WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Relationship Between Supply Chains and Global Inflation Using Math Methods

Alharbi Ali Hawas[1], Alharbi Fahad Hawas[2], Alharbi Ahmad Naif [3], Almutairi Ali Abdulah[4], Almalki Mohamed Mosalam[5], Alshammari Mohamad Hammad[6], Alanazi Abdulaziz Audah[7]

[1]Marketing Trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia
[2]Marketing trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia
[3]Marketing trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia
[4]Marketing trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia
[5]Marketing trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia
[6]Accounting trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia
[7]Mathematics trainer, TVTC Hafer Albattin Technical Collage, Saudi Arabia

ABSTRACT

The efficient management of any business on a global scale largely hinges on its supply chain. However, when dealing with a global supply chain, the impact of global inflation becomes a pivotal factor in determining either profit or loss. Another significant consideration is the deterioration of merchandise or services, which can occur during production, storage, or transportation, adversely affecting all stakeholders in the supply chain. This article explores the relationship between global inflation and supply chains using mathematical techniques, with global inflation being a primary variable in these mathematical models. For clarity and detailed understanding, a numerical example is presented to illustrate the profit or loss dynamics within the supply chain. Moreover, a sensitivity analysis is conducted towards the end of the study, aiming to ascertain the impact of changes in different parameters that significantly influence the mathematical model. It was found, based on these mathematical methods, that a decrease in the global inflation rate corresponds to a continuous increase in total profit. Conversely, an increase in inflation rate results in a continuous decline in total profit. Lastly, the study reveals a trend where the global inflation rate decreases as the profit within the supply chain increases.

Introduction

Logistics platforms, a fundamental element of supply chains, critically influence competitive advantage and profitability in business settings (Khakbaz&Tirkolaee, 2022). Effective management of supply chains, supported by competent logistics, guarantees steady customer service while yielding comprehensive cost reductions. These savings stem from various stages of the supply chain, including raw material procurement, production, storage, distribution, transportation, and the sale of the final product or service to the end consumer (Nguyen et al., 2022).

A supply chain can be described as a network comprising individuals and businesses actively involved in the creation and delivery of a specific product or service. This network is inclusive of producers, suppliers, warehouses, transportation companies, distribution centers, and retailers (Singh et al., 2020). While typically envisioned as a flow of goods from suppliers to producers, distributors, retailers, and ultimately consumers, the term 'supply chain' represents this sequence. Nevertheless, the circulation of data, money, and goods in all directions within this chain should also be considered (Hobbs, 2020).

Given the complexity of supply chains, where a manufacturer might source materials from various suppliers and distribute to multiple distributors, the structure more closely resembles a network than a simple linear chain. Crucial stages in this network include customers, retailers, wholesalers/distributors, manufacturers, and raw material suppliers. Consequently, expressions like 'supply network' or 'supply web' accurately describe the structure of most supply chains shownin Figure 1 (Jakehider, 2022).

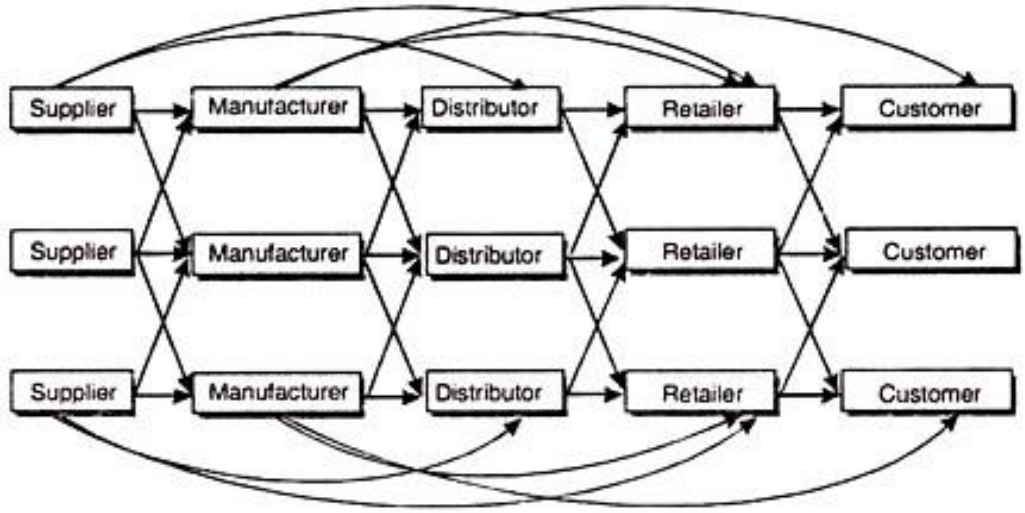

Figure 1: Supply chain stages

(Source: Jakehider, 2022)

Literature Review

Global Inflation

Global inflation is typically gauged as an annual percentage rise in the prices of goods and services. A mathematical model illustrating inflation, particularly with quadratic demand for deteriorating goods inclusive of inflation and trade credits, was introduced by Rudd (2022). The concept of global inflation primarily refers to the rate at which the general level of prices for goods and services escalates over time, contributing to a country's overall cost of living increase. Furthermore, Rudd (2022) underscores the possibility of calculating inflation more distinctly for individual items or services, such as food products.

The consumer's cost of living is derived from pricing an assortment of goods and services (Choi & Shin, 2022). Choi & Shin (2022) conducted an in-depth examination of a lot-size model for depreciating products amidst inflation. Additionally, a mathematical model of inflation within a predetermined planning period, designed to define the ideal replenishment schedule, was proposed by Kilian & Zhou (2022). This model postulated a time-sensitive demand and a limited planning horizon.

Recent economic conditions have necessitated that businesses raise their prices due to persistent inflation. Although there have been marginal improvements in container shipping rates and delivery times, the recovery in supply chains has not yet curbed the surge in consumer prices (Conrad et al., 2022). With demand continually surpassing market forecasts and an overburdened supply chain struggling to maintain pace, prolonged inflation appears to be an enduring concern in the foreseeable future (Nene et al., 2022).

A substantial challenge the global economy currently confronts is the consistent upswing in gasoline prices. This predicament, while global in its scope, is rapidly evolving into a grave concern. Kugler & Reynard (2022) observed record-breaking oil prices, unadjusted for inflation, and a significant rise in gasoline prices, exceeding 40 cents in the past year. This development could have a considerable impact on the entire global economy, potentially reaching a pivotal threshold set in the 1990s, and ultimately affecting living standards globally (Kugler & Reynard, 2022).

Global Inflation Rate

The inflation rate is typically determined as the percentage variation in a price index over a specific duration compared to the index captured during a prior period. This is often calculated annually or on a year-to-year basis (Eldomiaty et al., 2019). To illustrate, if the index value for this year's January is 179.4 and that for the previous January is 167.5, the yearly inflation rate for this January can be computed as: (179.4 / 167.5 - 1) * 100 = 7.1%.

It's worth noting that a modest degree of inflation can be advantageous for those possessing tangible assets, such as real estate and stocked goods, denominated in their own currency. Inflation can elevate the worth of these assets, enabling owners to sell them at an escalated price. Yet, inflation can induce speculation, compelling companies to engage in higher-risk projects and individuals to invest in business stocks in anticipation of returns that outstrip inflation (Choi & Shin, 2022).

Furthermore, maintaining an ideal inflation rate can, to some degree, boost spending instead of saving. As the buying power of money decreases with time, there exists a robust incentive to spend now rather than save for future expenses. This may result in augmented spending that fuels economic activity within a nation. A balanced approach strives to retain the inflation rate within an optimal and favourable band (Ishise, 2022). A visualization of the inflation rate in Malaysia isdepicted in the figure 2 as shown below.

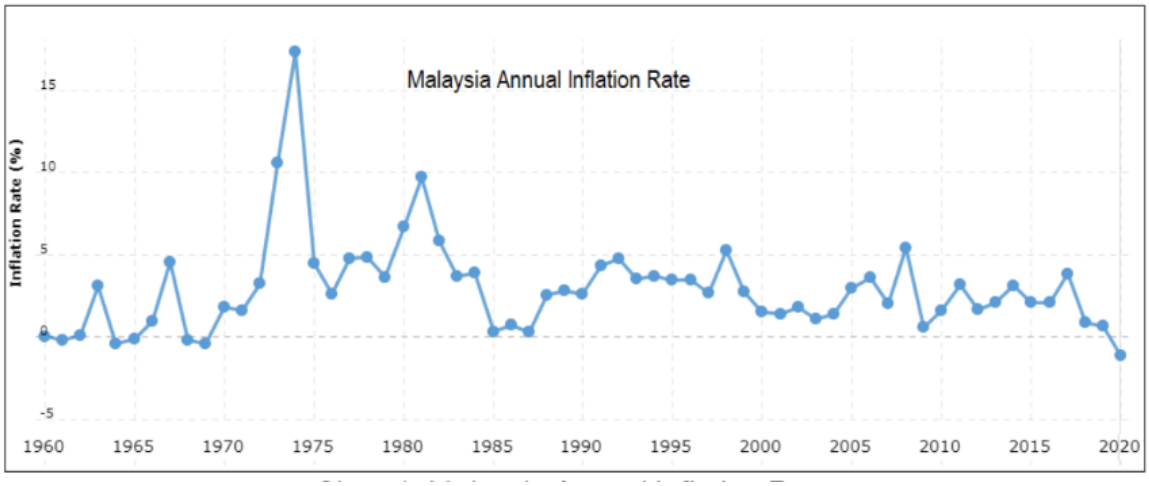

Figure 2: Malaysia Annual Inflation rate

(Source: Chew, 2022)

Supply chain

A supply chain is an intricate network involving all parties either directly or indirectly partaking in satisfying a customer's demand (Koberg&Longoni, 2019). It includes an extensive range of stakeholders such as manufacturers, suppliers, logistics providers, storage facilities, retailers, and ultimately, the customers themselves. Within an individual entity, for example, a manufacturing firm, the supply chain encompasses all the functional units engaged in receiving and fulfilling a customer's request. This includes new product innovation, marketing, operations, distribution, financial management, and customer service (Baah et al., 2021).

The supply chain is a dynamic system, encompassing the continuous flux of information, products, and finances across various stages (Jakehider, 2022). For example, a retailer provides customers with product availability and pricing data. Following this, the customer makes a payment to the retailer. The retailer then communicates point-of-sale data and replenishment orders to the distributor who delivers the ordered goods back to the store (Mukhamedjanova, 2020). After replenishment, the retailer pays the distributor, who also provides pricing details and delivery schedules to the retailer. This flow of material, information, and finances occur throughout the entire supply chain, underlining the critical role customers play in the supply chain process.

The central objective of every supply chain is customer satisfaction, achieved through efficient processes while ensuring profitability. Supply chain activities initiate with a customer order and culminate when a satisfied customer makes a payment for their purchase (Khan et al., 2022).

Moreover, the supply chain manages all actions tied to the movement and conversion of goods from raw materials to the final product, in addition to the accompanying information flow. Information and materials flow in both directions along the supply chain, covering a broad spectrum of activities including platform management, operations, procurement, production, scheduling, order processing, inventory management, transportation, warehousing, and customer service (Aday&Aday, 2020).

Every flow of information, goods, and finances incurs costs within the supply chain. The primary objective of any supply chain is to maximize the total value generated (Aslam et al., 2020). The effectiveness of a supply chain is evaluated by the supply chain surplus, which represents the difference between revenue generated from customers and the overall cost associated with the supply chain. Efficient management is fundamental to the success of a supply chain (Muafi&Sulistio, 2022). Supply chain management is a business concept that focuses on managing the bi-directional flow and coordination of goods, services, and information from suppliers to customers. This includes managing materials and physical distribution, with a key emphasis on the flow of goods, services, and information from producers to customers (Ozdemir et al., 2022).

The relationship between Supply Chains and global Inflation

Global inflation pertains to the rise in economic prices on a global scale. It can have a ripple effect on the pricing of goods and services within a supply chain, thereby increasing supply chain costs, which can fuel further inflation and price increases (Santacreu& LaBelle, 2022). The sources of inflationary pressures can be traced back to augmentations in manufacturing costs such as wages, raw materials, energy, and logistics costs. If these pressures remain unmanaged, global inflation could significantly undermine the buying power of consumers or organizations (di Giovanni et al., 2022).

In an attempt to navigate through the tumultuous seas of rising global inflation, procurement managers often resort to ordering supplies ahead of time to secure inventories. However, when mirrored across the entire economy, this surge in demand can exacerbate global inflation. The principle is simple: prices ascend when supply diminishes and demand swells. Since 2020, supply chain disruptions in ports and warehouses due to bottlenecks and labor shortages have provoked shipping delays, leaving businesses struggling with depleted inventory amidst a boom in consumer spending.

The procurement landscape morphs into a complex maze during periods of global inflation. If inflated costs are transferred to consumers, demand typically dwindles, leading to manufacturers needing fewer goods or services. This situation demands a more meticulous, agile, and comprehensive planning approach with cooperation from every stakeholder in the supply chain - from sales and marketing to warehousing and logistics teams. Faced with supply scarcity, some businesses have been forced to increase their prices. Despite some recovery in container shipping rates and delivery times, consumer prices remain elevated. For example, the Bank of England projects that global inflation will retrace its steps back to its 1.9% target within a year. Although this suggests a deceleration in price increase, higher costs might linger (Rudd, 2022).

The ripple effects of inflationary pressure are palpable throughout the supply chain. Challenges like port congestion and import container issues are aggravated by global inflation and labor shortages. Fuel costs, which play a crucial role in the logistics sector, drive up transportation and freight costs, already on the rise due to driver shortages (Benigno et al., 2022).

Many professionals in the supply chain and logistics industry believe that global inflation has negatively impacted their business operations globally. The consequences of this include capacity limitations, price hikes, supply chain instability, extended lead times and delayed orders, and ongoing issues with shipping containers. As reported by Materials Modern Handling (Rudd, 2022), global inflation heightens the risk of substantial bankruptcy. If a significant trucking operator were to go out of business, freight transportation would become even more strenuous, leading to further supply reduction and possibly triggering another surge in global inflation.

Discussion

Mathematical model

The mathematical development model is centered on establishing the connection between the supply chain and global inflation. It utilizes mathematical methods and takes into account the impacts of interest rates and global inflation rates. The holding and purchasing costs are represented as functions of the interest and global inflation rates, which are predominantly time-dependent (Paul et al., 2022). As the interest rate escalates, it results in an increase in the holding cost and consequently, the total cost also rises. On the other hand, as global inflation intensifies, the purchasing cost swells, leading to a surge in the total cost. The following sections provide detailed definitions of parameters, variables, and assumptions (Khakbaz&Tirkolaee, 2022):

Parameters

$f(t)$ = annual demand rate at time t

$F(t)$ = Cumulative demand at time t

$h(t)$ = Holding cost per order

$c(t)$ = Unit price at time t

i_r= Annual interest rate

$h(t) = i_r c(t)$

d_0 = Annual demand rate at start of the year

d_1 = Annual demand rate at end of the year

e = Annual global inflation rate (e> - 100%)

Variables

n= Number of annual orders

Q_i= Order quantity in period

Assumptions

- The replenishment happens instantaneously at an infinite rate.
- The ordering cost, A, is constant.
- Shortages are not allowed.
- Quantity discounts are not available.

The demand rate, f(t), is taking into consideration as a linear function of time,

$f(t)=at+d0,0\leq t\leq 1,$

$$F(t) = \int_0^t f(t)\,dt = \frac{at^2}{2} + d_0 t \quad (0 \le t \le 1)$$

Based on equation below: -

$$F(1) = \frac{a}{2} + d_0.$$

The total demand over the year = a/2+d0.

So, shortages are not permitted and ending inventory should be zero,

The total order quantity over the year = the total demand over the year

$$\sum_{i=1}^{n} Q_i = \frac{a}{2} + d_0.$$

$$I_i(t) = F(iT) - F(t) \quad (i = 1, 2, \ldots, n); (i-1)T \le t \le iT$$

$$F(T) = Q_1 = \frac{aT^2}{2} + d_0 T$$

$$Q_i = (2i-1)\frac{aT^2}{2} + d_0 T \quad (i = 1, 2, 3, \ldots, n)$$

The total cost includes ordering cost (OC), purchasing cost (BC), holding cost (HC).

Therefore,

TC=OC+BC+HC,

OC = nA

Assumed that Qi is received at the start of period i,

That is

T = (I – 1) T

i= c((i-1)T)

Therefore,

Purchasing cost (BC)

$$BC = \sum_{i=1}^{n} c(t)\, Q_i = \sum_{i=1}^{n} [(i-1)\, bT + c_0] Q_i = \sum_{i=1}^{n} [(i-1)\, bT + c_0] \left[(2i-1)\, \frac{aT^2}{2} + d_0 T \right]$$
$$= \sum_{i=1}^{n} \left[(i-1)\,(2i-1)\, \frac{abT^3}{2} \right] + \sum_{i=1}^{n} \left[(i-1)\, bd_0 T^2 \right] + \sum_{i=1}^{n} \left[(2i-1)\, \frac{ac_0 T^2}{2} \right] + \sum_{i=1}^{n} [c_0 d_0 T].$$

$\sum_{i=1}^{n} i = \frac{n^2+n}{2}$, $\sum_{i=1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$, and $T = \frac{1}{n}$,

$$BC = \left[\left(\frac{ab}{3} + \frac{bd_0}{2} + \frac{ac_0}{2} + c_0 d_0 \right) - \left(\frac{ab}{4} + \frac{bd_0}{2} \right) n^{-1} - \frac{ab}{12} n^{-2} \right].$$

$$HC = \int_0^1 h(t)\, I(t)\, dt = i_r \int_0^1 c(t)\, I(t)\, dt = i_r \sum_{i=1}^{n} \int_{(i-1)T}^{iT} c(t)\, I_i(t)\, dt$$
$$= i_r \sum_{i=1}^{n} \int_{(i-1)T}^{iT} (bt + c_0) \left[\frac{aT^2 i^2}{2} + d_0 T i - \frac{at^2}{2} - d_0 t \right] dt.$$

$\sum_{i=1}^{n} i = \frac{n^2+n}{2}$, $\sum_{i=1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$, $\sum_{i=1}^{n} i^3 = \frac{n^4+2n^3+n^2}{4}$, and $T = \frac{1}{n}$, HC is

$$HC = i_r \left[\left(\frac{2ab + 3bd_0 + 3ac_0 + 6c_0 d_0}{12} \right) n^{-1} + \left(\frac{ac_0 - bd_0}{12} \right) n^{-2} - \frac{ab}{24} n^{-3} \right]$$

TC is

$$TC = m_1 n^{-1} + m_2 n^{-2} + m_3 n^{-3} + m_4 + nA,$$

$m_1 = \frac{i_r}{12}(2ab + 3bd_0 + 3ac_0 + 6c_0 d_0) - \left(\frac{ab}{4} + \frac{bd_0}{2} \right)$, $m_2 = \frac{i_r}{12}(ac_0 - bd_0) - \frac{ab}{12}$, $m_3 = -\frac{i_r ab}{24}$, and $m_4 = \left(\frac{ab}{3} + \frac{bd_0}{2} + \frac{ac_0}{2} + c_0 d_0 \right)$

n

$$\frac{\partial TC}{\partial n} = -m_1 n^{-2} - 2m_2 n^{-3} - 3m_3 n^{-4} + A,$$

$$\frac{\partial^2 TC}{\partial n^2} = 2m_1 n^{-3} + 6m_2 n^{-4} + 12m_3 n^{-5}.$$

$$b = c_0 e,$$

$$m_1 = c_0 \left[a \left(\frac{i_r (2e+3) - 3e}{12} \right) + d_0 \left(\frac{i_r (3e+6) - 6e}{12} \right) \right],$$

$$m_2 = c_0 \left[a \left(\frac{i_r - e}{12} \right) - d_0 \left(\frac{i_r e}{12} \right) \right],$$

$$m_3 = -\frac{c_0 a i_r e}{24},$$

$$m_4 = c_0 \left[a \left(\frac{2e+3}{6} \right) + d_0 \left(\frac{3e+6}{6} \right) \right].$$

Since $a = d_1 - d_0$, then $\frac{a}{d_0} = \frac{d_1 - d_0}{d_0}$. In other words,

$$\frac{a}{d_0} = \frac{\text{Annual demand rate at the end of the year - Annual demand rate at the end of the year}}{\text{Annual demand rate at the end of the year}}$$

Conclusion

The relationship between supply chain and global inflation, established through mathematical methods, has been elucidated thoroughly. According to these mathematical models, it was found that a decrease in the global inflation rate would consistently lead to an increase in total profits. A supply chain encapsulates all parties, whether direct or indirect, instrumental in fulfilling a consumer's needs. This not only encompasses producers and suppliers but also includes entities involved in transportation, warehousing, retail, and even the customers themselves. Each component within an organization, such as a manufacturer, contributes to the supply chain by engaging in activities aimed at meeting and exceeding a client's expectations. Conversely, it was observed that a surge in the inflation rate would consistently precipitate a decline in total profits. To conclude, the global inflation rate displays an inverse relationship with profit in the supply chain - as profit rises, the rate of inflation diminishes.

References

Khakbaz, A., &Tirkolaee, E. B. (2022). A mathematical model to investigate the interactive effects of important economic factors on the behaviors of retailers. *Annals of Operations Research*. https://doi.org/10.1007/s10479-022-05116-1

Jakehider. (2022, April 19). *Supply chain - EVOLUTION.DOCX - supply chain management – A journey essay contents: 1. essay on the introduction to Supply Chain Management 2. essay on: Course hero*. Supply Chain - Evolution.docx - SUPPLY CHAIN MANAGEMENT – A JOURNEY Essay Contents: 1. Essay on the Introduction to Supply Chain Management 2. Essay on | Course Hero. https://www.coursehero.com/file/143070016/Supply-Chain-Evolutiondocx/

Aday, S., &Aday, M. S. (2020). Impact of covid-19 on the Food Supply Chain. *Food Quality and Safety*, *4*(4), 167–180. https://doi.org/10.1093/fqsafe/fyaa024

Ajide, K. B., &Alimi, O. Y. (2021). Inflation, inflation volatility and terrorism in Africa. *International Journal of Finance & Economics*, *28*(1), 493–509. https://doi.org/10.1002/ijfe.2432

Aslam, H., Khan, A. Q., Rashid, K., & Rehman, S. (2020). Achieving Supply Chain Resilience: The role of Supply Chain Ambidexterity and supply chain agility. *Journal of Manufacturing Technology Management*, *31*(6), 1185–1204. https://doi.org/10.1108/jmtm-07-2019-0263

Baah, C., Opoku Agyeman, D., Acquah, I. S., Agyabeng-Mensah, Y., Afum, E., Issau, K., Ofori, D., &Faibil, D. (2021). Effect of information sharing in supply chains: Understanding the roles of supply chain visibility, agility, collaboration on Supply Chain Performance. *Benchmarking: An International Journal*, *29*(2), 434–455. https://doi.org/10.1108/bij-08-2020-0453

Benigno, G., di Giovanni, J., Groen, J. J., & Noble, A. I. (2022). The GSCPI: A new barometer of global supply chain pressures. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4114973

Choi, S., & Shin, J. (2022). Bitcoin: An inflation hedge but not a safe haven. *Finance Research Letters*, *46*, 102379. https://doi.org/10.1016/j.frl.2021.102379

Conrad, C., Enders, Z., &Glas, A. (2022). The role of information and experience for households' inflation expectations. *European Economic Review*, *143*, 104015. https://doi.org/10.1016/j.euroecorev.2021.104015

di Giovanni, J., Kalemli-Ozcan, S., Silva, Á., & Yildirim, M. A. (2022). Global supply chain pressures, international trade, and inflation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4160084

Eldomiaty, T., Saeed, Y., Hammam, R., &AboulSoud, S. (2019). The associations between stock prices, inflation rates, interest rates are still persistent. *Journal of Economics, Finance and Administrative Science*, *25*(49), 149–161. https://doi.org/10.1108/jefas-10-2018-0105

Hobbs, J. E. (2020). Food Supply Chains during the Covid-19 pandemic. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie*, *68*(2), 171–176. https://doi.org/10.1111/cjag.12237

Ishise, H. (2022). Optimal long-run inflation rate in an open economy. *European Economic Review*, *148*, 104223. https://doi.org/10.1016/j.euroecorev.2022.104223

Ivanov, D., Dolgui, A., & Sokolov, B. (2022). Cloud Supply Chain: Integrating Industry 4.0 and digital platforms in the "supply chain-as-a-service." *Transportation Research Part E: Logistics and Transportation Review*, *160*, 102676. https://doi.org/10.1016/j.tre.2022.102676

Khan, S. A., Mubarik, M. S., Kusi-Sarpong, S., Gupta, H., Zaman, S. I., &Mubarik, M. (2022). Blockchain technologies as enablers of supply chain mapping for Sustainable Supply Chains. *Business Strategy and the Environment*, *31*(8), 3742–3756. https://doi.org/10.1002/bse.3029

Kilian, L., & Zhou, X. (2022). The impact of rising oil prices on U.S. inflation and inflation expectations in 2020–23. *Energy Economics*, *113*, 106228. https://doi.org/10.1016/j.eneco.2022.106228

Koberg, E., &Longoni, A. (2019). A systematic review of Sustainable Supply Chain Management in global supply chains. *Journal of Cleaner Production*, *207*, 1084–1098. https://doi.org/10.1016/j.jclepro.2018.10.033

Kugler, P., & Reynard, S. (2022). Money and inflation in Switzerland. *Swiss Journal of Economics and Statistics*, *158*(1). https://doi.org/10.1186/s41937-021-00081-1

Muafi, M., &Sulistio, J. (2022). A nexus between green intelectual capital, Supply Chain Integration, digital supply chain, supply chain agility, and Business Performance. *Journal of Industrial Engineering and Management*, *15*(2), 275. https://doi.org/10.3926/jiem.3831

Mukhamedjanova, K. A. (2020). Concept of supply chain management. *Journal of Critical Reviews*, *7*(02). https://doi.org/10.31838/jcr.07.02.139

Nene, S. T., Ilesanmi, K. D., &Sekome, M. (2022). The effect of inflation targeting (it) policy on the inflation uncertainty and economic growth in selected African and European countries. *Economies*, *10*(2), 37. https://doi.org/10.3390/economies10020037

Nguyen, D. N., Nguyen, T. T., Nguyen, T. T., Nguyen, X. H., Do, T. K., & Ngo, H. N. (2022). The effect of supply chain finance on Supply Chain Risk, supply chain risk resilience, and performance of Vietnam smes in Global Supply Chain. *Uncertain Supply Chain Management*, *10*(1), 225–238. https://doi.org/10.5267/j.uscm.2021.9.005

Ozdemir, D., Sharma, M., Dhir, A., & Daim, T. (2022). Supply Chain Resilience during the COVID-19 pandemic. *Technology in Society*, *68*, 101847. https://doi.org/10.1016/j.techsoc.2021.101847

Rudd, J. B. (2022). Why do we think that inflation expectations matter for inflation? (and should we?). *Review of Keynesian Economics*, *10*(1), 25–45. https://doi.org/10.4337/roke.2022.01.02

Santacreu, A. M., & LaBelle, J. (2022). Global supply chain disruptions and inflation during the COVID-19 pandemic. *Review*, *104*(2). https://doi.org/10.20955/r.104.78-91

Singh, S., Kumar, R., Panchal, R., & Tiwari, M. K. (2020). Impact of covid-19 on logistics systems and disruptions in Food Supply Chain. *International Journal of Production Research*, *59*(7), 1993–2008. https://doi.org/10.1080/00207543.2020.1792000

Wang, M., Wu, Y., Chen, B., & Evans, M. (2020). Blockchain and Supply Chain Management: A new paradigm for Supply Chain Integration and collaboration. *Operations and Supply Chain Management: An International Journal*, 111–122. https://doi.org/10.31387/oscm0440290

Chew, D.E.H. (2022) CPI alone may not be the best inflation gauge for Malaysia - focus malaysia, Focus Malaysia - Business & Beyond. Available at: https://focusmalaysia.my/cpi-alone-may-not-be-the-best-inflation-gauge-for-malaysia/ (Accessed: 26 July 2023).