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The Impact of Print-on-Demand on Spanish University Presses

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ABSTRACT

The university book plays a crucial role in disseminating research and teaching, but its usage has declined due to a preference for journal articles and digital materials. This article examines how Spanish university presses are employing Print-on-Demand (POD) to adapt to changes in the publishing market, enhancing flexibility, reducing costs and optimising the production of monographs and academic books. POD enables publishers to print copies based on actual demand, minimising the risk of overproduction and storage costs. This model has transformed the publishing supply chain, offering efficient solutions for managing the lifecycle of books, from their launch to potential delisting. University presses are also using innovations in digital printing to respond swiftly to fluctuations in the academic market. This study adopts a qualitative approach to examine how POD affects scholarly publishers' efficiency, longevity and production strategies, proposing that this technology is crucial for the future sustainability and competitiveness of the sector. The flexibility of POD is vital in environments where demand is unpredictable, and scholarly publishers must manage financial resources carefully.

2 | Introduction

Publishers specialising in academic books produce content from scientific research and materials intended for university teaching (Bonilla, Carabantes, and Sastre 2019; Gándara 2023; López, Delgado, and Martínez 2021). Academic books are specialised publications targeted at the scientific and scholarly community, focusing on specific curricula and may include monographs and reference books on specialised topics (Fitzpatrick 2021; Joseph 2015). These works can also serve scientific dissemination purposes, addressing experts and a wider public (Thompson 2022). In addition to disseminating their research, university professors and researchers seek academic recognition through positive evaluations from research and teaching quality agencies (Sanz 2023).

The use of academic books has declined both within and outside universities (Thompson 2022) due to several factors. First, the scientific article is the primary medium for disseminating research findings (Giménez 2017). Second, traditional textbooks are recommended and used less frequently because of the availability of cheaper, online digital materials (Grimaldi et al. 2019; Moro 2018; Watson, Domizi, and Clouser 2017) that are accessible and academically effective (Hilton 2020; Magadán and Rivas 2019b).

Evaluation agencies are developing indicators to measure the impact of books based on models analogous to those used for scientific journals to address this issue (San Fabián 2020). In Spain, the Scholarly Publishers Indicators (SPIs) provide metrics for publishers in the Humanities and Social Sciences, whereas databases such as the Book Citation Index and Scopus include only a limited number of Spanish publishers (Bonilla, Carabantes, and Sastre 2019; Romero 2024). The Union of Spanish University Publishers (UNE) established the CEA-APQ Quality Seal, endorsed by ANECA and FECYT, to highlight best editorial

Summary

- The study examines how Spanish university presses are using Print-on-Demand (POD) technology to adapt to changes in the publishing market. This is significant as university books play a crucial role in disseminating research and teaching, but their usage has declined due to the preference for journal articles and digital materials.
- A qualitative approach is used to assess the impact of POD on the efficiency, longevity, and production strategies of scholarly publishers.
- POD allows publishers to print copies based on actual demand, reducing overproduction risks and storage costs.
- This model has transformed the publishing supply chain, offering efficient solutions for managing the lifecycle of books, from launch to potential delisting.
- University presses are leveraging digital printing innovations to respond quickly to market fluctuations.
- The study concludes that POD technology is essential for the future sustainability and competitiveness of the sector. Its flexibility is crucial in unpredictable market environments, allowing scholarly publishers to manage financial resources effectively.

practices (Bonilla, Carabantes, and Sastre 2019; UNE 2021). Books remain essential for scientific communication, particularly, in the Social Sciences and Humanities (Abadía 2023; Giménez 2017).

In Spain, the rising costs of academic journals have reduced the purchase of monographs by university libraries (REBIUN 2023). Smaller print runs and higher prices have impacted both libraries and publishers. Solutions such as Print-on-Demand (POD) and e-consortia, which sell electronic books to academic institutions, have emerged as alternatives (Breeding 2020; Wilson-Higgins 2004). The digital age has transformed the publishing and marketing of books (Magadán and Rivas 2022).

The impact of POD focuses on the survival of academic monographs (Wilson-Higgins 2017). POD is, particularly, well-suited for monographs, whereas electronic journals are increasingly preferred for their prestige and professional advancement (Greco 2015). Digital printing has revolutionised editorial production by offering flexibility, reducing costs and enabling updated and customised versions (Adema and Stone 2017; Magadán and Rivas 2021a). This technology has prompted publishers to reassess their production and distribution methods (Fyfe et al. 2017; Magadán and Rivas 2021c).

The primary aim of this study is to analyse how Spanish academic book publishers can leverage POD to adapt to the evolving realities of the university publishing market.

The specific research questions are

a. How is the supply chain structured in university presses that use POD? This question seeks to understand how these publishers integrate this technology into their operations and its impact on the efficiency and flexibility of the publishing chain.

b. How does POD affect the lifecycle of academic books? This question explores how POD technology alters the lifecycle of books, including their production, distribution and updating. The aim is to understand POD's impact on the longevity and relevance of academic texts.

c. How do innovations in printing technology influence the strategies of university publishers? This question investigates how advances in digital printing assist university presses in adapting to the changing demands of the market.

The study aims to demonstrate how POD can optimise operations, reduce costs and enhance sustainability in university publishing, enabling a more efficient adaptation to the current market.

3 | Literature Review

3.1 | Transformation of the Traditional Publishing Model

POD has revolutionised the publishing landscape, reshaping traditional publishing models by significantly reducing costs and risks tied to large print runs and inventory management (Anderson 2006; Senftleben et al. 2017; Wilson-Higgins 2017). Traditional methods required mass printing, storage and later distribution of books, whereas the POD model produces books only when ordered (Baladrón and Correyero 2019; Magadán and Rivas 2021a). This approach minimises excess inventory (Eve 2020; Magadán and Rivas 2021a; Peltier, Benhamou, and Touré 2016), storage expenses, resource waste (Davis 2014; Gallagher 2014; Magadán 2017; Magadán and Rivas 2021a, 2022; Peltier, Benhamou, and Touré 2016; Wilson-Higgins 2017) and supports decentralised production (Thompson 2022), reducing delivery times and aligning more closely with market demand (Hall 2013; Magadán and Rivas 2021a). This flexibility proves, particularly, beneficial for publications with small print runs or specific needs (Davis 2014; Franzén 2008; Mabaso 2020), enabling publishers to sustain economically and environmentally viable production practices (Done, Warner, and Noorda 2022; Magadán and Rivas 2021b; Moberg, Borggren, and Finnveden 2011; Seuring and Müller 2008).

In addition to broadening access to printed content in resource-constrained settings (Dharwadker 2016), POD complements open-access models by providing physical editions of academic research, expanding the reach of scholarly findings and enhancing the visibility of publications within diverse communities (Ebner, Schön, and Alimucaj 2016; Hsieh 2020).

The technology behind POD has increased the efficiency of publishing processes (Adema and Stone 2017; Magadán and Rivas 2019a) through integration with digital tools (Magadán and Rivas 2020b) and direct sales platforms (Christopher 2016; Hall 2013; Wilson-Higgins 2017). These advancements enable publishers to respond effectively to global market demands, better navigating the challenges of an ever-evolving publishing

industry (Done, Warner, and Noorda 2022; Magadán and Rivas 2021b).

3.2 | Applications in Academic Publishing

POD significantly influences academic publishing, where titles often target specialised audiences with unpredictable demands (Wilson-Higgins 2017), providing an efficient solution for producing out-of-print works and low-demand titles (Andreoli and Pacull 1999; Lewis 2002; Poell, Nieborg, and Duffy 2021; Thoma 2016) while enabling the monetization of content that might otherwise fade into obscurity (Ho, Wang, and Cheng 2011; Peltier, Benhamou, and Touré 2016). It also allows publishers to produce revised and updated editions in small quantities, ensuring content reflects the latest advancements across various disciplines. This feature addresses the critical need for constant updates in academic fields (Davis 2014; Done, Warner, and Noorda 2022; Franzén 2008). Universities and academic presses can also use this model to publish specialised works, optimise resources and lower operational costs (Christopher 2016; Torres 2015).

In Spanish-speaking regions, where editorial budgets often face constraints, POD is a strategic solution to reduce storage costs and address specific needs within academic communities (Cisneros and Olave 2021; Gómez 2007). These benefits become, particularly, relevant in countries with limited publishing resources (Cisneros and Olave 2021; Mabaso 2020). On a global scale, POD has enhanced the accessibility and sustainability of academic titles (Chamberlain 2012; Done, Warner, and Noorda 2022; Ebner, Schön, and Alimucaj 2016), establishing a flexible and effective publishing model (Davis 2014; Franzén 2008; Magadán and Rivas 2021a; Wilson-Higgins 2017).

3.3 | Transformation of the Publishing Supply Chain

The traditional book publishing supply chain involves moving physical copies of books from printers to publishers, followed by wholesalers, traditional bookstores and consumers (Magadán 2017; Magadán and Rivas 2020a, 2022; Martin and Tian 2012). The POD model has dramatically reshaped this system, which once relied on numerous intermediaries such as printers, distributors and bookstores (Christopher 2016; Magadán and Rivas 2022; Martin and Tian 2012). By enabling direct-to-consumer sales, POD eliminates intermediaries, reduces delivery times and lowers operational costs, fostering a more efficient and sustainable production process (Christopher 2016; Davis 2014; Magadán and Rivas 2021b; Moberg, Borggren, and Finnveden 2011; Wilson-Higgins 2017).

POD's flexibility allows academic publishers to implement minimal-inventory models that align production with actual demand (Hall 2013; Senftleben et al. 2017; Szenberg and Ramrattan 2015; Thompson 2013). This approach mitigates overproduction risks, simplifies stock management and enhances operational efficiency (Hall 2013; Poell, Nieborg, and Duffy 2021; Thoma 2016; Wilson-Higgins 2017). Advanced technologies such as 3D printing further expand customization options and improve response times (Dong, Shi, and Zhang 2022; Song and Zhang 2024).

From a sustainability perspective, POD minimises environmental impacts by eliminating unnecessary inventory and reducing waste (Chang 2017; Davis 2014; Gallagher 2014; Magadán 2017; Magadán and Rivas 2022). It also promotes responsible practices by adopting Lean and Agile strategies, optimising resources and enhancing the overall efficiency of the supply chain (Brammer 2024; Hall 2013; Jubb and Fisher 2017).

The traditional publishing process and the POD model represent two distinct book production and distribution approaches (see Figure 1): it begins its flow when the author completes the manuscript and submits it to the publisher (Magadán and Rivas 2022). Once received, the text undergoes revisions, corrections and editing until the publisher deems it ready to be sent to the printer. At this stage, offset printing technology is employed for large print runs, as its cost-effectiveness relies on economies of scale, which means printing thousands of copies in a single batch, which entails high initial costs and significant risk if the books do not sell out. The publisher stores the printed copies in inventory, and a distributor handles their transportation to physical bookstores, where they remain until purchased by readers (Magadán and Rivas 2020a).

In contrast, the POD model has revolutionised publishing by offering a more streamlined and efficient flow. In this model, the process starts only when a reader purchases the book, typically through an online platform. The publisher sends the digital file directly to the printer, where digital technology to produce the requested book is used, even for print runs as small as a single copy (Magadán and Rivas 2020b). After printing, the book is shipped directly to the

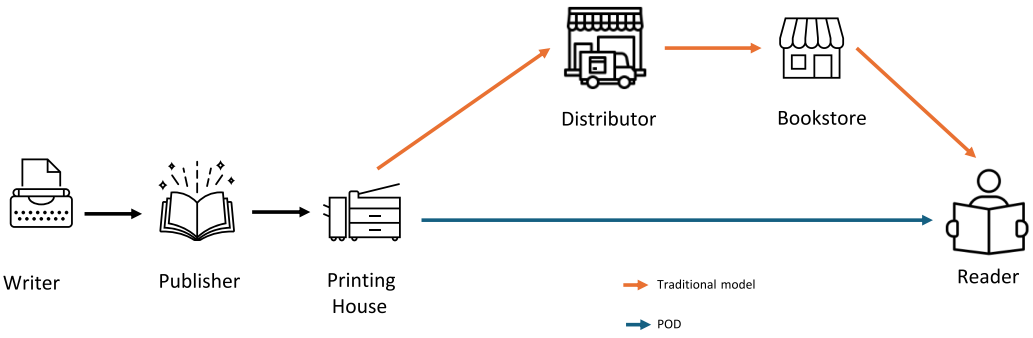

FIGURE 1 | Comparison of process flows: traditional model versus POD. *Source:* Own elaboration.

customer or a pickup point, eliminating the need for inventory and intermediary distributors (Magadán and Rivas 2022).

The comparison between the two models highlights significant differences. The traditional process is ideal for large print runs, where economies of scale justify the initial investment, but it presents limitations of flexibility and sustainability. On the other hand, the POD model is helpful for small print runs, self-published authors and niche title marketing. Additionally, it allows publishers to keep titles available indefinitely without worrying about stockouts or high reprinting costs.

4 | Theoretical Framework

4.1 | The Book Lifecycle and POD

The lifecycle of a book begins with its release as a new title (Kozak and Keolelan 2003), a stage where sales projections heavily influence the size of initial print runs (Kumar and Shah 2005). Over time, the book transitions into the backlist, where demand diminishes (Szenberg and Ramrattan 2015), reorders become less frequent and the financial risks of large print runs increase (Anderson 2006; Coelho, Moreira, and Moras 2018; Senftleben et al. 2017; Wilson-Higgins 2017). POD accommodates these shifts by enabling shorter, cost-effective print runs when demand declines, ensuring book availability without unnecessary expenses (Magadán and Rivas 2020a; Wilson-Higgins 2017).

The book lifecycle, from its launch to its removal from circulation, has undergone significant changes with the adoption of POD (Magadán and Rivas 2021a; Wilson-Higgins 2017). During the initial phase, traditional publishers relied on a 'push' model, producing large print runs based on projected sales (Kumar and Shah 2005). However, this approach carries substantial financial and environmental risks when actual demand falls short of forecasts (Coelho, Moreira, and Moras 2018; Hall 2013; Magadán and Rivas 2018). In this sense, POD enables a shift to a 'pull' approach by producing books in response to actual market demand, eliminating costs associated with storage and overproduction (Anderson 2006; Poell, Nieborg, and Duffy 2021), proving especially effective for 'long-tail' titles, which experience sporadic but steady demand, allowing them to generate revenue without requiring large print runs (Anderson 2006; Magadán and Rivas 2021a).

Finally, POD also supports printing out-of-print books and updated editions, ensuring accessibility while avoiding unnecessary inventory accumulation (Gillespie 1990; Magadán and Rivas 2021a; Peltier, Benhamou, and Touré 2016). This approach benefits publishers and authors while meeting the current market's expectations for sustainability and customization (Done, Warner, and Noorda 2022; Magadán and Rivas 2021b).

Figure 2 compares the product lifecycle between two models: the traditional model and the POD model. The horizontal axis represents the product lifecycle stages: production, distribution, sales and obsolescence, reflecting the route map a product follows from its creation to the end of its useful life.

The vertical axis illustrates a conceptual scale of effort or relative cost associated with each stage, considering economic resources, time, logistical complexity and inherent risks. Costs remain high at each stage due to mass printing, the need to store inventories, distribution through complex logistical chains and the build-up of unsold products, leading to obsolescence and waste in the traditional model. In contrast, the POD model shows a significant reduction in effort and costs, as it eliminates the need for physical inventories, reduces the risks of overproduction and

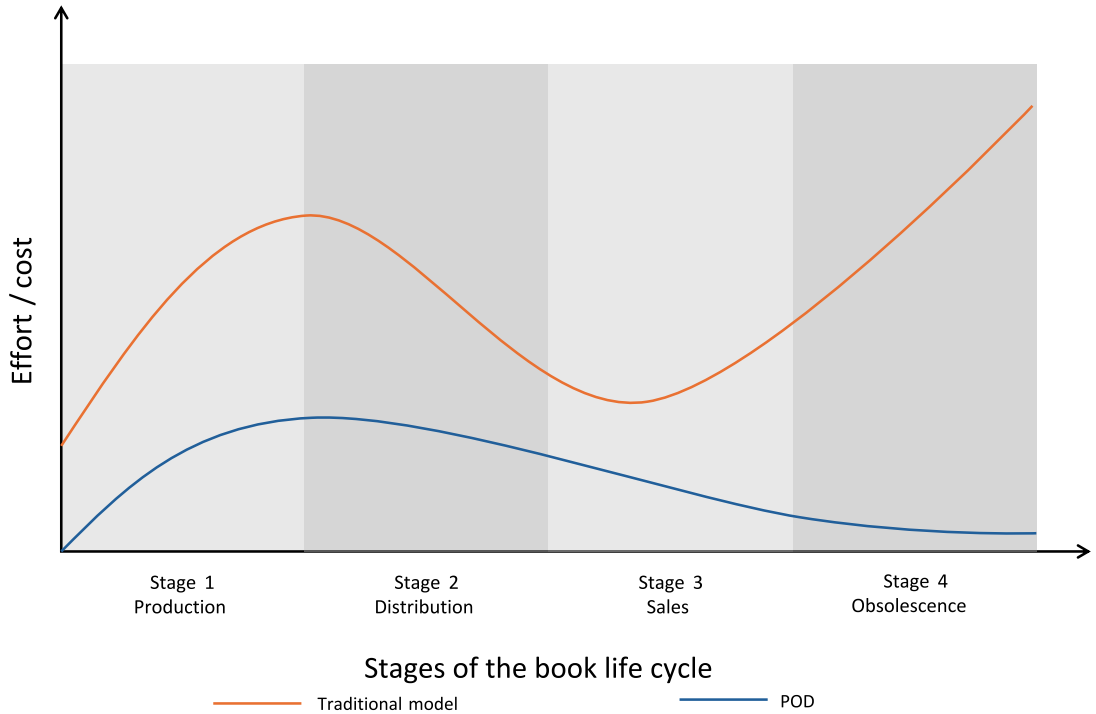

FIGURE 2 | Book lifecycle: Traditional model versus POD. *Source:* Own elaboration.

optimises both distribution and sales by adopting digital platforms and a demand-based approach.

Figure 2 clearly illustrates how the POD model mitigates the structural problems of the traditional model, offering not only economic benefits but also a reduction in environmental impact by only printing what is necessary and minimising waste, making the POD model a sustainable and efficient solution, well-suited to meet the demands of the modern market.

4.2 | Challenges and Perspectives of POD

Publishers must invest in advanced technologies and training to ensure print quality and the efficient integration of digital processes (Rejeb, Keogh, and Treiblmaier 2019; Weller, Kleer, and Piller 2015). Additionally, the perceived quality of works printed through this model continues to be a barrier in some market segments (Weller, Kleer, and Piller 2015; Wilson-Higgins 2017).

POD appears as an effective tool for rescuing books previously relegated to obscurity by non-traditional commercial channels, offering them a new opportunity for circulation (Anderson 2006; Senftleben et al. 2017; Wilson-Higgins 2017). However, in the case of newly created books, its use may indicate difficulty in securing space in commercial catalogues and bookstores, reflecting a significant challenge in visibility and market acceptance (Repiso and Montero 2019).

Nonetheless, POD's flexibility, along with its ability to adapt to the changing needs of the market, positions it as a significant tool for the future of the publishing industry (Hall 2013; Magadán and Rivas 2021a; Peltier, Benhamou, and Touré 2016; Tzouvaras and Hess 2001). Its integration with digital tools and sustainability strategies enables publishers to remain competitive in a dynamic global environment (Chamberlain 2012; Magadán and Rivas 2022; Naicker and Cohen 2016).

5 | Methodology

This research employs a qualitative and interpretive case study approach (Creswell 2003) to provide a detailed understanding of how Spanish academic publishers can utilise POD to adapt to the new realities of the scholarly publishing market and optimise their operations (Corbetta 2003), while also examining the impact of this technology on the supply chain for university books in Spain. This methodology is particularly, suited for analysing contemporary phenomena like POD as it allows for an in-depth understanding of organisational changes and innovations (Corbetta 2003; Yin 2017).

Assessing the integration of POD into a publisher's internal processes involves examining key aspects such as the supply chain model, inventory management, logistics and operational efficiency to identify the significant changes introduced by POD. It is also essential to evaluate how POD impacts the lifecycle of academic books by analysing its effects on the production, storage, and updating of texts. Additionally, one must investigate how POD influences the supply and demand for books, along with their longevity and relevance.

The data collection methods included document review, structured interviews, and audio recordings. These techniques facilitated information triangulation by validating and comparing data from various sources to assess its consistency and accuracy and by contrasting interview responses with documentary evidence.

This study selected the cases using convenience sampling due to limited access to industry professionals and because relevant data on publishers implementing POD innovations was readily available. This approach allowed for the selection of appropriate cases within the constraints of the research.

The study focused on five prominent Spanish university presses—included in the SPI—, each representing different sizes, structures and areas of specialisation within the scholarly publishing sector in Spain (see Table 1). These presses were chosen for their relevance to the POD field, ensuring that the selected cases show the challenges and opportunities faced by scholarly publishers in Spain when implementing POD.

The number of Spanish university presses—over 700 currently—that have adopted POD technologies is limited. As a result, the selected sample reflects a range of approaches within a growing market. While it is impossible to generalise to all Spanish university presses, the chosen cases offer a comprehensive view of the practices and strategies implemented, helping to understand how POD impacts editorial management and the supply chain for academic books in Spain.

Video conference interviews took place with representatives from the five selected publishers between March and June 2024. The interviews employed open-ended questions (see Table 2) to delve deeply into their views and perspectives. The questionnaire featured predominantly open-ended questions to encourage narrative responses and to avoid questions that might restrict answers or provoke defensive reactions. The aim was to facilitate a natural and comprehensive flow of information, respecting the interviewees' modes of expression to accurately assess their positions on the topics discussed (Furlong and Lester 2023; Morse 2020).

5.1 | U1

Based in Valencia since 1976, the publisher specialises in Law, Social Sciences, educational materials and academic texts for the university and professional sectors. It publishes books and journals in both print and digital formats, adapting its processes to new technologies by offering e-books and access through digital platforms. Additionally, it maintains a strong presence in Latin America, distributing its publications and collaborating with universities and legal professionals.

5.2 | U2

Founded in 1994 in Madrid, the publisher specialises in law, producing manuals, treatises, monographs and textbooks, as well as in sociology, politics and public administration. It provides educational materials for students and professionals and

TABLE 1 | Spanish scholarly publishers analysed.

Scholarly publisher	Legal structure	Years of operation	Range of employees	Range of turnover	CNAE code
U1	Limited Company	48	From 51 to 200	More than €2,500,000	5811—Book Publishing
U2	Limited Company	30	From 11 to 50	More than €2,500,000	4761—Retail Sale of Books in Specialised Stores
U3	Limited Company	44	From 1 to 5	Between €500,001 and €1,000,000	5811—Book Publishing
U4	Public Limited Company	33	From 11 to 50	€1,000,001—€2,500,000	5811—Book Publishing
U5	Public Limited Company	58	From 201 to 500	More than €2,500,000	5811—Book Publishing

Source: Own elaboration.

publishes journals in law and social sciences. With over 2500 titles, it has embraced new technologies, including e-books and digital access through its online platform. It has also developed a virtual bookstore on the Apple Store and distributes its publications in Spanish-speaking countries, collaborating with international academic institutions. The publisher is renowned for the quality of its publications in law and social sciences.

5.3 | U3

Established in 1980 in Granada, the publisher excels in Law with manuals, treatises and specialised books. It publishes Literature, History, Philosophy and Social Sciences as well. It has adopted new technologies by offering e-books and digital access through its online platform. The publisher distributes its publications in Spain and other Spanish-speaking countries, reaching an international audience through an extensive distribution network.

5.4 | U4

Based in Madrid since 1991, the publisher focuses on social sciences, including sociology, politics, economics and anthropology. It offers a wide variety of academic texts, manuals, reference books and specialised academic journals. The publisher has integrated digital technology by providing e-books and access through online platforms. Its website enables users to consult and purchase publications in both print and digital formats. Although headquartered in Spain, the publisher distributes in other Spanish-speaking countries and maintains an international presence.

5.5 | U5

Headquartered in Barcelona and founded in 1966, the publisher is renowned for its extensive range of social science publications, including Sociology, Politics, Economics and Management, as well as Literature, Philosophy, History, Art, Natural Sciences, Technology and other educational and academic materials. The publisher has adapted its processes to new technologies by providing e-books and digital access through its website. It distributes its publications in Latin America and other international markets, with some titles translated into different languages, thereby expanding its global reach.

6 | Results

The following presents the results obtained from the case study of the five university presses. The case study revealed that the offset printing model has ceased to be efficient as the sole option due to its ineffectiveness for small print runs. In contrast, POD emerges as a cost-effective solution, enabling the printing of short runs or single copies, which aligns with the low demand for many academic publications. This approach reduces costs by eliminating or diminishing inventories and minimising the risk of losses from unsold books. POD offers scholarly publishers an opportunity for optimisation and saving on production, storage and distribution.

6.1 | Book Supply Chain

In response to the first question in the section on the supply chain, the representative from U1 highlights that their POD supply chain model combines advanced digital printing technology with efficient order management, enabling precise production of specialised titles in law and social sciences. The representative from U2 notes that their agile and adaptable system integrates digital printing with a strategic logistics network, optimising the production and distribution of academic works. U3 emphasises that its model enhances the production and distribution of scholarly publications with a focus on precision and flexibility, using advanced technology to offer customised editions. U4 highlights the flexibility and customisation of its model, which adjusts the content and format of educational books and technical manuals according to

TABLE 2 | Open-ended questions asked.

Publishing supply chain	Model description	How would you define the supply chain model you use for Print-on-Demand?
	Logistics and distribution	How do you manage the logistics and distribution of Print-on-Demand books, and what technologies do you apply to optimise these processes?
	Flexibility and scalability	What level of flexibility does your model have to adapt to market demand fluctuations?
Book lifecycle	Impact on the lifecycle	What impact does your Print-on-Demand model have on the lifecycle of books, and what changes have you observed in this regard?
Publishing strategies	Product development	How has your Print-on-Demand model affected the development of new products and editorial services?

Source: Own elaboration.

educators' needs, supported by an efficient logistics network for prompt deliveries. Finally, U5 reports that their system efficiently handles a wide range of publications, employing advanced digital printers to produce everything from novels to academic essays and limited editions backed by an integrated management and logistics infrastructure to ensure high quality and reduced delivery times.

The interviewed publishers highlighted their collaboration with specialised POD service providers who supply both the necessary technological infrastructure and logistical services. For instance, U1 emphasised its agreement with IngramSpark, which provides access to platforms for printing and distributing books. U2, on the other hand, mentioned working with local platforms such as Podiprint and Lantia, offering tailored solutions for their academic needs. U3 highlighted the flexibility of their POD providers in adapting the systems to meet their specific requirements, enabling them to optimise the production of specialised academic publications. Both U4 and U5 noted that integrating these providers has allowed them to reduce operational costs and improve supply chain efficiency, aligning with the specific demand for academic books.

In response to the second question on managing the logistics and distribution of books produced through (POD), as well as the use of applied technologies to optimise the involved processes, U1 employs a combination of advanced technology and collaboration with logistics partners, using real-time management and tracking systems to coordinate production and delivery. U2 integrates technology and logistics partners to manage orders through advanced software, automating packaging and tracking to ensure swift distribution, particularly, for limited editions. U3 applies digital printing technology and an efficient supply chain management system featuring automatic labelling and route analysis to optimise the distribution of academic titles. U4 focuses on advanced technology and strategic partnerships, implementing warehouse management systems and automated packaging to ensure timely deliveries of educational books. U5 combines cutting-edge technologies with efficient processes, using a management platform that integrates printing and distribution and advanced tracking systems to guarantee fast and reliable deliveries of special editions and novels.

The publishers described how they work directly with service providers such as IngramSpark, Lulu, and Podiprint to set up their POD systems. U1 emphasised using the IngramSpark platform to upload manuscripts and manage sales. U2 mentioned collaborating closely with Lantia and Podiprint to implement the system and integrate digital tools that facilitate book customization. U3 noted how integrating digital design tools allowed them to meet specific educational requirements. U4 and U5 pointed out that implementing these platforms has significantly simplified the distribution process, enabling them to manage the production and distribution of academic books without handling complex logistics.

In response to the third question regarding the level of flexibility to adapt to market demand fluctuations, U1 highlights that their POD model offers significant flexibility through advanced digital printing technology, enabling production adjustments based on actual demand and reducing the need for large inventories. U2 notes that their POD system is highly adaptable, allowing real-time production adjustments according to client needs and overcoming the limitations of large print runs. U3 emphasises that their POD system customises academic book production according to demand, eliminating the reliance on large print runs and optimising resource use. U4 points out that their POD system is flexible and efficient, featuring digital technology and optimised management to adjust production to meet demand. U5 also highlights the

flexibility of its POD system, which facilitates agile production adjustments through advanced technology without requiring substantial inventories.

Figure 3 illustrates how the POD model promotes sustainability in the publishing sector while aligning with economic efficiency goals and environmental impact reduction. Within the context of university presses, POD enables resource optimization and mitigates financial risks by aligning production with actual demand, thereby avoiding the storage of large quantities of unsold books.

Figure 3 compares the relative costs and waste associated with the traditional offset process and the POD model. The analysis provides values classified into four key areas: production, storage, distribution, and waste. The chart includes relative values (on a scale from 0 to 100) that reflect the initial costs of each model and the percentage reductions achieved through POD.

The POD model lowers production costs by 50% compared to the offset model. This significant reduction stems from POD's ability to print smaller or customised runs, eliminating the expensive setup processes associated with offset printing. The savings occur in storage costs, with POD achieving a 75% reduction. This improvement results from POD's ability to eliminate the need for high inventories, allowing publishers to print books on demand. While distribution costs show a low reduction of 33%, POD optimises logistics by printing directly based on customer orders, reducing reliance on large distribution centres. Waste decreases by 86% as POD avoids overproduction and minimises the risk of obsolescence, common challenges in the offset model.

6.2 | Book Lifecycle

Regarding the impact of POD on the book lifecycle, U1 highlights that it has enhanced efficiency and flexibility by optimising each stage, reducing storage costs and mitigating the risk of obsolescence. U2 notes that POD has addressed issues of excess inventory and obsolescence, cutting both financial and environmental costs. U3 emphasises that POD has increased flexibility and efficiency, lowered the risk of obsolescence and improved responsiveness to market demand. U4 points out that POD has enhanced operational efficiency by eliminating the need for large inventories and reducing storage costs. Finally, U5 asserts that POD has transformed the management of the book lifecycle providing greater efficiency and flexibility while aligning the catalogue with market demands.

The interviewed publishers emphasised the integration of distribution channels directly into the POD platforms as a significant feature. U1 explained that their relationship with platforms like IngramSpark has provided access to digital and physical distribution networks without intermediaries. U2 highlighted that thanks to agreements with platforms such as Amazon and Google Books, achieved global distribution of their academic titles without complex logistical processes. U3 shared that these platforms also help printed books be available in physical bookstores, expanding their reach in the market. U4 and U5 agreed that the POD model also allows them to sell directly through their websites, enhancing their ability to manage sales and maximise profit margins without intermediaries, contributing to greater efficiency in managing the book lifecycle.

6.3 | Publishing Strategies

In response to the question about the impact of POD on the development of new products and publishing services, U1 highlights that POD has facilitated innovation and adaptability by eliminating the financial risk associated with large initial print runs. U2 notes that POD enables experimentation with new concepts and formats with reduced risk and allows for adjustments based on feedback. U3 views POD as crucial for flexibility and agility in product development. U4 points out that POD has enhanced the ability to innovate and adapt to market needs with more customised publications. Finally, U5 emphasises that POD has allowed for the launch of special editions and exploration of new genres with minimal financial risk, creating unique products for events and literary festivals.

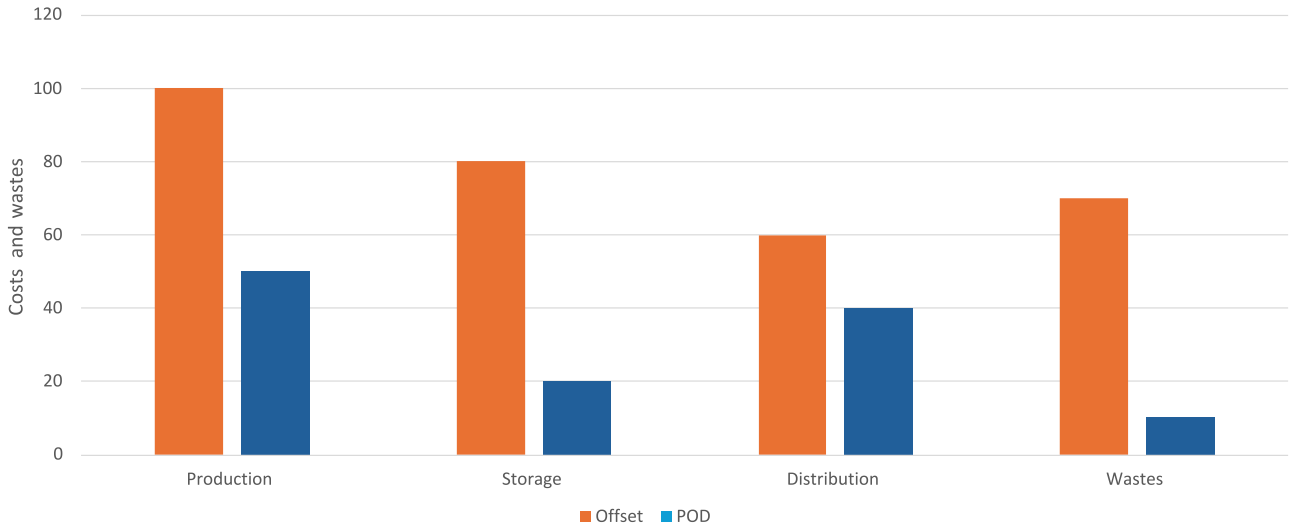

FIGURE 3 | Impact of the traditional offset model and the POD Model on cost and waste reduction. *Source:* Own elaboration.

The interviewed publishers explained that the prices of books produced through POD vary depending on factors like print run size, binding type and other production-related aspects. U1 shared that they adjust the retail prices based on the cost of printing, adding a profit margin that can vary depending on the type of work. U2 noted that, due to the nature of their academic books, particularly, specialised titles, their POD prices tend to be slightly higher, allowing them to adjust prices based on market demand. U3 mentioned that the POD model helps them adjust prices for niche books with sporadic demand, thus helping them better match market trends and avoid overproduction costs. U4 and U5 agreed that this flexible pricing model has helped them reduce financial risks associated with wide initial print runs, optimising the balance between demand and supply.

7 | Discussion and Conclusions

The adoption of POD by Spanish university presses has stemmed from the need to overcome economic challenges, adapt to low demand (Andreoli and Pacull 1999; Lewis 2002; Poell, Nieborg, and Duffy 2021; Thoma 2016), and leverage the opportunities presented by digital technology (Baladrón and Correyero 2019; Magadán and Rivas 2021a). POD has transformed their traditional business model, enabling greater flexibility, efficiency and profitability in a constantly changing environment (Gallagher 2014; Magadán and Rivas 2022).

Spanish university presses embrace technological innovations such as POD to enhance efficiency and reduce production costs (Adema and Stone 2017; Magadán and Rivas 2019a). Many university presses have implemented POD to optimise their workflow and production processes (Thompson 2022). This advancement has facilitated publishing models like short print runs and managed the life cycle of printing, directly aligning with actual demand and minimising storage costs (Anderson 2006; Senftleben et al. 2017; Wilson-Higgins 2017) and the risk of excess stock (Eve 2020; Magadán and Rivas 2021a; Peltier, Benhamou, and Touré 2016).

POD offers significant flexibility compared to offset printing, which requires a costly setup and fits better with large print runs (Davis 2014; Franzén 2008; Mabaso 2020). Digital printing allows for the efficient production of small runs or even single copies, adjusting to actual demand (Andreoli and Pacull 1999; Lewis 2002; Poell, Nieborg, and Duffy 2021; Thoma 2016) and avoiding the unnecessary printing of large volumes (Magadán and Rivas 2020b). This flexibility proves essential in academia, where requirements vary across courses and students (Hall 2013; Senftleben et al. 2017; Szenberg and Ramrattan 2015). The book supply chain must adapt to technological innovations and market demands to maintain efficiency and sustainability (Done, Warner, and Noorda 2022; Magadán and Rivas 2021b). Adaptability and flexibility remain crucial for competitiveness in the publishing sector (Thompson 2013). POD has transformed the traditional model by enabling direct sales and eliminating intermediaries (Christopher 2016; Hall 2013; Magadán and Rivas 2022; Wilson-Higgins 2017), reshaping the supply chain (Brammer 2024; Hall 2013; Jubb and Fisher 2017). The findings from the analysis of the five university presses align with the academic literature. Furthermore, these five presses evolve similarly, both at the time of digital technology integration and in their subsequent development (Christopher 2016; Hall 2013; Wilson-Higgins 2017).

Taking a book from its initial release to its inclusion in the backlist and potential delisting involves complex strategic and financial decisions. Publishers must carefully balance sales expectations with market evolution, adopting production and distribution models that mitigate risks and enhance long-term profitability. In this context, POD emerges as an efficient and flexible solution in an environment of uncertain demand where storage costs need strict control (Magadán and Rivas 2021a, 2021b; Peltier, Benhamou, and Touré 2016). POD allows printing only what is necessary at the time, eliminating the need to maintain large inventories. This approach reduces storage costs and minimises the risk of book deterioration and obsolescence. Publishers can allocate their financial resources to more strategic areas, such as research and the development of new content, by avoiding excess inventory.

While POD technology offers significant advantages, such as cost reduction, flexibility and adaptability to fluctuating demands, its adoption comes with challenges (Hall 2013; Senftleben et al. 2017; Szenberg and Ramrattan 2015). Understanding these limitations provides a more balanced view of its implications for academic publishers.

First, transitioning to POD requires substantial upfront investment in advanced digital printing equipment and logistics infrastructure. For smaller presses or those with limited resources, this initial cost may pose a significant barrier to entry (Dharwadker 2016).

Second, the successful implementation of POD relies heavily on continuous access to cutting-edge technology. Recurring costs for updates, maintenance and staff training are ongoing challenges. Furthermore, technological disruptions, such as system failures or supply chain delays for printing materials, can directly impact production schedules and profitability (Brammer 2024; Hall 2013; Jubb and Fisher 2017).

Third, although POD is effective for short-run printing, its quality can sometimes fall short of traditional offset printing. For example, graphic resolution and the durability of printed materials may not meet the same standards, which could affect customer satisfaction and the perception of the final product (Dong, Shi, and Zhang 2022; Song and Zhang 2024).

Fourth, the financial viability of POD depends on maintaining a consistent level of demand (Andreoli and Pacull 1999; Lewis 2002; Poell, Nieborg, and Duffy 2021; Thoma 2016). In academic markets, where demand can be highly unpredictable due to changing curricula, institutional budgets or research priorities, relying on POD alone may not always be sustainable (Christopher 2016; Davis 2014; Magadán and Rivas 2021b; Moberg, Borggren, and Finnveden 2011; Wilson-Higgins 2017).

Finally, compared to offset printing, POD often incurs higher costs per unit, particularly, for larger print volumes, making POD less suitable for high-demand publications or those intended for wider commercial distribution (Christopher 2016;

Davis 2014; Magadán and Rivas 2021b; Moberg, Borggren, and Finnveden 2011; Wilson-Higgins 2017).

By acknowledging these limitations, publishers can make more informed decisions about integrating POD into their production models. While these challenges highlight the trade-offs involved, they also underscore the importance of strategic planning and targeted implementation to maximise the benefits of POD while mitigating its risks (Cisneros and Olave 2021; Mabaso 2020).

POD helps mitigate the risk of dealing with large amounts of unsold inventory. Traditionally, publishers had to take the risk of printing large book runs to obtain lower unit prices, often resulting in excess inventory and losses if books did not sell as anticipated. With POD, this risk significantly diminishes as publishers can adjust production based on actual demand, printing only the necessary copies to meet current requests.

Implementing POD to manage the book lifecycle represents an efficient and flexible response to current challenges in the publishing market. This technology allows for the optimisation of each stage of the book lifecycle, from its launch to its inclusion in the backlist and eventual delisting. When launching a new title, sales expectations used to be high, influencing the initial print run, following the push model (Kumar and Shah 2005). Greater expectations for commercial success result in larger initial print runs designed to meet anticipated demand and ensure the book's availability from the outset (Poell, Nieborg, and Duffy 2021). However, the period that a book remains a new release is increasingly short. As it moves to the backlist, generally after a few months, restocks become less frequent and more spaced out, reflecting a decrease in demand and forcing publishers to reconsider their production and distribution strategies (Coelho, Moreira, and Moras 2018; Magadán and Rivas 2020a). As sales continue to decline, publishers replace large print runs with a pull-based model (Kumar and Shah 2005), which allows the printing of small quantities of books without incurring high financial costs for the publisher (Anderson 2006; Poell, Nieborg, and Duffy 2021). This approach is viable because development costs, such as layout, illustrations, formatting and proofreading, have already been covered during the initial marketing phase (Coelho, Moreira, and Moras 2018). This model is helpful for books that have entered the 'long tail' of the publishing market, meaning those that do not have continuous high demand but continue to receive occasional orders (Anderson 2006).

When book stocks run out, the publisher faces a critical decision: reprint or delist. Reprinting involves an uncertain and slow-return investment, with the risk of unsold copies. On the other hand, delisting means forfeiting even minimal revenue and may result in a loss of market presence and potential contractual issues with authors and literary agents. Depending on the contract, the publisher might be required to maintain a minimum stock of titles, further complicating the decision to delist. In this context, the 1:1 digital printing model (PTO) is considered, which allows for the sale of books without maintaining physical stock, printing each book only when an order is received, thus eliminating the risk of overproduction and unnecessary storage.

POD implementation offers strategic benefits, such as cost reduction, by printing only the necessary, thereby minimising storage costs and financial risk. POD enables a swift response to market fluctuations by adjusting production to actual demand, thus reducing resource waste, and preventing overproduction. The integration of advanced technology, personalisation and sustainability enhances the competitiveness of publishers and contributes to a more responsible future in the publishing sector (Done, Warner, and Noorda 2022; Magadán and Rivas 2021a). The POD model proves ideal for avoiding stock shortages in warehouses and bookstores. This method facilitates short print runs, tailored based on demand estimates derived from sales history, with quick production and delivery. The ability to produce small print runs, lower storage costs and minimise the risk of unsold inventory allows publishers to respond more agilely to academic market needs.

The following conclusions address the research questions posed in the specific objectives:

Regarding the structure of the supply chain in university presses using POD, integrating POD into the supply chain of scholarly publishers has significantly enhanced operational efficiency and flexibility. The analysed academic publishers have adopted POD models that combine advanced technology with strategic collaboration with logistics partners. This approach has enabled more agile order management, reducing the need for significant inventory levels and minimising risks associated with storage and obsolescence. Adjusting production based on actual demand has streamlined workflows and facilitated a prompt response to market fluctuations.

Concerning the impact of POD on the academic book lifecycle: POD has transformed the academic book lifecycle by enabling more efficient and adaptive production and distribution. The technology has reduced the risk of obsolescence and associated storage costs by allowing on-demand printing of specific titles. This advancement has extended the longevity of academic texts by facilitating constant updates and the production of new editions without the need for large initial print runs. The ability to adjust and personalise publications has enhanced the relevance and adaptability of texts in a continually evolving academic environment.

Regarding the influence of printing innovations on scholarly publishers' strategies: advances in digital printing have revolutionised university publishing strategies, offering increased flexibility and adaptability. Advanced printing technology has allowed university presses to explore new opportunities, quickly adjust production to market demands, and reduce the financial risk of high initial investments. POD has facilitated the introduction of new editorial products and services, enabling the testing of innovative concepts and formats and has improved publishers' ability to respond rapidly to emerging trends and needs in the academic sphere.

Based on the findings presented in this work, several areas for future research emerge, particularly, in the context of the adoption of POD by Spanish university presses. First, future research could focus on how the POD model contributes to environmental sustainability within the publishing industry. Further investigation into reducing the carbon footprint of publishers and minimising material waste could provide valuable

insights, especially as Spanish publishers continue to adopt more sustainable practices. Second, future research could investigate the cost–benefit and flexibility of POD compared to conventional printing methods to assess its long-term efficiency and economic viability in the Spanish academic context. Third, future research could examine how POD drives the creation of new editorial products, such as customised editions or updated academic texts, to explore how these innovations affect the competitiveness and relevance of Spanish publishers in the global academic market. Fourth, future research could analyse how variability in academic demand, both domestically and internationally, impacts the adoption and effectiveness of POD in university presses, how publishers manage the risks associated with unpredictable demand for academic titles, and how POD helps mitigate these risks. Fifth, future research could focus on a comparative analysis of the different platforms used by Spanish publishers, such as IngramSpark, Podiprint and Lantia, examining how choosing a specific platform affects operational efficiency, costs and the global reach of publishers, as well as the advantages and disadvantages of each platform based on the type of academic content published. Finally, further research could investigate how POD helps extend the lifespan of academic titles, studying the production of subsequent editions on demand, constant updates and managing books in the second-hand market, an area that could benefit from the POD model.

These research directions would provide a more detailed and nuanced understanding of the benefits and challenges of adopting the POD model in academic publishing.

Author Contributions

Marta Magadán-Díaz: conceptualization, formal analysis, investigation, methodology, project administration, resources, visualization, writing – original draft, and writing – review and editing. **Jesús I. Rivas-García:** conceptualization, formal analysis, investigation, methodology resources, writing – original draft, writing – review and editing.

Consent

Participants who opted to take part in the survey were asked to provide their names and contact details for follow-up questions, but access to all personal data was restricted to the investigating team and was removed before analysis of the results. Obtaining informed consent from participants was exempted by the Institutional Review Board of the Universidad Internacional de La Rioja because there was no identifiable information of participants in the survey data.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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