**Supply Chain Finance:**

**A systematic literature review and bibliometric analysis**

**Abstract**

Supply Chain Finance (SCF) is an effective method to lower financing costs and improve financing efficiency and effectiveness, and it has gained research momentum in recent years. This paper adopts a systematic literature review methodology combined with bibliometric, network and content analysis based on 348 papers identified from mainstream academic databases. This review provides insights not previously fully captured or evaluated by other reviews on this topic, including key authors, key journals and the prestige of the reviewed papers. Using rigorous bibliometric and visualisation tools, we identified four research clusters, including deteriorating inventory models under trade credit policy based on the EOQ/EPQ model; inventory decisions with trade credit policy under more complex situations; interaction between replenishment decisions and delay payment strategies in the supply chain and roles of financing service in the supply chain. Based on the clusters identified, we carried out a further content analysis of 112 papers, identifying research gaps and proposing seven actionable directions for future research. The findings provide a robust roadmap for further investigation in this field.

**Keywords**: Supply chain finance; Literature review; Bibliometric analysis; Network analysis; Co-citation; Content analysis

1. **Introduction**

Supply Chain Finance (SCF) has played an increasingly important role in operational and financial practices and attracted growing attention from academia and industry alike (Yan *et al.*, 2016; Milder, 2008). The history of SCF research can be traced back to the 1970s, well before the popularisation of the term supply chain management. For example, Budin and Eapen (1970) study the net flow of cash generated over the course of business operations in a cash planning period and how such net inflows are affected by changes in policies concerning trade credit and inventories. Haley and Higgins (1973) investigate the relationship between inventory policy and trade credit policy in the context of the basic lot-size model.

The first formal definition of SCF did not appear until the 2000s. Stemmler (2002) finds that the key characteristic of SCF is the integration of financial flows into the physical supply chain, and SCF can be characterised as an essential part of supply chain management. Hofmann (2005) describes SCF as located at the intersection of logistics, supply chain management, and finance and defines it as an approach for two or more organisations in a supply chain, including external service providers, to jointly create value by planning, steering, and controlling the flow of financial resources on an inter-organisational level.

Pfohl and Gomm (2009) define SCF as the inter-company optimisation of financing and the integration of financing processes with customers, suppliers, and service providers to increase the value of all participating companies. Gomm (2010) states that the objective of SCF is to optimise financing across company borders to decrease the cost of capital and accelerate cash flow. Pfohl and Gomm’s (2009) definition is adopted in this paper. However, we realise that early studies in SCF tend to focus on the effects of only one supply chain player’s financing on inventory, which has implications for other supply chain members (supplier or retailer). To trace the complete evolution of the topic, we include these early studies in this review. The methods we used to select the papers are reflected in the search strings and keywords in the methodology section.

SCF aims to optimise financial flows through solutions implemented by financial institutions (Camerinelli, 2009) or technology providers (Lamoureux and Evans, 2011). The ultimate objective is to align financial flows with product and information flows within the supply chain, improving cash flow management from a supply chain perspective (Wuttke *et al.*, 2013). The benefits of the SCF approach rely on cooperation among stakeholders within the supply chain and typically result in lower debt costs, new opportunities to obtain loans (especially for weak supply chain players) or reduced working capital within the supply chain (Gelsomino *et al*., 2016).

Specifically, when we selected search strings and keywords, we chose “trade credit” and “factoring” because trade credit, factoring and reverse factoring are all specific solutions in SCF that should be included in the review of SCF. Trade credit is a short-term loan between firms that is tied in both timing and value to the exchange of goods between them (Ferris, 1981). Seifert *et al.* (2013) point out that the role of trade credit in the global economy is extensive and consequently, it has received considerable attention in the SCF research. Factoring is a type of supplier financing in which firms independently sell their creditworthy accounts receivable at a discount to a financier, the factor, and receive immediate cash (Klapper, 2006; Soufani, 2002). Reverse factoring is a financial arrangement in which a corporation facilitates early payment of its trade credit obligations to suppliers; this arrangement has received considerable attention from both the business and research communities (Vliet *et al.*, 2015; Tanrisever *et al.*, 2012). In reverse factoring, the lender purchases accounts receivables only from specific informationally transparent, high-quality buyers, and the credit risk becomes the default risk of the high-quality buyers instead of the risky Small and Medium-sized Enterprise (SME), which make it possible to provide low-risk financing to high-risk suppliers (Klapper, 2006).

There have been a few literature reviews on certain themes of SCF. These review papers cover one or two themes of SCF. For example, Chang *et al.* (2008) provide a review of inventory lot-size models under conditions of extended payment privileges. Birge (2015) discusses the interaction of operations and finance in which financial activity has significant potential to make an impact on operations and operational considerations provide new perspectives for financial decisions. Zhao and Huchzermeier (2015) propose a risk management framework for the multidimensional integration of operations-finance interface models.

However, there is no comprehensive review paper except for Gelsomino *et al*. (2016). There are several significant differences between our review and that of Gelsomino *et al*. (2016): 1) Gelsomino’s study is focused on SCF concepts and solutions, while we review papers containing all aspects of SCF; 2) We include a more comprehensive list of keywords than Gelsomino’s study and separate keywords into two search strings (financing and supply related), which theirs does not; 3) Gelsomino *et al.* (2016) identify more than 2000 articles and select 119 papers for final review, while our study examines more than 4700 articles and focuses on 348 papers for bibliometric analysis together with 112 papers for content analysis; 4) Gelsomino’s study first covers papers from a period between 2000 and 2014 and then examines the reference of the papers selected in the first step based on a handful of elite journals, while we trace back to the origin and did not put a time limit or constrain the review with a set of journals for the bibliometric analysis (we do constrain the journals as AJG 3, 4 and 4\* for the content analysis to be explained later); 5) Gelsomino’s paper adopts only the content analysis method for reviewing selected papers while we adopt a combination of bibliometric and content analysis and the results are significantly different. In a sense, we provide a more comprehensive view of how SCF research developed and identify four clusters based on rigorous mathematics tools, which are different from their themes and advanced a different set of future research directions for SCF researchers. To illustrate the similarities and difference between Gelsomino’s and our paper more explicitly, Table 1 is presented for comparison.

**[Please Insert Table 1 here]**

In this study, we first carried out a comprehensive and systematic literature review and rigorous bibliometric and network analysis on SCF (e.g., citation and co-citation analysis) to map out the knowledge structure of this topic and then conducted a content analysis of the key papers based on journal quality and the papers’ PageRank score. Network analysis through bibliometric tools proves powerful for identifying established and emerging topical areas. These algorithmically identified clusters set the stage for topical classification of the published models and further investigation of the evolution of these clusters over years. Based on the bibliometric and network analysis, we selected papers published in 3, 4 and 4\* journals of the Association of Business Schools’ Academic Journal Guide (AJG) from each cluster and carried out a content analysis. From these results, we gained additional insights into the current research themes and potential directions for future research.

The AJG, which was called the ABS Guide before 2015, is recognised as an influential journal ranking system. It is based upon peer review, editorial and expert judgements and is informed by statistical information relating to citations. The guide not only is based on a weighted average of journal metrics but also reflects the perceptions of the subject experts and scholarly associations (AJG, 2015). We choose the AJG because it has been widely adopted as a policy tool for staffing in business schools (Kelly *et al.* 2009; Hussain, 2011) and is commonly used by researchers in papers (Mingers and Willmott, 2013; Tüselmann *et al.*, 2016).

We make contributions to SCF research in the following ways. First, this is one of the most comprehensive reviews of this emerging albeit important topic in supply chain management. Second, the combination of bibliometric and content analysis presents a methodological contribution to a systematic literature method. Third, the identification of the four clusters and additional insights from the content analysis provide a systematic knowledge structure for SCF based on which actionable ideas for future research are proposed.

The remainder of the paper begins with an introduction to the literature review methodology used and descriptive analysis in section 2. Section 3 presents the results of bibliometric analysis and network analysis (including citation and co-citation analysis). In section 4, we carry out a content analysis. Section 5 discusses the findings of all the analysis and proposes numerous future research directions. Section 6 summarises the results and presents the limitations of this study.

1. **Research methodology and descriptive data analysis**

Literature reviews aim to map and evaluate the body of literature to identify potential research gaps and highlight the boundaries of knowledge (Tranfield *et al.*, 2003). Structured literature reviews are typically completed through an iterative cycle of defining appropriate search keywords, searching the literature, and completing the analysis (Saunders *et al.*, 2009). Rowley and Slack (2004) recommend a structured methodology for scanning resources, designing the mind map to structure the literature review, writing the study and building the bibliography. In this study, we follow a systematic literature review methodology (Tranfield *et al.*, 2003) combined with bibliometric and network analysis for a comprehensive evaluation of the field, aiming to identify the most influential studies and authors and the existing topical areas of research and provide insights for current research interests.

**2.1 Defining the appropriate search terms**

The term SCF consists of two elements (i.e., supply chain and finance) and is cross-disciplinary, straddling supply chain management and finance. To ensure that both aspects are fully captured by the keywords, we included two search strings, which are shown in Table 2. The first string is supply chain-related terms, including keywords such as “supply chain”, “value chain”, “inventory” and “purchasing” (Seuring and Müller, 2008). The second search string contains finance-related keywords such as “finance”, “financing”, “trade credit” and “bank credit”. The keywords were chosen based on previous literature reviews on similar topics, the authors’ own research experience and expert views from fellow SCF academics.

**[Please Insert Table 2 here]**

**2.2 Search results**

We followed a three-step approach to identify the papers for final review. *First*, in the Scopus and EBSCO databases, we collected and stored journal articles (conference papers, books and chapters of books excluded) for the defined search terms with an open starting time to include as many publications as possible up to December 2016. The initial search attempts identified 4787 titles (2381 papers in EBSCO and 2406 papers in Scopus). The search results were stored in CSV format to include all the essential paper information such as paper title, authors’ names and affiliations, abstract, keywords and references.

There is some degree of overlap between the two databases. After eliminating duplicates, 4078 papers remained. *Second*, we reviewed the titles and abstracts, applying inclusion and exclusion criteria (Table 3). In particular, studies focusing on the effects of one supply chain player’s financing on their inventory, which has implications for other supply chain members (suppliers or retailers), are included. Four hundred and twenty journal articles were selected for the third round of selection. *Third*, we reviewed the full text of these papers applying the same inclusion and exclusion criteria and identified **348** journal articles for bibliometric analysis. Papers were excluded when 1) they mainly focused on supply chain management but superficially touched on finance; or 2) they mainly focused on finance but superficially touched on the supply chain. To do this, two of the co-authors drew a table with all 420 papers and a column to judge ‘include’ or ‘exclude’ or ‘unsure’ based on their independent reasons. We then compared the results and reached agreements on all the items with which we did not agree initially.

**[Please Insert Table 3 here]**

**2.3 Descriptive analysis**

The 348 journal articles were published between 1970 and 2016. Figure 1 shows an upward trend in terms of the number of articles published per year since 2000. Before 2003, 1 or 2 papers were published per year. This shows that the 348 papers are scattered approximately 120 journals, 56 of which have contributed 80.17% of all publications reviewed. The top 12 journals have published 161 of these identified articles, representing approximately 46.26% of the 348 papers. Table 4 shows the top 12 journals that published the largest number of these papers. It can be seen that the majority of the journals are operations research journals.

**[Please Insert Figure 1 here]**

**[Please Insert Table 4 here]**

**3. Bibliometric and network analysis**

**3.1. Description of bibliometric and network analysis**

**3.1.1 Bibliometric analysis**

Bibliometric analysis offers additional data statistics including author, affiliation and keywords. Several software packages such as HistCite and BibExcel have been used in the past for bibliometric analysis, and each has different capabilities and limitations (Garfield, 2009; Persson *et al.*, 2009). BibExcel was chosen for this study due to its high degree of flexibility in modifying and/or adjusting the input data imported from various databases, including Scopus and Web of Science, and its ability to provide comprehensive data analysis for use in a range of network analysis tools, including Gephi, VOSviewer and Pajek (Persson *et al.*, 2009). We used BibExcel to perform some initial bibliometric and statistical analysis and to prepare the input data for additional network analysis in Gephi. Due to space constraints, we do not report bibliometric analysis here. The original data source containing the bibliographic information of the articles is in CSV format. We transferred the CSV format to TXT format using a Python program to create a suitable format to input into BibExcel. Citation information such as author, title, journal, publication year, keyword, affiliation, and reference was extracted from the papers identified.

**3.1.2** **Network analysis**

A network analysis and graphical investigation was then applied to the 348 papers. We used Gephi software to perform a citation analysis and topical content-based classification of the existing literature of SCF. Gephi was chosen for this study over existing network analysis software such as Pajek (Batagelj and Mrvar, 2011) and VOSviewer (van Eck and Waltman, 2013) due to its easy and broad access to network data, visualisation flexibility (editable and user-friendly environment), advanced filtering capabilities, specialised clustering of data, ability to work with different data formats, and built-in network analysis toolboxes (Gephi, 2013; Bastian *et al.*, 2009). To use Gephi to map and visualise the citations among papers, a graph dataset needed to be generated, with published papers shown as nodes and citations represented by the arcs/edges between the nodes. The bibliographic data were reformatted with BibExcel to represent a graph dataset, which is in “.NET” format, to allow for Gephi analysis. The network analysis consists of citation and co-citation analyses, which are detailed in sections 3.2 and 3.3, respectively.

**3.2 Citation analysis**

In the past, different methods have been used to measure the significance of a publication. The most common method is a citation analysis, which aims to determine the popularity of a publication by counting the number of times a publication is cited by other publications (Cronin and Ding, 2011). A citation analysis for the 348 papers revealed that 214 papers have cited others in this 348-node network. Table 5 shows the top 11 of 348 papers based on the number of their citations. A local citation analysis shows how many times a paper has been cited by others within this 348-node network, while a global citation analysis provides the overall number of citations in all databases, including citations from other disciplines and research areas.

**[Insert Table 5 here]**

**3.2.1 Journal quality analysis**

We analysed paper quality based on the AJG 2015 journal guide. Among the 348 papers, 14 papers were published in AJG Grade 4\* journals, which are world-leading journals; 24 papers were published in Grade 4 journals; 82 papers were published in Grade 3 journals; 26 papers were published in Grade 2 journal and 35 papers were published in Grade 1 journals. The other 167 papers were published in journals with no rating. 52.01% of the papers were published in journals of Grade 1 and above, and 34.48% of the papers were published in journals of Grade 3 and above.

**3.2.2 PageRank analysis**

In addition to citations, Ding *et al.* (2009) argue that “prestige” is an important indicator of impact. Prestige can be measured by the number of times a paper is cited by other highly cited papers. A highly cited paper may not necessarily be a prestigious paper, although in some cases there might be a strong positive correlation between the two measures. PageRank (Brin and Page, 1998) can be used as a measure of both popularity and prestige. PageRank was introduced to prioritise web pages when a keyword search is performed in a search engine. Although originally created to discover the connectivity of webpages, PageRank can be extended to find the citation link between papers. Consider paper A, which has been cited by other papers—namely, $T\_{1}$, ... , $T\_{n}$, where paper $T\_{i}$ has citations $C\left(T\_{i}\right)$. In this case, the PageRank of paper A (denoted by $PR\left(A\right)$) in a network of N papers can be calculated as

$$PR\left(A\right)=\frac{\left(1-d\right)}{N}+d\left(\frac{PR\left(T\_{1}\right)}{C\left(T\_{1}\right)}+…+\frac{PR\left(T\_{n}\right)}{C\left(T\_{n}\right)}\right)$$

where parameter d is a damping factor between 0 and 1 that represents the fraction of random walks that continue to propagate along the citations.

PageRank forms a probability distribution over papers, so the sum of all papers’ PageRank calculations will be equal to one. Using this formula, PageRank is calculated based on an iterative algorithm and corresponds to the principal eigenvector of the normalised citation matrix of the papers. In the original Google PageRank algorithm of Brin and Page (1998), the parameter d was chosen to be 0.85. This value was prompted by the anecdotal observation that an individual surfing the web will typically follow approximately six hyperlinks, corresponding to a leakage probability of 1/6 ∼= 0.15 = (1 − d), before becoming either bored or frustrated with the search and beginning a new search. In the context of citations, the entries in the reference list of a typical paper are collected following somewhat shorter paths of average length 2 (Chen *et al.*, 2007), making the choice d = 0.5 more appropriate for a similar algorithm applied to the citation network.

For the 214 papers identified from co-citation analysis (detailed in the next section 3.3), PageRank values vary between 0.0009 and 0.0164. When we focus on the journals of AJG Grade 3, 4 and 4\*, the top 10 papers based on a PageRank measure are shown in Table 6. It can be seen that a higher number of local and global citations cannot guarantee the prestige of a paper. For example, Chung and Liao (2004) is a high-ranked paper by citations (ranks the third in Table 5), but only lists tenth as a prestigious paper in Table 6. Equally, there are prestigious papers that are not highly ranked (e.g., Jaggi *et al.*, 2008; Buzacott and Zhang, 2004).

**[Insert Table 6 here]**

**3.3 Co-citation analysis**

A co-citation network consists of a set of nodes representing journal articles and a set of edges or links representing the co-occurrence of the nodes (articles) in other papers (Leydesdorff, 2011). Therefore, two publications are considered to be co-cited if they appear together in the reference lists of other documents. Papers that are more often cited together are more likely to present similar subject areas or be related (Hjørland, 2013). The co-citation map visualisation is a form of exploratory data analysis (EDA) that relies on graph theory to explore data structure (Pampel, 2004). The initial co-citation mapping with Gephi revealed that 214 of the 348 articles have been co-cited by other papers within this sample. We use these 214 papers for the further Gephi data-clustering analysis. When opening the ‘.NET’ file in Gephi for the first time, the positioning of the nodes in the co-citation map is randomly generated by the software. This layout has no discernible pattern, which is unsurprising in light of the random nature of the positioning. The nodes have identical sizes but different (x, y) coordinates.

**3.3.1 Literature classification: Data clustering**

The nodes of a network can be divided into clusters or modules in which the connection (density of edges) is greater between the nodes of the same cluster compared to those of different clusters (Clauset *et al.*, 2004; Leydesdorff, 2011; Radicchi *et al.*, 2004). In a co-citation network, a cluster can be seen as a group of well-connected publications in a research area with limited connection to publications in other clusters or research areas. Data clustering (also termed modularity) has been used in the past as a classification tool for grouping a set of given publications (Radicchi *et al.*, 2004). It allows for the topological analysis of a co-citation network, identifying topics, interrelations and collaboration patterns. Data clustering has received increasing attention from scholars and research organisations, turning it into a critical research field in social network analysis (Blondel *et al.*, 2008).

The default clustering tool in Gephi is based on the Louvain algorithm, an iterative optimisation model that aims to determine the optimal number of partitions that maximise the modularity index (Blondel *et al.*, 2008). The modularity index of a partition is a scalar value between −1 and +1 that measures the density of links inside communities versus the links between communities. According to Blondel *et al.* (2008), for a weighted network (i.e., networks with weighted links, such as the number of co-occurrence of two articles in the reference list), modularity index Q can be calculated as

$$Q=\frac{1}{2m}\sum\_{ij}^{}\left[A\_{ij}-\frac{k\_{i}k\_{j}}{2m}\right]δ\left(c\_{i},c\_{j}\right)$$

where $A\_{ij}$ represents the weight of the edge between nodes $i$ and $j$, $k\_{i}$ is the sum of the weights of the edges attached to node $i$ ($k\_{i}=\sum\_{j}^{}A\_{ij}$), $c\_{i}$ is the community to which node $i$ is assigned, $δ\left(u,v\right)$ equals 1 if $u=v$; and equals 0 otherwise, and $m=\frac{1}{2}\sum\_{ij}^{}A\_{ij}$, which represents the sum of the weights of all the edges, as every edge is calculated twice when we add up all the $A\_{ij}$.

To get the optimal value efficiently, the Louvain algorithm repeats two phases below iteratively. First, each node of the network is assigned to a different community. For each node $i$, the gain of modularity is evaluated by removing $i$ from its community and by placing it in the community of each neighbour $j$ of $i$. Second, node $i$ is placed in the community for which this gain is maximum if the gain is positive or $i$ stays in the original community if no positive gain is possible (Blondel *et al.*, 2008). The first phase stops when a local maximum of the modularity is attained. Applying this algorithm to the filtered 214-node co-citation network in Gephi resulted in the creation of four clusters.

The number of papers in each cluster varies from 31 articles for Cluster two to 63 articles each for Clusters one and three, the largest modules (Table 7). To capture the high-quality papers for the content analysis (next section 4), we only chose papers published in journals of AJG Grade 3, 4 and 4\* due to their generally higher academic rigour and quality. Overall, **96** papers out of the 214 were selected for further clustering and content analysis. Among them, 34 papers fall into Cluster one, 11 papers fall into Cluster two, 25 papers fall into Cluster three, and 26 papers fall into Cluster four.

**[Insert Table 7 here]**

To determine the research focus for each cluster, we needed to identify the lead papers (top 10 papers) in each cluster (Table 8). This is a common practice in other bibliometric analysis papers (e.g., Fahimnia *et al*., 2015). The lead papers provide a general description of each cluster. A PageRank measure was used for this purpose. In a co-citation network, the PageRank algorithm takes into account how many times a paper is co-cited with other papers (the popularity measure) and how many times it is co-cited with highly co-cited papers (the prestige measure). Most of the papers in this study that have a high PageRank also have a high citation count.

**[Insert Table 8 here]**

Identifying the contributing journals for each research cluster can help determine the most relevant journal outlets in each area. Table 9 shows the key contributing journals for each cluster. We find that IJPE contributes the most to three out of the four clusters (the only exception being Cluster four). EJOR ranks the second in contributing journals based on the number of papers in the four clusters.

**[Insert Table 9 here]**

**3.3.2 Analysis of the research clusters**

As discussed in section 3.3.1, four research clusters have been identified with co-citation analysis. To identify the area of research focus of each cluster, we analysed and evaluated the contents of the top 10 papers of each cluster shown in Table 8. **Cluster one** focuses on the deteriorating inventory model under trade credit policy. This cluster is focused on the impact of trade credit policy on the optimal ordering or production quantity based on the classical EOQ or EPQ model, respectively. **Cluster two** is about the inventory decisions made with trade credit policy and was primarily developed from cluster one. It examines how trade credit policy impacts optimal ordering/product quantity within the EOQ or EPQ framework but tends to extend the traditional model or assumptions. **Cluster three** is a transition from Clusters one and two to Cluster four. It focuses on the interaction between replenishment decisions and delay payment strategies in the supply chain. This cluster begins to study the impact of SCF throughout the supply chain. **Cluster four** is mainly focused on the roles of financing service in the supply chain. This cluster investigates how formal or informal financing services (e.g., bank credit or trade credit) affect joint operational and financial decisions in a supply chain and show whether the SCF coordinates the supply chain or creates value for individual companies or the entire supply chain.

**3.3.3 Dynamic co-citation analysis**

To understand the evolution of SCF research over time, we also completed a dynamic co-citation analysis for the papers of all clusters, which shows the evolution/development of clusters over time. Table 10 shows the number of papers published in each cluster since 1973. The earlier publications are more focused on Cluster one. Research on cluster one appeared in the 1970s and developed steadily but declined from 2014 onwards. The numbers of articles for Clusters three and four began to grow nearly at the same time, in 2005 and 2004, respectively. Cluster two emerged the latest (in 2007) and declined from 2014 onwards. Clusters one and two stopped developing in recent years while Clusters three and four continue to grow (Table 10).

This chronological evolution of the four clusters is also shown graphically in Figure 2. One node represents one article and the size of a node for each layout represents the PageRank score of the article. Hence, the larger the size of a node, the more highly cited and prestigious the corresponding paper. The links between the nodes represent the citation rates: the thicker the links, the closer the clusters. It can be seen that Cluster one had many papers published between 1973 and 2013 but has gone silent since 2013. Cluster four did not catch up until 2007 after which the number of its papers has increased significantly. Cluster three emerged and has grown steadily since 2005. Cluster two has a relatively smaller number of papers, emerged in 2007 and has declined since 2013.

Additionally, we observe that Clusters two, three and four have grown since approximately 2008. The reason for this may lie in the rapid development of literature on supply chain management in the late 2000s. We refer the readers to de Kok and Graves (2003) and Simchi-Levi *et al*. (2004) for a general overview of supply chain management. Supply chain management is focused on the coordination of material, information, and capital flows, and therefore it is logical for scholars to start examining the effects of joint financial and operation decisions of firms on their supply chain management (Babich and Sobel, 2004; Buzacott and Zhang, 2004). As a result, the literature on SCF has grown rapidly since 2008.

**[Insert Table 10 here]**

**[Insert Figure 2 here]**

**4. Content analysis of the four clusters**

To obtain insights into each cluster, a content analysis was conducted to identify the research sub-themes within each of the four clusters identified from co-citation analysis. Since co-citation analysis considers only co-cited papers, recent articles tend to be missed due to a low number of citations. To perform the content analysis, we screened papers that were published in 2014, 2015 and 2016, but not included in the 214-node co-citation network. Overall, 90 papers were found to be published in these three years outside the 214-node and 16 papers of that 90 were published in AJG Grade 3, 4 and 4\* journals. We found that the 16 papers fit in the existing clustering structure and fall into Clusters 2, 3 and 4. Finally, the content analysis is based on the 96 papers (Table 7) from the co-citation analysis plus the 16 papers published in the most recent three years. Overall, 112 papers (all published in AJG 3, 4 and 4\* journals) were reviewed for content analysis.

**4.1 Cluster one: Deteriorating inventory model under trade credit policy based on EOQ/EPQ model**

With 34 papers, Cluster one is the largest cluster and emerged as early as 1973. This cluster focuses on the impact of specific forms of financing mechanisms on decisions of the classical inventory model (Haley and Higgins, 1973; Goyal, 1985; Jaggi and Aggarwal, 1994; Abad and Jaggi, 2003; Liao, 2008; Ho *et al.*, 2008). The papers in this cluster have similar research frameworks. First, and more specifically, almost all the research objectives of these papers are perishable products or deteriorating inventory systems. Second, the financing mechanisms that these papers study are all trade credit policies in the forms of permissible delays in payment, discounted cash flows (DCF) and date terms (Robb and Silver, 2006). Third, inventory decisions are focused on the optimal price, ordering quantity or replenishment frequency. These models are all based on traditional EOQ or EPQ models.

One empirical paper in Cluster one analyses the firm-level data of five African countries from the survey administered by the Regional Program on Enterprise Development (RPED) at the World Bank (Fisman, 2001). That paper found that the supplier credit is positively correlated with capacity utilisation i.e., firms lacking trade credit are likely to face inventory shortages, which lead to lower rates of capacity utilisation (ibid). Papers within Cluster one have strong connections with one another.

**4.2 Cluster two: Inventory decision with trade credit policy under more complex situations**

With only 11 papers, Cluster two is the smallest cluster and emerged the latest, in 2007. This cluster develops from Cluster one and includes further study of the impact of trade credit policy on inventory decisions. It is focused on deteriorating items and considers inventory decisions within the EOQ or EPQ framework, but extends the traditional model and assumptions compared with Cluster one in two ways. The first way in which this cluster extends the traditional model and assumptions is to extend the classical EOQ or EPQ models by introducing new methods such as fuzzy sense into the modelling and considering the demand rate, holding cost, ordering cost and purchasing cost as fuzzy numbers (Mahata and Goswami, 2007). Some other papers extend the model in terms of trade credit by considering two-level trade credit instead of one-level trade credit (Teng and Chang, 2009; Chang *et al.*, 2010). The second way in which this cluster extends the traditional model and assumptions is to extend the assumptions and consider extreme cases. For example, some papers assume that retailers can obtain the full trade credit offered by suppliers while they offer partial trade credit to their customers (Huang and Hsu, 2008; Mahata, 2012); other papers consider extreme scenarios in which suppliers offer retailers a partially permissible delay in payments when the order quantity is smaller than a predetermined quantity (Huang, 2007a).

**4.3 Cluster three: Interaction between replenishment decisions and delay payment strategies in the supply chain**

Cluster three consists of 25 articles and began in 2005. This cluster represents a transition from Clusters one and two to Cluster four. It focuses on the interaction between replenishment decisions and delayed payment strategies in the supply chain. Because Cluster three developed earlier than Cluster two, it not only contains similar topics (e.g., replenishment/ordering/inventory decisions) to those contained in Clusters one and two and extends the classical EOQ or EPQ models (Chung *et al*., 2014) but also begins to consider various forms of supply chain-level financing mechanisms that are totally different from those considered in Clusters one and two but are closer to those considered in Cluster four, e.g., it focuses on the entire supply chain instead of a single player and SCF mechanisms other than trade credit. Thus, we conclude that Cluster three represents a transition from Clusters one and two to Cluster four.

More specifically, this cluster has three main features compared to Clusters one and two. First, it extends the traditional replenishment models, which are focal company focused, by considering supply chain players and trade credit stages and constructing a Stackelberg game (Zhou and Zhou, 2013). Second, it relaxes some strict assumptions. For example, one commonly used assumption is that the retailer either pays for all the ordered items within a short permissible delay period to receive a cash discount or pays for all the ordered items within a long permissible delay period at the full price. However, Zhou *et al.* (2013) assume that the retailer may pay for any fraction of the ordered items within a short permissible delay period to receive a cash discount and then the remaining is paid within a long permissible delay period, which offers more flexible payment choices to retailers in reality. Furthermore, it adds new assumptions such as uncertain investment opportunity, varying deterioration and limited storage space (Marchi *et al.*, 2016; Sarkar *et al*., 2015; Zhong and Zhou, 2013). It also considers imperfect situations, e.g., the items are of imperfect quality and the production processes are imperfect (Ouyang and Chang, 2013). Third, it tends to consider new research ideas such as cost and credit risks (Wu *et al.*, 2014) and the coordination of the supply chain in the form of supply chain contracts (Kouvelis and Zhao, 2016), combining these ideas with supply chain finance.

**4.4 Cluster four: Roles of financing service in supply chains**

With 26 papers, Cluster four is the second largest cluster. The earliest article in Cluster four was published in 1981, but the number of papers for this cluster then remained stagnant until 2004. This cluster developed rapidly, especially after 2008 and is primarily focused on the impact of integrated operations and financing decisions on supply chain performance.

This cluster also studies the roles of financing service providers in the supply chain, i.e., how they innovate and transform SCF. First, it investigates how formal or informal financing services, e.g., bank credit and trade credit, affect joint operational and financial decisions in a supply chain. Some papers in this cluster compare trade credit with bank credit (Chen, 2015). Second, this cluster considers not only trade credit but also other forms of supply chain financing mechanisms, e.g., reverse factoring (Vliet *et al.*, 2015) and different supply chain contracts (Lee and Rhee, 2010). Cluster four pays more attention to supply chain coordination and examines how supply chain financing service providers coordinate the supply chain or creates value for both individual companies and the entire supply chain. Third, the models in this cluster can be applied to more complicated situations. This cluster stresses the budget-constrained conditions of supply chain players and introduces new conditions of tariff or fluctuated demand information or bankruptcy (Shang *et al.*, 2009; Yan and Sun, 2013). Finally, we notice that unlike Clusters one, two and three, which almost exclusively adopt the modelling method, more diverse methods were adopted in Cluster four, including surveys, experiments (e.g., Chen *et al.*, 2013) and a combination of empirical and modelling methods (e.g., Ferris, 1981; Bougheas *et al.*, 2009).

Two papers in Cluster four used a mixed method of modelling and empirical methods. Ferris (1981) develops a theory of trade credit adopted by supply chain partners to decrease the transaction costs arising out of trading uncertainty and then used data collected from the Internal Revenue Service publication Statistics of Income: Corporate Income Tax Returns, Total Active Returns (in the US) for the years between 1945 and 1972 to test his theory. In our analysis, this paper is the earliest published article to use the empirical method in SCF research. Bougheas *et al.* (2009) develop a model that recognises the motivation for a firm to offer and receive trade credit, which in turn affects inventory and profitability. To validate their model, they use the profit and loss balance sheet data gathered by Bureau Van Dijk Electronic Publishing in the FAME database (<https://www.bvdinfo.com/en-gb/home>) and focus on firms in the manufacturing sector from 1993 to 2003 (ibid).

**4.5 Papers published in the recent three years**

In this section, we present additional insights and trends identified from the review of the 16 papers published in 2014, 2015 and 2016 and not included in 214 papers from the co-citation analysis. The 16 papers primarily fall into Clusters two, three and four and contain six empirical studies (out of 10 overall). Some empirical papers examine the factors affecting the SCF solution. Fabbri and Klapper (2016) use a novel firm-level database of Chinese firms to investigate how the supplier’s bargaining power affects trade credit. Houston *et al.* (2016) analyse an extensive dataset that captures the supply chain relationships of bankrupt firms over the period of 1990-2009 and examine how a firm’s bankruptcy affects the bank financing costs of its key suppliers. They find that the borrowing costs of key suppliers significantly increased in the aftermath of their client firm’s bankruptcy. Alan *et al.* (2014) analyse a sample of publicly listed US retailers during the period of 1985-2010 and find that inventory productivity strongly predicts future stock returns.

Some other empirical papers examine the effects of SCF on supply chain performance, e.g., the coordination of entire supply chains. Kutsuna *et al.* (2016) study financial and supply-chain data for private firms from the Cosmos database provided by Teikoku Databank (<https://www.tdb.co.jp/english/news_reports/t030918.html>), which contains financial reports and firm-attribute data for each firm’s top 5 suppliers and customers. They examined the effects of Initial Public Offering (IPO) on revenue growth, PP&E (property, plant and equipment), accounts receivable, and the cash and loans of different supply chain players.

Birge (2015) studies the relationship between operations management and financial management in which financial activities have a significant impact on operations and operation management provides new perspectives on financial decisions. He provides examples and empirical observations about the relationship between operations and finance under the conditions of the absence of arbitrage, the differences between systematic and idiosyncratic risk, the valuation of limited production resources and imperfect market assumptions (ibid).

In addition, adopting a case study method, Caniato *et al.* (2016) analyse 14 cases involving the application of SCF solutions among Italian companies and provide a reference framework in which under the two objectives (improving the adopter’s financial performance (objective 1) vs. securing the upstream/downstream supply chain’s financial performance (objective 2)), different factors lead to the adoption of different SCF solutions. For objective 1-driven SCF solutions, the factors that affect successful adoption include the level of trade process digitalisation (negatively related), inter-company collaboration and the bargaining power towards supply chain players; for objective 2-driven SCF solutions, the factors leading to adoption include intra-company collaboration, level of trade process digitalisation and the financial attractiveness of the focal companies (ibid).

**5. Discussion and future research directions**

Cluster one appeared first, in 1973, and Cluster two emerged last, in 2007, but both clusters declined beginning in 2014. From 2008 onwards, there was a boost in Clusters three and four. SCF research has gradually developed into two main streams. One stream consists of Clusters one and two, which represents the traditional SCF research with a focal company focus. Cluster two was developed from Cluster one. These two clusters are focused on how financial mechanisms affect operation decisions through inventory models, especially classical EOQ and EPQ models and their variations within a firm’s boundary.

The other stream is represented by Cluster four, which examines how financial mechanisms influence the operation decisions in the entire supply chain and focus more on how SCF services create value for the supply chain, usually under conditions of uncertain demand and information asymmetry. The focus of the second stream (i.e., financing in the supply chain) represents a step change from the traditional internal operations management view of financing within a firm’s boundary to a supply chain view of financing going beyond a firm’s boundary. Cluster three is a transition from the first stream to the second.

The following key conclusions can be drawn from the findings obtained from bibliometric, network and content analyses:

(1) A frequency analysis showed that SCF research has had a long research history since 1973, but it has gained momentum and started growing rapidly especially in and after 2008.

(2) After filtering the papers based on the journal quality, 82.14% of the 112 articles are published in 8 major journals. IJPE and EJOR published the most number of SCF papers with relatively high quality among all journals.

(3) SCF research can be classified into two main streams comprising four clusters. Research stream two (Cluster four) develops from research stream one (Clusters one and two). Cluster three is a transition from the first stream to the second. Cluster four represents a new and emerging research area in SCF, emphasising financing service and exploring the value creation for the whole supply chain, which deserves more attention. Based on the bibliometric and content analyses, we propose **seven** future research directions for SCF (Table 11).

First, existing studies tend to investigate either one-level or two-level trade credit. Cluster one focuses on the one-level trade credit and Cluster two develops the model based on Cluster one and considers the two-level trade credit so that the retailer can obtain the full trade credit offered by the supplier and the retailer just offers the partial trade credit to customers. There is a need to go beyond one or two levels and to look into the SCF of multi-tier supply chains. In Cluster three, Pal *et* *al.* (2014) investigate the optimal replenishment lot size of the supplier and optimal production rate of the manufacturer under three levels of trade credit policy in which the supplier provides a fixed credit period to the manufacturer while the manufacturer gives a fixed credit period to the retailer, who in turn offers a credit period to each of its customers. In the future, scholars may focus on the multi-level trade credit or even SCF in a supply network.

Additionally, from the papers across the clusters, we found a few limited forms of trade credits. Usually, the papers consider partial or full trade credit, e.g., permissible delay in payment, discounted cash flows (DCF), and date terms. In the future, SCF scholars may consider more complex forms of trade credit policies and may assume that the credit amount or period offered by suppliers is based on the order quantity of retailers. More specifically, SCF researchers may study whether the conclusions in the one- or two-level SCF will stand in the multi-level situation or how the conclusions will change from the original forms of trade credit to more complex forms.

Second, some assumptions for SCF research are strict and may be relaxed and new assumptions may be introduced. For example, all the existing SCF research papers across Clusters one to three have the assumption of symmetric information, i.e., all the players in the supply chain have equal information about financing. In reality, however, this may not be the case, e.g., more powerful firms in the supply chain tend to have more financial information than others. In Cluster four, more papers consider the asymmetric information assumption (Daripa and Nilsen, 2011; Jing *et al.*, 2012; Cai *et al.*, 2014). Shang *et al.* (2009) examine three information scenarios: echelon, local, and quasilocal. In the echelon scenario, each supply chain player can access the inventory and cost information within its echelon, which includes the player itself and all downstream players, including customer demands; in the local scenario, each local supply chain partner accesses only local information, i.e., its own inventory and cost information; in the quasi-local scenario, all customer-demand information is shared by the supply chain players, but not cost information is not. Future research could consider how financing adds value to the entire supply chain under the condition of information asymmetry.

Another example is that nearly all of the papers except for one (i.e., Birge, 2015) in Clusters one to three assume that all the players in the financial market are risk-neutral. In reality, however, different firms have different attitudes towards risk. Tang and Musa’s (2011) literature survey points out that financial risk is one of the major risk issues in supply chain research. According to Heckmann *et al.* (2015), the subjective perception of the importance of risk is divided into three groups: risk-averse, risk-seeking, and risk-neutral. Risk attitudes have a decisive influence on the measurement of future supply chain performance and consequently co-determine supply chain decisions (ibid). In Cluster four, researchers begin to investigate the SCF in risk-averse cases (Babich and Sobel, 2004; Yan and Sun, 2013; Zhang *et al.*, 2014). Kouvelis and Zhao (2012) build their basic model with the risk-neutral assumption and extend the model to a scenario in which there is a risk-averse retailer. They find that the risk-averse retailer can order a larger quantity and obtain larger expected utility under supplier financing when the supplier’s interest rate equals the bank’s, which means that supplier financing is preferable over bank financing for a retailer regardless of its risk preferences (ibid). However, Heckmann *et al.* (2015) find that there is a lack of research focusing on the effects of different attitudes towards supply chain risk on supply chain decision-making. The same conclusion can be drawn from our content analysis of the four clusters. Interestingly, none of the reviewed paper across the clusters examine the risk-seeking assumption. Future research may consider assumptions based on different attitudes towards risk, which will lead to different operational and financial decisions in SCs (Chen and Wang, 2012).

Third, with the rapid development of SCF practice, scholars will need to adjust and extend the research models to adapt to a more turbulent environment for SCF. This is reflected in the following aspects:

1) The assumptions of certain demand considered in EOQ or EPQ models do not match reality. Most of the papers in Clusters one and two, especially in Cluster one, adopt the classical EOQ or EPQ models considering that demand is certain. As the research and application of SCF develop, the theoretical analysis of inventory under certain demand cannot satisfy the sophisticated demand found in reality. In the future, more flexible forms of demand or fluctuated demand information should be considered for a broader scope of application. For example, Ouyang *et al.* (2009), in Cluster one, suggest that future research could assume that demand is a function of selling price and varying time. Cai *et al.* (2014), in Cluster four, argue that demand could be a random variable following a cumulative distribution function.

2) According to all the papers in Clusters one and two, optimal decisions are made based on the cost of SCF using EOQ or EPQ models (e.g., Chen and Kang, 2007, Cluster one). However, the aim of adopting SCF could be not only to reduce the cost of the supply chain but also to increase the revenue of supply chain players. Zhou *et al.* (2012), in Cluster three, consider a two-echelon supply chain in which the supplier hopes to incentivise the retailer to order more items by offering trade credit. They show that trade credit policy could increase not only the overall chain profit but also each member’s profit under some conditions (ibid). In the future, more research focusing on both cost reduction and profit generation by the supply chain players should be conducted.

3) Without being limited to the classical inventory models and theories, different models and theories may be considered. For example, scholars tend to adopt game theory to model the decisions of supply chain players engaging with SCF and compare the bargaining power of each player. Caldentey and Haugh (2009), in Cluster four, study the performance of a stylised supply chain in which two firms compete in a Stackelberg game and consider the payoff of the retailer and producer. In their paper, the producer acts as a Stackelberg leader and offers a fixed wholesale price; the retailer acts as a follower and determines the purchasing quantity. Guan *et al.* (2016), in Cluster four, consider a two-stage Stackelberg game between the assembler and the two suppliers, in which the assembler is a leader and initially chooses the contract type and the buffer time, and the two suppliers are followers and simultaneously determine their production lead times. These studies suggest that more game theory models and their variations can be used to analyse the SCF problems in further research; examples include the Bertrand duopoly model or dynamic games with complete or incomplete information.

4) One important transition involves the transformation of the function of SCF from a marketing tool to a coordination tool. Clusters one and two study the change of inventory or replenishment policies with or without trade credit. Some papers find that trade credit increases optimal replenishment quantities and others do not (e.g., Daellenbach, 1986, Cluster one). In this way, trade credit is considered a marketing tool in these two clusters. However, scholars now tend to shift their attention towards the coordination of up-stream and down-stream supply chain players instead of the inventory decisions or replenishment policies of a single player. In Clusters three and four, we find that more papers began to consider supply chain coordination contracts, thus demonstrating that trade credit plays an important role in coordination and incentive mechanism of supply chain and works as a coordination tool. For instance, Lee and Rhee (2011), in Cluster four, consider coordination contract, employ a buyback/markdown allowance contract, and derive the optimal markdown allowance and risk premium in the trade credit for full coordination. This shows that trade credit is an instrument for supply chain coordination (ibid). Yan *et al.* (2016), in Cluster four, design a partial credit guarantee contract for SCF that incorporates the bank credit financing and manufacturer’s trade credit guarantee to analyse its equilibrium financing strategies. They find that the partial credit guarantee contract may realise profit maximisation and channel coordination in the SCF system and achieve the super-coordination effect with a suitable guarantee coefficient (ibid). In the future, more SCF research can be done by combining different contracts with trade credit to achieve the coordination of the supply chain. Scholars can also design contracts combining the advantages of different types of credit to better coordinate the whole supply chain.

5) Co-opetition in SCF deserves more attention from researchers. According to Pathak *et al.* (2014), the concept of co-opetition, or simultaneous competition and cooperation, originated from the game theory literature and is a network-level phenomenon. They specify four supply network archetypes that cover a wide range of economic activities: Community, Federation, Consortium and Hierarchy. They then explain how co-opetitive relationships may evolve in these supply network archetypes (ibid). As discussed previously, the focus of SCF research turns to the combination of game theory and SCF, and scholars should do more work on the multi-level trade credit or even SCF in a supply network. Additionally, combining contracts and trade credit provides opportunities for supply chain collaboration and competition. In the future, researchers could focus on how co-opetition between players affects SCF or even co-opetition in finance at the supply network level. Researchers may investigate how co-opetitive dynamics change as firms allocate financial resources and respond to environmental changes and the actions of other firms over time (Pathak *et al.*, 2014).

Fourth, papers in Cluster four have examined complicated situations, e.g., considering budget-constrained conditions, and introduce new conditions of tariffs or bankruptcy (e.g., Yan *et al.*, 2016), assuming that the retailer may have bankruptcy risk. In addition to existing forms of trade credit policy studied across the clusters, more forms of financing mechanisms such as taxes should be introduced to SCF research. For instance, future research could study the effects of tax and exchange rates on SCF in a global supply chain context. Brick and Fung (1984) and Qin *et al.* (2015) study the effect of taxes on the trade credit decision and replenishment policies, but generally, there are few papers of this kind. It is interesting to study how taxes influence the decisions of governments and supply chain players. Additionally, there are different tax codes such as sales tax and value-added tax. According to Consumption Tax Trends 2016, 166 of the world’s approximately 193 countries have adopted a VAT system. Taking the two biggest economies in the world as examples, the United States has used a sales tax while China conducted a tax reform that transitioned from sales tax to value-added tax in 2016. Scholars may study the effects of different tax codes on the entire supply chain so that researchers and policy makers can obtain a better understanding of whether a tax reform is needed. Especially with globalisation, more research is needed on the global supply chain, and the topics of exchange rates will become salient in SCF. Hsu and Zhu (2011) study the impacts of a set of Chinese export-oriented tax and tariff rules on the optimal supply chain design and operations for a firm that produces its product in China and sells it in markets both inside and outside China. Kazaz *et al.* (2005) examine the impact of exchange rate uncertainty on the choice of various optimal production policies and the conditions that lead to them. Their model identifies the value of financial hedging for each firm rather than a single price for all firms (ibid). In the future, scholars may consider the application of SCF in global supply chains and examine the impact of exchange rate or tariff rules on the SCF decisions of supply chain players. Researchers could provide more ideas about how to improve the profit and efficiency of the global supply chain with SCF, helping firms make better import and export decisions and offering suggestions to policy makers.

Fifth, we found that SCF papers across the four clusters tend to be a niche since the link to other SCM topics is lacking. Increasing attention is being paid to sustainable development and sustainable supply chain management. Suppliers and retailers have begun to care about the environmental and social sustainability of their supply chains. For example, Nestlé was the world’s largest food and beverage company in terms of revenue in 2015 and has adopted the *“creating shared value”* principle as its sustainability strategy. Nestlé purchases fresh milk from dairy farmers and helps them upgrade and modernise their dairy farms. Lack of capital is a big challenge for dairy farmers. To tackle this, Nestlé collaborated with local governments and local banks to provide farmers with financial support (Gong *et al.*, 2017). However, few papers examine the relationship between sustainable development and SCF. Future research could examine the effects of the adoption of sustainability criteria in the supply chain on SCF or explore how SCF promotes supply chain sustainability. For example, Dye and Yang (2015), in Cluster three, study sustainable trade credit and replenishment decisions under carbon emission regulations. The combination of sustainability and SCF may become a fertile area for SCF research.

Sixth, combining SCF with specific industry sectors or real problems would add value to SCF research. SCF in specific industry sectors, such as the manufacturing sector or the retail sector, deserves more attention from SCF researchers. Specifically, there is very little research on SCF in the agricultural sectors. Obaidullah (2015) reviews the principles, modes and models of Islamic agricultural finance targeted at small-holder farmers and adopts a case study method to examine several modes of Islamic agricultural finance for the rural poor. Among them, credit-based and sharing-based modes work well under specific conditions, and there is no one-size-fits-all solution for financing the rural poor. Chen *et al.* (2015) conduct a review of the existing literature on agricultural value chains and their financing mechanisms in China and India. They find that the internal financing of value chains (in terms of provision of inputs, technology and services) plays a dominant role in both countries and that value chain finance from commercial banks and other financial institutions is limited and primarily occurs through tripartite agreements among financing institutions, lead firms and farmers (ibid).

Boyabatlı *et al.* (2011) examine the integration of long-term and short-term contracting (i.e., a form of SCF) in the beef supply chain. They analyse the optimal decision of the meat-processing company in the beef supply chain and focus on the structure of optimal sourcing portfolios between spot sourcing and long-term contracts. Here, they analyse window contracts, with the contract price equal to a linear function of the spot price but capped by upper and lower limits on the realised contract price. Their paper shows that the meat-processing company benefits from a low correlation between the spot price and product market uncertainties, and this conclusion is independent of the form of the window contract (ibid). Using a calibration based on the GIPSA (2007) report, this paper elucidates for the first time the value of long-term contracting as a complement to spot sourcing in the beef supply chain (ibid).

In reality, crop failure and market volatility may bring significant risks to SCF. The practice of SCF in agricultural sectors develops quickly, and many governments, such as China, publish policies to promote and support agricultural SCF. However, the existing SCF research in agricultural supply chains is fairly rudimentary, e.g., few financing service tools have been applied to the agricultural supply chain. All players in the agricultural supply chain need to have a better understanding of underlying financing risks and mitigating strategies with the help of trade credits, therefore more research on SCF in agricultural supply chains is needed.

Seventh, we found that papers in Clusters one, two and three predominantly adopt a modelling method, whereas Cluster four shows some early signs of adopting an empirical method, including the mixed method, e.g., case studies and surveys in addition to the modelling method. More studies using empirical and case study methods are called for in the future to gain a better understanding of SCF. Specifically, it would be meaningful to conduct case studies to study the business models and determinants of SCF. In future research, different types of SCF business models could be identified. The empirical method of statistical analysis based on secondary data is a common method found in the empirical studies in our sample (see the supplementary table for details). For example, to understand how bankruptcy risk is transformed through the supply chain, Houston *et al.* (2016), in Cluster four, collect and construct data on bankrupt companies and their suppliers from various sources such as BankruptcyData.com, the Moody’s Default and Recovery Database and the DealScan database. Fabbri and Klapper (2016), in Cluster four, use firm-level data on 2500 Chinese firms that were collected as part of the World Bank Enterprise Surveys conducted by the World Bank with partners in 76 developed and developing countries. With the development of data science, databases will be improved and integrated. We may have more data on different firms or sectors, e.g., the Cosmos database provided by Teikoku Databank, which contains financial reports and firm-attribute data that include each firm’s top 5 suppliers and customers (Kutsuna *et al.*, 2016, Cluster four). Therefore, future research could adopt a statistical analysis based on secondary data.

**[Insert Table 11 here]**

**6. Conclusions**

Supply Chain Finance (SCF) has been established as an important but niche research area in supply chain management. The increasing number of publications in this area supports this argument. We have used bibliometric and network analysis tools to analyse the SCF literature, examine the evolution of this research area and identify four research themes/clusters. In addition, based on the co-citation/clustering analysis, we carry out a content analysis focusing on AJG 3, 4 and 4\* journal publications and obtain additional insights into SCF.

Adopting different objective measures, our study makes the following contributions that can help SCF researchers position their research against this mapping. *First*, we have mapped out the knowledge structure of SCF and identified the contributions of journals and papers in the SCF research. *Second*, we have identified existing research themes in different streams of research (four clusters) and additional insights from the content analysis. These themes can help SCF researchers identify and avoid mature, saturated or stagnant research themes in their own research. *Third*, seven actionable future research directions are advanced based on the bibliometric and content analysis and topics outside the SCF research (e.g., sustainability and tax) for SCF scholars. *Fourth*, the combination of bibliometric, network and content analysis presents a methodological contribution to systematic literature review, as we found that the bibliometric and network analysis and content analysis complement each other: the former lacks topical details or insights while the latter is often criticised for a lack of academic rigour due to the subjective judgement of researchers in coding. By combining the two, the weaknesses could be significantly reduced, if not removed.

This paper is not exempt from limitations. We choose our keywords according to the definition of SCF and the related literature. Although we have tried our best, the keywords used may not be exhaustive. Some papers that fit our inclusion and exclusion criteria were omitted because they do not have both supply chain and finance-related keywords in the keyword section. In addition, a different set of search terms could generate different clusters, resulting in different interpretations for the state of art of the field. Expanding the keywords to include supplier finance, financial supply chain, working capital optimisation, hedging, VMI, and so on could result in a more exhaustive review of the ﬁeld, and include much border scope of papers studying the integration of finance and operations of the supply chain.

For instance, we used the keyword “supplier” combined with all the finance-related keywords defined in Section 2.1 and searched the Scopus and EBSCO databases; 2444 papers were returned. We read through these papers and identified 372. Among those 372 papers, 206 papers duplicate what we have in our sample of 348, and most of the remaining 166 papers (approximately 75%) focus on traditional EOQ/EPQ modelling of supplier or retailer (Cluster 1), while the others are focused on decisions of credit period or other trade credit policy of a single firm, which should be excluded. Furthermore, of the 166 papers, only 34 papers are published in journals such as AJG 3, 4 and 4\*.

SCF is an emerging area that has developed rapidly in recent years, and the choice of relevant search terms is open to debate. In addition, the constraint put on selecting papers from AJG 3 and above journals for the content analysis also excluded certain papers that fit the inclusion criteria. Different criteria and ranking systems may also influence the results.