School of Business & Economics
Research Area: Innovation Economics

Freie Universität Berlin

A Media-based Innovation Indicator: Examining declining Technological Innovation Systems

Highlights:

- A **novel text-based innovation output indicator** exploiting the role of the media in forming collective expectations
- Innovation articles in the media are identified using **unsupervised topic modelling** and **sentiment analysis**
- An increasing number of ICE innovation articles with positive sentiment until 2015
- Misalignment between collective expectations and decreasing sales suggest **a vicious cycle of decline for ICE**
- A **methodological framework** to **derive technology-specific innovation indicators** on the firm-level

Motivation

- **Technological innovation system (TIS)** life cycle is used to analyze the decline of mature technologies like the internal combustion engine (ICE).
- Currently used **indicators for TIS decline** do not consider the relevance of collective expectations for the success of innovations and lack timeliness as well as granularity (Borup et al. 2006, Kinne and Axenbeck 2020).
- We propose a **novel text-based innovation output indicator** using the media attention and sentiment towards TIS technological improvements to capture the relation of **collective expectations** and TIS innovation dynamics (Isoaho and Markard 2020).

Conceptual Framework

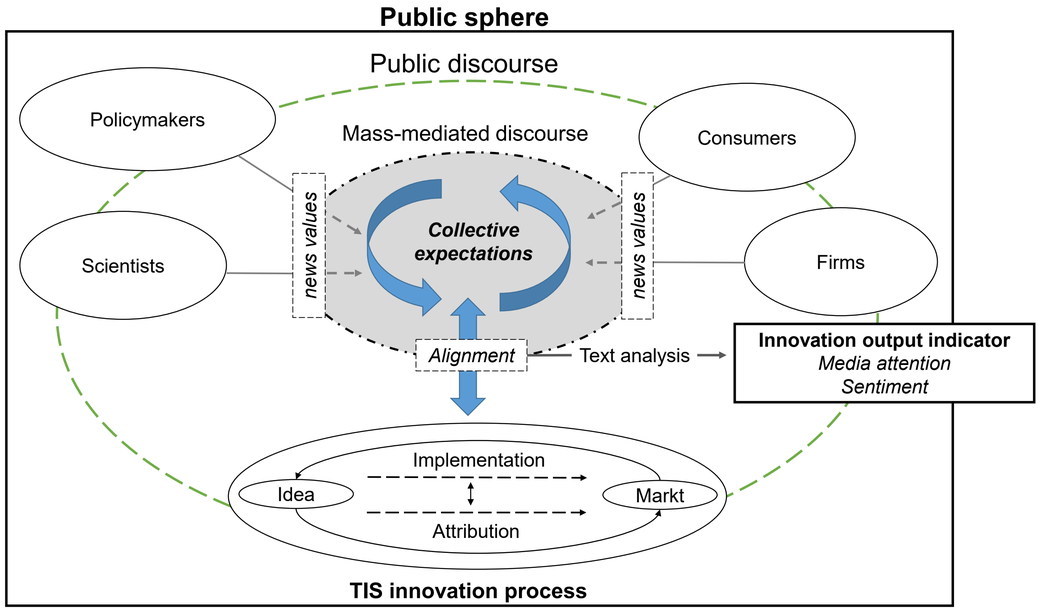

Fig. 1: Mass-mediated discourse and TIS innovation process, with reference to Waldherr (2012)

- Indicator based on the **role of the mass-mediated discourse** for the formation of collective expectations and its connection to innovation processes through attribution and implementation (Waldherr 2012).
- **Technology-specific news values** that guide reporting: relevance, timeliness, and relatedness to prevailing societal problems (Waldherr 2012, Allern 2017).

Data & Method

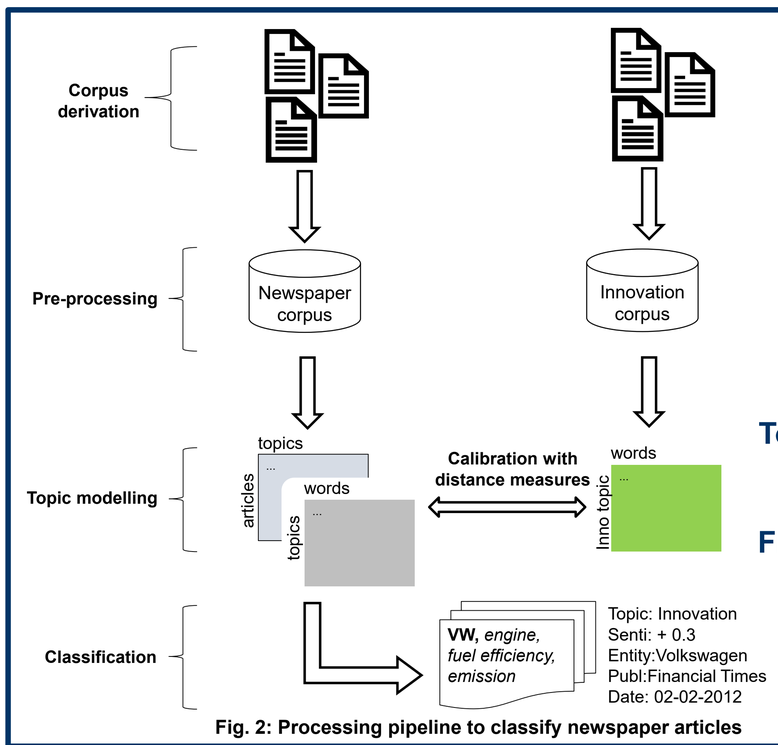

Fig. 2: Processing pipeline to classify newspaper articles

Data Source:
Nexis Uni database provided by LexisNexis

English news articles on:
Internal combustion engine

Total number of raw articles:
42,479

Final pre-processed articles:
15,282

Results

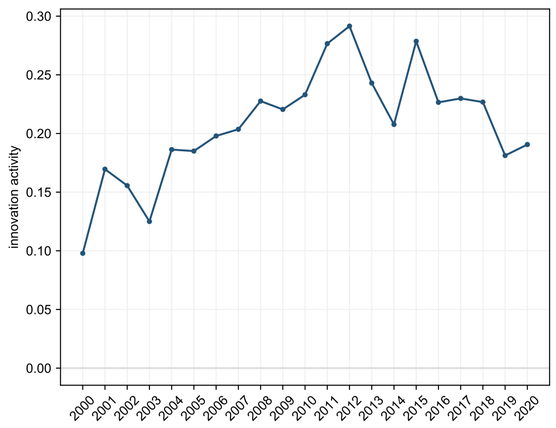

Fig. 4: Share of innovation articles in the newspaper corpus per year

Firm	Total number of innovation articles	Average sentiment	std	min	max
Mazda	53	0,17	0,07	-0,04	0,35
Bmw	50	0,16	0,09	-0,03	0,32
Daimler	33	0,17	0,06	0,08	0,31
Wartsila	29	0,14	0,08	-0,02	0,30
Honda	28	0,16	0,09	0,02	0,37
Infiniti	28	0,21	0,07	0,08	0,32
Ford	26	0,22	0,07	0,08	0,36
Peugeot	19	0,21	0,04	0,13	0,30
Achates	17	0,15	0,06	-0,02	0,27
Hyundai	16	0,17	0,11	-0,01	0,33

Tbl. 1: Most innovative companies in the newspaper corpus, ranked by total innovation frequency

- We observe an **alignment between collective expectations and TIS innovation output** until 2015, indicating a successful resistance against TIS decline. Rejuvenation driven by companies from the USA, Europe and Japan.
- **Downturn in innovation reporting after 2015** suggests increasing misalignment and negative outlooks on the future development of ICE.

Contribution

- Our **negative outlook on the ICE** is conflicting with recent conclusions derived from patent data statistics (Song and Aaldering 2019), poiting out the need for conceptual work on TIS indicator prioritization and benchmarking.
- **Novel innovation output indicator** (binary and continuous) to evaluate long-term time series trends, policy measures, and firm's innovation strategies.
- **Methodological framework to derive technology-specific innovation indicators from any text source** without needing pre-labelled training data or firm-specific text documents (see also Weiss and Nemeczek 2021).
- Besides the innovation strength, we are also able to observe **differentiated technological choices across car manufacturers**, which is in line with earlier studies on the technological trajectories in the automobile sector (Weiss and Scherer 2022).

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