For instance, [Akcigit et al. \(2019\)](#) find declines in entrepreneurial entry in Turkey, but only after 2012. 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 ([Medonald, 2014](#)).

## 2.2 Declining share of young and small firms

[Ács \(1992\)](#), [Kirchhoff \(1994\)](#), [Audretsch and Thurik \(2000, 2001, 2010\)](#) 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., 2014). 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., 2014). And not only do young firms account for a smaller share of employment, they are also less likely to be high-growth firms (Decker et al., 2016b).

The declining share and potential of young and small firms to be high-growth firms partly reflects that the underlying entrepreneurial ecosystem may have become less conducive for firm performance. Guzman and Stern (2019), using data on entrepreneurship across 32 US states over the period 1988-2014 compiled a Regional Entrepreneurial Acceleration Index (REAI). This index “a measure of whether the ecosystem in which a start-up grows is conducive to growth (or not)” [Ibid, p.4]. They find that the REAI “declined sharply in the late 1990s, and did not recover through 2008” and that this reflects that “there seems to be a reduction in the ability of companies to scale in a meaningful and systematic way” (Guzman and Stern, 2019, p.5-6).

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<sup>3</sup> (measured in terms of employment) started to decline. Somewhat contrarian evidence has been found for Sweden by Heyman et al. (2019). The authors find that in Sweden, over the period 1990 to 2013, that young firms in Sweden did not see a declining share as in the US, and moreover that young Swedish firms contributed more to job creation than US firms. They do find however, that since the mid-2000 there has also in Sweden been a (slight) decline in the share of employment in young firms (Heyman et al., 2019).

### 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 surprisingly that after 2000 job creation in the USA shifted from creation of high-paying jobs to low-wage (low-skilled)

---

<sup>3</sup> High-growth firms are defined as “firms which grows in terms of employment by more than 25 percent per year” (Decker et al., 2014, p.8).

jobs. The shift towards low-skilled jobs 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”.

### 3 Explanations

The main theoretical model that have been used in the literature to explain more more broadly the decline in business dynamism have been that of Hopenhayn (1992). See Also Hopenhayn and Rogerson (1993). According to Decker et al. (2016a) this model predict that a decline in entrepreneurship “...indicates either falling dispersion and/or persistence of idiosyncratic business productivity, or falling responsiveness of businesses to their productivity”. From the “Knowledge Spillover Theory of Entrepreneurship” (Ács et al., 2009) changes in business productivity, and changes in the responsiveness of businesses to their productivity, can be the outcome of changes in the growth of the stock of knowledge, the efficiency with which incumbents exploit knowledge, and changes in regulatory measures <sup>4</sup>.

A growing empirical literature has started to offer explanations for the decline in entrepreneurship, taking these theoretical approaches as point of departure, either explicitly or implicitly. This literature has found evidence supporting the following explanations:

#### 3.1 Declining population growth

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 started concurrently with the decline in population growth in these economies, in the mid-1970s. In most advanced economies, fertility rates started to drop below replacement rates<sup>5</sup> in the 1970s<sup>6</sup>. 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 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.

Why would declining population growth and an ageing population lead to lower entrepreneurial

---

<sup>4</sup> 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).

<sup>5</sup> 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).

<sup>6</sup> 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 1970s, which was also the period when fertility rates in these countries, for the first time in history, fell below replacement levels.

entry rates?

The answer is first, that population growth drives innovation. [Strulik et al. \(2013, p.415\)](#) recognise that “a larger population meant a larger number of tinkerers producing more ideas”, and [Kremer \(1993\)](#) provides a growth model wherein more people generate more ideas, and ideas diffuse faster. Thus, a growing population will see, *ceteris paribus*, a higher number of ideas and knowledge in circulation. A decline in mortality, which is one of the mechanisms raising population growth, will furthermore raise 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](#)).

Secondly, as far as an ageing population is concerned, it may be the case that in an older society economic growth prospects and returns to entrepreneurship may be lower. [Pugsley and Sahin \(2015\)](#) find some evidence for this, because it seems that countries with fewer young entrepreneurs are less resilient during recessions, and tend to grow slower after such growth shocks. However, whether population ageing is implicated in the decline of entrepreneurship in the USA may be in doubt, 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](#)).

### 3.2 Growing market concentration

Whereas declining population growth will adversely affect the growth in the stock of knowledge, which is a driver of entrepreneurial entry, growing market concentration may reduce the ability of potential new entrepreneurs to exploit the stock of knowledge. With growing market concentration and domination, access to the knowledge stock may be limited, and the diffusion of new knowledge will slow down. The slowdown in the diffusion of new knowledge is argued in the “Knowledge Spillover Theory of Entrepreneurship” of [Ács et al. \(2009\)](#) to reduce the knowledge accumulation by incumbent firms, which in turn would reduce spillovers of unutilized opportunities by new firms. Moreover, slower knowledge diffusion could lead incumbents to better exploit their existing knowledge, which will lead to a reduction in start-ups, which previously would have exploited this knowledge.

A growing body of evidence suggests that market concentration has been increasing in the West. For instance [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 (i.e. “efficient concentration” as in the superstar firms of [Autor et al. \(2017\)](#)), but rather due to higher market power of incumbents allowing them to raise mark-ups. [Covarrubias et al. \(2019\)](#) finds that after 2000 higher profits in the USA have been due not to efficient concentration, but due to a rise in “bad” concentration with has been accompanied by higher barriers of entry.

[Chatterjee and Eyigungor \(2018\)](#) presents a growth model wherein a decline in the interest



rates (as has been the case over the past decade) benefits larger, 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.

Finally, Akcigit and Ates (2019b) show that leading incumbent firms in the USA use patenting and IP laws to try and build up large and unassailable technological leads over potential rivals. Akcigit and Ates (2019a) refer to this as the “use and abuse” of patents for defensive innovation. As supporting evidence, they 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.

It is not only the use and abuse of patents that hinders the diffusion of new knowledge. Increasing evidence points to the impact of digital technologies, which relies on data-network effects that benefits firms with access to large data, often the firm who were the first movers<sup>7</sup> - see also Calligaris et al. (2018), Ernst et al. (2019) and Korinek and Stiglitz (2017). Moreover, antitrust regulations and enforcement of competition legislation has turned out more difficult in the case of large dominant digital platform firms (Chen, 2019).

The upshot is that, “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).

### 3.2.1 Zombie-firm congestion

Another finding that suggests changes in the structure of market competition as underlying the decline in entrepreneurial entry, by limiting the exploitation of the stock of knowledge, is the recognition of the growing presence of so-called “Zombie firms”. These are old firms ( 10 years old) that have “persistent problems meeting their interest payments” (McGowan et al.,

---

<sup>7</sup> Ernst et al. (2019, p.18) highlights the problem of “data-driven mergers” whereby first-mover dominant digital platform firms maintain their dominance and concentration of the market.

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 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 to compete against zombie firms. Evidence for this is 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).

### 3.3 More burdensome regulations

Many scholars argue that a progressive accumulation of business regulations, including increasing complexity of tax codes, have been making entrepreneurial entry more cumbersome. The possibility that regulations can depress the incentives to start-up a new firm is a clear result from theoretical models - see e.g. Hopenhayn and Rogerson (1993); Fonseca et al. (2001); Klapper et al. (2006). Regulatory barriers raises the productivity threshold for entry and makes it more difficult to exploit existing knowledge. The extent of such regulations in advanced economies have indeed become extensive and perhaps even excessive<sup>8</sup>. 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:

*“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 (Liebrechts and Stam, 2019).

As far as the empirical evidence that a growing complex regulatory environment has

---

<sup>8</sup> A certain level of regulations is however important and good for entrepreneurs and consumers, see e.g. Fonseca et al. (2007)

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.

## 4 New Perspectives

### 4.1 Shortcomings of existing explanations

The explanations discussed in the previous section have two shortcomings. First, they tend to take a supply-side view. As such, entrepreneurial entry rates decline, and less productive firms stay in business, because of slower population growth (supply of knowledge), inadequate competition, and too much regulation. Second, these explanations are essentially proximate causes: it leaves unexplained why competition and the supply of knowledge are declining.

While the supply-side is undoubtedly important, 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 incumbent workers and entrepreneurs to be rising, but it is however generally not. And second, while there is strong evidence that indeed the proximate explanations are relevant, it begs the question why these proximate causes are largely found in advanced economies. Indeed, what all countries where entrepreneurship 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. It reflects that economic growth is a “scaling phenomenon” (West, 2017, p.27). Such scaling brings with it advantages, but also disadvantages. The entrepreneurship literature has generally been oblivious<sup>9</sup> to the possibility of negative scale effects.

The rest of the paper will complement the supply-side and proximate explanations surveyed in section 3, with explanations that considers the demand side, as well as possible ultimate causes for the decline. Section 4.2 will argue for three demand-side constraints, namely declining population growth, rising inequality, and rising energy costs, and section 4.3 will introduce and explain how negative scale effects associated with high GDP, as possible ultimate cause.

### 4.2 Demand constraints

There are three factors contributing to a demand constraint on entrepreneurship entry rates: (i) the decline in population growth in the West; (ii) rising inequality and the declining share of labor in GDP, and (iii) the rise in energy costs. All of these factors started to decline from around the 1970s - the same time that the structural break in entrepreneurial entry occurred.

---

<sup>9</sup> The partial exception is the small and recent literature on sustainable entrepreneurship and on entrepreneurship and ecological constraints, e.g. Potts et al. (2010).

### 4.2.1 Declining population growth - again

Entrepreneurship is the exploitation of opportunities. The set of opportunities, their perception and resources to exploit, will depend on the extent of aggregate demand in the economy. Population size and composition are obvious and direct determinants of aggregate demand. In the survey in section 3.1, it was clear that the current explanations of the decline of entrepreneurship sees population rather as a supply-side factor, in that a slower growing and ageing population will limit the supply of new ideas (innovation) and limit the supply of risk-taking individuals.

It is likely however, that changes in population size and composition have been a cause of slower growth in the West through its effect in reducing the growth of aggregate demand (Yoon et al., 2014). The problem for economists however, is that economic growth models are supply-driven, wherein “aggregate demand usually makes its exit and aggregate supply rules the roost” (Dutt, 2006, p. 319). As aggregate demand is missing from theoretical models, it therefore rarely shows up in searches for explanations.

To overcome this lacuna, Gries and Naudé (2018) provides an economic growth model that includes aggregate demand. They then show mathematically that slower growing aggregate demand will constrain entrepreneurship. Furthermore, they show that slower aggregate demand growth will reinforce the basic supply-side constraints that characterises current mainstream explanations. They also argue that because of the decline in entrepreneurship, that technology is slower in diffusing, that incumbent firms’ profit shares will rise, and that this will be reflected in a further decline in the labor share (i.e higher inequality). This again in turn leads to further declines in aggregate demand growth and in reduced incentives for entrepreneurship. From this it is clear that declining population growth is somewhat intertwined with higher inequality as reason for the decline in entrepreneurship.

### 4.2.2 Rising inequality

As far as higher income inequality is concerned, it is important to point out that within-country income inequality started to rise, particularly in the West, and not coincidentally, in the 1970s.

A particularly strong trend in this regard, which poses for other reasons a particular challenge for 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 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, and as was already mentioned, Gries and Naudé (2018) also links declining population growth with rising income inequality, through the disproportionate rise in profits.

The decline in the relative share of labor in GDP would lead to a declining growth in aggregate demand because of the higher propensity to consume of labor. The decline in the growth of aggregate demand will in turn 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 [Konczal and Steinbaum \(2016\)](#) . 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.

If GDP growth and entrepreneurship entry are demand constrained then supply-side policies to boost technological progress, for instance to support innovation, 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 then slow down, and 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. Because wealthy capitalists consume less than workers, aggregate demand will slow down. The conclusion is that if supply-side policies aiming to stimulate technological innovation fails to raise the share of labor in GDP, then the slower growth in aggregate demand will impact negatively on total economic growth and ultimately entrepreneurial entry rates ([Gries and Naudé, 2018](#)).

### 4.2.3 Rising energy costs

A third demand-side constraint on entrepreneurial entry may be the gradual but steady increase in the costs of energy. Like the other constraints so far discussed, also this started during the 1970s, following more than century of sharply declining energy prices associated with the industrial revolution and the exploitation of fossil fuels. The rapid growth in the use of fossil fuels since the mid 19th century and the rise of the modern industrial economy, has been the engine of development that lead to the rise in GDP and economic complexity of the West ([Foster, 2012](#); [Stern and Kander, 2012](#); [Wrigley, 2013](#)).

The widespread use 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](#)). As a result of the decline in energy costs, energy consumption based on fossil fuels (mainly coal) during the Industrial Revolution in England spiralled upward from around 35,000 megajoules per person per year in 1760, to more than 96,000 megajoules by 1859, of which 92 percent came from coal ([Wrigley, 2013](#)).

[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.

There are however, physical limits to the process of ever-greater complexity driven by fossil fuels [Court \(2018\)](#) argues that complexity has reached such a state in the present global economy that current energy is only sufficient for maintenance of the system, but not further growth. At the same time however, energy demand per capita is decreasing - see e.g. the graph in [Court \(2018, p.20\)](#) or the International Energy Agency data which indicates that energy use per capita in the USA declined from 98,139 kWh in 1978 to 79,056 kWh in 2015<sup>10</sup>. One could argue that this reflects more efficient use of energy; while no doubt energy efficiency has increased substantially, some authors sees this as approaching physical limits, with continued rises in energy prices a given ([Court, 2018](#); [Foster, 2012](#)). [Advani et al. \(2013, p.14\)](#) shows that the index of energy

---

<sup>10</sup> see <https://tinyurl.com/y8819n13>

prices faced by households in Britain was 60 percent higher in 2012 than 1974.

The price of energy and of energy services do not include the total cost of energy. Due to the Second Law of Thermodynamics economies will increasingly suffer the cost to “pay” for their increased complexity (and order) by giving entropy back to the system in terms of increased heat, CO<sub>2</sub> 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”. According to West (2017, p.423). the world “ may be producing so much entropy that the resulting pollution become insurmountable.”

The decline in energy consumption and rise in energy costs, together with the need to deal with the entropy (pollution) from the rising complexity that the utilisation of fossil fuels has enabled, will slow down GDP and productivity growth, as well as entrepreneurship. More household consumption and business investment expenditure will have to be diverted to energy, reducing discretionary spending. And, as Ridley (2020) point out the consequences for innovative entrepreneurship will be detrimental, because higher energy costs “...become embedded in the costs of the capital they create and they deter experimental innovation”.

Growing ecological stress and hitting against the limits of energy efficiency 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 than exponential for most of the known history and most strikingly so in the last centuries”. They have 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”. They predict that this singularity will occur at around the year 2052 plus or minus 10 years. Hence, it may well be that the planetary economy is in a transition towards stagnation, which is characterized by amongst others the decline in entrepreneurship.

### 4.3 Negative scale effects

In addition to not considering demand constraints as reason for the decline in entrepreneurship, current explanations tend to be proximate explanations. It begs the question what the deeper, underlying mechanisms may be that drive the decline in entrepreneurship. It also begs the question why these proximate causes are largely found in advanced economies. Indeed, what all countries where entrepreneurship is declining have in common, are high levels of GDP per capita and high economic complexity (Goldschlag and Tabarrok, 2018).

Intuitively, higher GDP per capita and larger economic scale 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 in decline, however, suggests that decreasing returns have kicked in. It suggest that as economies increase in scale and complexity, that negative scale effects will hamper entrepreneurial entry and growth of smaller, younger firms. Negative scale effects are akin to the congestion effects that characterises growing cities - there are many activities for which the costs will increase as the activity increases. In the previous section, energy cost was an example - the more fossil fuels are transformed into goods and services, the larger the overall increase in entropy. In this section the nature and causes of negative scale

effects and its impact on entrepreneurship are explained.

### 4.3.1 Sigmoid growth curves

Scholars regularly stress that entrepreneurship, in particular “innovative” entrepreneurship, is one of the key drivers of economic growth, e.g. [Ács et al. \(2012\)](#), [Aparicio et al. \(2016\)](#), [Kritikos \(2014\)](#), and [Wong et al. \(2005\)](#). It is also recognised, although less often, that economic growth can also drive entrepreneurship, e.g. [Aparicio et al. \(2016\)](#), [Koellinger and Thurik \(2012\)](#) and [Naudé \(2011\)](#). What scholars however completely miss to consider, is the possibility of declining scale effects - in other words, the positive association between entrepreneurship and economic growth (in both directions) - is unlikely to hold indefinitely. This would imply unbounded economic growth - to continuing growing, just add more innovative/ambitious/opportunity entrepreneurs to the economy!

If unbounded growth is ruled out by physical constraints, then the question is at what level does the growth start to flatten out? The answer may be in the form of a sigmoid growth curve. [West \(2017\)](#) argues that the same sigmoid growth curve that characterises living organisms also apply to the growth of economies, cities, 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.”

[Sequeira et al. \(2018\)](#) proposes an endogenous growth model with which to model this maturity and to estimate when global economic growth will start to level off. They compile a “complexity index”, which is very similar in description to the (Schumpeterian) entrepreneur, in that it leads through innovation to ever higher levels of product variety and complexity. However, in their model there is no free lunch or unbounded growth : due to entropy, entrepreneurship and growth eventually levels off. In one of their scenario’s they find that “the TFP slowdown intensified after the 1960s will continue until complete stagnation occurs near 2450.” ([Sequeira et al., 2018, p.115](#)) and other scenario’s (depending on their parameterization) that growth and entrepreneurship level off between either 2200 and 2700. This is much further into the future than the prediction of [Johansen and Sornette \(2001\)](#) that growth would level of as a finite-time singularity around 2052.

What is a particularly interesting insight illuminated by their model, is that growth and entrepreneurship (complexity) “levels off despite the continuous increase in the stock of available knowledge” ([Sequeira et al., 2018, p.101](#)). They ascribe this to “a low substitutability of ideas or, alternatively, a relatively high ‘relative risk aversion’ to adopt new ideas” (*Ibid*, p. 101). Given the importance accorded to knowledge and ideas in innovation, entrepreneurship and growth theories, it is worthwhile to explore why entrepreneurship would decline despite an apparent growth in knowledge and ideas. Indeed, the topic of growth in knowledge and ideas has become a central one in the debate on the “great stagnation” as for instance argued in [Cowan \(2010\)](#), [Gordon \(2016\)](#) and [Mokyr \(2014\)](#). Why would there be a high relative risk aversion to adopt new ideas in today’s advanced economies? Why would ideas seem to have low substitutability? Is the decline in entrepreneurship a further reflection of the “great stagnation”? Answering these questions may throw light on the dynamics, the inflection points, of the kind of sigmoidal growth curve that characterises entrepreneurial entry and growth over the longer-run.

### 4.3.2 Ideas and entrepreneurs

In section 3.1 of this paper, it was discussed that population growth will lead to more “tinkering and new ideas. This notion is explained rigor in [Strulik et al. \(2013\)](#) , [Galor and Weil \(2000\)](#) and [Kremer \(1993\)](#). Put properly, technological innovation is a function of population size. 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. However, with negative scale effects, this relationship will not be a linear one. Over time as the more ideas and knowledge come into existence, the more difficult it may become to create and use new valuable knowledge. It becomes more difficult in other words to innovate.

Whether or not innovation has been getting more difficult is a question that has led to an important debate in economics, a debate that seeks to explain the twin dilemmas of secular stagnation and the productivity slowdown. This debate has been started off by the slowing down in economic growth that the USA, European countries and Japan experienced since roughly the end of the 1970s ([Teulings and Baldwin, 2014](#)). For instance [Gordon \(2018\)](#) noted that between 1920 and 1970 average annual growth in the USA was 3,7 percent, which then slightly declined between 1970 and 2006 to 3,1 percent but then slowed down much significantly in the decade after 2006 to just 1,35 percent per year. Economic growth also declined in European countries, for instance between 2006 and 2016 average annual GDP growth in Germany and the UK was respectively 1,5 and 1,3 percent, down from 1,9 percent and 2,6 percent over the period 1970 to 2006. A sizable proportion - almost half - of this slowdown in economic growth is ascribed to the slowdown in labour productivity growth ([Gordon, 2018](#)).

The central question, about which answers there are somewhat disagreement, of why productivity and economic growth has declined, is whether innovation has been getting more difficult. The data seems to suggest that innovation is indeed getting more difficult. 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). [Jones \(2009\)](#) reported 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. In particular, [Bloom et al. \(2020, p.1105\)](#) find, using Compustat data, that “research productivity for the aggregate US economy has declined by a factor of 41 since the 1930s, an average decrease of more than 5 percent per year”.

To explain this, it is argued that the ICT revolution has reached ‘maturity’ and that despite much innovative activity we are in an age of “diminished impact of ongoing innovation” ([Gordon, 2018](#), p.20). [Cowen \(2016, p.43\)](#) concurs, declaring that “most new technologies today generate only marginal improvements in well-being. Opposing these explanations are [Mokyr \(2014, 2018\)](#) and ([Brynjolfsson et al., 2017](#)) who argues that there are mis-measurement problems in GDP and innovation, and that innovations needs more time to diffuse and have impact on productivity and growth.

The relationship between declining entrepreneurship and innovation getting harder has however been rather neglected. If innovation was getting harder, it will certain help explain why “Schumpeterian” entrepreneurship has declined; in turn, depending on the reasons for innovation getting harder, the decline in entrepreneurship can also help cast more light on the innovation debate.



So, why would innovation get more difficult as the economy, the population becomes larger, and complexity grows? And how would it impact on, and be mediated by, entrepreneurship?

The main reason, emanating from the endogenous growth literature, is product proliferation. 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. It could do so in two broad ways: first, by reducing the returns on a given level of R &D, and second, by raising the costs to maintain the average level of R &D per worker. Both of these effects would affect businesses productivity dispersions and responsiveness to changes in their productivity, consistent with the theoretical insights from models of business dynamism, e.g. Hopenhayn (1992); Hopenhayn and Rogerson (1993).

*Consider first product proliferation and returns on R &D.*

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.

They 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.

*Consider next product proliferation and the rise in costs to maintain average worker R &D.*

The previous paragraphs have concluded, from Peretto and Smulders (2002) that the growth in ideas would decline due to the complexity effects of product proliferation on R &D returns. This will be the case, unless there are increases in the growth in R&D, so that R&D per worker do not decline<sup>11</sup>. 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).

---

<sup>11</sup> Bloom et al. (2020) finds evidence from the USA however that R &D per worker did decline, implying that the growth in R &D was not fast enough - 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.1105).

In this regard [Bucci \(2015, p.173\)](#) explained, “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”. As has been shown however, population increases, at least in the West, has been declining since the 1970s.

But even if ideas do not decline, say for instance due to rising R&D effort and an increase in population, then the arguments from negative scale effects will still lead to a decline in innovation, if innovation is fundamentally “recombinant”<sup>12</sup>. Then “The ultimate limits to growth may lie not so much in our ability to generate new ideas, so much as in our ability to process an abundance of potentially new seed ideas into usable form” ([Weitzman, 1998, p.333](#)).

[Arora et al. \(2019\)](#) makes a case that the processing of ideas “into useable form” has been further complicated by the growing division of innovation after around 1980, between research, done by universities, and development, by firms. They argue that university research, which has increased due to this specialisation, is more difficult to apply than the research done in corporate labs, and that this could help explain why productivity growth started to decline around the time when the research by corporate labs started to go into decline - they refer to this as the “corporate withdrawal from science” ([Arora et al., 2019, p.24](#)). They document the corporate withdrawal from science in the USA, noting that the average number of scientific publications of large firms halved between 1980 and 2015, dropping from 20 to 10 per annum.

[Bhattacharya and Packalen \(2020\)](#) add to the corporate withdrawal from science a further reason for why the ability to process ideas into usable form has declined. They argue that the particular scientific process that scientists and innovators are following in modern society has become focused more on incremental progress rather than radical breakthroughs, as the “emphasis on citations in the measurement of scientific productivity shifted scientist rewards and behavior on the margin toward incremental science and away from exploratory projects that are more likely to fail, but which are the fuel for future breakthroughs” [*Ibid*, p.1].

Empirical evidence to support the above effects of product proliferation is presented by [Ang and Madsen \(2015\)](#). The authors estimated an “ideas production function” using a dataset covering 26 countries between 1870 and 2010. Their estimates suggest 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](#)).

## 5 Concluding Remarks

[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” may until now have been seen to be a thousand unrelated cuts, it was shown 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 three centuries is unprecedented in the history of humanity. It is not completely understood nor appreciated

---

<sup>12</sup>In other words, “new knowledge that depends on new recombinations of old knowledge” ([Weitzman, 1998, p.332](#)).

fully why this happened, nor whether it is a once-off fluke, or sustainable. One should consider seriously the opinion of [Gordon \(2012, p.1\)](#) that “there was virtually no economic growth before 1750, suggesting that the rapid progress made over the past 250 years could well be a unique episode in human history rather than a guarantee of endless future advance at the same rate”.

This growing level of complexity will inevitably bring with it negative scale effects. This paper has argued that these effects, manifesting as declining rates of return on R &D and rising cost of R &D, and accentuated by the corporate withdrawal from science and growing market concentration, may already be contributing to the decline in entrepreneurship. To the extent that innovation has been the avenue through which entrepreneurs entered the economy during the past three centuries, the restrictions in this avenue, especially since the 1970s, implies that economic development can not be expected to “advance at the same rate” as in the past.

It was noted in this paper that virtually all the explanations of the decline in entrepreneurship identifies the 1970s as the period when fundamental structural breaks occurred. Population growth decline, rising energy cost, growing inequality, increasing market concentration, the corporate withdrawal from science, and declining entrepreneurship - all changes that started in the 1970s. And perhaps most fundamentally and most un-appreciated, as [Weinstein \(2012\)](#) has pointed out, the 1970s also marked the end of progress in fundamental physics, the scientific discipline which underpinned much of the modern economy, from the steam engine to space flight, nuclear energy and the internet. As he describes it *“around 1973-1974, ... our consensus picture of fundamental particle theory stopped advancing. This stasis, known as the ‘Standard Model’, seemed initially like little more than a temporary resting spot on the relentless path towards progress in fundamental physics...But that expected entry into the promised land of new physics turned into a 40-year period of half-mad tribal wandering in an arid desert.”*

Entrepreneurship theory and practice need to be reoriented to a reality in which there is neither an “endless future advance at the same rate” nor a “relentless path towards progress”. This reality confronts entrepreneurship scholars with two challenges. First, with a decline in Schumpeterian entrepreneurship, complex *ossified* modern economies will be less flexible, less adaptable to external change, and hence more vulnerable to shocks, including shocks from pandemics such as COVID-19, a point variously made by amongst others [Beck \(2009\)](#), [Bostrom and Ćircović \(2008\)](#), [Decker et al. \(2014\)](#) and [West \(2017\)](#). And second, as [Thiel \(2011\)](#) recognised a decade ago, *“in a world without growth, we can expect a loser for every winner. Many will suspect that the winners are involved in some sort of racket, so we can expect an increasingly nasty edge to our politics. We may be witnessing the beginnings of such a zero-sum system in politics in the U.S. and Western Europe, as the risks shift from winning less to losing more, and as our leaders desperately cast about for macroeconomic solutions to problems that have not been primarily about economics for a long time.”* Zero-sum politics and the demise of innovative entrepreneurship are caught up in a vicious downward circle.

## Acknowledgements

Earlier versions of this paper were presented at the Dutch Academy for Entrepreneurship's (DARE) research seminar on entrepreneurial dynamics held at the University of Leiden; at the Oxford Residence Week for Entrepreneurship Scholars 2019 at Oxford University's Green Templeton College; at the Department of Economics, Friedrich Schiller University Jena; at the Jheronimus Academy of Data Science; and Erasmus University Rotterdam. I am grateful to the participants of these seminars and lectures for their constructive comments and suggestions, in particular Pontus Braunerhjelm, Uwe Cantner, Marcus Dejardin, Saul Estrin, Maryann Feldman, Maximilian Göthner, Jolanda Hessels, Roger Koppl, Werner Liebrechts, Matthias Menter, Mark Sanders and Roy Thurik. The usual disclaimer applies.

## References

- Ács, Z. (1992). Small Business Economics: A Global Perspective. *Challenge*, 35(6):38–44.
- Ács, Z., Audretsch, D., Braunerhjelm, P., and Carlsson, B. (2012). Growth and Entrepreneurship. *Small Business Economics*, 39:289–300.
- Ács, Z., Braunjerhjelm, P., Audretsch, D., and Carlsson, B. (2009). The Knowledge Spillover Theory of Entrepreneurship. *Small Business Economics*, (32):15–30.
- Advani, A., Johnson, P., Leicester, A., and Stoye, G. (2013). Household Energy Use in Britain: A Distributional Analysis. *IFS Report R85, Institute for Fiscal Studies*.
- Akcigit, U., Akgunduz, Y. E., Tok, E. O., Cilasun, S., and F.Yilmaz (2019). Facts on Business Dynamism in Turkey. *Discussion Paper DP 13999, Centre for Economic Policy Research*.
- 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.
- Aparicio, S., Urbano, D., and Audretsch, D. (2016). Institutional Factors, Opportunity Entrepreneurship and Economic Growth: Panel Data Evidence. *Technological Forecasting and Social Change*, 102:45–46.
- Arora, A., Belenzony, S., Pataconiz, A., and J.Suh (2019). The Changing Structure of American Innovation: Some Cautionary Remarks for Economic Growth. *Mimeo, 22 May*.
- 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.
- Audretsch, D. and Thurik, A. (2001). What’s New about the New economy? Sources of Growth in the Managed and Entrepreneurial Economies. *Industrial and Corporate Change*, 10(1):267315.
- Audretsch, D. and Thurik, A. (2010). Unraveling the Shift to the Entrepreneurial Economy. *Tinbergen Institute Discussion Paper 10-080/3; Indiana University-Bloomington: School of Public & Environmental Affairs Research Paper No. 2010-08-02.*, Available at <http://dx.doi.org/10.2139/ssrn.1664466>.
- 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.
- Bhattacharya, J. and Packalen, M. (2020). Stagnation and Scientific Incentives. *NBER Working Paper no. 26752*.
- 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. (2020). Are Ideas Getting Harder to Find? *American Economic Review*, 110(4):1104–1144.
- Bostrom, N. and Ćirković, M. (2008). *Global Catastrophic 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.
- Brynjolfsson, E., Rock, D., and Syverson, C. (2017). Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics. *NBER Working Paper no. 24001, National Bureau for Economic Research*.
- 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*.
- Chen, R. (2019). Policy and Regulatory Issues with Digital Business. *Policy Research Working Paper no. 8948, Washington DC: The World Bank*.
- 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.

- Covarrubias, M., Gutierrez, G., and Philippon, T. (2019). From Good to Bad Concentration? U.S. Industries over the past 30 years. *NBER Working Paper no. 25983, National Bureau of Economic Research*.
- Cowan, T. (2010). *The Great Stagnation. New York : Penguin (Dutton)*.
- Cowan, T. (2017). *The Complacent Class: The Self-Defeating Quest for the American Dream. New York: Picador*.
- Cowen, T. (2016). Is Innovation Over? The Case Against Pessimism. *Foreign Affairs*, March/April:42–46.
- 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. (2014). 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. (2016a). Declining Business Dynamism: What we Know and the Way Forward. *American Economic Review, Papers and Proceedings*, 106(5):203–207.
- Decker, R., Haltiwanger, J., Jarmin, R., and Miranda, J. (2016b). Where has all the skewness gone? The decline in high-growth(young) firms in the U.S. *European Economic Review*, 86:4–23.
- 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.
- Du, K. and O’Connor, A. (2019). Examining Economic Complexity as a Holistic Innovation System Effect. *Small Business Economics Journal*, published online 26 July.
- Dutt, A. (2006). Aggregate Demand, Aggregate Supply and Economic Growth. *International Review of Applied Economics*, 20(3):319–336.
- EIG (2017). Dynamism in Retreat: Consequences for Regions, Markets and Workers. *EIG.org. Feb*.
- Ernst, E., Merola, R., and Samaan, D. (2019). Economics of Artificial Intelligence: Implications for the Future of Work. *IZA Journal of Labor Policy*, 9(4):1–35.
- Fonseca, R., Lopez-Garcia, P., and Pissarides, C. (2001). Entrepreneurship, Start-Up Costs and Employment. *European Economic Review*, (45):692–705.
- Fonseca, R., Michaud, P.-C., and Sopraseuth, T. (2007). Entrepreneurship, Wealth, Liquidity Constraints, and Start-Up Costs. *Comparative Labor Law and Policy Journal*, (28):637–674.
- 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 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. (2012). Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds. *NBER Working Paper No. 18315. National Bureau for Economic Research*.
- 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*.
- Guzman, J. and Stern, S. (2019). The State of American Entrepreneurship: New Estimates of the Quality and Quantity of Entrepreneurship for 32 US States, 1988-2014. *NBER Working Paper No. 22095*.
- 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.
- Heyman, F., Norbck, P.-J., Persson, L., and Andersson, F. (2019). Has the Swedish Business Sector Become more Entrepreneurial than the US Business Sector? *Research Policy*, 48:1809–1822.



- Hidalgo, C. and Hausmann, R. (2009). The Building Blocks of Economic Complexity. *PNAS*, 106.(26):10570–10575.
- Hopenhayn, H. (1992). Exit, Entry and Firm Dynamics in Long-Run Equilibrium. *Econometrica*, (60):1127–1150.
- 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*.
- Kirchhoff, B. (1994). Entrepreneurship and Dynamic Capitalism. *Praeger Publishers: Westport*.
- Klapper, L., Laeven, L., and Rajan, R. (2006). Entry regulation as a barrier to entrepreneurship. *Journal of Financial Economics*, (82):591–629.
- Kleiner, M. (2015). Guild-Ridden Labor Markets: The Curious Case of Occupational Licensing. *Kalamazoo, MI: W.E. Upjohn Institute for Employment Research*.
- Koellinger, P. and Thurik, A. (2012). Entrepreneurship and the Business Cycle. *The Review of Economics and Statistics*, 94:1143–1156.
- 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*.
- Korinek, A. and Stiglitz, J. (2017). Artificial Intelligence and its Implications for Income Distribution and Unemployment. *NBER Working Paper no. 24174. National Bureau for Economic Research*.
- Kozeniauskas, N. (2018). Whats Driving the Decline in Entrepreneurship? *Mimeo*.
- Kremer, M. (1993). The O-Ring Theory of Economic Development. *Quarterly Journal of Economics*, 108(3):551–575.
- Kritikos, A. (2014). Entrepreneurs and their Impact on Jobs and Economic Growth. *IZA World of Labor*, doi: 10.15185/izawol.8.

- 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):145–167.
- Marinoni, A. and Voorheis, J. (2019). Who Gains from Creative Destruction? Evidence from High-Quality Entrepreneurship in the United States. *CES Working Paper no. 19-19, Washington DC*.
- 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*.
- Mokyr, J. (2014). Secular Stagnation? Not in Your Life. In *Teulings, C. and Baldwin, R. eds. Secular Stagnation: Facts, Causes and Cures. CEPR. Available at: <https://voxeu.org/content/secular-stagnation-facts-causes-and-cures> (accessed 23 July 2018)*.
- Mokyr, J. (2018). The Past and the Future of Innovation: Some Lessons from Economic History. *Explorations in Economic History*, 69:13–26.
- Mueller, H., Quimet, P., and Simintzi, E. (2015). Wage Inequality and Firm Growth. *Working Paper no. 20876, National Bureau of Economic Research*.
- Naudé, W. (2011). Entrepreneurship is Not a Binding Constraint on Growth and Development in the Poorest Countries. *World Development*, 39(1):33–44.
- 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.
- 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*.
- Ridley, M. (2020). The Government’s Energy Policy could Cripple Global Britain. *Matt Ridley Online Blog, 9 March*.
- 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.
- Song, J., Price, D., F.Güneven, Bloom, N., and Von Wachter, T. (2015). Firming Up Inequality. *Working Paper no. 21199, National Bureau of Economic Research*.

- Stern, D. and Kander, A. (2012). The role of Energy in the Industrial Revolution and Modern Economic Growth. *The Energy Journal*, 33(3):125–152.
- 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*.
- Teulings, C. and Baldwin, R. (2014). Secular Stagnation: Facts, Causes and Cures. *London: Centre for Economic Policy Research*.
- Thiel, P. (2011). The End of the Future. *National Review*, 3 October.
- Thurik, A. (2011). From the Managed to the Entrepreneurial Economy: Considerations for Developing and Emerging Economies, (in Naudé, W. ed. 2011. Entrepreneurship and Economic Development. Basingstoke: Palgrave Macmillan.).
- 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.
- Weinstein, E. (2012). Einstein’s Revenge: The New Geometric Quantum. *The Edge*, <https://www.edge.org/response-detail/11441>.
- Weitzman, M. (1998). Recombinant Growth. *Quarterly Journal of Economics*, 63(2):331–360.
- West, G. (2017). Scale: The Universal Laws of Life and Death in Organisms, Cities and Companies. *London: Weidenfeld and Nicolson*.
- Wong, P., Ho, Y., and Autio, E. (2005). Entrepreneurship, Innovation and Economic Growth: Evidence from GEM Data. *Small Business Economics*, 24:335–50.
- Wrigley, E. (2013). Energy and the English Industrial Revolution. *Phil Trans R Soc, A* 371::20110568.
- Yoon, J.-W., Kim, J., and Lee, J. (2014). Impact of Demographic Changes on Inflation and the Macroeconomy. *IMF Working Papers no. WP/14/210, International Monetary Fund*.