The Bullwhip Effect in Closed Loop Supply Chain: a Systematic Literature Review

BRAZ, A.C., DE MELLO, A.M., VASCONCELOS GOMES, L.A., NASCIMENTO, P.T.S.
School of Economics, Business Administration and Accounting (FEA/USP)
University of São Paulo
acarlosbraz@hotmail.com

FEAUSP

Academic Work

Introduction 1/2

Context and Relevance

- Understanding the uncertainty associated with final customer's demand that affects the whole supply chain the so called bullwhip effect (BWE) (Forrester, 1961).
- If we consider forward and reverse supply chains simultaneously, the result network will be a closed-loop supply chain(CLSC) (Govindan et al., 2015).
- There is a well established research stream on studying BWE causes and factors, as well as how to mitigate it on FWSC. A brief search in Scholar Google, shows approximately 20.000 results for the query “BWE in supply chains”.
- In spite of this consistent literature on BWE in FWSC, to our knowledge, little research has been done in investigating the BWE in CLSC.

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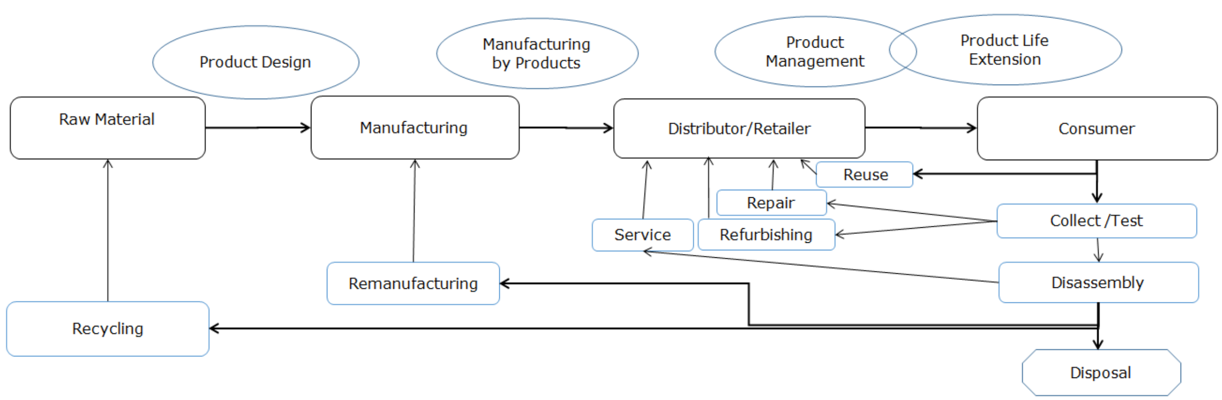
Objectives

- This paper aims to compare the bullwhip effect causes and factors in forward supply chains with those for closed loop supply chains.

- How is the bullwhip effect characterized in CLSC?
- Are the causes and factors that lead to BWE in FWSC are the same as those found in CLSC?

Basic Concepts

- **The bullwhip effect (BWE)**
  - It means where orders to the supplier tend to have larger variance than sales to the buyer (demand distortion), and the distortion propagates upstream in an amplified form (variance amplification) (Lee et al., 1997).
- **Closed Loop Supply Chain (CLSC)**
  - A number of processes can be added in order to improve the sustainability in supply chains, such as product design, manufacturing by products, product management during use, product life extension and recovery processes at end-of-life products, to ensure that CLSC's are at the same time sustainable supply chains (Quariguasi Frota Neto et al.,2010).



Research Methods

The systematic review followed the three stages of the process suggested by Tranfield et al. (2003):

- Planning the review
- Conducting a review
- Reporting and dissemination

Database name	web address	1st Phase	2nd Phase	3rd Phase
		search	Each abstract article was manually reviewed	A full-text review of the article was conducted
Scopus	https://www.scopus.com	163	42	17
Web of science	https://webofknowledge.com	31	18	12
Science Direct	https://www.sciencedirect.com	49	4	2
Springer	https://link.springer.com	48	2	1
	Total	291	66	32

Research Methods

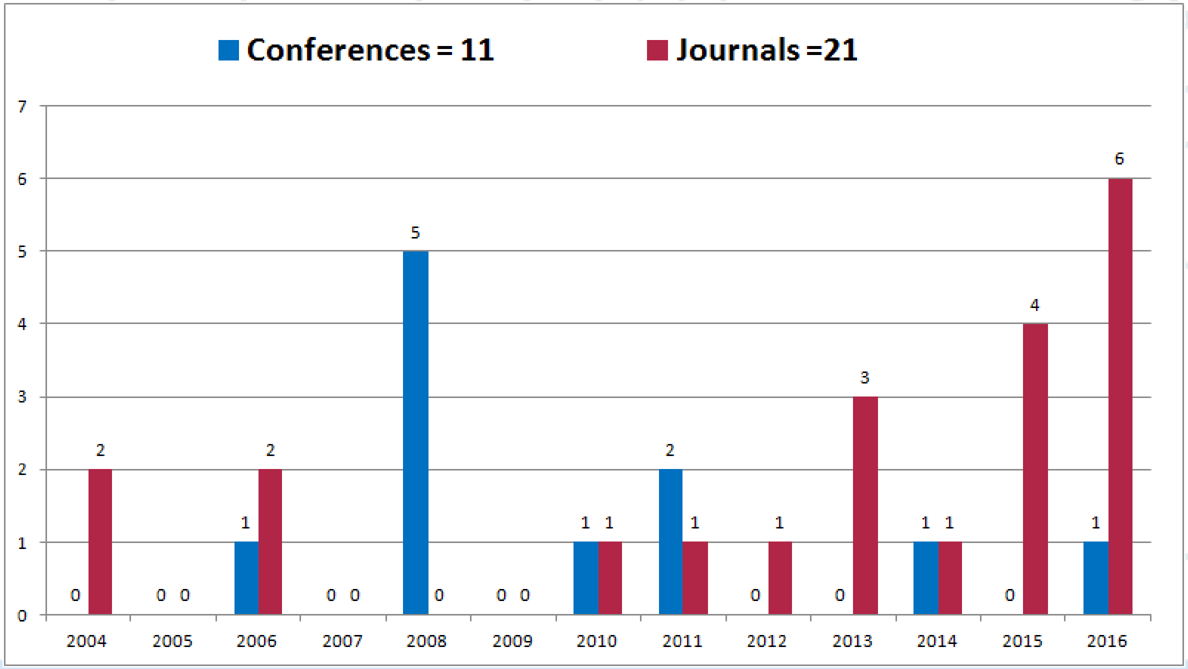
The content-analysis based literature reviews in supply chain management suggested by Seuring & Gold (2012):

The following three analytic categories were used:

- Factor to Increase the BWE;
- Factor to mitigate the BWE;
- Factor to Decrease the BWE.

Results

The distribution of publications per year and source of the selected 32 articles

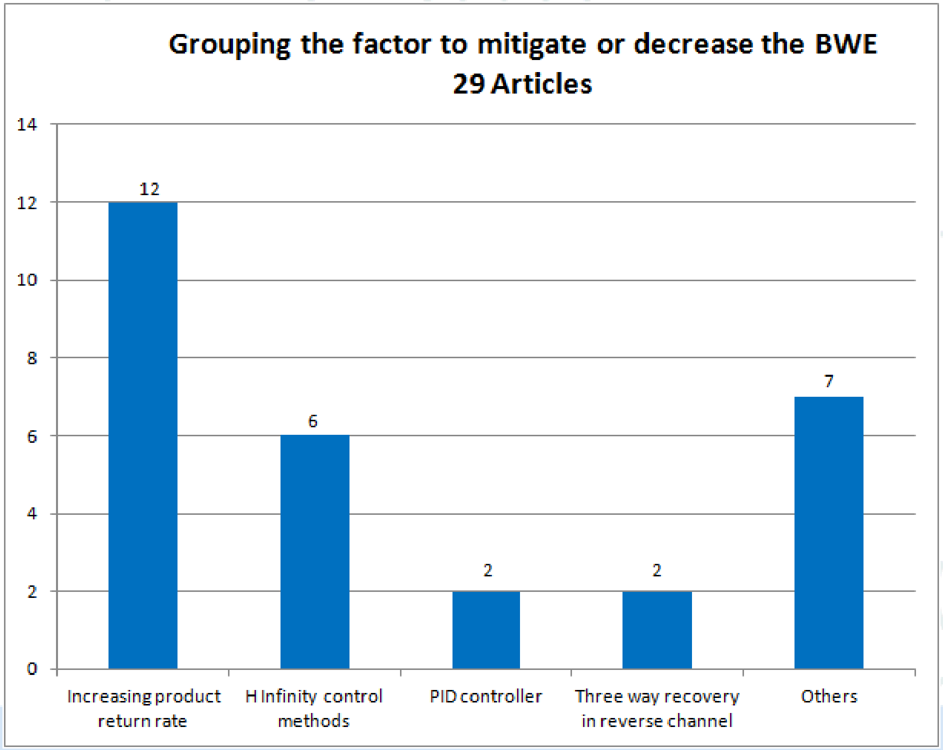


Results

No	Authors	Year	Journal or Conference *	Article findings as factor to Increase, Decrease or Mitigate the BWE	Grouping the Factor	categories D= decrease M= Mitigate I=Increase
1	Zhou, et al.,	2016	IJPE	Higher return yield	Increasing product return rate	D
2	Cannella et al.,	2016	IJPE	Increasing product return rate	Increasing product return rate	D
3	He et al.,	2016	DDNS	Increasing recycling ratio	Increasing product return rate	D
4	Wei & Yuan,	2016	DCDIS	Improving replacement policy ratio	Increasing product return rate	D
5	Yuan & Zhang,	2015	DDNS	Percentage increases of recovery of recyclers	Increasing product return rate	D
6	Corum et al.,	2014	JOCLP	Increasing remanufacturing rates	Increasing product return rate	M
7	Ma et al.,	2014	Conference 2	Increasing recovery products rate	Increasing product return rate	D
8	Turrisi, et al.,	2013	IJPD	Increase the percentage of end-of-life product collected	Increasing product return rate	D
9	Yisheng & Dunbing,	2010	Conference 3	Higher product returns-ratio	Increasing product return rate	D
10	Qingli, et al.,	2008	Conference 4	Improving reuse ratio	Increasing product return rate	D
11	Adenso-Dıaz et al.,	2012	IJPE	percentage of the material returned	Increasing product return rate	D
12	Zhou & Disney,	2006	ORSPECTRUM	Larger return rate	Increasing product return rate	D
13	Zhang, et al.,	2011	Conference 10	H Infinity control methods	H Infinity control methods	D
14	Guo,	2010	Conference 11	H Infinity control methods	H Infinity control methods	D
15	Guo, et al.,	2008	Conference 8	H Infinity control methods	H Infinity control methods	D
16	Guo, et al.,	2008	Conference 7	H Infinity control methods	H Infinity control methods	D
17	Guo, et al.,	2008	Conference 6	H Infinity control methods	H Infinity control methods	D
18	Guo & Huang,	2006	Conference 9	H Infinity control methods	H Infinity control methods	D
19	Jing, et al.,	2013	IJAM	PID controller	PID controller	D
20	Lin et al.,	2004	JPC	Proportional integral or cascade inventory control	PID controller	D
21	Zhang & Yuan,	2016	DDNS	Old-for-new policy and three electronic products recovery ways	Three way recovery in reverse channel	D
22	Das & Dutta,	2013	CIE	Three way recovery in reverse channel	Three way recovery in reverse channel	D
23	Barbey,	2016	Conference 5	A customers order and a stock order strategy.	A customers order and a stock order strategy.	D
24	Dev et al.,	2016	IJPE	Adopting periodic review policies.	Adopting periodic review policies.	M
25	Ignaciuk,	2015	IEEEX	Compensation mechanism with a smooth ordering pattern	Compensation mechanism with a smooth ordering pattern	M
26	Matamoros, et al.,	2011	IJPS	Shorter of lead time	Shorter of lead time	D
27	Pati, et al.,	2010	OPSEARCH	Degree of segregation	Degree of segregation	D
28	Zanoni et al.,	2006	IJPR	Remanufacturing shifted PULL policy	Remanufacturing shifted PULL policy	D
29	Tang & Naim,	2004	IJPR	Coupling remanufacturing within manufacturing process	Coupling remanufacturing within manufacturing process	D
30	Das & Dutta,	2015	IJAMT	Increasing demand variation	Increasing demand variation	I
31	Hosoda et al.,	2015	EJOR	with identically and independently distributed (i.i.d.)	With identically and independently distributed (i.i.d.)	I
32	Huang & Liu,	2008	Conference 1	short term lead time of remanufacture cycle time	Short term lead time of remanufacture cycle time	I

Results

Grouping the Factors to mitigate or decrease the BWE



Final Considerations

- **Conclusions:**
  - Studying BWE in the CLSC is growing interest from academia.
  - 31 articles studied the BWE in the CLSC, based on the same main causes of the BWE reported in the FWSC
  - Increasing product return improves the information sharing and data access reducing the demand variance

- **Contributions:**
  - Increasing product return rate to mitigate or decrease the BWE is quantitatively the most representative factor.
  - We have proposed the CLSC dynamics can reduce even eliminating the BWE.

- **Limitations:**
  - All of articles used as research method, simulation, modeling and /or quantitative approaches.

- **Future research:**
  - Developing in depth qualitative analysis, focusing on the strategic and managerial causes for BWE and how to mitigate it, considering specific aspects of different contexts and supply chains.

Thank you.

Obrigado!

acarlosbraz@hotmail.com