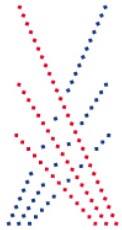

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Causes of the Global Productivity and Innovation Slowdown: Revisiting the role of Managerial Research

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ABSTRACT

The purpose of this paper is to review literature that suggests that the word is currently experiencing a global productivity growth slowdown. This slowdown is also associated with a slowdown in returns to investments in innovation, in the form of research and research and development. The paper presents an overview of different predicted causes of this phenomenon. Some argue that the slowdown in global productivity growth reflects a paradox, in itself. We advance a polemic, challenging certain widely held assumptions about the primary causes of the global productivity slowdown. In so doing, we seek, and find, support for our arguments that certain of its structural causes relate specifically to problems well suited to the problem-solving capabilities of management theory and practice, with important societal implications. On the basis of a synthesis of the literature, implications are derived and suggestions made for how to contribute to efforts to mitigate it.

Keywords: Innovation; knowledge; management theory development and practice; Solow paradox; global productivity slowdown

1. Introduction

Growth in global volumes of goods and services, produced using a given amount of labour and capital, is the primary determinant of growth in living standards over time (Fabina and Wright, 2013:1). Since 1850, the world's gross domestic product (GDP) per capita has risen 20-fold, transforming standards of living (Stewart, 2018). Productivity is therefore the primary determinant of a group, country, or the world's standard of living (Conerly, 2015). The simplest measure of productivity is output per hour worked.

The productivity of an economy is therefore a measure of the efficiency with which it uses its resources, and particularly its labour and investments in capital, to "produce valuable goods and services" (Fabina and Wright, 2013:1). Starting well before the recent global financial crisis, however, productivity growth has slowed, a phenomenon some have described as the "productivity puzzle" (Haldane, 2017:2).

Different schools of thought suggest different hypotheses to explain this puzzle, but all seem in agreement that the world has entered an era of low productivity growth, or secular stagnation. Such a global decline has important implications.

Recent empirical work using Granger causality tests suggests that glow economic growth is a cause of the productivity growth slowdown (Erber, Fritsche and Harms, 2017). Granger tests indicate which effects persist over time, which is as close a proxy to causality that one can arrive at using econometric methods. Although slowing growth may be a contributor to the phenomenon of slowing productivity, there are a host of other causes of the productivity growth slowdown, including differences in firm-level productivity (Andrews, Criscuolo and Gal, 2016; 2017) that question certain assumptions about global inequality.

Until the 1970s, economic convergence between advanced and emerging countries seems to have been largely on track, with emerging countries closing the gap with advanced countries. This catch-up has since stalled. The trend toward convergence seems to have perhaps even "gone into reverse, in both advanced and emerging economies," whereby classical "growth dynamics appear for some reason to have stopped operating, with the gap to the frontier widening the more so the greater the distance to it" (Haldane, 2017:10).

Debates persist as to which specific causal channels account for this current trend of declining productivity growth, and the extent to which they do. In this paper, we suggest that an overview of these debates, with special reference to the U.S. context, may be helpful, as it can illustrate the complexities associated with the phenomenon, and allow for a synthesis of its implications, and even its causes. Hence, this is what we seek to do here.

Given the importance of the consequences of a global slowdown in productivity, the objective of this paper is to provide a synthesis of diverse streams of literature in order to derive novel insights into its nature, and causes. In doing so, certain widely held assumptions are challenged, and an argument is presented, that at the heart of the problem, and key to its solution, is also the development of management theory, and the dissemination of management knowledge.

Whereas a review of certain proposed causes of the global productivity growth slowdown creates an impression of disordered change, a core logic is suggested here that seeks to explain that these mooted causes instead reflect stable conditions that largely have a few identifiable causes. The objective of this paper is therefore to provide a critical review of a broad range of mooted causes of the global productivity growth slowdown, and to offer a synthesis to summarise certain of its core themes. In doing so, we highlight the role of management, as a scholarly field, in mitigating certain of its causes, given the level of analysis required might be the firm-level, or even the process level, in the case of the global R&D productivity slowdown.

Having outlined the objective of this paper, it proceeds as follows. A wide range of views on the causes of the global productivity slowdown is considered, each in turn. A synthesis of these views is then offered, and three overarching causes are identified. An argument is then presented, that certain of these causes fall squarely within the ambit of management science. Different perspectives of the causes of the global productivity slowdown are now introduced and discussed.

2. Contested causal channels: What is causing the slowdown in productivity growth?

According to Fabina and Wright (2013) there has been a dramatic reduction in the rate of growth of productivity across almost all advanced economies for the period 2003-2012. Reseach has however recently questioned longstanding assumptions that technological advances will necessarily spur productivity growth, or reverse its declining trend.

2.1. What happened to the promised technology productivity revolution?

US productivity data seem to support the notion that transformative innovation is only happening on the Internet and not across the economy, as the behavioural impact of innovations enabled by Google and others is largely not being felt in economic terms (Byrne, Fernald and Reinsdorf, 2016). Scepticism as to a dominant role of IT in productivity growth, however, is not new. Indeed, according to Solow (1987:36):

> What this means is that they, like everyone else, are somewhat embarrassed by the fact that what everyone feels to have been a technological revolution, a drastic change in our productivity lives, has been accompanied everywhere, including Japan, by a slowing-down of productivity growth, not by a step up. You can see the computer age everywhere but in the productivity statistics.

To understand the potential for technology to reverse the current declining productivity trend it is necessary to consider its contribution to productivity across past decades.

2.2. The contribution of IT to productivity growth over the past decades

Using a standard neoclassical growth accounting framework, Oliner and Sichel (2000:3/4) estimate that in the 1990s, increases in the stocks of IT products and infrastructure accounted for about two-thirds of the increases in labour productivity of the nonfarm business sector.

However, using manufacturing sector data, Acemoglu, Autor, Dorn, Hanson and Price (2014) focus on IT-using rather than IT-producing industries, finding little evidence of faster productivity growth in IT-intensive industries after the late 1990s. This was despite a rise in output per worker over the entire 1980-2009 period, as more rapid growth of labour productivity was associated with declining output, and even more rapidly declining employment in IT-intensive industries. According to Acemoglu et al. (2014:394):

> If IT is indeed increasing productivity and reducing costs, at the very least it should also increase output in IT-intensive industries. As this does not appear to be the case, the current resolution of the Solow paradox does not appear to be what adherents of the technological-discontinuity view had in mind.

Chui, Manyika and Miremadi (2016:1) analyse approximately 2000 work activities for over 800 occupations, suggesting that automation "will affect portions of almost all jobs to a greater or lesser degree, depending on the type of work they entail." Automation therefore has the potential "to transform sectors such as healthcare and finance, which involve a substantial share of knowledge work. (p.1)" There seems little doubt as to the growing influence of technology, but its potential influence on productivity growth, and thereby on development, seems at yet unclear. According to Byrne et al. (2016:5):

> First, as measured, aggregate business-sector labour productivity and TFP growth rise sharply in the mid-1990s but then slow again after 2004 or so. Second, the slowdown was broadbased across industries, including relatively well-measured ones…Third, the TFP slowdown is similar if we hold industry weights fixed- it does not reflect a rising share of slow-growth industries.

Byrne et al. (2016:5) therefore rule out the "alternative explanation" of productivity mismeasurement, which supports the "return to normal" hypothesis, that the mid-2000s marked "an end(or pause) in a phase of exceptional, broad-based gains from the production and use of information technology." This suggests that the productivity gains of technology have largely been short-lived.

2.3. A slowdown in business spending?

According to Picerno (2017), the sluggish rate of growth in capital spending by businesses may be contributing to declining productivity growth. The Capex measure of capital expenditures, which includes investments in new technologies to boost productivity, suggests that business

investment has been “flat to negative” in recent years (Picarno, 2017:1). Keen (2017) suggests that the global slowdown is also a result of the fact that a large share of business investment is debt-financed, and with high levels of accumulated corporate debt worldwide; investment has therefore fallen, with fewer investments in new technology. Indeed, as the slowdown has been universal, it might reflect weak demand growth, rather than technological influences because countries that are less technologically developed are expected to show rapid growth, which is not evident (Baker, 2017).

2.4. To what extent is government policy to blame?

According to Abbot (2017), low productivity growth may have resulted from tax distortions, including high corporate income taxes in the U.S. that disincentivise the capital formation, producing inefficient capital markets, with the associated costs largely borne by labour. However, according to Lacalle (2017), declining productivity growth may be a result of the perpetuation of overcapacity that has resulted from cheap debt and excess liquidity, increases in subsidies for obsolete or low productivity sectors (such as those previously designated ‘national champion’ status), and currency devaluations that effectively take the form of indirect subsidies to rent-seekers and these sectors.

Lacalle (2017) also highlights the role of increases in government spending that have financed certain areas of the economy that have inherently low real economic returns, further contributing to low overall productivity growth. Capital allocation is typically channelled to low productivity sectors because of incentives provided by fiscal and monetary policy (Lacalle, 2017). Indirect productivity losses can result from deficit spending that reduces the value of one’s earnings, such as the 7% monetary loss from U.S. Federal Debt expansion (Denninger, 2018). Abbot (2017) suggests that the secular slowdown in productivity may be a function of a steadily increasing burden of regulation, which has given rise to anticompetitive market distortions. Similarly, Cochrane (2017) stresses that bureaucratic red tape is problematic, and that the strengthening of regulatory barriers may have resulted in declining competitiveness across many industries. The results of this are fewer new businesses, high corporate profits that occur together with lower investments, and the effects of social welfare programmes that keep people from moving to better jobs.

Shedlock (2017) criticizes the Fed for its monetary policy, which has sought to have a 2% inflation rate in a technological price-deflationary world. This is particularly problematic when the discipline of the gold standard has been replaced by a worldwide phenomenon of burgeoning credit. Selgin (2017) highlights the role of policies that hinder the efficiency of banks, as macroprudential and monetary policies may have shifted savings away from the most productive areas of lending and investment and toward government and government agencies. Low market interest rates, interest on excess reserves, and new liquidity coverage ratio requirements have led to a decrease in commercial bank loans and leases, from about 100% to about 80% of total bank deposits, and bank reserves to about 20% of the value of bank deposits. This may all have contributed into lower productivity overall (Selgin, 2017). Table 1 summarises debates on the declining productivity growth phenomenon. Long term economic implications and implications for management theory and practice are also summarised in this table. The role of labour in the productivity slowdown is now discussed.

Table 1. Summary overview of certain debates on the causes of the global productivity slowdown

Reasons for the global productivity slowdown	Author/s
Measurement issues and the productivity slowdown	
Productivity slowdown has been universal, may therefore reflect decline in demand growth.	Baker (2018)
Dramatic reduction in rate of growth of productivity across all advanced economies for the period 2003-2012.	Fabina and Wright (2013)
Productivity slowdown may reflect a measurement problem	Aizcorbe et al. (2009)
Productivity slowdown largely not a measurement problem	Byrne et al. (2016)
The role of technology	
Computer age evident everywhere but in the productivity statistics.	Solow (1987)
Productivity growth has not been driven by IT-intensive industries.	Acemoglu et al. (2014)
US productivity data suggest that transformative innovation is only happening in the Internet economy.	Byrne et al. (2016)
IT key in the productivity revival over the years 1995-2000 but smaller role after 2000, when cost cutting and industry restructuring may have taken over in contribution to productivity (unsustainable).	Oliner et al. (2007)
Problem of IT replacement of human work rather than enhancing human performance.	Lloyd (2017)
Analysis of 2000 work activities for over 800 occupations: automation will transform certain sectors.	Chui et al. (2016)
Productivity may have declined due to effects of technology economy which have died out.	Fatas (2017)
The influence of the financial crisis	
Hysteresis effects of recession that dampen productivity	Fatas (2017)
Behaviours of Firms	
Sluggish rate of growth in capital spending by businesses	Picerno (2017)
Large share of business investment is debt-financed	(Keen, 2017)
Role of governments	
Tax distortions, high corporate income taxes that disincentivise capital formation and produce inefficient capital markets.	Abbot (2018)
Government spending to finance low productivity sectors/areas of the economy, and role of incentives to do this provided by fiscal and monetary policy	Lacalle (2017)
Deficit spending reducing the value of earnings	Denninger (2017)
Steadily increasing burden of regulation, particularly problematic in their creation of market distortions	Abbot (2017) Cochrane (2017)
Federal Reserve is mistaken in seeking monetary policy to achieve a 2% inflation rate in a technologically price-deflationary world. Dropping the gold standard was problematic as it has led to a proliferation of global credit.	Shedlock (2017)

Reasons for the global productivity slowdown	Author/s
Certain policies hinder the efficiency of banks, and macroprudential and monetary policies have shifted savings away from the most productive areas of lending toward low productivity government areas.	Selgin (2017)
Declining productivity growth might be driven by the collapse of gross private domestic investment and excess financialisation, as government consumption and gross investment have declined.	Norman (2017)
Labour Effects	
Financial crisis affected wages and led to a renegotiation of psychological contracts, negatively influencing productivity	Charalanbous (2017)
Medical cost inflation and incentives to remain ill and not work may contribute to declining productivity growth	Denninger (2017)
Weaker labour markets put pressure on workers to take lower pay and lower productivity jobs in sectors with lower levels of capital investment	Baker (2017)
Productivity increases might reflect the effects of payroll cuts in certain periods and decline with increased hiring in other periods	Miller (2017) Morss (2017)
Technologies such as email and cellular phones can reduce workplace productivity as they consume time.	Shedlock (2017)
Declining growth in labour productivity might reflect slowing investment as labour productivity is simply a measure of the output to employment ratio.	Keen (2017)
Disintermediation of the financial and real economic sectors	
A breakdown has occurred, between the financial and real economic sectors as the financial sector is no longer primarily focused on the productive allocation of capital and socially productive activity is no longer as strongly associated with market returns in an information economy.	Quiggin (2017)
Excessive financialisation may be taking the place of investments in roads, bridges, infrastructure, science research and basic R&D.	Norman (2017)
Financial transactions tax should be used to reduce wasteful trading in the financial sector	Baker (2017)
Aging populations	
Poor institutions and aging populations are important contributors to declining productivity growth	Di Matteo (2017)
It is not aging populations as baby boomer aging does not explain the rise of real output amidst a decline in median earnings.	Shedlock (2017)
Obesity and its complications contribute to healthcare costs, a large portion of GDP	Kimball (2018)
Shift toward labour intensive and lower-productivity services from manufacturing is reducing productivity. The productivity gains of new technologies take longer to manifest than those associated with the production of new goods.	Di Matteo (2017)
Major categories of goods have price elasticities less than one and will decline in price relative to other goods and services, and their share of the budget will decline.	Kimball (2017)
Shift from manufacturing to service economies has changed the fundamental nature of knowledge and technology diffusion. This has interacted with a decline in funding for basic R&D and the financial crisis to create a climate of low investment and knowledge diffusion. Productivity has therefore suffered.	Flynn (2017)
Political shifts	
Factors of production are failing to diffuse to their most productive uses, and the anti-free trade policies of the Trump presidency in the US and Brexit in the UK are expected to act to constrain this further.	Flynn (2017)

2.5. Labour productivity and the productivity slowdown

According to Charalambous (2017), declining productivity growth might to some extent be explained by the assumption that labour is paid its marginal product, in that the financial recession of 2007-2008 affected wage levels and led to the renegotiation of psychological contracts, with a negative effect on productivity. On its own, the term productivity is typically used in reference to labour productivity, but can relate to other forms of productivity (Conerly, 2015). Given the difficulties inherent in measuring services, healthcare, or other intangible relationships, labour productivity is however not well measured. It is also better measured over longer periods, as it is pro-cyclical. Notwithstanding its measurement issues, the question here is to what extend did labour productivity effects contribute to the global productivity decline?

An aging population might contribute to a productivity slowdown. The standard of living of a society is dependent on its labour productivity, which is also a function of how many of the population are of working age (Conerly, 2015). Worldwide, about 52% are of working age, and a country is typically dependent on this ratio, short of importing immigrants of working age. Over the long term, worker compensation will tend to follow increases in productivity, as a function of the natural tendency of markets (Conerly, 2015). However, in terms of labour productivity, medical cost inflation might also have contributed to declining productivity growth, according to Denninger (2017). Rising medical costs associated with an aging population are especially problematic.

Poor institutions and aging populations are important contributors to the problem of declining productivity growth (Di Matteo, 2017). Shedlock (2017) argues that the recession and the aging of baby boomers do not account for poor earnings growth, however, because real output has continued its upward trend across time, whereas median real earnings have fallen.

2.6. Disintermediation of the financial and real economic sectors?

Another school of thought relates to how financialisation has overtaken economic activity in the real economy. Declining productivity growth might be driven by the collapse of gross private domestic investment and excess financialisation, in that government consumption expenditures and gross investment have declined (Norman, 2017). Excessive financialisation may be taking the place of investments in roads, bridges, infrastructure, science research and basic R&D (Norman, 2017).

Quiggin (2017) argues that a breakdown has occurred between the financial and real economic sectors, as the former is no longer concerned with the productive allocation of capital, and socially productive activity is no longer strongly related to market returns in an information economy. Pro-growth policies might also be useful in this regard, as well as a financial transactions tax to reduce wasteful trading in the financial sector, and a similar approach to the health care sector (Quiggin, 2017). These sources of waste, however, cannot account for the productivity slowdown, according to Baker (2017).

2.7. A sectoral shift from manufacturing to services activities?

Di Matteo (2017) suggests that declines in productivity growth can largely be accounted for by a shift toward services industries, which are more labour intensive, and the fact that the productivity gains of new technologies are slower to manifest than the production of new goods. Kimball (2017) suggests that as long as major categories of goods and services have price elasticities less than one, they will decline in price relative to other goods and services, and decrease their share of the budget. Thus, improvements even in agriculture and manufacturing may offer diminishing returns to overall economic growth measures. There are however opportunities in sectors like construction to bring down housing costs that have to

date been resistant to technological progress. Similarly, obesity and its complications add to healthcare costs, which is a sizeable portion of GDP (Kimball, 2017). Sectoral changes therefore have the potential to contribute to productivity growth.

Flynn (2017), however, suggests that the transition from manufacturing to service economies may have changed the fundamental nature of knowledge and technology diffusion, which, combined with a decreasing policy focus on funding for basic R&D, and with the disruptions of the financial crisis, have created a climate of low investment and low knowledge diffusion, with fewer productivity gains. According to Shedlock (2017), a slowdown in manufacturing productivity is related to the decline in overall productivity, whereas technological productivity enhancements in the services sector have been slow in coming. Real manufacturing output has risen while numbers of employees have fallen, but diminishing returns are evident in the way technology can replace workers (Shedlock, 2017). These changes, together with increasing technological inequality, are a cause for concern (Brynjolfsson and McAfee, 2014:47).

2.8. The role of rising inequality

To what extent is inequality within the firm a contributor to the global phenomenon of increasing wage inequality? Whereas Piketty (2013) and Mishel and Sabadish (2014) argue that overall inequality is primarily driven by chief executive officer earnings and compensation, other evidence in the US context challenges this argument.

Song, Price, Guvenen and Bloom (2015) test the relationship between rising earnings inequality in the US context over a thirty-year period and the contribution of firms to this inequality. Song et al. (2015) sought to question how much of the rise in earnings inequality can be attributed to differences in average wages paid, to rising wage dispersion between workers within firms, or to characteristics like gender, age or tenure differences. They constructed a matched employer-employee data set for the US of all firms across the years 1978-2012.

In doing so, they found that almost all of the rise in earnings dispersion between workers was explained by a higher dispersion of wages paid by different employers, whereas pay differences within employers remained largely unchanged. This finding was robust across industry, geographical, and firm size differences. They also found that the wage gap between the highest paid employees and average employees increased only slightly, putting paid to the assumption that this accounted for much of the increasing inequality in the population (Song et al., 2015).

According to Song et al. (2015), there are two possible explanations for these findings. The first is that increased sorting has occurred, whereby in earlier periods firms employed workers with a broader range of skills levels, but now may tend to employ more specialised workers, with narrower skills groups. This would account for certain firms paying higher average wages due to increased quality of work. The second explanation relates to growing productivity differentials across firms. If production technology "delivers positive assertive matching and workers are mobile and then higher skill workers will flock into higher productivity firms" and visa versa, then higher productivity differences could themselves result in higher sorting (Song et al., 2015:3).

Song et al. (2015:4) therefore suggest that their results "stress that any explanation for rising inequality must take into account an understanding of the nature of the firm and the economic motivations that led to its boundaries." According to Taylor (2018), low productivity growth can also be explained by the slow diffusion of technologies and practices that lead to higher levels of productivity. Pointing to the OECD (2015) report on the future of productivity, Taylor (2018) suggests that slow diffusion of technologies and practices has led to an increasing

productivity gap between firms. This therefore gives rise to the question of whether many firms lack the ability, perhaps due to a lack of organisational or human capital, to make productivity-related improvements or whether the incentives to make such investments are lacking, in turn perhaps due to the uncertain profitability of such investments. Within-firm wage dispersion might therefore not primarily be driving increasing overall inequality. This is considered further in the following section.

2.9. Does a productivity gap account for divergence of firms and countries from the productivity frontier?

The OECD report of 2015 suggests that divergence of high- versus low-productivity firms can largely explain the global productivity growth slowdown. According to Gurria (OECD, 2015:3):

> Productivity is the ultimate engine of growth in the global economy. Raising productivity is therefore a fundamental challenge for countries going forward…[the OECD report] shows that we are not running out of ideas. In fact, the growth of the globally most productive firms has remained robust in the 21st century. However, the gap between those global leaders and the rest has increased over time, and especially so in the services sector…The rise in wage inequality largely reflects the increasing dispersion in average wages paid across firms. Raising the productivity of laggard firms, via better diffusion, could contain increases in wage inequality.

This perspective contests the notion that returns to R&D are declining (that we are running out of ideas, as suggested by the work of Kortum (1997), Segerstrom (1997), Cowen (2011), and Gordon (2016), placing the blame for decreasing productivity growth instead on slow knowledge diffusion of productivity-enhancing technologies and practices. This is a heterogeneity issue, in that mean productivity reflects a large tail of less productive firms together with fewer firms at the frontier.

According to the OECD (2015) report, leading firms in industries, termed Global Frontier firms, have become more productive than the rest of their cohorts. Diffusion of technologies and practices that enable productivity improvements has been slow. According to this report, such diffusion is typically a function of the following. (i) Global connections, that result from foreign direct investment (FDI), trade, global value chain (GVC) participation and international skilled labour mobility. (ii) Firm experimentation (particularly by new entrants), such as that related to new ideas, technologies and business models. (iii) The efficient allocation of scarce resources associated with the flows of labour, capital and skills to the most productive firms, and (iv) investments in innovation, R&D, managerial capital, and organisational know-how that allow for the absorption, adaptation, and ability to take full advantage of new technologies. If to some extent the global productivity slowdown reflects the divergence of high- versus low-productivity firms, then this problem is primarily one of poor diffusion. Academic research and teaching (the academy) should therefore shoulder some of the responsibility for improving such diffusion.

2.10. What is the role of the academy in the global productivity slowdown?

Constraints to the diffusion of highly-productive management practices may be at the heart of the problem of declining productivity, according to the OECD (2015) logics. Indeed, evidence points to substantial productivity differences between firms which is driving the statistics that report substantial inequalities in firm performance (Bloom and Van Reenen, 2007; Bloom, Sadum and Van Reenen, 2012). The slow diffusion of productivity-enhancing technologies and practices accounts for the increasing divergence between highly productive firms on the technological frontier and laggard firms. The latter are found to comprise a large tail of the distribution (OECD, 2015). This divergence is echoed in trends towards a slowdown in

developing country convergence with industrialised countries (Rodrik, 2011), and in the way US firms outperform those in other contexts such as Europe (Bloom et al., 2012). It must be asked, is there a failure of the academy in diffusing the necessary knowledge, if between-firm divergence is primarily at the heart of the productivity growth slowdown?

Some have argued that the structure of academic publishing is anachronistic, with its structure a legacy of the printed journal industry (Davis, 2014). Such a structure imposes structural constraints on the publishing process that are now no longer appropriate, given the capabilities offered by today's technology. Others (see Callaghan, 2018) suggest that technology now offers the potential for near real time research productivity, or technologically-enabled research that can achieve economies of scale in not only data collection but also in analysis and theory development. Such arguments suggest that academic research is simply not able to contribute sufficiently to societally important problem solving in its current form, unless complemented by technologically enabled research innovations that offer economies of scale.

Such perspectives build on work by Nielsen (2012) that suggests that we are entering a new era of discovery, whereby radically increased connectedness can increase the potential for breakthroughs across different fields. However, according to Gordon (2016: 2):

> …advances since 1970 have tended to be channelled into a narrow sphere of human activity having to do with entertainment, communications, and the collection and processing of information. For the rest of what humans care about- food clothing, shelter, transportation, health, and working conditions both inside and outside the home- progress slowed down after 1970, both qualitatively and quantitatively. Our best measure of the pace of innovation and technical progress is total factor productivity (hereafter TFP), a measure of how quickly output is growing relative to the growth of labor and capital inputs. TFP grew after 1970 at barely a third the rate achieved between 1920 and 1970.

Certain decades-old theoretical models have sought to explain the phenomenon associated with declining productivity growth and returns to investments in research and development (R&D). Indeed, "puzzling trends in industrial research, patenting, and productivity growth" have been recognised in that patenting has "been roughly constant as research employment has risen sharply over the last forty years" (Kortum, 1997: 1389). Although endogenous growth theory advanced by Romer (1990; 2008) offers an opposing prediction, Segerstrom's (1997) model, also from within the endogenous growth literature, accords with Kortum's (1997) in that it predicts that the achievement of research breakthroughs are becoming harder to achieve with time. If research discoveries are being fished out over time, and returns to investments in R&D, or innovation, are declining, what then are the implications of this for development? This paper seeks to make the argument *that there exists a common pattern in these developments*, and that it is possible to make this pattern explicit. The implication of this argument is that a single causal effect may underlie all these developments.

Cowen (2011: 2) stresses that the "pace of technological development has been slowing down" since the 1970s, due to the exhaustion of the benefits of previous technological change. Discussions associated with the 'Fourth Industrial Revolution' (the emergence of novel technologies that are interacting to blur boundaries between the physical, digital and biological domains to create cyber-physical systems) predicts hitherto unrealised productivity gains (Schwab, 2017). These technological changes have, however, also been described as a 'second machine age' (Brynjolfsson and McAfee, 2014:47) associated with technologies that can substitute for human cognitive work, as opposed to the first machine age, associated as it was with technology as a complement to human work. Despite these promises, Gordon (2016)

suggests that these technological developments are limited, and have largely not reflected in TFP measures. Although TFP might be considered a poor measure of innovation, it does offer a useful account of productivity. Why is this?

In cross-country regressions, productivity functions are typically estimated using quantities of capital and labour. As such, it is possible to consider TFP (which is the residual value left over when capital and labour are accounted for) as a measure of technical or technological progress, or the productivity with which capital and labour are combined to generate gross domestic product in an economy. Following Haldane (2017:2):

> At this point, it is customary to wheel out the following, now rather over-used Paul Krugman quote: "productivity isn't everything, but in the long run it is almost everything." Despite its over-use, this quote does have one important virtue, something not to be taken lightly in this post-fact, post-truth world: it is empirically verifiable and appears to be factually accurate.

The global decline in productivity growth began prior to the onset of the global financial crisis, therefore reflecting a "fundamental decline in the rate of growth of efficiency of economies, not simply declines in factor utilization" (Fabina and Wright, 2013:1).

3. Summary and Synthesis

Having reviewed different arguments for what the causes of the global productivity growth slowdown are, in this section we present a summary and synthesis of this literature, and argue that there do exist certain root causes of the phenomenon.

Given the failure of advances in IT to translate into productivity growth (Fabina and Wright, 2013; Acemoglu et al., 2014; Byrne et al., 2016; Lloyd, 2017), the evidence seems to support Solow's (1987:36) longstanding paradox, in that you "can see the computer age everywhere but in the productivity statistics."

Whereas the much mooted upside of the technology revolution is yet to reflect in productivity statistics, this cannot be said about certain of its downsides. Technological change is arguably an important source of unemployment (Brynjolfsson and McAfee, 2014; Chui et al., 2016), perhaps contributing to a decrease in spending by those displaced in this way. Indeed, weakening labour markets can make it necessary for people to take jobs with lower productivity, in sectors with lower capital investments (Baker, 2017).

Slow rates of growth in capital spending by businesses (Picerno, 2017), the high share of business investment that is debt financed (Keen, 2017), and a context of monetary policy that seeks to create inflation in a technological price-deflationary world of expanding credit (Shedlock, 2017), might present a context in which it is difficult to increase productivity growth. High corporate income taxes may also have a role in disincentivising capital formation, and together with an increasing burden of regulation (Abbot, 2017) and bureaucratic red tape that results in declining competitiveness (Cochrane, 2017) may also be contributing to the global productivity slowdown. Further, cheap debt and excess liquidity may have acted as subsidies for sectors that are obsolete or that have low productivity (Lacalle, 2017). These influences might vary across contexts, however, and are thus not likely to account fully for the productivity slowdown effect as it has occurred globally.

Less developed countries do not currently seem to be able to use technology to grow more rapidly than developed countries (Baker, 2017) and the productivity decline has largely occurred across all advanced economies (Fabina and Wright, 2013), exacerbated by the influence of aging populations and rising healthcare costs (Conerly, 2015; Baker, 2017) associated with medical cost inflation (Denninger, 2017), dampening productivity growth.

Although all these factors might have a combined influence in driving the global productivity slowdown, we suggest that there is a common fundamental cause that underlies them all. We argue that this fundamental cause relates to a failure of management science research and teaching, and scale disadvantages associated with insufficient funding and state support of universities and the research effort in general.

Negative structural change

A structural change might be occurring, as the financial sector is no longer as strongly related to the real economy as it used to be, and financialisation *takes the place of investments in infrastructure, science research and basic R&D* (Norman, 2017). The financial sector might therefore not be sufficiently concerned with the productivity allocation of capital, and socially productive activity (Quiggin, 2017). The expansion of the financial sector might also reflect the broader trend away from manufacturing toward service sector jobs, with lower inherent productivity (Di Matteo, 2017). A global shift of manufacturing toward the East Asian regions might account for much of this slowdown, as it is clear that services are largely less productive than manufacturing activity. Acknowledging this as an important contributor to the productivity slowdown, we argue that there is another effect at work underpinning productivity declines across contexts.

Inequality in productivity between firms

Inequality (divergence, or a failure to converge) between highly productive firms and less productive firms, and even countries, might be a dominant cause of the global productivity slowdown. In terms of countries, the trend toward convergence seems to have perhaps even "gone into reverse, in both advanced and emerging economies," whereby classical "growth dynamics appear for some reason to have stopped operating, with the gap to the frontier widening the more so the greater the distance to it" (Haldane, 2017:10). The fundamental productivity problem relates to the fat tail of low productivity firms that have fallen behind the technology frontier, and not to the productivity of all firms, as a minority are able to maintain their place at this frontier (OECD, 2015; Haldane, 2017). *Given that the productivity gap seems to be between firms, and therefore not within firms, the problem primarily becomes one of knowledge diffusion*. Thus, if the OECD (2015) diagnosis is correct, then the challenge falls to management theory development and management education to address this knowledge diffusion problem.

The global decline in R&D and research productivity

Another body of theory points to a further reason for the global productivity growth slowdown, in the form of a generalized global slowdown in R&D and research productivity. This global slowdown is predicted by longstanding theoretical models (see Kortum, 1997; Segerstrom, 1997; Jones, 2009). Just as with the promised technology productivity revolution, evidence of the R&D slowdown is at odds with Romer's (1990; 2008) theory. In light of overwhelming evidence of this global R&D slowdown, from the 1970s onwards (Cowen, 2011; Gordon, 2016), it is argued here that it is this research slowdown that has failed to provide the research solutions needed to address the global productivity growth slowdown. If we are facing a slowdown in innovation, or R&D-linked innovation, then we suggest that this is not unrelated to the global productivity slowdown. However, if the global productivity slowdown is to a large extent explained by a productivity divergence between firms, then it is still a lack of an understanding of how to effect knowledge diffusion across firms that might be at the heart of the global productivity slowdown problem.

If so, then some responsibility for the global productivity slowdown might need to be shouldered by the academic project, on both counts, as it is the site of the global R&D and research slowdown since the 1970s and it is also failing to solve the problem of the lack of knowledge dispersion between firms. If the primary problem of the global productivity slowdown is a dispersion, or inequality, between productive firms and less productive firms (see OECD, 2015; Haldane, 2017), then the primary finding of this paper is that this firm inequality-based explanation might be a minority view, notwithstanding fairly compelling evidence that it might account for much of the slowdown.

Further evidence to support the firm inequality hypothesis

What other evidence exists to support this explanation? At stake is the idea that certain assumptions of the inequality literature are essentially incorrect, and that to solve the global productivity slowdown it is necessary to clarify these debates. As previously discussed, Piketty (2013) and Mishel and Sabadish (2014), for example, have argued that overall inequality is primarily driven by chief executive officer earnings and compensation. Challenging these assumptions, Song et al. (2015) have questioned how much of the rise in earnings inequality can be attributed to differences in average wages paid and to rising wage dispersion between workers within firms, or by characteristics like gender, age or tenure differences. They found a rise in earnings dispersion between workers was explained by a higher dispersion of wages paid by different employers, whereas pay differences within employers remained largely unchanged. This finding was robust across industry, geographical, and firm size differences. They also found that the wage gap between the highest paid employees and average employees increased only slightly, putting paid to the assumption that this accounted for much of the increasing inequality in the population (Song et al., 2015).

Importantly, this perspective places the firm at the heart of the global productivity slowdown problem, and management as a field at the centre of its problem-solving efforts. Having made arguments to narrow the field of suspected causes of the global productivity growth slowdown, and having summarised the main findings of the analysis, the paper concludes with recommendations for policy and further research.

4. Conclusions and recommendations for policy and further research

The objective of this paper was to draw together a relatively wide range of suggested causes of the global productivity growth slowdown. In doing so, a qualitative perspective of these competing views was used to draw tentative conclusions about its dominant causes. Another objective of the paper was to provoke new thinking about the causes of the global productivity growth slowdown, and to highlight the potential role for management in crafting solutions to it. Three overarching themes were identified, which suggest ways that management as a field can contribute to mitigating the consequences of this slowdown.

The first theme relates to a shift that may have occurred, away from real economy relationships, perhaps related to a time when manufacturing had a larger share in the economy. This shift seems to have largely been toward services, creating negative structural change, as services are less productive than manufacturing. This shift has co-occurred with the financialisation of the financial sector, whereby it is less engaged with its previous role, of channelling resources to productive outcomes in the real economy (related to goods and services).

The second theme relates to the phenomenon of a growing inequality in the productivity of firms, which has perhaps, at least in the US context, been labelled incorrectly as inequality within firms. This is the cause favoured by the OECD (2015) study.

The third theme relates to a large body of theory and evidence that shows that a global slowdown has occurred, since the 1970s, in R&D and research in general.

We conclude that management, as a scholarly field, should look at how to address the issues associated with the second and third themes, and that is uniquely placed to deal with the second. Certain policies are required to sustain productivity growth. The OECD report highlights eight areas in which policy can contribute to an increase in productivity growth. Given that we suggest that the OECD (2015) analysis offers the diagnosis that is (perhaps) most amenable to scholarly interventions in our field, recommendations to solve the problem from the OECD study are discussed as follows.

4.1. Increased public funding and organisation of basic research

These include increased public funding and organisation of basic research to provide the right incentives for researchers, so as to "push out the global frontier" and compensation for an "inherent underinvestment in basic research" (OECD, 2015:10). This accords with the theoretical arguments of others (see Author, 2018) that suggests that the structure of scientific research is fundamentally mismatched to the speed at which technological proliferation is enabling geopolitical conflict, technological unemployment, and other potentially catastrophic threats. Implied in these arguments is the need to radically increase numbers of universities, and to not abdicate the responsibility for research, particularly basic research, to the market. We suggest that it might be useful to take a leaf out of the books of China and other emerging countries that are gaining on others through a concerted focus on state investment in research capabilities.

4.2. Support for increasing international connectedness and coordination of research investment

Policy should support rising international connectedness and the role of multi-national enterprises in driving frontier R&D, which require the support of global mechanisms to co-ordinate investment "in basic research and related policies, such as R&D tax incentives, corporate taxation and IPR regimes" (OECD, 2015:10). Given a seeming 'withdrawal' from globalisation associated with recent political turns in the US, UK, and Europe, it is not clear whether there is as much support for international research connectedness today. Further research should seek to link the need for multi-national research and trade cooperation with the consequences of the global productivity and R&D productivity slowdown.

4.3. Enabling the diffusion of innovations at the global frontier to national frontier firms

Policy should support the diffusion of innovations at the global frontier to national frontier firms, through increasing trade openness, global value chain participation, and the mobility of skilled workers (OECD, 2015). Accordingly, benefits due to the reduction of barriers to international trade and of services regulation should be enhanced through global value chain participation. A radical clamp down on foreign high skilled researchers in universities, in particular, might be counterproductive, as the global shift in manufacturing to the East might ultimately be followed by a shift in the centres of research productivity. Openness in the flows of highly skilled workers might keep a global balance of power in research-enabled national frontier firms.

4.4. Facilitate the effective functioning of markets

Policies should support the effective functioning of product, labour and risk capital markets and ensure that resources are not trapped in inefficient firms, and should ensure "efficient judicial systems and bankruptcy laws that do not excessively penalize failure" (OECD,

2015:10). Such policies would help firms at the national frontier to achieve sufficient scale and enable their entry into global markets to benefit from innovations at the global frontier. Academic research, particularly of the multidisciplinary nature, should seek to support these goals through research and teaching efforts that reduce inefficiencies in firms.

4.5. Ensuring an open and competitive business environment

Policies should ensure a competitive and open business environment that enables "the adoption of superior managerial practices" while not incentivising inefficient business structures, but at the same time facilitating within-firm productivity improvements (OECD, 2015). This also relates to the effects of stronger competition which increases the diffusion of existing technologies to laggard firms, allowing them to catch up to the national frontier. Again, the common thread here is the need for multidisciplinary research and teaching that addresses this problem of knowledge diffusion.

4.6. Ensuring support for basic research so that young firms are not neglected

Policies should ensure that no bias occurs in funding applied research over basic research and incumbents over younger firms, in terms of innovation policies, R&D financial incentives, university-firm collaborations, and IPR protections (OECD, 2015).

4.7. Improving the efficiency of matching in labour markets

Policies should seek to improve the efficiency of matching in labour markets to improve productivity performance, which can be done through reducing barriers to firm entry and exit (OECD, 2015).

4.8. Policy reforms to increase worker mobility and reduce skills mismatch

Policy reforms are necessary to reduce the influence of policies that restrict worker mobility and amplify the costs of skill mismatch, examples of which include high transaction costs on property purchases and excessively restricted property planning requirements, with these supplemented by finding for lifelong learning to mitigate slowing growth and increasing inequality (OECD, 2015).

In summary, the review conducted here suggests that the problem of the global productivity slowdown seems to be widely attributed to different causes. The primary finding of this paper is that certain of its causes are uniquely suited to engagements by multidisciplinary research, with firm-level dynamics of productivity inequality an important contributor to the global productivity slowdown. We suggest that our field should take note of the ways in which it can contribute to addressing the global productivity slowdown problem.

We also suggest that multidisciplinary research, not limited to any single domain, should pay attention to the problems associated with the management of the research and R&D process itself. Bringing the full force of theory development and empirical testing to bear on the R&D/research productivity slowdown might also contribute to addressing the global productivity slowdown. This might be reconceptualised as a problem for which the research process is the unit of analysis. This would bring this problem squarely within the ambit of transdisciplinary research, and present new opportunities for solving problems.

In short, the objective of this paper was to provoke new thinking about the causes of the global productivity growth slowdown, and to highlight the potential role for multidisciplinary research in crafting solutions to it. The key message of this paper is to suggest avenues for productivity enhancement that are not dependent on the technological productivity mooted by fourth industrial revolution advocates, as these are yet to show up in global productivity.

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