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Process Improvement and Inflation: A missing connection

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Abstract

Purpose: This paper explores the role of process improvement within the context of inflation to better understand the relevance of inflation within research on process improvement and operations management more broadly.

Design/methodology/approach: The work systematically surveys literature that draws upon inflation and process improvement individually, before identifying work that draws from both, specifically by referring to them in either their titles, abstract or keywords. Economics literature is drawn from to explore the concept of inflation before applying this within the context of literature related to process improvement. Real world examples are presented, that illustrate the mechanisms that contribute to and result in price inflation as seen by consumers, moving away from more broadly held views of what inflation is.

Findings: The results from literature provide limited evidence on the role of inflation within operations management literature. However, by applying the insight developed from the review of economics literature to process improvement, the research provides useful insight into theory and understanding of key concepts related to organisations' ability and need to engage in improvement.

Originality/value: Given the very limited volume of studies exploring the overlap between inflation and process improvement, the work opens a fertile new seam of research, connecting operations and economics research. The work also suggests a need for operations management researchers to question established views of inflation within their work.

Keywords: Inflation, Process improvement, Measurement, Economics, sustainability, literature review

Quick value overview

Interesting because: This paper introduces the concept of inflation, with clear definitions drawn from economic literature, into the core operations management concept of process improvement. By exploring an underlying, underexplored driver of operations improvement, the paper provides a missing connection between operational and macro variables that affect business operations.

Theoretical value: Due to the very limited use of the concept of inflation within operations management literature, the paper explores the relationship between process improvement and inflation. For example, by engaging in process improvement to reduce costs, firms can maintain the value customers receive in inflationary environments without reducing profit margins or increasing prices to customers.

Practical value: The paper provides a novel, inherently practical perspective on a topic that has become central to broader economic discussions; inflation. This provides policy makers and economists practical strategies to offset the negative consequences of inflationary monetary policies on business and individuals. The paper also provides practitioners and managers a foundation on which to build process improvement initiatives to work proactively against external factors affecting the business. Finally, the paper highlights the limitations of broadly accepted economic frameworks that suggest 'inflation is good for an economy', even though it can negatively impacts those in the economy, as well as the environment.

1. Introduction

Process improvement (PI) is a critical activity within operations management, providing firms with a mechanism with which to reduce costs, adapt, increase customer satisfaction and ultimately continue to operate sustainably (Matthews et al. 2015). However, outside of operations management, while PI research covers a broad range of topics from software engineering to healthcare, much less attention is given to the relationship between PI and higher-level constructs. PI tends to focus on making adaptations to reduce errors, increasing the volume of production, or improving the ability to produce multiple product variants; operational metrics. Even so, coordinated PI can have a significant impact on a sector as a whole. For example, Womack et al. (1990) explored differences between automotive manufacturers across the globe, where coordinated PI contributed to dramatic company and nation state level differences in performance. The impact outlined by Womack et al. (1990) was significant improvements in automobile factory productivity and finished product quality were realised by manufacturers who applied different approaches to PI, resulting in significant differences in firm productivity and profitability.

PI provides companies with the opportunity to learn from mistakes and make changes to processes that add value within their operations. Compared to making changes to the characteristics of the product itself, it is possible for organisations to make internal changes to their processes without sharing this information with their customers or competitors, allowing them to sustainably increase profitability without having to increase prices to customers (Matthews et al. 2015). While recent work has explored the impact of technological capabilities (Fitz-Oliviera and Tello-Gamarra 2024) and robotisation (Stingl et al. 2024) for improving operational efficiency, no attention is given to the role of inflation and its impact on costs. The attention of PI research is oriented around operational measures, overlooking connections between PI and higher-level concepts or metrics, such as inflation. This leads to the following research question that will be addressed within the study:

What is the role of inflation within operational process improvement initiatives?

The following sections will focus firstly upon exploring how inflation is defined, measured and its role in an economy. This section will focus specifically on answering the question of 'what is inflation?' by drawing from economic literature, exploring this from an established Keynesians perspective and critically reviewing this viewpoint with discussions from an alternate, Austrian economics angle. These perspectives usefully mirror the focus of PI and inflation, with Keynesian economics focusing upon macro factors and Austrian economics focusing upon micro level decisions. Following this section, the literature-based research methodology employed within the paper will be presented, before discussing how research has discussed PI and inflation together. To illustrate the potentially important role of PI, a recent inflationary episode is used to illustrate a key driver of inflation, and the role PI efforts could have played. The next section presents research on PI with explicit attention given to the role of inflation, drawing from literature identified by the systematic survey of literature to further connect the two topics. The paper will be drawn to an end with a discussion that answers the research question while also identifying limitations. The paper concludes with an increased awareness of PI's ability to contribute more to understanding of inflation, practical recommendations for working against inflationary pressures and theoretical implication for incorporating the concept of inflation within operations management research.

2. Theoretical Background: What is inflation?

To clearly articulate inflation for the context of operations management, 3 articles that explicitly ask, "what is inflation?" are explored. They originate from 3 distinct time periods, the 1950's (low inflation), 2010's (low inflation) and 2020's (high inflation). A further piece emphasising inconsistences in the measurement of inflation, and how that data is used, will also be drawn from (Bullard 2011). Importantly, across the work looking at *what is inflation*, distinct perspectives are taken to discussions, with the earlier works (Hart 1957, Oner 2010) taking a Keynesian perspective (Keynes 1920), with the later piece drawing from the work of Murray Rothbard (2009) and other scholars associated with the Austrian school of economics (Hansen and Newman 2022).

Hart (1957) stated the need to move away from the "incantations" associated with inflation and move towards "sober descriptions of facts" (p.8). At its simplest, inflation was described as "a process that raises price levels" (p.8), where excessive levels, defined as hyperinflation, can have significant societal impacts. Hyperinflation has historically occurred when governments were unable to pay their debts through collected taxes and chose to print their currency, leading investors and citizens to lose faith in monetary authorities. While this highlights the risks of countries being able to issue currency themselves, Hart (1957) described a similar situation when new gold supplies were unlocked in the new world, and how their introduction resulted in the inflation of prices denominated in gold, or gold losing value, although this was stated as a temporary phenomenon.

Oner (2010) provided a more recent perspective on inflation, with more attention on specific mechanisms within an economy that lead to price increases. Rather than the impact of absolute inflation, the relative difference between consumer income and price inflation was referred to, where even if prices were rising, if wages were increasing more quickly, this was acceptable to citizens. An interesting angle of the work was not only the dynamic between prices and income, but also between borrowing and inflation, where those with debt (such as mortgages, for examples) were able to benefit, if inflation was above the rate at which they were borrowing, leading to the value of what they had borrowed effectively falling over time. Having been published by the International Money Funds, while outlining problems with high inflation, the general consensus was "inflation is good for an economy" (Oner 2010, p45) by promoting consumption before a currency's purchasing power fell. From this position, the opposite of inflation, deflation, was described as bad for an economy, illustrated by the example of Japan, where sustained deflation hampered economic growth since the late 1980's, resulting from delays in spending, due to the value of the money increasing overtime.

As a counter perspective, Bullard (2011) provided a more critical rather than descriptive view, not simply on what inflation was, but how it was measured, building upon aspects of Oner (2010), stating that central banks could influence how inflation was measured. By focusing upon core inflation, that excludes energy and food, Bullard (2011) suggested the Federal Reserve (the central bank of the US) would change policies based on measures that were less dynamic than price changes in an economy. The use of core inflation excludes larger trends, such as economic development in China and India during the 2000's, that dramatically increased demand for energy. Fascinatingly, Hart (1957, p.11) suggested "Wage rates may have a powerful enough upward drive to override" inflation-based price increases, however, if the government did not measure the impact of energy, inflation linked wage increases would not capture energy-based price inflation, leaving wage earners behind inflation-based price increases. Within such an environment, by reporting lower inflation rates, concerns about further price increases could be reduced, moderating "inflation expectations" (Oner 2010, p.45), so justifying smaller wage increases, which were also stated as driving inflation. Rather than actioning causes of inflation, inflation expectations were stated as a primary tool of central banks in gaining control of inflation (Oner 2010). Unfortunately, unless the causes of inflation

were identified and addressed, the process of reporting inflation at lower levels than those experienced by consumers, would reduce upwards pressures on wages, so reducing the rate at which lower earners' wages increase. With lower earners tending to have food and energy as higher portions of their expenses, they would be disproportionately affected as energy and food became an ever-larger portion of their income (such as pensioners), thus leaving them with progressively less purchasing power.

To take a small step back from this "Keynesian Revolution" (Hansen and Newman 2022, p.148), the final piece reflects on the works of Von Mises and Rothbard, approaching the subject from an Austrian economics perspective, that gives attention to micro-level behaviours. Within this viewpoint, rather than inflation being viewed as a measure of the increase in the cost of goods, and whether particular items should or should not be included in measures, inflation was defined simply as:

> "the process of issuing money beyond any increase in the stock of specie" (Rothbard 2009, p990)

This perspective on inflation (termed monetary inflation), suggested that those within central banks determined inflation by changing the supply of money in a way that did not reflect economic growth, measured by an increase in the amount of "specie" the bank held in reserve (historically gold). The impact of this definition is there does not need to be a systematic increase in the circulating supply of money, suggesting "no inflation can occur in an unhampered market economy" (Hansen and Newman 2022, p.151), meaning stable prices. The counter argument for this was then stated as "an increase in the supply of money (also known as inflation) must necessarily lead to a decline in the value of the currency" (Hansen and Newman 2022, p.153), providing a connection with the fall in purchasing power mentioned above. This argument is clearly illustrated in environments where central banks and governments issue currency to deliver services that cannot be funded directly through tax revenue. This leads to the value of their currency declining, which is then seen by consumers as prices of goods increasing (the outcome of monetary inflation). Interestingly, within these two perspectives, there is a distinct gap between macro-level incantations (Hart 1957) and expectations (Oner 2010) of a Keynesian perspective and the micro-level of increasing the money supply of an Austrian perspective (Hansen and Newman 2022). The next section provides an overview of the process of identifying and selecting the literature included in the review of operations literature related to inflation and process improvement.

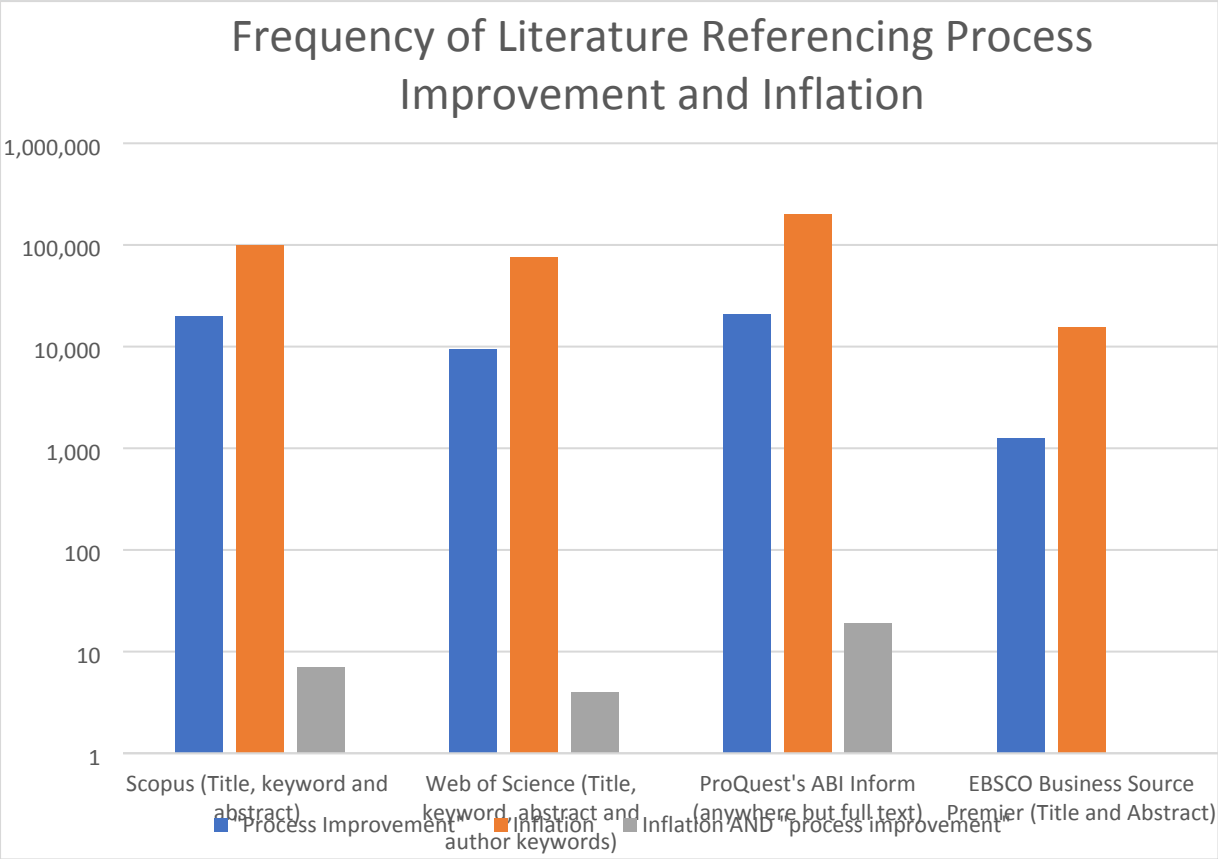
3. Research Methodology: Inflation in Operations Management

Dekkers et al. (2024) suggested that within a systematic literature review, at least two databases need to be drawn from. Table 1 presents the search terms used within this systematic survey, across the four identified databases, Scopus, Web of Science, Proquest's ABI inform and EBSCO Business Source Premier, published up to year end, 2024. Figure 1 shows the significant differences between the volume of "process improvement" and "inflation" papers, as well as papers discussing the topics together. Web of Science and Scopus provided most comparable search functionality, consistent with systematic literature review procedures outlined by Tranfield et al. (2003). To explore the overlap between "process improvement" and "inflation", articles were identified that referred to them both, in their title, abstract and keywords (TAK), which returned 7 titles from Scopus and 4 from Web of Science.

Table 1: Systematic Survey Data

Data Base	"Process Improvement"	Inflation	Inflation AND "process improvement"
Scopus (Title, keyword and abstract)	20,108	99,430	7
Web of Science (Title, keyword, abstract and author keywords)	9,471	75,644	4
ProQuest's ABI Inform (anywhere but full text)	20,833	202,698	19
EBSCO Business Source Premier (Title and Abstract)	1,260	15,587	0
Secondary Whole Document Search	Inflation	"Process improvement"	n/a
Scopus	36 (0.180%)	41 (0.04%)	
Web of Science	3 (0.03%)	4 (0.005%)	n/a
ProQuest's ABI Inform	256 (1.2%)	433 (0.2%)	n/a
EBSCO Business Source Premier	8 (0.6%)	5 (0.03%)	n/a

Figure 1: Process Improvement and Inflation related literature frequency across databases



Of the 7 Scopus titles, one was a conference review, one was a note related to wage inflation resulting from outsourcing to India (Wheatley 2005) and one was related to traditional Chinese drugs, which was not accessible. The remaining 4 were published in peer-reviewed academic journals. 3 of the 4 Web of Science titles were the same as the peer-reviewed Scopus sources. The article not identified within the web of science database was related to blood safety and availability. Within the 3 articles from both databases, PI was discussed in terms of improving operational systems with inflation being used in terms of increasing orders (Tang et al. 2013, Mao et al. 2016) or increasing risks in peer-to-peer lending (Chulawate and Kiattisin 2023). Only Goodman et al. (2023) (from the Scopus search) referred to inflation as an increase in prices over time, in terms of measuring costs but also choosing measures of inflation to captures changes in the product price.

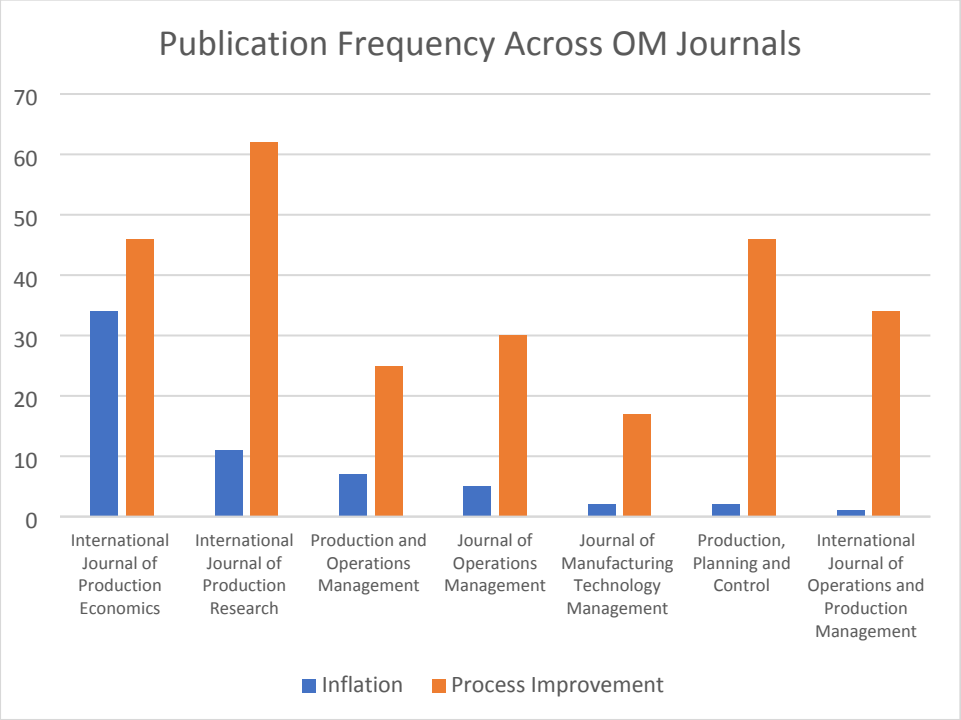
In comparison to this small population of pieces that refer to both PI and inflation as core topics (appearing in TAK), the search criteria were broadened to include sources that referred to each term in the whole article. Within the sample of PI as a core topic (20,108 documents), 36 sources were identified in the Scopus database where inflation appeared within the rest of the article. Research topics were across the subject areas of Business, Management and Accounting, Engineering, Decision Science and Medicine. These studies covered multiple perspectives on PI, such as it being part of a lean initiative (Assen 2018) or the mechanisms for making changes to industrial processes to reduce energy consumption (Napp et al. 2014). Even when drawing on broader improvement approaches, the work broadly emphasised the importance of PI to enable organisations to achieve goals and change outputs to meet requirements. However, within the identified sources, the concept of inflation, while mentioned, was not given attention, from appearing within a title of a

reference (Nahra et al. 2006) to a reference to a statistical term (Assen 2018) to comparing prices across years using government inflation data (Napp et al. 2014).

Of the 99,430 documents with inflation in their TAK, 41 documents referred to "process improvement" within the rest of the article, with Medicine, Decision Sciences and Engineering being the major subject areas (accounting for 28 of the papers). Topics included healthcare costs in India (Balarajan and Selvaraj 2011), Lean Manufacturing (Palange and Dhatrak 2021) and supply chain risk (Handfield et al. 2020), with inflation focusing upon risks of increasing prices. Within this work, limited reference was given to PI, apart from Palange and Dhatrak (2021), where PI was the outcome of a lean initiative. This piece will be explored in more detail later in the review. Although it was possible to explore the theoretical underpinnings of the sample of papers using bibliometric techniques, such as those outlined by Marzi et al. (2024), that allow more objective analysis, due to the low number of sources returned, a conceptual, narrative approach was selected.

4. Inflation in Operations Management Research

Figure 2: Inflation and Process Improvement Articles in Operations Management Journals



As illustrated by table 1, the overlap between research on "process improvement" and inflation is limited, representing less than 1% of the initial sample. A further exploration of operations management journals within the sample of 99,430 articles with inflation as a core theme resulted in a sample of 57 sources, where inflation was covered within operations management journals. Figure 2 provides a comparison between the papers that related to inflation and those related to PI. While not drawing directly from economics literature, the sample shows an alternative sample where the concept of inflation has been able to inform operations management research. Broadly, inflation was used to explore the optimisation of order quantities and the need to consider inflation when holding stock (Chandra and Bahner 1985, Sarker and Pan 1994). These concepts were explored further by Mohamed and Youssef (2004), who considered how different inflation rates affected the location of overseas facilities, which determined the comparative profitability of disperse production sites. More recently, Segelod (2020) suggested inflation was a factor affecting short-termism of

manager perceptions in US companies, when compared to other countries. In locations where inflation was low, such as Sweden, management demonstrated longer-term approaches to management, compared to more short-term approaches in higher inflation environments. Khakbaz et al.'s (2023) work reflected recent inflationary episodes (to be discussed later), suggesting that inflation and interest rates could impact inventory management systems, finding that within high inflation environments, inventory hording took place, due to it acting as a better store of value than local currencies. Finally, while focusing upon the role of blockchain technologies in supply chain management, Grida and Mostafa (2023) acknowledged the importance of preventing currency inflation that may reduce the value of the rewards for maintaining the blockchain. While focusing upon a specific context, this piece illustrated how an increase of a currency's supply could impact behaviours of those within a system.

This small, but recent sample demonstrates the growing relevance of research on inflation within the context of operations management, in terms of it representing a concept that warrants further investigation. However, none of this sample draws directly from the work of Keynes, Von Mises nor Rothbard, suggesting operations management is yet to draw directly from economics-based definitions of inflation. The following section begins by presenting the role of PI within a broader organisational context rather than focusing upon process level metrics of performance, which will provide a foundation on which to discuss an inflationary episode.

5. Process improvement within a Broader Economic Context

"Process improvement is central to operations management" (Anand et al. 2010, p. 304), due to it providing the connection between the current approach to operating and a desired future state. Unfortunately, attention upon PI is often oriented towards short-term reductions in non-conformances and cost savings, with less attention on making connections between PI and long-term firm-level outcomes (Cankaya and Sezen 2019, Yacob et al. 2019). As the previous section demonstrates, research is also yet to draw from economics-based literature to explore how consistent and coordinated PI may impact higher level metrics. For example, if firm level PI is oriented towards cost saving and increasing the value as received by customers, it is logical to suggest that the cost of products would reduce over time, similar to findings presented by Womack et al. (1990) in the automotive sector. Unfortunately, it is very difficult to show direct causal relationships between micro level operational PIs and macro level measures of inflation. However, outside carefully selected examples (Bullard 2011), over time, the price of food, fuel, housing and utilities have risen significantly, with knock on effects of upwards pressure of wages (ONS 2024A), inconsistent with the established view that "inflation is good for the economy" (Oner 2010, p.45). While recent surges in inflation can be attributed to specific geopolitical events (the invasion of Ukraine, to be discussed later) (Resolution Foundation 2024), the driver of longer-term price increases is given less attention, remaining a combination of *incantations* (Hart 1957) and *expectations* (Oner 2010).

Globally, central banks have chosen inflation targets (Oner 2010), where changes are made to central bank interest rates, with the intention to promote or slow economic growth, with the aim of promoting sustainable economic development alongside stable prices and full employment (IMF, 2024). "Inflation targeting is straightforward, at least in theory" (IMF, 2024), unfortunately, the process of accurately defining what to measure and then actually measuring inflation is a difficult process that can separate broader changes in prices from what is being measured (Bullard, 2011). While questioning this is an important part of this paper, the aim is not to recommend improved approaches to measuring inflation; *There is nothing so useless as doing efficiently that which should not be done at all* (Attributed to Peter Drucker). As a result, rather than improving how accurately

inflation is measured, attention can be directed towards efforts to minimise inflation. The following section presents a recent episode of increased inflation that was attributed to a natural gas supply shock, although attention is given to identifying another factor that contributed to the cost-of-living crisis that was experienced in the UK (House of Commons, Library 2022).

6. Inflation in a Macro Context

Before 2022, in the UK and most of *the west*, inflation was something mentioned by statisticians on a monthly or quarterly basis, where figures below 2% (the central bank target) were a cause for mild concern, due to risks of deflation and above 2%, a cause for moderate concern due to increasing prices (Oner 2011). For over a decade before 2022, inflation had tended to be something that did not generate much interest or news, however, in 2022 this changed, when prices started to rise dramatically, causing pressure on individuals' incomes, creating what became known as the "cost of living crisis" (House of Commons Library, 2022). Reflecting on section 2, there were various *incantations* of what inflation was (Hart 1957), whether it was the impact of a loss of cheap Russian gas, or the impact this had on other markets, there were multiple, identified *causes* of inflation. From this viewpoint, attention was given to providing relief, but also attempting to manage consumer inflation expectations (Oner 2010).

Within this example, attention was not given to understanding the broader, long-term drivers of inflation. Reflecting this, the British government approached the problem from a Keynesian perspective, that suggested inflation was a result of demand, with the right amount promoting economic growth, and too little resulting in unemployment. However, Keynes also stated that:

> "By a continuing process of inflation, governments can confiscate, secretly and unobserved, an important part of the wealth of their citizens." (Keynes. 1920, Ch.VI)

Unless broader drivers of inflation are understood, with decision makers aware of them, questions are not raised in terms of whether inflation was only caused by a lack of short-term supply. Without understanding broader drivers, inflation expectations may change behaviours, increasing short-term demand which then results in further increases in prices. In the case of 2022, a cause of the reduction in supply of gas was identified as Russia's invasion of Ukraine, disrupting the supply of gas from Russia into Europe, but also wheat supplies from Ukraine to global markets (Lodewick and Lichtenberg 2022). The knock-on effects of these shortages were reduced supplies with consistent demand (and then increasing demand into winter), creating upwards pressure on prices. The impact of simple supply-demand economics, with global markets for commodities, was the cost of utilities (particularly natural gas) and food increasing dramatically. Consequently, if the average citizen had not received an increase in income that matched the increase in prices of what they purchased, their cost-of-living increased more than their income, that resulted in the *cost-of-living crisis*.

From this situation, the question is raised of what interventions can governments make to provide support or relief for struggling citizens? Given it was a supply shock that created increases in gas prices, bringing alternate, local supplies of gas online appear to be a logical option. However, it would take time to increase production of a given facility and likely work against government policies related to the reduction of carbon emissions (Commons Library 2023). An alternative approach for the government was to provide short-term support for consumers, by borrowing money to purchase the gas (increasing money supply) and subsidizing the cost for consumers (Energy Price Guarantee) (Commons Library 2022). Unfortunately, while providing immediate relief for the cost of gas to citizens, the impact of prices increasing in the rest of the economy were not supported, leading to broader increases of expenses for consumers, via food price increases that

were indirectly affecting by gas price increases (Sky News 2022). As a result, without addressing the cause of a lack of supply of gas, money supply was added to a system than led to price inflation.

The micro-level dynamics are outside the scope of this work, other than acknowledging that by increasing the money supply led to price inflation. This meant, the value of citizen's wealth they had saved, had been reduced, or *confiscated*, by the actions of the government. Rothbard (2009) viewed such actions of governments as a "violation of property rights" (Hansen and Newman 2022, p.150), effectively theft. Consequently, the money the government borrowed to *subsidize* expensive gas was accrued by those selling the gas (labelled as profiteering), who pay taxes to government, dividends to shareholders or invest that money into assets to store wealth, without the need to invest in developing additional supply. A further consequence of the additional capital originating from government borrowing, was traditional stores of value increasing in value (for example, equities, real estate or commodities). The knock-on-effect of this within the 2022 example was that an issue with gas supply was initially, increases in gas prices, then increased food prices, but later fed into various assets increasing in price. As a result, citizens who did not own such assets were able to buy fewer assets, reflecting the value of their currency reducing. For those citizens who were wealthier, who owned assets, and potentially were able to afford increases in gas prices, benefited from asset price inflation resulting from governments borrowing money to subsidize gas prices. The unintended consequence of government subsidies that aim to control prices, was those without assets and needed support were negatively affected, while those less reliant on subsidies benefited from increases in asset values. Without realising the impact of their actions, while politicians aimed to support the less wealthy, their action contributed to increasing the wealth gap between those holding and those not holding assets. While there are many drivers of wealth gaps in an economy, this example illustrates how the actions of the government can, while not necessarily creating the gap in the first place, clearly contribute to increasing it.

While each item within an economy will have unique inflationary and deflationary forces acting upon them (determined by supply and demand), free markets allow producers to effectively communicate information to the market through price. In comparison, the above example attempts to logically explore and understand the main contributor to systemic inflation, using the UK example (2022-2023), and how government intervention distorted price signals, creating unintended consequences for citizens. Interestingly, if a central bank was to only focus upon core inflation, that excludes energy and food (Bullard 2011), the impact of a Russian gas supply shock would likely only be identified once the impact of energy and food had infected the rest of the economy. Reflecting upon section 2, Hart (1957, p.11) stated "our only shield against secular inflation is the growth of productivity", where increasing the output while reducing or maintaining inputs of a process, would result in deflation. For the UK gas example, productivity improvement could have consisted of investment into local gas production, extraction technologies or distribution pipelines, with the aim of reducing prices and establishing local markets with objectives of long-term cost reduction for UK citizens. Unfortunately, this solution would likely take considerable effort of those in the oil and gas industry, as well as the need for government to modify environmental regulations to be effective. When compared to issuing currency to provide a short-term fix that government could take credit for, increasing gas supply would have been both practically and politically more difficult. Interestingly, specifically within the gas sector, while the increasing supply could lead to deflation occurring with energy prices falling, by considering the "fracking revolution" in the US (Feng et al. 2021), rather than causing problematic deflationary episodes, consumer spending could be released from essential, *core* spending, and directed toward broader consumption, likely a net positive for the economy and society.

7. An Inflation Perspective on Process Improvement

At its most simple, PI works to reduce the cost, time and materials used to produce a product or deliver a service. Reflecting on section 2, this would suggest that engaging in PI activities act in a way to counteract the effects of inflation. From the survey of literature presented earlier (Figure 2), operations management research has not drawn from the concept of inflation extensively when compared to PI. Work has drawn on inflation in relation to statistical tests (Assen 2018), estimations (Mao et al. 2016) or artificial increases in order sizes (Tang et al. 2014), rather than increasing prices.

By broadening the search criteria within PI literature (Table 1, secondary search) and identifying operations management sources discussing inflation (Figure 2), examples referring to inflation as defined by economics, in terms of costs increasing over time were identified. Holweg et al. (2011) presented inflation as one of the hidden costs of global sourcing, linking the process of establishing overseas production as a driver of local inflation, based on wage expectations increasing, as they reflect economic development of a region. More recently, Handfield et al. (2020) identified inflation as a supply chain risk, where sourcing from low-cost countries could introduce risks into a supply chain caused by local currency inflation. More broadly, inflation was discussed in relation to the cost of healthcare, with Balarajan et al. (2011) presenting the disproportionate impact inflation had on lower income healthcare users. Ross and Bidanda (2014) then identified PI techniques as something healthcare managers had tended to not be exposed to. From this position, if managers in healthcare had not been exposed to PI, figures presented by Bullard (2011) across various sectors reflect this, showing healthcare costs increasing more rapidly that other sectors. Given healthcare is labour intensive, utilises highly trained staff, with likely above inflation pay expectations, regulation, patented medicine and managers not applying PI to reduce costs, higher inflation rates appear logical.

While providing evidence for the need to more deeply explore the overlap between PI and inflation, only one piece gave attention to both topics in the manner defined within the current study. Interestingly, this piece, Palange and Dhatrak (2021), a conference paper, had been cited extensively (110 times in Scopus and 348 times in Google Scholar, as of 08-04-2025), illustrating its impact in a short period of time since publication. Although inflation is only mentioned within the abstract, it is stated that prices “will increase with the inflation rate” (Palange and Dhatrack 2021, p.729). The article focused upon the application of lean techniques for the improvement of productivity and reduction in costs across a selection of industries, with attention given to reducing waste and increasing the output of staff. While inflation was not mentioned outside the abstract, the article illustrates that the implementation of lean as a tool for delivering PI oriented toward reducing costs, is a mechanism for counteracting inflation.

To locate discussions on PI within the context of inflation, a simple, yet practical, micro example can be drawn from, that both illustrates how much prices increase over multiple years and the need for awareness of PI when interpreting figures. Glasgow Live (2024) stated that in 1990, a 65g Mars bars cost 25p, compared to 2024, where a 51g Mars bar costs 85p (Tesco 2024), meaning that all else being equal, the inflation rate (per gram) of a Mars bar has been around 4.43% (see Appendix). Interestingly, over this period, the average CPI was 2.8% (ONS 2024B), suggesting that either taxes had increased on Mars bars in addition to inflation, or the inflation rate of this product was above what was reported. In comparison, from an Austrian perspective, inflation is caused by increasing the money supply (Hansen and Newman 2022), where increases in productivity could assist in working against increasing prices (Hart 1957). As a result, the identified inflation rate of a Mars bar of 4.43% needs to be viewed as the result of the productivity gains and cost reductions efforts of those in the system, rather than simply an increase in price. Reflecting on the gas example in section

6, the increase in price could alternatively reflect manufacturers and retailers increasing profit margins, however, competition between retailers and the power retailers have over suppliers, opportunities to increase profits margins are limited (Statista 2024).

Considering developments in fertilizers, farm equipment, supply chain management and production processes, if productivity is not given attention within inflation figures, the efforts of operations managers globally are devalued. Attention could alternatively be given to subtle products changes, in addition to a reduction in size, in the form of thinner chocolate and lighter nougat (Drewett, 2019). While not the case for the relative luxury example of a Mars bar, Ammous (2021) highlights how changes in product ingredients could also be used to obscure inflation-based cost increases, leading to the reduction of the food's nutritional content. External factors can also impact final product cost, such as increasing global prices of cocoa (JPMorgan 2024). Within similar products, this has led to the cocoa content being reduced, while the sugar content has been increased (Morris 2025a), resulting in certain products no longer being referred to as chocolate (Morris 2025b). These provide clear examples of the nutritional value of food being reduced with the aim of reducing the need to increase product costs to customers (Ammous 2021).

From an Austrian perspective, inflation represents an increase in money supply (with a simple measure being national debt, although bank lending can also be included). In 1990, UK debt was £160 billion (BoE, 1990), and in 2024 it was £2.8trillion (TaxPayers' Alliance 2024), representing a compounded increase in money supply of nearly 9% a year. This would then suggest that while the price of the Mars bar increased at a rate of 4.43% each year, in order to achieve this figure, it was necessary to work against the 9% increase in money supply, suggesting that operations managers were able to make annual improvements of around 4.5%. With ONS (2024C) figures likely being carefully managed, in order to reduce the need for similar wage increases, this example highlights that actual inflation figures are likely higher than those reported, while also overlooking the deflation enabled by PI. This introduces important variables that would benefit from being included within data related to inflation while also increasing the relative importance of PI as part of a broader dialogue related to inflation.

8. Discussion

The above discussions provide a novel insight into understanding both inflation and PI, even if the volume of literature targeting this overlap is rather limited. To answer the research question, giving attention to the importance of PI, not simply in terms of improving operational metrics (such as cost, speed or waste), but a necessity to combat the systematic devaluation of currencies is important. By giving attention to PI as a central tenant of business operations, it may be possible to prevent profit margins being reduced by ever increasing material, labour and equipment costs that result from monetary inflation. With an appreciation of this by those in a business, frameworks and ideas can become embedded in order to "encourage a culture of continuous improvement" (Palange and Dhatrak 2021, p.735) necessary for counteracting increasing prices. Without attention on this relationship, businesses may feel powerless when inflation across an economy gradually strips companies of their profit margins, as was the case in 2022 when hundreds of thousands of UK businesses failed (Dowdeswell, 2023). The insight from the current research also raises questions about sectors that have previously been accepted as having above average inflation rates, where PI efforts are not embedded, such as healthcare (Ross and Bidanda 2014). With hindsight of the recent surge in inflation, the risks associated with the "creation of money at no cost" (Hansen and Newman 2022, p.163) provide strong motivation for embracing operational improvement efforts rather that issuing monetary stimulus or deficit spending. Using the UK gas example, attention could be given to increasing local supply and reducing extraction costs, instead of choosing to simply create more

money for short-term relief from price inflation and political point scoring. Austrian economics and empirical evidence, suggest that attempting to solve higher prices by printing money is a difficult choice to defend.

This work also begins to introduce PI as a critical factor when interpreting official inflation figures, away from viewing them as price increases, but also reflect an industries' ability to counteract inflationary forces through improvement efforts. Booth (2020) provides multiple examples of how the application of technology results in product prices falling, while the value users realise increases. Those industries that can harness their creative powers and ingenuity, then apply them through innovation, that in manufacturing is often realised through PI, will be impacted less by inflation. Firms engaging in PI may then be able to outpace increases in money supply, helping defend profit margins. Figure 3 uses ONS inflation data to illustrate how the value of the British pound has reduced overtime, rather than viewing inflation as prices increasing (the value of a Mars bar remains broadly constant). Alongside this, the impact of moderate PI initiatives (annual 3% improvement) over the same 25-year period, provide an interesting comparison. Although the value of the currency is consistently reducing (down to less than half its initial value), due to PI, the value received by the customer marginally increases over that same period. However, as highlighted in section 2, there is an incentive to under report inflation figures, meaning the actual rate of PI to maintain parity is likely considerably higher than 3% a year, possibly closer to the increase in money supply presented in the previous section.

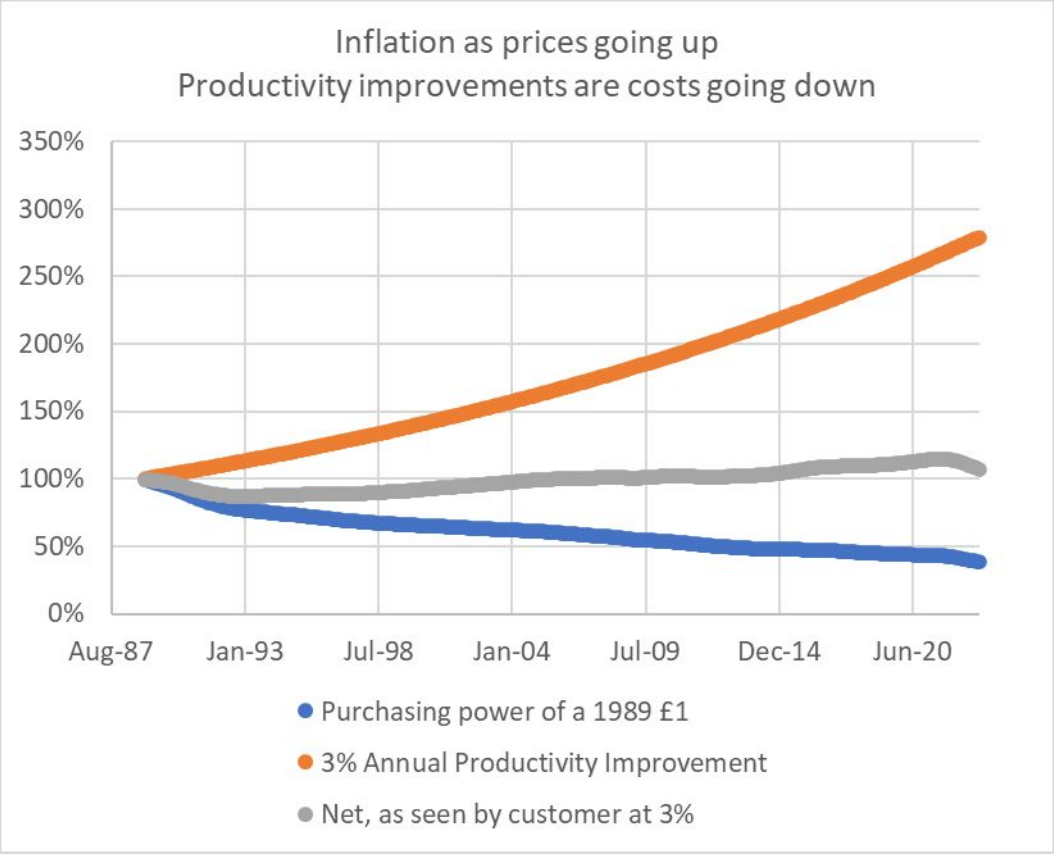


Figure 3: Process improvement as a mechanism to offset the impact of currency debasement

9. Limitations

There are three primary limitations of this work, the first being that it was conducted by an operations management researcher, rather than an economist, approaching the topic from a very

different academic perspective. As a result, subject experts from an economics perspective may question some of the views presented in the work, however, by drawing from a selection of economic sources and logically linking discussions to aspects of operations, this limitation is mitigated, while allowing established views to be critiqued (e.g. 'inflation is good'). Even so, having economists review and discuss the potential relevance of considering the impact of PI within their work would be insightful, allowing the connection between the micro-level PI, factory level productivity measures and macro-level inflation to be explored more thoroughly. Secondly, by only drawing from examples of gas supply disruption and the cost of a chocolate bar, the work only draws from snapshots of empirical evidence. Exploring the issues of inflation with operations practitioners, particularly after recent inflationary episodes would assist in building a better understanding of inflation as a topic to give attention to, combined with actions practitioners took during these events. Exploring how practitioners integrate economic factors within operational performance measures would provide links between these two academic disciplines within practice.

Building upon Bullard's (2011), charting inflation within different sectors would also provide an interesting foundation on which to build further work. By capturing internal improvement metrics, and comparing these with labour, machinery and material costs, it may be possible to begin connecting micro-level PI behaviours, with mid-level, product cost increases. By drawing on more nuanced understanding of inflation, operations management practitioners and researchers can better appreciate the factors leading to price increases and how their actions can work against them. Such research may be in the form of large scale, empirical, quantitative research, allowing it to benefit from considering the impact of operations management within economics research. By focusing attention on specific industries' capacity, ability and opportunity to engage in PI, insight may be gained on inflation rate differences between industries. Research of this type would allow more critical reviewing of broad measures that attempt to capture an economy's inflation rate in a single figure, by showing how PI may provide a mechanism to protect citizens from inflation's negative consequences. Ammous (2021) stated that inflation was not a scaler figure, rather a vector, with both scale and direction, but also that it was unique for each individual, depending on what they spend their money on. Further research in this area, as well as dissemination of findings, would greatly benefit both those determining policy (government) and those affected by policy (citizens), hopefully reducing the risk of future cost-of-living crises.

The final limitation relates to the scale of the literature this review was able to draw from and the approach taken to analysing it, reflecting the limited quantity of research that explores how inflation and PI relate. Dekkers et al. (2024) provided clear guidelines on the processes for using literature reviews for advancing research agendas and practice, with Dekkers et al. (2022) providing clear guidance on assessing the quality of literature reviews. While not drawing from the broadest sample of literature, this research provides clear avenues to extend both research and practice, by reflecting on how existing literature and operations management theory can be augmented with the inclusion of inflation within analytical frameworks. Amundson (1998) outlined how theoretical lenses could assist in more clearly understanding operations management issue, where inflation could provide an important variable to include within established operations management lens. This gap is illustrated by Stingl et al. (2024), who did not consider the goal of cost reduction as a driver of the robotisation of manufacturing or Hristov et al. (2024), who did not account for inflation when presenting financial measures within their research on the Balance Scorecard. Including the concept of inflation within other theoretical frameworks used within operations management may provide an important connection with researchers in other fields. While this was not possible for brevity, as well as the sample of literature the work drew from, figure 1 provides larger samples of literature that could be viewed from alternative perspectives. Drawing from a larger sample of literature may allow the

application of bibliometric techniques to objectively structure literature to enable more robust theory development (Marzi et al. 2024). Such work may highlight the relevance of the operations management function when attempting the make economic policy decisions aimed at promoting economic growth.

10. Conclusion

The above review and discussion of the concepts of inflation, PI and their overlap begin to illustrate that while the topics have very limited overlap (see Table 1), they appear to be strongly related. By initially presenting insight on inflation, based on economics literature, the work has begun to explore this intersection, such as the effects of inflation being counteracted by productivity improvements (Hart 1957) to PI being initiated by rising costs (Palange and Dhatrak 2021). Unfortunately, when combining PI initiatives with Keynesian, debt-based economics, individual ingenuity leading to lower prices is counteracted by government actions and policies driving prices higher. Alongside this situation, as central banks manipulate and "influence inflation expectations" (Oner 2011, p.45), if wage rises are linked to official figures that undershoot actual increases in expenses, citizens have to work longer hours, to earn more currency units, that purchase less. While discussions on inflation may be viewed as outside the domain of operations management, without awareness of inflation, there is a risk, practitioners within our field will be tasked with an unwinnable challenge of outpacing inflation, unable to give attention to more strategic improvements. Reflecting on Segelod (2020), this insight would support managers in moving beyond decisions oriented toward short-term, reactionary needs of the business.

To attempt to better understand this relationship, future research can focus upon the role of PI within various industries and its impact on the rate of sector wide price increases. Alternatively, research could involve global regions, to explore the impact of PI initiatives and the level of monetary inflation on relative competitiveness, already identified as an important supply chain risk (Handfield et al. 2020). While healthcare has been identified within this work as somewhere PI is not widely adopted (Ross and Bidanda 2014), exploring how process-oriented technologies or regulation affect inflation within healthcare would be insightful. Such research could help citizens, researchers and policymakers better understand and question reported inflation figures, or how the introduction of regulation may contribute to cost inflation.

From an economics perspective, it would be useful to consider the impact of PI within those items included within any basket of goods used to calculate inflation (Bullard 2011) and make reference to the impact of process driven cost reductions in presented figures. For example, the ability to reduce costs of highly processed, less healthy food compared to that which is grown, illustrates the propensity for governments to include items that have benefited from PI, even if they negatively impact citizen health (Lysiak and Ammous 2023). A complementary example is the use of fracking technology, that meant the price of natural gas "collapsed" in the US (Feng et al. 2021). While energy is outside core inflation (Bullard et al. 2011), due to the reduction is gas prices, there was likely a distortion in overall inflation figures, meaning greater awareness of the mechanisms at play would allow consumers to be better informed of reported inflation figures. This particular example also illustrates that economists need not fear deflation, if it returns wealth to citizens and allows them to spend more on items other than food and energy.

Finally, from an alternate, environmental perspective, PI and inflation may provide new and crucial variables to consider. While Cankaya and Sezen (2019) demonstrated how multiple dimensions of green supply chain impact sustainability, the role of inflation was completely overlooked. Similarly, Machingura et al. (2024) presented PI and waste reduction as important factors in being

environmentally sustainable, without considering the impact of inflation. To explore this further, if products last longer, the need for end-of product life and waste management would be greatly reduced. In combination with this view, few things must be worse for the environment than promoting consumption simply for the sake of *economic growth*. This leads to paraphrasing Peter Drucker; *there is nothing so unsustainable, as manufacturing something sustainably, which should not be consumed at all*. Rather than manufacturers creating less waste, consumers could instead only buy products they need, that last longer, without feeling the need to spend an inflating currency before it loses its value, all in the name of promoting *economic growth*.

Building upon Palange and Dhatrak (2021), in addition to introducing a deflationary force into product price, PI can be oriented towards reducing waste, reducing energy consumption and giving attention to those working within the operations function, in order to improve their jobs. From such a position, rather than operations management research focusing upon optimising models that include inflation (Sarker and Pan 1994) or refining policies that account for inflation (Khakbaz et al. 2023), operations management research could focus upon adding value. Worryingly, without awareness of inflation, Khakbaz et al. (2023) recommended that central banks should increase interest rates dramatically, to prevent the hording of inventory, while not realising they were recommending a violation of property rights (Rothbard 2009). This recommendation shows a distinct lack of understanding of operations management research, related to the impact of interest rates and inflation on those within the system. Rather than attempting to measure or counteract inflation, but instead controlling, managing or reducing the amount of currency expansion, following Hansen and Newman (2022), a more ethical suggestion would be to simply move away from money that can be created at no cost. Unfortunately, if governments can "confiscate… the wealth of their citizens" (Keynes. 1920, Ch.VI) in the current system, why would they stop, or want their citizens to know what they were doing, highlighting the relevance of this research.

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Appendix

Based upon the initial prices of a 65g Mars bar in 1990 of 25p and a 51g Mars bar in 2024 of 86p, the rate of price inflation is presented below, from a figure of 3% inflation (consisted with the reported average)

	65g bar	Normalised for a 51g bar		
	3.00%	3.00%	4.00%	4.43%
1990	£0.25	£0.20	£0.20	£0.20
1991	£0.26	£0.20	£0.20	£0.20
1992	£0.27	£0.21	£0.21	£0.21
1993	£0.27	£0.21	£0.22	£0.22
1994	£0.28	£0.22	£0.23	£0.23
1995	£0.29	£0.23	£0.24	£0.24
1996	£0.30	£0.23	£0.25	£0.25
1997	£0.31	£0.24	£0.26	£0.27
1998	£0.32	£0.25	£0.27	£0.28
1999	£0.33	£0.26	£0.28	£0.29
2000	£0.34	£0.26	£0.29	£0.30
2001	£0.35	£0.27	£0.30	£0.32
2002	£0.36	£0.28	£0.31	£0.33
2003	£0.37	£0.29	£0.33	£0.34
2004	£0.38	£0.30	£0.34	£0.36
2005	£0.39	£0.31	£0.35	£0.38
2006	£0.40	£0.31	£0.37	£0.39
2007	£0.41	£0.32	£0.38	£0.41
2008	£0.43	£0.33	£0.40	£0.43
2009	£0.44	£0.34	£0.41	£0.45
2010	£0.45	£0.35	£0.43	£0.47
2011	£0.47	£0.36	£0.45	£0.49
2012	£0.48	£0.38	£0.46	£0.51
2013	£0.49	£0.39	£0.48	£0.53
2014	£0.51	£0.40	£0.50	£0.56
2015	£0.52	£0.41	£0.52	£0.58
2016	£0.54	£0.42	£0.54	£0.61
2017	£0.56	£0.44	£0.57	£0.63
2018	£0.57	£0.45	£0.59	£0.66
2019	£0.59	£0.46	£0.61	£0.69
2020	£0.61	£0.48	£0.64	£0.72
2021	£0.63	£0.49	£0.66	£0.75
2022	£0.64	£0.51	£0.69	£0.79
2023	£0.66	£0.52	£0.72	£0.82
2024	£0.68	£0.54	£0.74	£0.86

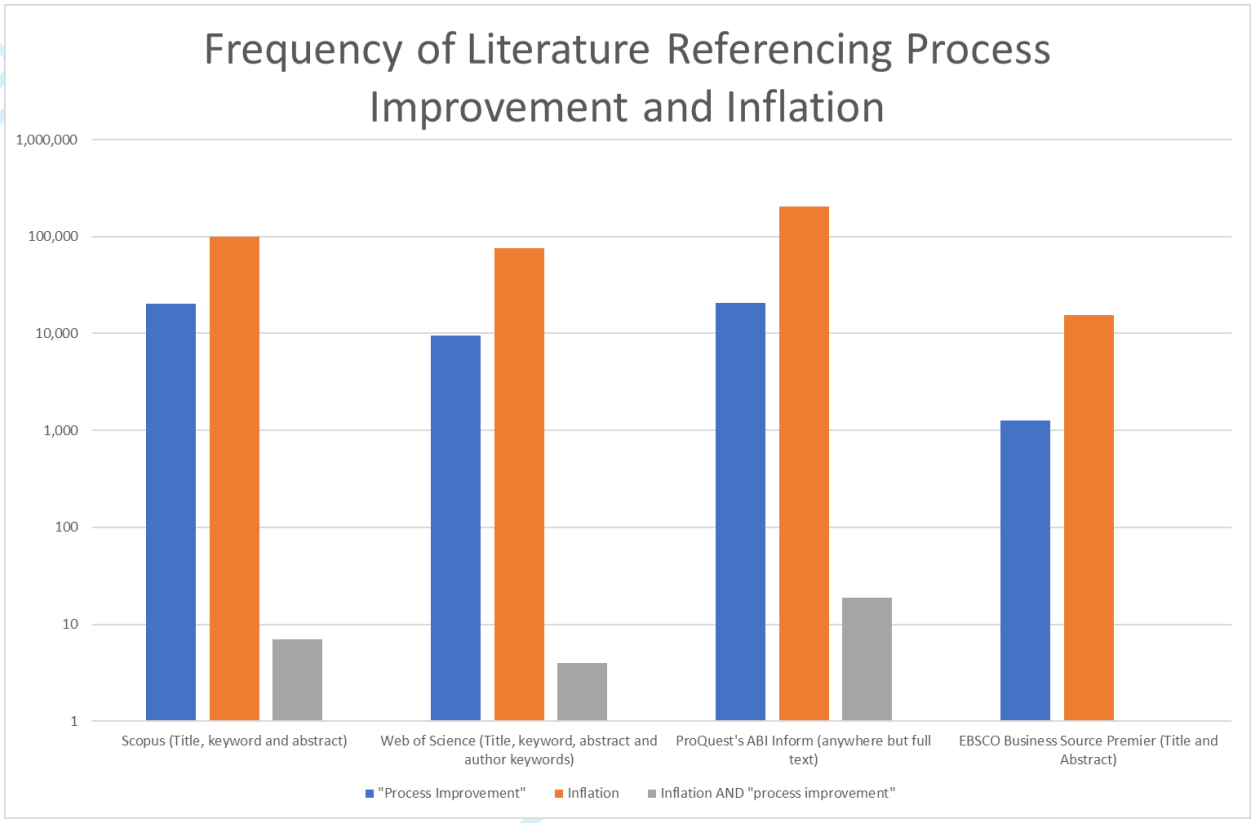

Figure 1: Literature Survey Results

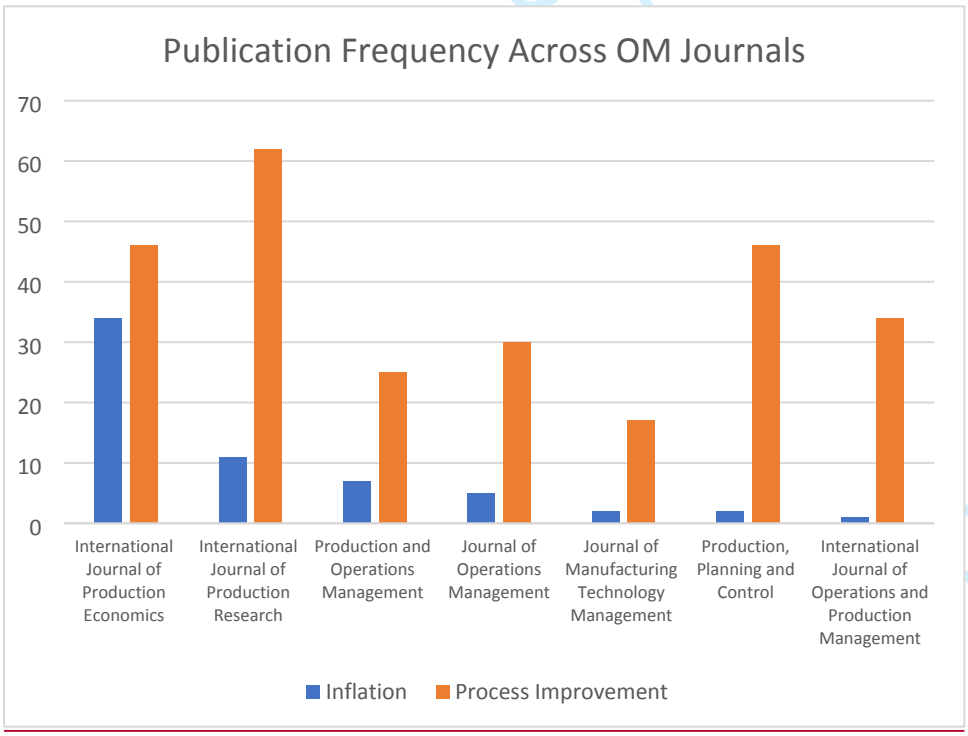

Figure 2: Inflation and PI literature in Operations Management Journals

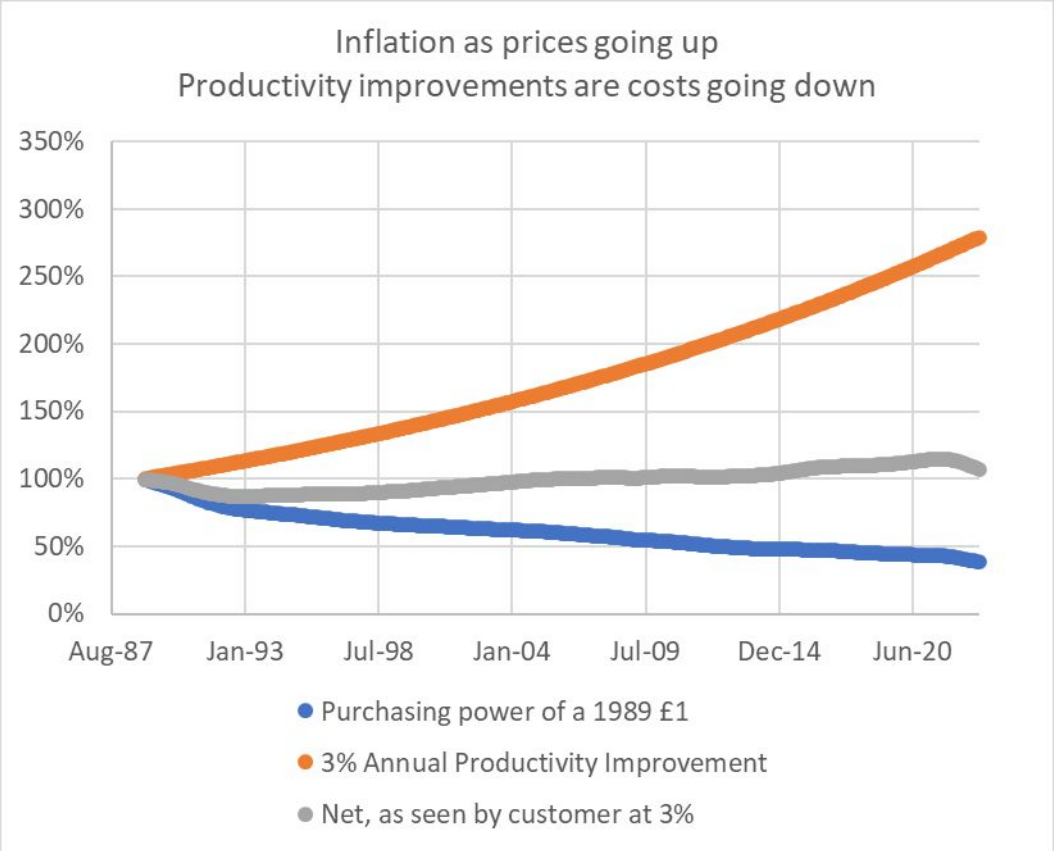

Figure 3: Process improvement as a mechanism to offset the impact of currency debasement

Table 1:

Table 1: Systematic Survey Data

Data Base	"Process Improvement"	Inflation	Inflation AND "process improvement"
Scopus (Title, keyword and abstract)	20,108	99,430	7
Web of Science (Title, keyword, abstract and author keywords)	9,471	75,644	4
ProQuest's ABI Inform (anywhere but full text)	20,833	202,698	19
EBSCO Business Source Premier (Title and Abstract)	1,260	15,587	0
Secondary Whole Document Search	Inflation	"Process improvement"	n/a
Scopus	36 (0.180%)	41 (0.04%)	
Web of Science	3 (0.03%)	4 (0.005%)	n/a
ProQuest's ABI Inform	256 (1.2%)	433 (0.2%)	n/a
EBSCO Business Source Premier	8 (0.6%)	5 (0.03%)	n/a
Secondary Whole Document Search	Inflation	"Process improvement"	n/a
	n/a	n/a	
Initial Search	Whole Document	Whole Document	Whole Document
ProQuest's ABI Inform	265,322	11,710,484	37,603
Initial Search	Title	Title	Title
EBSCO Business Source Premier	3,620	61,316	0

Appendix:

	65g bar	Normalised for a 51g bar		
	3.00%	3.00%	4.00%	4.43%
1990	£0.25	£0.20	£0.20	£0.20
1991	£0.26	£0.20	£0.20	£0.21
1992	£0.27	£0.21	£0.21	£0.22
1993	£0.27	£0.21	£0.22	£0.23
1994	£0.28	£0.22	£0.23	£0.24
1995	£0.29	£0.23	£0.24	£0.25
1996	£0.30	£0.23	£0.25	£0.26
1997	£0.31	£0.24	£0.26	£0.27
1998	£0.32	£0.25	£0.27	£0.28
1999	£0.33	£0.26	£0.28	£0.30
2000	£0.34	£0.26	£0.29	£0.31
2001	£0.35	£0.27	£0.30	£0.32
2002	£0.36	£0.28	£0.31	£0.34
2003	£0.37	£0.29	£0.33	£0.35
2004	£0.38	£0.30	£0.34	£0.37
2005	£0.39	£0.31	£0.35	£0.38
2006	£0.40	£0.31	£0.37	£0.40
2007	£0.41	£0.32	£0.38	£0.42
2008	£0.43	£0.33	£0.40	£0.44
2009	£0.44	£0.34	£0.41	£0.46
2010	£0.45	£0.35	£0.43	£0.48
2011	£0.47	£0.36	£0.45	£0.50
2012	£0.48	£0.38	£0.46	£0.52
2013	£0.49	£0.39	£0.48	£0.54
2014	£0.51	£0.40	£0.50	£0.57
2015	£0.52	£0.41	£0.52	£0.59
2016	£0.54	£0.42	£0.54	£0.62
2017	£0.56	£0.44	£0.57	£0.64
2018	£0.57	£0.45	£0.59	£0.67
2019	£0.59	£0.46	£0.61	£0.70
2020	£0.61	£0.48	£0.64	£0.73
2021	£0.63	£0.49	£0.66	£0.77
2022	£0.64	£0.51	£0.69	£0.80
2023	£0.66	£0.52	£0.72	£0.84
2024	£0.68	£0.54	£0.74	£0.87

Data source:

Glasgow Live, (2022), "Average price of nostalgic childhood chocolates soared by 153% since the 90's", Published by Glasgow Live, Access 22-07-2024, URL https://www.glasgowlive.co.uk/whats-on/shopping/average-price-nostalgic-childhood-chocolates-25391934

Tescos, (2024), "Online shopping", Published by Tesco.com, Accessed 22-07-2024, URL https://www.tesco.com/groceries/en-GB/search?query=mars