

ORIGINAL ARTICLE

Behind the 'creative destruction' of human diets: An analysis of the structure and market dynamics of the ultra-processed food manufacturing industry and implications for public health

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Abstract

A global transition towards diets increasingly dominated by ultra-processed foods (UPFs) has occurred in recent decades to the detriment of public health and the environment. This study aimed to examine long-term trends in the structure and market dynamics of the global UPF manufacturing industry as part of broader efforts to understand the drivers of this transition. Using diverse methods, metrics and data sources, we examined several dimensions (e.g., industry concentration and profitability) according to an adapted structure–conduct–performance model. We found that the global UPF manufacturing industry has evolved to become a major component of global food systems, with its longstanding dominant corporations becoming some of the system's largest accumulators of profit and distributors of capital. It follows that reversing the global UPF dietary transition will require structural and regulatory changes to ensure that population diets, and food systems more broadly, are not subordinated to the interests of powerful for-profit business corporations.

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KEYWORDS

commercial determinants of health, corporate power, industrial organisation, nutrition transition, ultra-processed foods

1 | INTRODUCTION

The role of large for-profit ultra-processed food (UPF) manufacturing corporations (hereafter UPF corporations; collectively referred to as the global UPF industry) in driving unhealthy diets—a leading contributor to the global burden of disease—is coming under increasing scrutiny (Baker et al., 2020; Monteiro & Cannon, 2012; Moodie et al., 2013, 2021; Swinburn et al., 2019). As defined by the NOVA classification system, UPFs are industrial formulations made mostly or entirely with substances extracted from foods that have typically undergone considerable chemical and physical transformation (Monteiro et al., 2018). Examples of UPFs include most soft drinks, confectionery, many snack foods, a range of breakfast cereals and industrially made sauces.

There is an emerging evidence base that links diets high in UPFs with adverse population health outcomes, such as higher risks of all-cause mortality, overweight and obesity, and a range of diet-related chronic diseases (e.g., type 2 diabetes and heart disease) (Chen et al., 2020; Elizabeth et al., 2020; Gómez-Donoso et al., 2020; Lane et al., 2020; Orlich et al., 2022; Pagliai et al., 2020). Although UPFs are a heterogeneous group of products, at least in terms of nutrient profiles, the average quality of the group as a whole becomes increasingly important when UPFs come to define the dietary patterns and health outcomes of large parts of the population (Scrinis & Monteiro, 2022). Moreover, the production and consumption of UPFs are linked with adverse environmental outcomes, including those related to the negative impacts of plastic waste and the monocultural production of key commodity crops such as soya, sugar, palm oil and cereals (Anastasiou et al., 2022; Break Free From Plastic, 2020; Fardet & Rock, 2020; Garzillo et al., 2022; Seferidi et al., 2020).

A global transition towards diets increasingly dominated by UPFs (hereafter the global UPF dietary transition) has occurred in recent decades, albeit with wide geographic variations (Baker et al., 2020; Monteiro et al., 2013). According to a recent study, UPFs now account for around half of the total dietary energy consumed in numerous high-income countries (HICs) (Monteiro et al., 2019). Especially, high levels of dietary exposure to UPFs have been observed in specific population sub-groups of HICs, such as those that live in disadvantaged areas (Marchese et al., 2022; Scrinis & Monteiro, 2022). UPF exposure is also rapidly increasing in many low- and middle-income countries (LMICs), in many instances at a rate faster than historical growth rates for HICs (Monteiro et al., 2019; Moodie et al., 2013).

A defining feature of UPFs that sets this group of food products apart from other groups of foods (i.e., unprocessed, minimally processed and non-ultra-processed processed foods) is that UPFs are almost exclusively made by for-profit business corporations (Scrinis & Monteiro, 2022). Indeed, it is well recognised that transnational corporations have played a central role in driving the global UPF dietary transition, with considerable work in particular documenting the diverse range of strategies that large UPF corporations use to expand and protect their share of the 'global stomach' (Baker et al., 2023; Lacy-Nichols & Williams, 2021; Mialon et al., 2015; Wood, Williams, Nagarajan, & Sacks, 2021).

Although there is increasing discussion of the powerful role of the UPF industry as part of global food systems (Baker et al., 2020; Monteiro & Cannon, 2012; Moodie et al., 2021; Wood, Williams, Nagarajan, & Sacks, 2021), there has only been limited analysis of the ways in which the global UPF industry has evolved over time. This type of analysis, we argue, would likely be well placed to shed light on some of the important links between the global UPF dietary transition and the various capitalist processes underpinning it, such as, *inter alia*, the expansion and consolidation of the global UPF industry and its markets. Such insights may help identify, and facilitate implementation of, structural changes that can improve the healthiness of population diets.

Given the abovementioned considerations and research gap, this study aimed to examine trends in the structure and market dynamics of the global UPF industry. The purpose of the study was to contribute to broader efforts to understand and address the political economic drivers of the global UPF dietary transition.

2 | METHODS

2.1 | Overview of research design

Guided by several theories, we used multiple methods to examine a range of indicators related to the structure and market dynamics of the UPF industry, according to an adopted structure–conduct–performance (SCP) model (discussed below) (Wood, Williams, Baker, et al., 2021). Quantitative methods were used to analyse several firm-, market- and industry-level metrics, with data sourced from a range of business and market research databases. Periods of quantitative analysis were based on available data. (Refer to [File S1](#) for a detailed description of the dimensions examined using quantitative techniques.) We also conducted a narrative review of the literature to provide information on key issues for which quantitative analysis was not performed (e.g., certain aspects of corporate strategy) and to complement findings from the quantitative analyses (e.g., by providing historical context). Given the complexity and scope of the study, we used a combination of structured and branching searches to source literature related to the dimensions examined in this study. Scopus, Web of Science and Google Scholar were used to source academic literature; Factiva was used to source licensed and non-licensed media content; and Google and company websites were used to source grey literature. Documents found during the literature search were supplemented with the authors' knowledge of relevant documents. [Table 1](#) provides an overview of the dimensions examined in this study, including the methods, metrics and data sources used.

2.2 | Analytical approach and theoretical framework

The analytical approach used in this study was based on an approach to analyse industry structure, corporate strategy and financial performance, itself an adaptation of the so-called SCP model commonly used in the industrial organisation literature (Wood, Williams, Baker, et al., 2021). This adapted SCP model posits that industry and market structure (e.g., size and concentration) shape, and are shaped by, firm conduct (Carlton & Perloff, 2000). For instance, dominant firms in highly concentrated markets, which are often an outcome of corporate strategy (e.g., the acquisition of a rival company), are generally better able to deploy strategies to increase and maintain their profits compared with firms in competitive markets (Carlton & Perloff, 2000). Industry structure and firm conduct, in turn, influence the 'performance' (e.g., profitability) of the industry in question.

Our analysis and interpretation were guided by two related theories. First, we drew from the theory of 'monopoly profits'. This theory contends that a major pathway by which large firms generate substantial profits is by exercising their power to create and shape the markets in which they operate in a manner conducive to sustained profit-making (Barney & Mackey, 2018; Harvey, 2014). This theory is consistent with, and in fact underpins, the adapted SCP model described above (Barney & Mackey, 2018). The theory of 'monopoly profits' was popularised in the strategic management literature by Michael Porter (1980, 2008), who developed the 'Five Forces Framework' to illustrate the power imbalances in market and industrial environments that firms can create and leverage to generate profits.

For our analysis of corporate strategy, we examined four interrelated strategic objectives that stem from a version of Porter's 'Five Forces Framework' adapted for the UPF industry: (i) to increase and maintain consumer demand, (ii) to spread and consolidate, (iii) to control and leverage new technologies and innovations and (iv) to raise barriers to market entry (Wood, Williams, Nagarajan, & Sacks, 2021). Whereas these are primarily constituted of so-called market strategies (i.e., a concerted pattern of actions taken in the market environment), we also considered the role of so-called non-market strategies (i.e., a concerted pattern of actions designed to influence the interconnected policy, regulatory, institutional and ideological structures that shape market environments) in achieving these objectives (Baron, 1995).

We also drew from the theory of 'creative destruction' popularised by Joseph Schumpeter. Schumpeter (2003) argued that capitalism is 'by nature a form or method of economic change' that 'never can be stationary'; what keeps the 'capitalist engine' in motion are 'new methods of production and transportation', 'new markets' and 'new forms of industrial organisation'. This perspective encourages the evolution of the global UPF industry to be understood as part of Schumpeter's capitalist engine in motion, wherein corporate actors and their investors have pursued new

TABLE 1 An overview of the dimensions examined in this study, as well as the methods, metrics and data sources used.

Dimension	Method(s)	Metric(s)/indicator(s)	Data source(s)
<i>Structure and market dynamics</i>			
Industry size and concentration	Quantitative analysis of revenue, assets and market capitalisation data, 1989–2019	Absolute size and size relative to related industries Top 10 firms in the global industry by annual revenue Share held by the 'central' UPF corporations ^a relative to the global UPF industry, in terms of revenue, assets and market capitalisation	Compustat Global and North America
Industry entry and geographic dynamics	Quantitative analysis of revenue, assets and market capitalisation data, 1989–2019	Number of active firms in the industry by country/region Industry share by country/region of incorporation in terms of revenue, assets and market capitalisation	Compustat Global and North America
Market size	Quantitative analysis of market data	UPF market size by sales revenue, disaggregated by product and country	Euromonitor International's Passport
Market concentration	Quantitative analysis of sales revenue data for certain product and national markets, 2019	Herfindahl–Hirschman index (HHI), calculated by summing the square of the market shares of every firm active in the market Description of markets in which the 'central' UPF corporations were active and dominant	Euromonitor International's Passport
Common ownership	Descriptive analysis of equity ownership data of dominant firms, 2019 Quantitative analysis of national sales revenue data for certain UPF products, 2019	Description of shares held in dominant UPF corporations by key institutional investors Modified Herfindahl–Hirschman index (MHHI), calculated by determining the MHHI delta, an estimated quantification of the competitive effects of common ownership, and then adding this value to the original HHI value	Orbis Euromonitor International's Passport
<i>Corporate strategy</i>			
Increase and maintain consumer demand	Descriptive analysis of advertising and marketing data Narrative review of literature	Description of advertising and marketing expenditure made by dominant UPF corporations Narrative review of key strategies used by the 'central' UPF corporations to create and maintain consumer demand	Statista Targeted literature

TABLE 1 (Continued)

Dimension	Method(s)	Metric(s)/indicator(s)	Data source(s)
Spread and consolidate	Descriptive analysis of merger and acquisition data, 1980–2019 Narrative review of literature	Description of number, type and geography of M&As made by the 'central' UPF corporations Narrative review of the use of joint ventures and strategic alliances by the 'central' UPF corporations	Thomson Reuters SDC M&A data Targeted literature
Control of technologies and prevention of market disruption	Descriptive analysis of new food products launched by the 'central' UPF corporations entering the global market, 2000–2019 Narrative review of literature	Description of number and type of new food products made by the 'central' UPF corporations entering the global market Narrative review of the use of venture capital by the 'central' UPF corporations to control technologies and prevent market disruption	Mintel Global New Products Database Targeted literature
Raise barriers to market entry	Quantitative analysis of brand value data related to the 'central' UPF corporations Descriptive analysis of size and spread of the corporate groups of the 'central' UPF corporations Narrative review of literature	Total value of brands held by the 'central' UPF corporations Total number of subsidiaries in the corporate groups of the 'central' UPF corporations, as well as the number of countries where the corporate groups are physically located Narrative review of brand power, economies of scale (in terms of production, finance and marketing) and the control of supply chains as important barriers to market entry	Statista Orbis Targeted literature
<i>Profitability and shareholder returns</i>			
Profitability	Quantitative analysis of return on assets, 1989–2019 Quantitative analysis of net profit margins, 1989–2019	Return on assets calculated by dividing net income by value of total assets, shown as a 5-year moving average, for each industry, as well as for the 'central' UPF corporations Return on assets calculated by dividing net income by value of total revenue, shown as a 5-year moving average, for each industry, as well as for the 'central' UPF corporations	Compustat Global and North America

(Continues)

TABLE 1 (Continued)

Dimension	Method(s)	Metric(s)/indicator(s)	Data source(s)
Shareholder returns	Quantitative analysis of dividend, share buyback and revenue data, 1989–2019	Shareholder returns calculated by summing dividend payments and share buybacks for each industry, as well as for the 'central' UPF corporations Shareholder value ratios calculated by dividing total shareholder returns by total revenue for each industry, as well as for the 'central' UPF corporations	Compustat Global and North America

Abbreviation: UPF, ultra-processed food.

‘The ‘central’ UPF corporations were identified during industry concentration analysis as the eight largest UPF corporations by revenue in 2019 (the final year of the analysis). These corporations consistently held dominant industry positions throughout the period of analysis. The ‘central’ UPF corporations therefore became the focus of analysis involving examinations of the industry’s dominant firms (e.g., market concentration, common ownership, corporate strategy, profitability and shareholder returns).

profit-making opportunities through the development of new product and geographic markets, technologies, innovations and modes of organisation. It could be argued that, in many contexts, a by-product of this industrial and economic change has been the ‘creative destruction’ of traditional diets and food cultures by UPF corporations. This argument aligns with Monteiro et al.’s (2018) conceptualisation of UPFs as ‘products designed to displace all other food groups’ in human diets. Moreover, the theory of ‘creative destruction’ encourages the global UPF industry to be analysed in a way that captures its dynamic nature, such as by encouraging structural and strategic analyses over long periods of time (data permitting), including with respect to the industry’s evolving relationship with technology.

2.3 | Defining the global UPF industry and selecting and defining other industries for comparison

For selected metrics, such as industry size, we decided to compare the global UPF industry to other key industries described in Hawkes’ (2009) ‘consumption-oriented’ food value chain. These comparators were (i) the global ‘food production and primary processing’ industry, which produces non-UPF products (i.e., unprocessed, minimally processed and processed food products), as well as production inputs for UPF manufacturers, animal foods and feed, and biofuels; and (ii) the global ‘food retail’ industry, including supermarkets, food distributors and grocery stores.

Before industry-level analysis could be performed, the industries needed to be defined. We used the North American Industry Classification System (NAICS) to inform our industry definitions. Given that UPFs are mostly made by food manufacturing corporations (including those under contract with food retailers and restaurants) and that most of the largest food manufacturing corporations generate a large proportion of their sales from UPFs, we used the global food and non-alcoholic manufacturing sector as a starting point in defining the global UPF industry.

To differentiate between food manufacturing (i.e., ultra-processing for the purposes of this study) from primary food processing, we chose not to strictly follow the NAICS in some cases. Such decisions were based on the NOVA’s classification of food categories according to level of processing (Monteiro et al., 2018). For instance, although the animal slaughtering and processing, seafood product preparation and packaging, and grain and oilseed milling industries are considered part of the ‘food manufacturing’ sector under NAICS, we chose to instead group these industries as part of the ‘food production and primary processing’ industry. In cases in which further differentiation was

required, such as in certain cases when a company's NAICS group was reported at the three- or four-digit level, we drew from the company's Global Industry Classification Standard (GICS) group to inform selection. (Refer to [File S2](#) for a detailed description of included NAICS and GICS groups for each industry included in the analysis.)

Following this industry definition, financial data from all publicly listed corporations with data accessible via Compustat North America and Global databases (accessed via Wharton Research Data Services) were extracted. Combined, Compustat North America and Global cover firms listed on stock exchanges in more than 80 countries (Refinitiv, 2021). To facilitate currency conversion over the period of analysis, we chose to only analyse financial data reported in a currency for which the US Federal Reserve Bank had publicly accessible nominal exchange rate data. (Refer to [File S2](#) for a detailed description of the currencies included in the analysis.) Thus, we did not analyse global industries per se, although we did manage to capture most of the world's largest corporations in these industries. We use the term 'global' as a qualifier for each sector throughout the paper for convenience.

Unless the data could be cross-checked with another source (e.g., company reports), companies with data that were extreme and implausible outliers for the respective variable were excluded from the analysis (e.g., a Brazilian company with a market capitalisation of more than US\$200 billion in the late 1990s, despite generating a relatively small revenue and owning very few assets). Included financial data were converted to year-on-year US dollars (USD), which were then adjusted to 2019 USD (unless otherwise stated) using the World Bank's (2021) gross domestic product (GDP) deflator data.

3 | RESULTS

Our results are structured as follows. First, we examine structure and market dynamics by analysing industry size and concentration, industry entry, geographic dynamics, market size and concentration, and common ownership (i.e., the situation wherein investors own shares in a number of firms active in the same market). Second, we examine the role of corporate strategy deployed by the UPF manufacturing industry's most dominant corporations in shaping these structural and market dynamics. Third, we analyse trends in profitability and shareholder returns of the different industries selected for analysis.

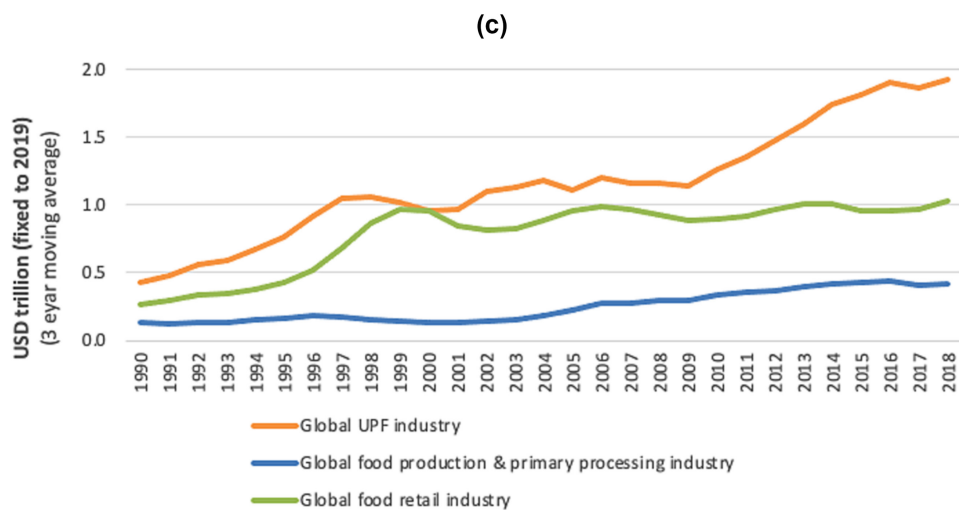
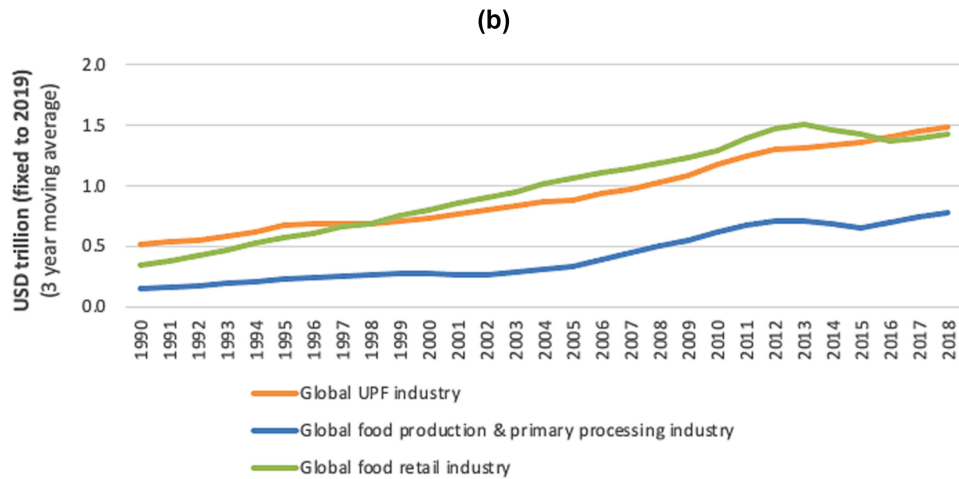
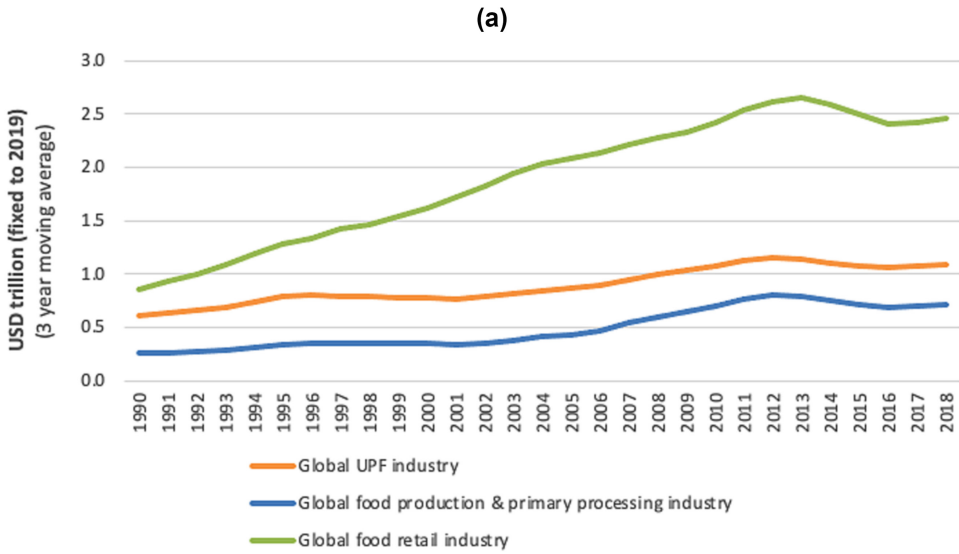
3.1 | Structure and market dynamics

3.1.1 | Industry size and concentration

The global UPF industry grew considerably over the examined period. Between 1989 and 2019, we estimated that the adjusted value (constant 2019 USD) of the industry almost doubled in terms of revenue (approximately US\$570 billion to US\$1.1 trillion); more than tripled in terms of total assets (approximately US\$490 billion to US\$1.5 trillion); and increased more than fivefold in terms of market capitalisation (approximately US\$400 billion to US\$2.0 trillion) (Figure 1).

We also found that the global UPF industry was consistently larger than the global food production and processing industry in terms of revenue, total assets and market capitalisation (by 2019, 1.6 times larger in terms of revenue, 2 times larger in terms of assets and 4.7 times larger in terms of market capitalisation). The picture was mixed relative to the global food retail industry. In terms of revenue, the global UPF industry was consistently smaller than the global food retail industry (less than half the size by 2019). In terms of assets, the global UPF industry and global food retail industry were approximately similar over the period of analysis, and in terms of market capitalisation, the global UPF industry was consistently larger than the global food retail industry (nearly twice the size by 2019).

The eight largest UPF corporations in 2019 in terms of industry share by revenue were Nestlé, PepsiCo, Unilever, Coca-Cola Co, Danone, Fomento Económico Mexicano (an operator of Coca-Cola Co's largest bottling plant), Mondelez and Kraft Heinz Co (Table 2). We found that these eight corporations (hereafter referred to as the 'central' UPF corporations) consistently held top positions within the global UPF industry between 1989 and 2019.



Between 1989 and 2019, the share of the global UPF industry's annual revenue and total assets held by the 'central' UPF corporations fluctuated between 29% and 38% and between 27% and 43%, respectively (Figure 2). Between 1989 and 1999, the share of the industry's market capitalisation held by the 'central' UPF corporations increased from 39% to 59%, before declining to 52% in 2014 and steadying at 53% in 2019.

Led by Coca-Cola Co, the combined market capitalisation of the 'central' UPF corporations surged in the late 1980s and 1990s, increasing nearly fivefold from 1989 (approximately US\$150 billion in 2019 USD) to 1998 (approximately US\$730 billion in 2019 USD). By 2019, the combined market capitalisation of the 'central' UPF corporations was almost 2.5 times larger than the aggregated market capitalisation of the entire global food production and primary processing industry.

3.1.2 | Industry entry and geographic dynamics

There was a rise in the number of publicly listed firms that entered the global UPF industry during the 1990s and 2000s, resulting in part from a rise in the number of publicly listed firms based in China, South Korea, Singapore, Taiwan and Hong Kong (Table 3). In comparison, since the late 1990s and early 2000s, the number of publicly listed US-, Western Europe- and Japan-based firms active in the industry was seen to decrease. The period between 2009 and 2014 saw the number of China-based publicly listed firms exceed the number of US-, Western Europe- and Japan-based publicly listed firms active in the global UPF industry.

In terms of industry share by revenue, total assets and market capitalisation, US- and Western Europe-based corporations were seen to dominate the global UPF industry between 1989 and 2019 (Figure 3). Japan-based firms saw a relative decline in their combined share of the global industry (all three terms), starting in the 1990s. Starting from around the late 1990s, firms based in China, South Korea, Hong Kong, Taiwan and Singapore increased their combined global share of the industry, particularly in terms of revenue. Notably, though, there appears to be an important difference between where large US- and Western Europe-based firms generate their revenue compared with those based in China, South Korea, Hong Kong, Taiwan and Singapore. According to Passport's sales data, many of the largest UPF corporations based in these five East Asian countries rely heavily on domestic and regional markets for revenue generation. In comparison, many large US- and Western Europe-based UPF corporations, including most of the 'central' UPF corporations, appear to generate a large proportion of their revenue in foreign markets across multiple global regions.

3.1.3 | Market size

Unfortunately, historical data on global UPF markets are limited. Company documents, however, shed some light on the development and expansion of key products made by some of the 'central' UPF corporations. For instance, Nestlé notes that, in 1874, 7 years after its first infant formula was marketed in Switzerland, the company sold around 1.6 million cartons of its processed baby food products to customers in over 18 countries (Nestlé, 2017). As another example, in Coca-Cola Co's 1928 annual report it was reported that, since 1886, the year the company was founded, annual production of its flagship product had increased from approximately 90 litres to more than 90 million litres

FIGURE 1 Estimated size of the global ultra-processed food (UPF) industry, the global food production and primary processing industry and the global food retail industry in real terms by (a) revenue, (b) assets and (c) market capitalisation, 1989–2019. *Source:* Data sourced from Compustat accessed via Wharton Data Research Services (WRDS). There may be some missing data in the datasheets extracted from Compustat, as well as discrepancies between data sourced from Compustat and data from official company filings and reports. All values have been adjusted to 2019 USD.

TABLE 2 Top 10 leading corporations in the global ultra-processed food industry in terms of revenue, 1989–2019 (5-year intervals).

	1989	1994	1999	2004	2009	2014	2019
1	Nestlé	Unilever	Nestlé	Nestlé	Nestlé	Nestlé	Nestlé
2	Kraft General Foods ^a	Nestlé	Unilever	Unilever	Unilever	PepsiCo	PepsiCo
3	Unilever	PepsiCo	Kraft Foods ^a	Kraft Foods ^a	PepsiCo	Unilever	Unilever
4	Conagra Brands	Conagra Brands	Conagra Brands	PepsiCo	Kraft Foods ^a	Coca-Cola Company	Coca-Cola Company
5	PepsiCo	Coca-Cola Company	PepsiCo	Coca-Cola Company	Coca-Cola Company	Mondelez International ^a	Danone
6	Grand Metropolitan	Nabisco Group Holdings	Coca-Cola Company	Danone	Coca-Cola Europacific Partners	Danone	Fomento Económico Mexicano
7	Nabisco Group Holdings	Danone	Coca-Cola Europacific Partners	Coca-Cola Europacific Partners	Danone	Suntory Holdings	Mondelez International ^a
8	Coca-Cola Company	Megmilk Snow Brand	Danone	Conagra Brands	Suntory Holdings	Associated British Foods Group	Kraft Heinz Co ^a
9	Danone	Grand Metropolitan	Suntory Holdings	Cadbury	Fomento Económico Mexicano	Fonterra	Yihai Kerry Arawana Holdings
10	Megmilk Snow Brand	Suntory Holdings	Megmilk Snow Brand	Suntory Holdings	General Mills	Kraft Foods Group ^a	Suntory Holdings

^aIn 1989, Kraft merged with Phillip Morris's General Foods to become Kraft General Foods. In 1995, Kraft General Foods changed its name to Kraft Foods. In 2012, the snack food business of Kraft Foods was renamed Mondelez International. In 2015, Kraft Foods merged with H.J. Heinz Co to become Kraft Heinz Co.

Source: Data sourced from Compustat accessed via Wharton Data Research Services (WRDS).

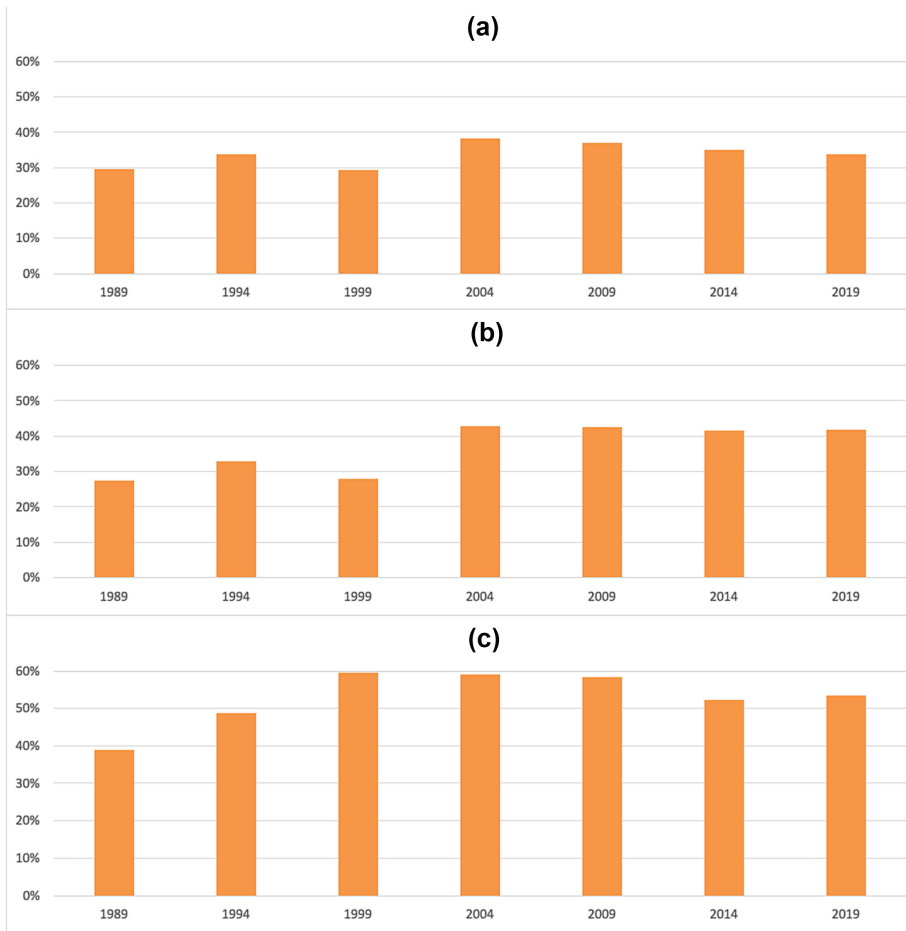


FIGURE 2 Combined share of the global ultra-processed food (UPF) industry held by the 'central' UPF corporations in terms of (a) revenue, (b) assets and (c) market capitalisation, 1989–2019. *Source:* Data sourced from Compustat accessed via Wharton Data Research Services (WRDS). There may be some missing data in the datasheets extracted from Compustat, as well as discrepancies between data sourced from Compustat and data from official company filings and reports. 'Central' UPF firms = Nestlé, PepsiCo, Unilever, Coca-Cola Co, Danone, Fomento Económico Mexicano (data from 1993), Mondelez (data from 2001) and Kraft Heinz Co.

TABLE 3 Number of publicly listed corporations, by location of headquarters, active in the global ultra-processed food industry.

	1989	1994	1999	2004	2009	2014	2019
Number of active firms	192	277	385	468	499	551	557
Countries represented (headquarter location)	20	29	31	48	44	43	40
US-based firms	85	100	91	73	63	69	57
Western Europe-based firms	39	35	51	79	71	73	67
China-based firms	1	9	16	27	54	81	96
Japan-based firms	38	58	78	85	75	69	67
South Korea-, Singapore-, Taiwan- and Hong Kong-based firms	4	15	25	48	51	62	70

Source: Data sourced from Compustat accessed via Wharton Data Research Services (WRDS).

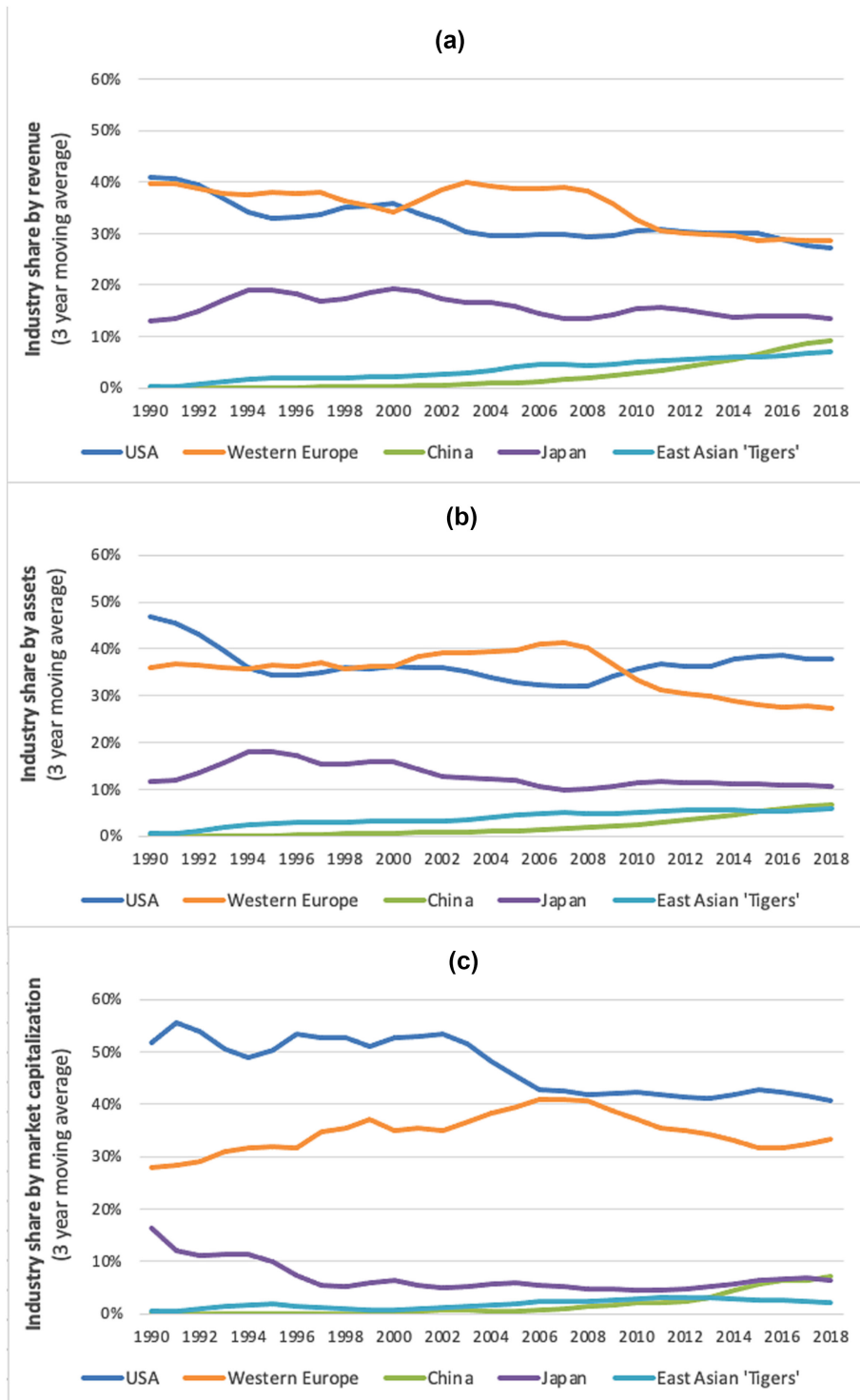


FIGURE 3 Industry shares by (a) revenue, (b) assets and (c) market capitalisation according to geography, 1989–2019. Source: Data sourced from Compustat accessed via Wharton Data Research Services (WRDS). There may be some missing data in the datasheets extracted from Compustat, as well as discrepancies between data sourced from Compustat and data from official company filings and reports. East Asian 'Tigers' = South Korea, Hong Kong, Taiwan and Singapore.

(Internet Archive, 2017a). By 1928, the average citizen in the United States was consuming 25 Coca-Cola products a year (Internet Archive, 2017a).

Studies focusing on the United States and Canada show that there was a dramatic increase in the consumption of many processed foods and UPFs in these two countries over the 20th century (Lee et al., 2021; Moubarac, Batal, et al., 2014). More broadly, UPFs reportedly became a prominent source of dietary energy in several countries after the Second World War, although they did not become widely available on a truly global scale until globalisation of the industry accelerated from the 1970s onwards (Baker et al., 2020). During the late 1990s and 2000s, UPFs were already dominant in the food supplies of many HICs, with the consumption of UPFs rapidly increasing in many LMICs (Monteiro et al., 2013; Stuckler et al., 2012).

Based on available data from Euromonitor International's Passport, we estimated that the size of the global UPF market increased from approximately US\$1.5 trillion in 2009 to US\$1.8 trillion in 2019 in terms of retail sales revenue (constant 2019 USD) (Figure 4). The global UPF market is forecasted to increase to approximately US\$2.0 trillion by 2024.

There are considerable differences among the different regional and product markets in terms of size. In 2019, the Asia-Pacific UPF market was found to be the largest regional market at approximately US\$570 billion, more than five times the size of the Eastern European UPF market (approximately US\$110 billion). There was also considerable variation in the growth of regional UPF markets between 2009 and 2019—the Middle East and African market increased by nearly 90% in real terms, the Eastern European UPF market increased by nearly 50%, the Asia-Pacific and Latin American UPF markets both increased by more than 40%, the North American UPF market increased by less than 3% and the Western European UPF market decreased by nearly 2%.

In 2019, the global ultra-processed soft drink market was estimated to be the largest global UPF product market, reaching nearly US\$540 billion in 2019 (in terms of retail sales revenue). Using our own broad grouping system, most global UPF product markets increased in size in real terms by approximately 10%–25% between 2009 and 2019. Exceptions to this included the global baby food market (increased by nearly 70%), the global savoury snack market (increased by approximately 40%) and the breakfast cereal market (decreased by approximately 1%).

3.1.4 | Market concentration

The global UPF market consists of a patchwork of diverse national and product market structures (Table 4). In some key UPF product markets, such as carbonated soft drinks and baby foods, many of the largest national markets were found to be either highly or very highly concentrated.

The 'central' UPF corporations do not compete among each other across all UPF product markets but, instead, have established rivalries often in the form of global oligopolies. As cases in point, Coca-Cola Co and PepsiCo dominate the global carbonated soft drink market; Nestlé and Danone dominate the global baby food market; and Unilever and Nestlé (taking into account Froneri, Nestlé's joint venture with R&R) dominate the global ice cream market.

Within these established global UPF product oligopolies, patterns of regional dominance in some cases appear to be linked with broader colonial and geopolitical patterns. Switzerland-based Nestlé and France-based Danone, for instance, are particularly dominant in Eastern European baby food markets, with Danone also seen to be dominant in numerous countries that were once French colonies. US-based Coca-Cola Co (soft drinks) and PepsiCo (savoury snacks and, to a lesser extent, soft drinks) were found to be particularly dominant in Latin America. Notably, the Middle Eastern region was the only region where PepsiCo was consistently seen to hold larger national market shares for carbonated soft drinks than Coca-Cola Co. This is most likely a consequence of the Arab League's boycott of Coca-Cola Co, which started in 1966 and lasted a few decades, in retaliation for the company announcing plans to open a bottling plant in Israel (Jarnagin, 2016).

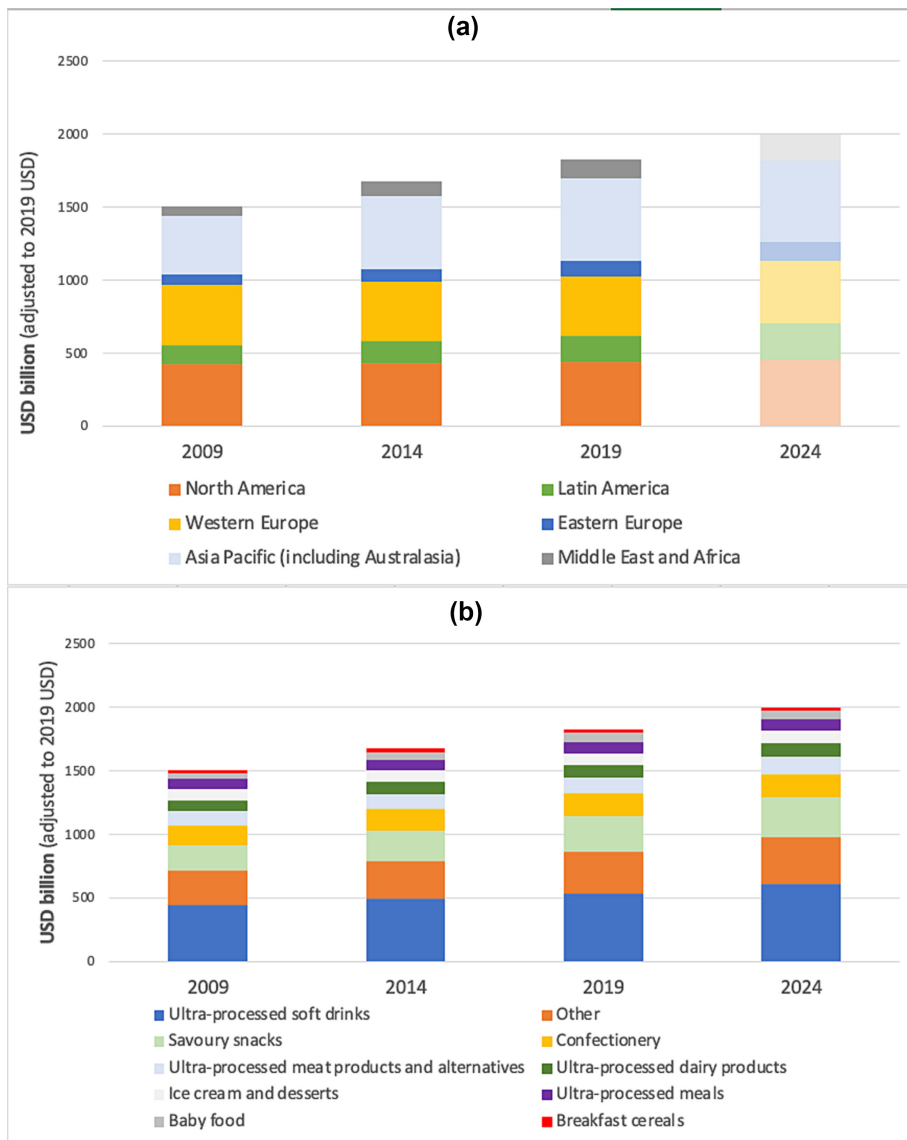


FIGURE 4 Estimated global ultra-processed food market size (a) by region and (b) by product category, 2009–2024 (forecasted). *Source:* Data sourced from Euromonitor International's Passport database. Values adjusted to 2019 USD using Passport's own adjustment function. Global regions categorised as per Passport. Ultra-processed food markets were categorised into the following groups: ultra-processed soft drinks (carbonates, concentrates, juice products excluding 100% juice, ready-to-drink tea, ready-to-drink coffee, energy drinks, sport drinks, Asian specialty drinks and 'other' hot drinks [flavoured]), ultra-processed meals (ready meals and soups), ultra-processed snacks (savory snacks, chilled snacks, fruit snacks, snack bars and sweet biscuits), ultra-processed dairy products excluding infant formula (margarine and spreads, spreadable cheese, processed and soft cheese, flavoured milk drinks, flavoured yoghurt and coffee whiteners), baby food (including infant formula), ultra-processed meat products and alternatives $\times 0.5$ (processed meats, seafood and alternatives), ice cream and desserts (ice cream, chilled and shelf stable desserts and chilled dairy desserts), confectionery, breakfast cereals and other (sauces, dips and condiments; and baked goods $\times 0.5$). We divided the values of the processed meats, seafood and alternatives market and the baked goods market by 2 to account for the likelihood that both markets consist of a considerable proportion of non-ultra-processed foods.

TABLE 4 Market concentrations across 150 key ultra-processed food markets.

National market	Carbonated soft drinks	Savoury snacks	Chocolate confectionery	Breakfast cereals	Ice creams and frozen desserts	Baby food
United States	2413	1741	1912	1927	688	1927
China	4615	174	1752	614	325	546
Japan	2281	450	471	2455	744	1661
Brazil	4470	1719	1830	1632	648	5595
Germany	1536	621	941	783	728	1828
France	4217	663	954	1902	1479	2111
Russia	1790	1004	1041	943	640	1216
United Kingdom	3663	891	1418	1031	1075	1983
India	3159	406	3446	2733	515	3615
Italy	2245	351	1955	2671	215	1961
Mexico	5555	4138	1384	2094	2821	3510
Canada	2094	1558	764	2002	1717	1465
Australia	3467	1091	1786	1196	2049	1404
Indonesia	6358	342	2811	3777	2031	2138
Turkey	5705	1564	1699	2609	3607	2039
South Korea	2266	1014	1565	3783	2611	1373
Argentina	3404	1952	3062	1545	2681	3811
Poland	2633	535	830	1920	1403	3183
Saudi Arabia	6637	1392	1774	1734	1225	1347
South Africa	4653	2110	1438	1844	2862	2692
Thailand	4536	740	1040	2434	2750	3061
Philippines	4949	1332	1875	1973	4848	4394
Chile	4929	2080	2460	1724	2628	4013
Vietnam	3783	878	367	4089	2114	1693
Kazakhstan	4056	1726	1153	2135	2010	2296

Source: Data sourced from Passport Database.

	Very high concentration (>2500)
	High concentration (1800–2499)
	Moderate concentration (1000–1799)
	Low concentration (<999)

Note: Market concentration based on Herfindahl–Hirschman index, calculated by squaring the market share of each firm active in the specific market. Market share based on global brand owner share of total retail sales revenue, except for the market share of carbonated soft drinks, which, due to data limitations, was calculated based on off-trade retail sales revenue. Products made by the global brand owner, a local subsidiary, or an independent firm that has a licensing agreement with the global brand owner. Thresholds based on adapted European Central Bank and historical US Department of Justice thresholds.

3.1.5 | Common ownership

We found that the common ownership of the ‘central’ UPF corporations by five large institutional investors—Blackrock, Vanguard, Capital Group, State Street and Norway’s sovereign wealth fund—considerably increased the estimated effective concentration level of the global UPF industry in 2019 (from 231 to 831 based on the

modified Herfindahl–Hirschman index [HHI]). The same pattern of common ownership was seen to increase the estimated effective concentration levels of both the carbonated soft drink and baby food oligopolies by a substantial degree. Across the 25 national carbonated soft drink and baby food markets examined, the median market concentration value (HHI) was seen to increase from 3783 to 5062 and from 2039 to 2692, respectively (Figure 5).

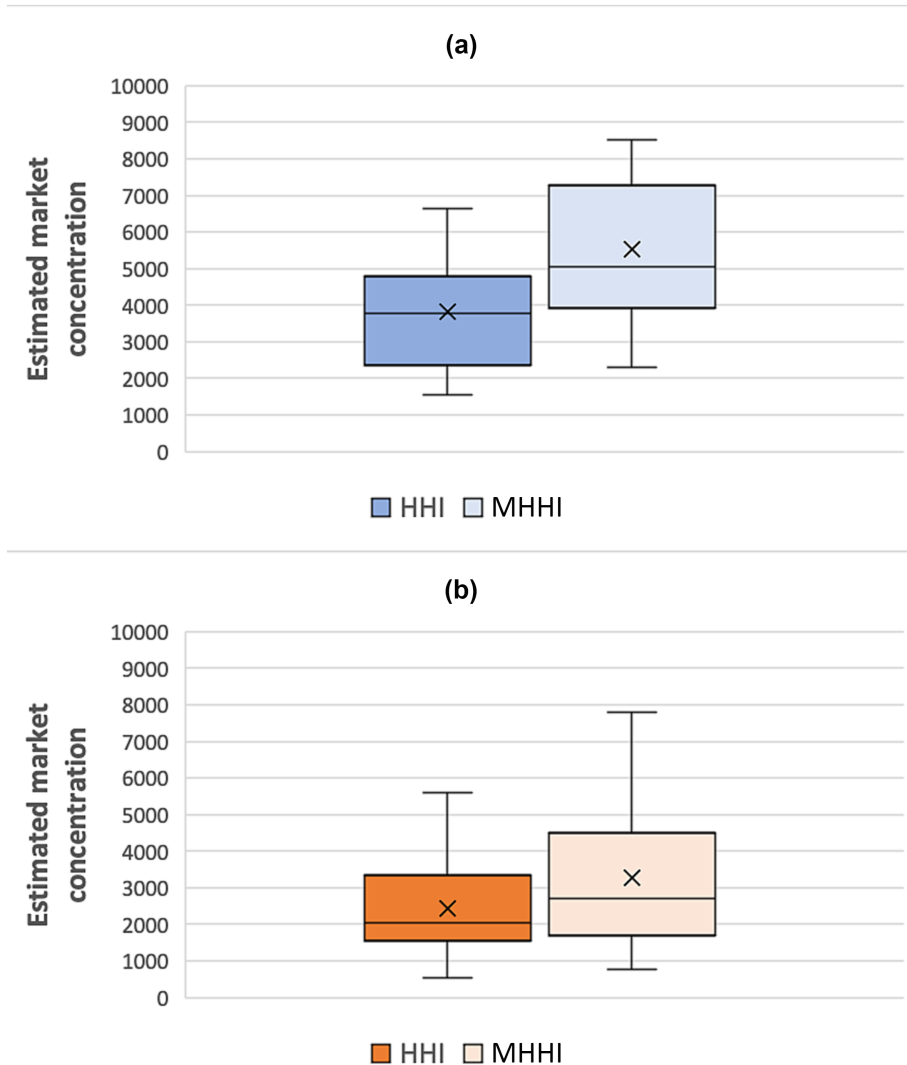


FIGURE 5 The estimated effect of common ownership (modified Herfindahl–Hirschman index) of the ‘central’ ultra-processed food (UPF) corporations on 25 national (a) carbonated soft drink and (b) baby food markets, 2019. *Source:* Market share data were sourced from Passport; Ownership data were sourced from Orbis. Box plot representing the median (middle line through box), 25th percentile (lower line of box), 75th percentile (upper line of box), minimum value (end of lower vertical line) and maximum value (end of higher vertical line). HHI, Herfindahl–Hirschman index; MHHI, modified HHI. Estimated effect on market concentration was calculated by determining the modified Herfindahl–Hirschman index delta (MHHI Δ) using methodology outlined in appendix A of Lambert and Sykuta (2019). ‘Central’ UPF firms = Nestlé, PepsiCo, Unilever, Coca-Cola Co, Danone, Fomento Económico Mexicano (data from 1993), Mondelez (data from 2001) and Kraft Heinz Co.

3.2 | Corporate strategy

3.2.1 | Increase and maintain consumer demand

Nestlé, Coca-Cola Co, PepsiCo and numerous other large UPF corporations have been manufacturing demand for their branded products for more than a century. As early as 1867, for instance, Nestlé promoted its 'Farine Lactée', the precursor of the company's modern infant formula, as a product that could cure sick, premature babies (Nestlé, 2014, 2017). In 1892, newly incorporated Coca-Cola Co allocated more than US\$11,000 to what was at the time the most 'extensive promotional campaign for one product in history' (Gasbarre & Salamie, 2005). By 1911, the corporation's budget exceeded US\$1 million for the first time, and, by the 1920s, outdoor advertising and radio programme sponsorships had been added into its marketing mix (Porsche, 2022).

The 'central' UPF corporations allocate enormous sums of money towards marketing and have done so for a long period of time (Rollins et al., 2016; Stuckler et al., 2012; Wood, Williams, Nagarajan, & Sacks, 2021). According to Statista, the largest UPF corporations allocate several billion USD towards marketing every year, with Nestlé alone spending approximately US\$100 billion on marketing and related expenses between 2015 and 2019 (Statista, 2022). Unfortunately, it is difficult to find out exactly how much these corporations allocate towards marketing every year, given that marketing data in company reports are usually collapsed under the broader category of selling, general and administration expenses. However, before the early 2000s, Coca-Cola Co often reported its marketing expenses separately, and, thus, it was possible for us to determine that the company spent approximately US\$40 billion (constant 2019 USD) on marketing expenses between 1981 and 1990 and approximately US\$86 billion USD on marketing expenses between 1991 and 2000 (Internet Archive, 2017a). For comparison, during 1991 and 2000, the company's entire cost of production, including wages and cost of supplies, was approximately US\$85 billion.

Yet there has been more to the successful manufacturing of mass demand for UPFs than just large marketing budgets. Since their inception, the 'central' UPF corporations have often been at the vanguard of innovative and effective marketing. As a case in point, most of the Christian world today perceives Santa Claus—as a warm, happy and chubby old white man dressed in red and white—based on a 1931 Coca-Cola marketing campaign (Coca-Cola Co, 2022). More broadly, large UPF corporations have generally been very innovative at tailoring their marketing strategies to local cultural conditions (i.e., 'glocalisation') and regulatory environments (e.g., through the use of cross-promotional techniques), as well as at taking advantage of major social movements (e.g., women empowerment) and world-changing events (e.g., the fall of the Berlin Wall and the COVID-19 pandemic) (Baker et al., 2020; Global Health Advocacy Incubator, 2020; Knai et al., 2018; Prügl, 2019). In recent years, their ability to market in innovative and effective ways has clearly been facilitated by digital marketing, artificial intelligence and neuropsychology technologies (Brooks et al., 2022; Rollins et al., 2023).

Another important factor behind the ability of UPF corporations to drive consumer demand is that, despite their much higher profit margins, UPFs are generally cheaper than substitutable unprocessed and minimally processed food products in many contexts (Vandevijvere et al., 2020; Warner, 2013). As food prices are very often a key determinant of affordability and consumption, large UPF corporations thus have a considerable competitive advantage over businesses producing and marketing less processed products for direct human consumption (Baker et al., 2020; Monteiro & Cannon, 2012). There are many interrelated reasons as to why UPFs tend to be cheaper than less processed products, including, inter alia, the strategies deployed by large UPF corporations to drive down labour and other production costs, various technologies and innovations (e.g., innovations in extrusion, transport, distribution and supply chain organisation), and government policies (e.g., subsidisation of the production and exportation of commodity crops that serve as major UPF ingredients) (Baker et al., 2020; IPES-Food, 2017b, 2018; Monteiro et al., 2018).

As with corporations active in other harmful industries, the 'central' UPF corporations deploy a range of non-market strategies (often referred to as corporate political activity) to block, weaken and delay government regulation designed to dampen the demand they have managed to manufacture. As an example, Nestlé's attempts to undermine the development and implementation of national regulations designed to curb aggressive and harmful

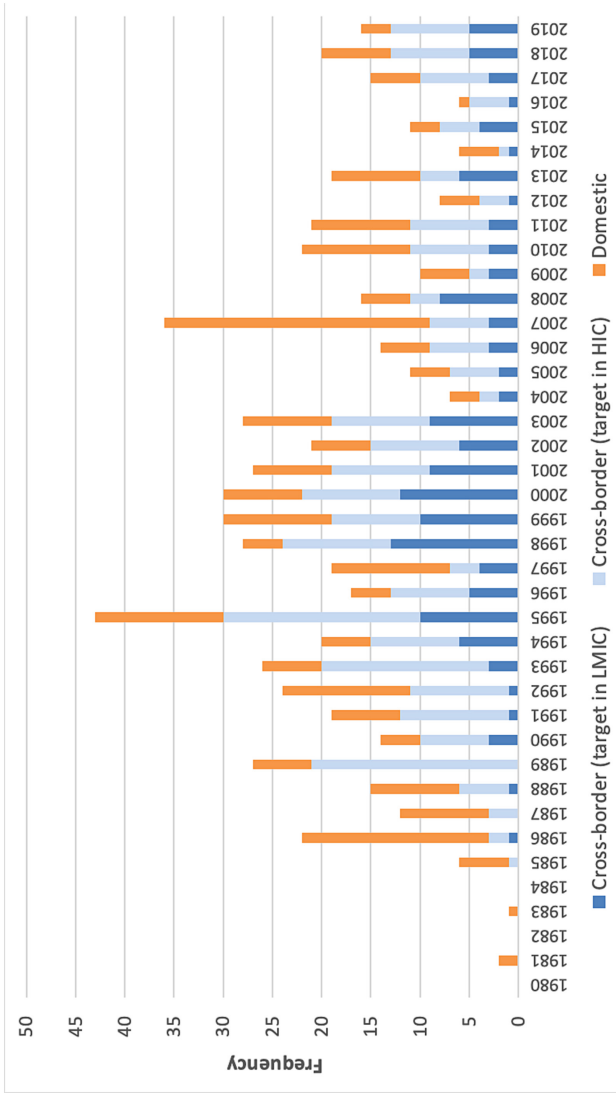


FIGURE 6 Number of mergers and acquisitions made by the 'central' ultra-processed food (UPF) corporations according to the location of the target company, 1980–2019. HIC, high-income country; LMIC, low- and middle-income country. Source: Data sourced from Thomson Reuter SDC M&A database accessed via Wharton Research Data Services (WRDS). 'Central' UPF corporations = Nestlé, PepsiCo, Unilever, Coca-Cola Co, Danone, Fomento Económico Mexicano, Mondelez and Kraft Heinz Co.

marketing of infant formula are well documented (Baker et al., 2021, 2023), along with general UPF industry efforts to block the implementation of sugar-sweetened beverage taxes (Gómez, 2019), undermine the government regulation of marketing unhealthy products to children (Kraak et al., 2016) and weaken food labelling regulatory requirements (Kollbrunner, 2022). The use of a range of other non-market strategies used by the UPF industry, including more indirect and covert strategies such as influencing science and public opinion on political matters, has been extensively documented in multiple regions (Braithwaite & Drahos, 2000; Mialon & da Silvia Gomes, 2019; Mialon, Swinburn, Allender, & Sacks, 2016; Mialon, Swinburn, Wate, et al., 2016).

3.2.2 | Spread and consolidate

Large UPF corporations, especially the 'central' UPF corporations, have relied heavily on foreign direct investment (FDI), including mergers and acquisitions (M&As) and greenfield investments, to create and penetrate new national markets. This is because, for UPF revenue generation in foreign markets, FDI in general tends to be more cost-effective than trade, it can optimise the effectiveness of branding and marketing, and it allows for much greater capture of national market shares (Hawkes, 2005). Historically, FDI was also a particularly important strategy for circumventing trade barriers and in the establishment of globally and regionally integrated sourcing and production networks (Hawkes, 2005).

Prior to 1980 (the beginning of our M&A analysis), most of the 'central' UPF corporations had already transnationalised—at least in terms of reputation and production—to a considerable degree (Company Histories, 2022; PepsiCo Inc, 1980; The Coca-Cola Company, 2011; Unilever, 1980). Our M&A analysis suggests, though, that the late 1980s, 1990s and early 2000s represented a particularly important period by which some of the 'central' UPF corporations were able to extend their geographical reach and penetration through M&As. Based on data sourced from Refinitiv's SDC M&A database, we found that the eight 'central' UPF corporations underwent 669 M&As between 1980 and 2019, with more than half of these ($n = 373$) occurring between 1986 and 2001 (see Figure 6). Of note, the 'central' UPF corporations underwent 147 cross-border M&As in LMICs over the period of analysis, mostly in the 1990s. A considerable number of these M&As involved target companies and/or assets in the newly opened ex-Soviet bloc markets, as well as China, with Nestlé, Unilever, PepsiCo, Coca-Cola Co, Danone and Kraft all seen to acquire companies and/or assets in these regions during the 1990s.

Relatedly, M&As have played an important consolidating role within and across the global food industry (Clapp, 2021; IPES-Food, 2017a). A total of 572 (86%) of the 669 recorded M&As undertaken by the eight 'central' UPF corporations between 1980 and 2019 were found to be horizontal in nature. In comparison, 71 (11%) were vertical or ancillary in nature, with the majority of these involving the acquisition of a company or assets related to retail and distribution. Additionally, we found numerous cases of Nestlé acquiring a company or assets in the pharmaceutical, healthcare and biotechnology sectors. This included US-based (2006) and Australia-based (2011) Jenny Craig companies, both of which are described as operators of weight management and fitness centres, although Nestlé later divested both of these companies in 2013 (Nestlé, 2013).

Not captured in the market and industry share data is that the 'central' UPF corporations have long used joint ventures and strategic alliances to enter and penetrate new product and geographic markets. These have often been undertaken to circumvent restrictive foreign investment laws and to leverage existing production and distribution networks of local companies. As a pertinent example, Coca-Cola Co entered into a joint venture with state-owned COFCO to begin bottling operations in Beijing shortly after the company became the first foreign corporation allowed back in China in 1978 (Internet Archive, 2017a). In the late 1980s, Nestlé and Danone also entered joint ventures in China—a market that would soon become the most lucrative for the global infant milk formula industry—relating to dairy production and processing (Forbes, 2009; Nestlé, 2008). PepsiCo's joint venture with a domestic soft drink bottling operation in Vietnam, which came into full effect immediately after the US trade embargo against Vietnam was lifted in 1994, allowed the company to 're-enter' the Vietnamese market after nearly two decades hiatus (Wallace, 1994). Similarly, Unilever has been described as using joint ventures, including with state-owned compa-

nies, at different periods of time to penetrate the so-called 'frontier' markets of Iran, Cuba and Myanmar (Bourse & Bazaar, 2020; Frank, 2016; Vasagar & Peel, 2017).

At times, integrated strategy—corporate strategy with market and non-market dimensions (Baron, 1995)—has enabled and facilitated the entry and penetration of markets by 'central' UPF corporations. The global soft drink duopoly offers some striking examples, with both Coca-Cola Co and PepsiCo successfully leveraging US geopolitics and foreign policy at different times during the 20th century to increase their access to markets. Coca-Cola Co, for instance, entered a partnership with the US military during the Second World War, thanks in part to then-CEO Robert Woodruff's close friendship with then-US General Dwight Eisenhower. This 'strategic alliance' enabled Coca-Cola Co to open more than 60 new bottling plants in and near combat zones around the world, such as in Algiers, during the Second World War (Pendergrast, 2013; The Coca-Cola Company, 2012). During the 1970s, Coca-Cola Co managed to mobilise the influence of the US government to persuade the Egyptian government to lift its boycott of Coca-Cola Co, reportedly as part of a US-brokered peace deal between Egypt and Israel (Jarnagin, 2016). Also, in the 1970s, PepsiCo secured a temporary cola monopoly in the Soviet Union, with then-CEO's Don Kendall's close relationships with Richard Nixon and Nikita Khrushchev noted to have played an important role (Stenberg, 2020). Later, PepsiCo aired the first ever paid television advertising in the Soviet Union (Internet Archive, 2017b).

Especially since the 1980s, the liberalisation of trade and investment via structural adjustment programmes and neoliberal-style trade and investment agreements has reportedly played an important role in further facilitating the entry and penetration of markets by the 'central' UPF corporations (Baker et al., 2014; Hawkes, 2006). It is likely that post-1980s and 1990s trade and investment liberalisation partly explains why we found a surge in the cross-border M&As made by the 'central' UPF corporations between the late 1980s and early 2000s. As a specific example, following India's World Bank-driven structural adjustment programme in the 1990s that included the repeal of laws prohibiting the repatriation of profits made by foreign companies, Coca-Cola re-entered the Indian soft drink market via the acquisition of the domestic company (and then-market leader) 'Parle' (Baker et al., 2014).

3.2.3 | Control and leverage new technologies and innovations

The global UPF industry owes its very existence to the advent of disruptive technological innovations. Nestlé and Kellogg's, for instance, were largely built upon the development of infant formula and mass produced breakfast cereals, respectively, both of which were created in the mid-to-late 1800s through new industrial technologies (Moubarac, Parra, et al., 2014). Over the course of more than a century, new technologies and innovations have greatly facilitated the development and expansion of UPF corporations and markets around the world. For instance, new production and processing technologies, such as fractionation, extraction and hydrogenation, have increased production efficiencies, improved product durability and led to the development of highly pleasurable, quasi-addictive products (Baker et al., 2020). Similar innovations in extrusion have allowed the standardisation of products in terms of size and shape characteristic of many UPFs. Moreover, improved distribution and marketing technologies have greatly facilitated the growth and spread of UPF corporations and their markets, as have legal (e.g., limited liability) and organisational innovations (e.g., supply chain diversification) (Wood, Williams, Nagarajan, & Sacks, 2021).

Although disruptive production and processing technologies have substantially shaped global food systems in the last century and a half (Moubarac, Parra, et al., 2014), they appear to pose minimal threat to the market dominance of the 'central' UPF corporations. This claim is supported by the fact that some of the 'central' UPF corporations have managed to maintain their dominant market positions, at least at the global level, for long periods of time. A potentially important reason for this is that large UPF corporations have generally been able to develop, control and take advantage of important pathways of technology. At least with respect to production, processing and packaging technologies, this could in part be due to their large 'internal' research and development (R&D) programmes—Nestlé, for instance, reportedly boasts the largest 'private nutrition' research capability in the world

(Baker et al., 2020; Nestlé, 2022). Large UPF corporations also often collaborate with students and researchers at universities around the world to develop and commercialise innovations (Nestlé, 2019). Just as importantly though, the 'central' UPF corporations acquire key technologies and innovations, especially those with disruptive potential, from new or rival companies. Danone's 2021 acquisition of plant-based 'pioneer' Earth Island serves as one of many examples (Reuters, 2021).

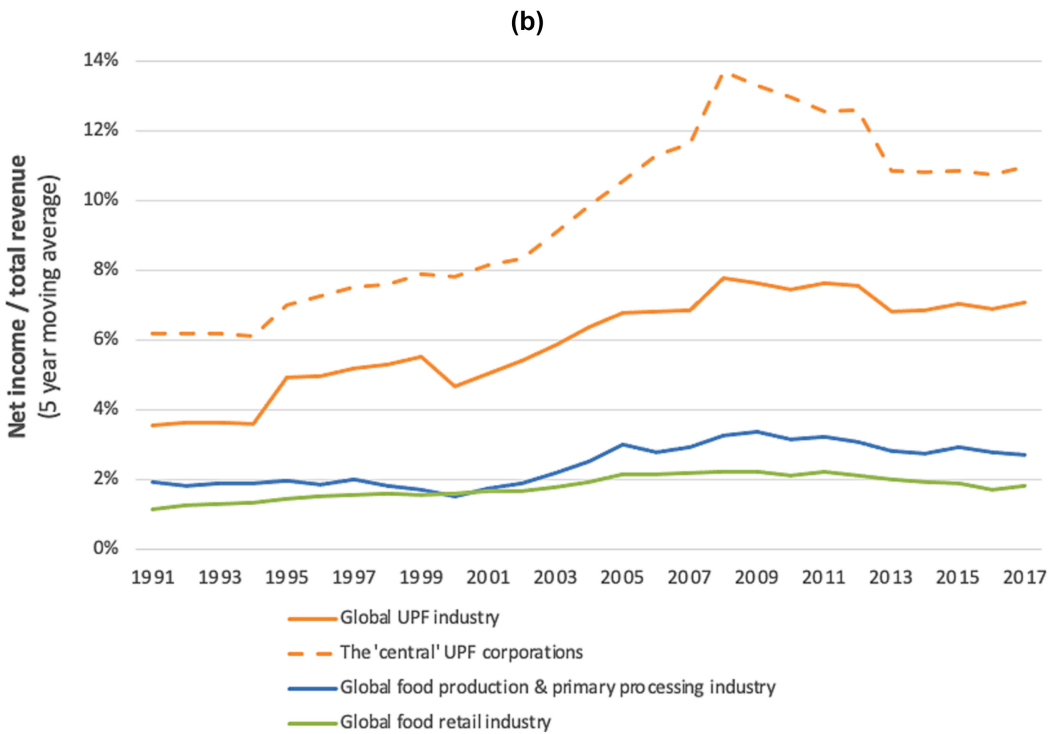
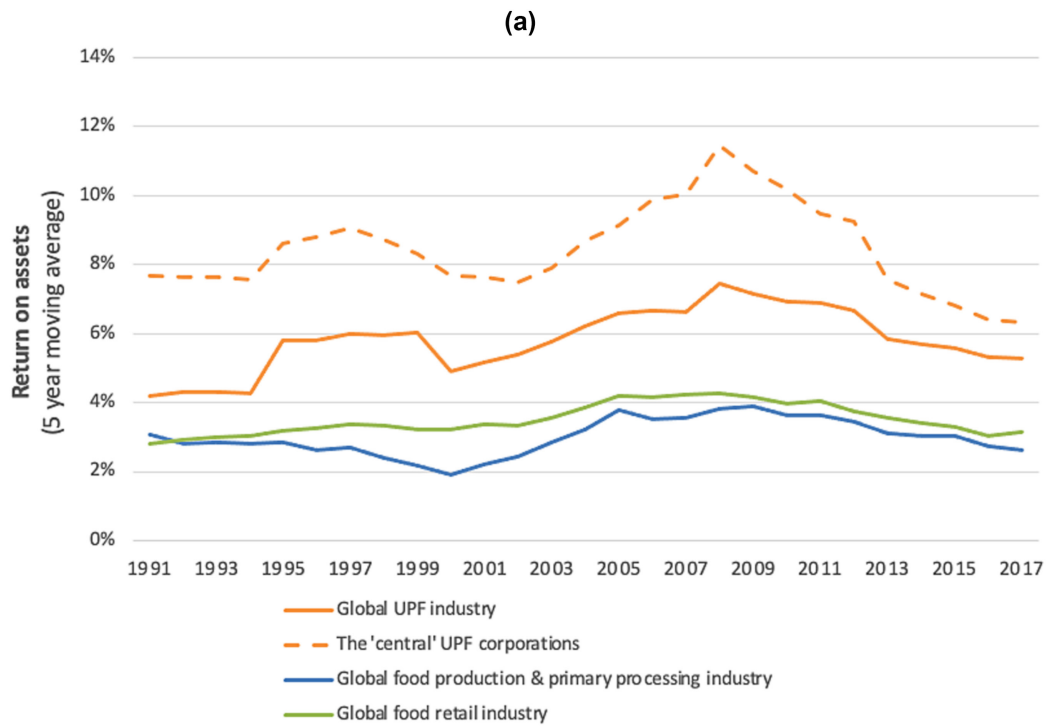
Relatedly, the 'central' UPF corporations have increasingly turned to in-house venture capital funds to take advantage of new technologies that enter the market or are about to enter the market (Coyne, 2020; Daneshkhu, 2016; Kruppa, 2020; Painter, 2019). Notably, a large number of new firms entering the UPF industry have reportedly received funding from the in-house venture capital programmes of the 'central' UPF corporations (Citi GPS, 2018). Among other advantages, this has allowed the 'central' UPF corporations to cherry pick promising products or developments from a pool of smaller and often more innovative firms (Citi GPS, 2018). As a pertinent illustration, Kraft Heinz, Danone and Nestlé have all invested in plant-based protein alternatives for their dairy products (Doering, 2020; Siegner, 2020; Watson, 2019). Unilever also recently invested in Olapic, a technology firm that sources photos on social media platforms, clears the rights and makes them promptly available for marketing purposes (Daneshkhu, 2016).

The 'central' UPF corporations appear to have an aptitude to 'innovate' in response to widespread social and environmental trends that have influenced consumer demand on a large scale. According to data from Mintel GNPD's database, between 2000 and 2019, the number of products launched by the 'central' UPF corporations with nutritional claims (e.g., functional, fortification and reformulation claims) skyrocketed from approximately 2000 in 2000 to nearly 40,000 in 2019. A similar trend was seen for new products with ethical (e.g., those related to animal welfare) and environmental (e.g., recycling) claims, which together jumped from approximately 300 in 2000 to nearly 30,000 in 2019. These trends point to what are perhaps the two most significant disruptive threats that the 'central' UPF corporations face. The first of these threats is increasing consumer awareness about the adverse health and environment effects of UPFs. It has been noted that, in response to the economic threat posed by widespread health concerns arising from the consumption of their products, a key 'strategic' response of large UPF corporations has been to modify the nutritional profiles of these products through 'nutritional engineering'—notably, reformulation, fortification and functionalisation (Scrinis, 2015b). These new UPF product markets almost always operate in tandem with the core UPF product markets, thereby serving the purposes of both portfolio diversification and corporate responsibility. In a similar fashion, large UPF corporations have increasingly turned to environment-related process and packaging innovations to mitigate reputational damage and protect sales in light of being exposed as some of the largest global plastic polluters (Break Free From Plastic, 2020; Han, 2015; Schmidt et al., 2020).

The second major disruptive threat is government regulation, particularly with respect to regulations that seek to limit the marketing of harmful products, as well as measures designed to ensure UPF corporations 'internalise' some of the costs they externalise (e.g., taxes on sugary drinks) (Moodie et al., 2013; Swinburn et al., 2019). As alluded in the previous paragraph, some scholars have argued that large UPF corporations seek to build an image of corporate responsibility through the claims they make in order to promote the idea that industry self-regulation, as opposed to mandatory government regulation, is sufficient to address critical public health and environmental issues (Baker et al., 2021; Han, 2015; Scrinis, 2015a; Scrinis & Monteiro, 2018).

3.2.4 | Raise barriers to market entry

An important reason as to why the some UPF corporations have been able to maintain positions of market dominance for long periods of time is that most UPF markets have high barriers to market entry—that is, for a number of reasons, it is generally very difficult for new firms to enter UPF markets and then capture market share from incumbent firms (Wood, Williams, Nagarajan, & Sacks, 2021). Some of the most important barriers to UPF market entry are the brand power, economies of scale (in terms of production, finance and marketing) and supply chain control of the market leaders (Wood, Williams, Nagarajan, & Sacks, 2021).



Brand power, defined as the ability of a brand to capture a share of its particular market (Cambridge University, 2023), is a particularly formidable entry barrier in UPF markets. A key reason for this is that, in many UPF markets, consumers often prefer to buy products with well-established brands (Sexton, 2012). Potential market entrants thus face the prospect of having to spend heavily on marketing just to develop an initial consumer base. Whereas new UPF companies might be able to effectively compete (at least over the short term) with established UPF corporations in one local or national region, capturing brand share at the regional or global levels takes a substantial amount of time, resources and effort (Wood, Williams, Nagarajan, & Sacks, 2021). According to Statista, Coca-Cola's brand was worth nearly US\$100 billion in 2022, with many of the leading brands held by the other 'central' UPF corporations also worth many billions of dollars (Brand Finance, 2020). The brands of these corporations have thus become some of the most valuable assets in the global food system.

Another key barrier to UPF market entry is the well-established economies of scale of the 'central' UPF corporations, which tend to encompass large production networks with extensive manufacturing capabilities that span across the world (Baker et al., 2020). The production and distribution networks of some of the largest existing UPF corporations have been over a century in the making. Starting from single sites in their respective home countries, Nestlé, Coca-Cola Co, PepsiCo, Danone and the predecessors of Kraft Heinz Co had already managed to establish large transnational production and distribution networks prior to the Second World War (Company Histories, 2022; Internet Archive, 2017a, 2017b; Nestlé, 2017). In contrast, when it was established in 1929, Unilever already had control of a vast production and distribution network spanning over 40 countries, including many colonies and ex-colonies of the then-British Empire, as well as the French, Belgian, Portuguese and Spanish Empires (New Internationalist, 1987; Unilever, 1975).

As of 2019, the 'central' UPF corporations had considerable productive economies of scale, an argument supported by their very large and expansive corporate groups. According to Orbis, Nestlé's corporate group consisted of nearly 900 subsidiaries in more than 120 countries. Within this corporate group were more than 400 manufacturing factories across 84 countries (including 31 in China and Taiwan, 16 in Brazil and 13 in Mexico) (Nestlé, 2019). In comparison, PepsiCo's corporate group consists of 970 subsidiaries in 92 countries; Danone's corporate group consists of 261 subsidiaries in 73 countries; and Unilever's corporate group consists of 398 subsidiaries in 54 countries. Coca-Cola Co's corporate group consisted of 296 subsidiaries in 57 countries, but these figures do not take into account the company's extensive bottling system—the so-called 'Coca-Cola system', encompassing Fomento Económico Mexicano—largely built upon franchising agreements in which companies are essentially required to pay Coca-Cola Co monopoly prices to use its brands and import its concentrates (Burch & Lawrence, 2009; The Coca-Cola Company, 2020). Of note, this seemingly extractive system pioneered by Coca-Cola Co came under antitrust scrutiny during the 1970s (Internet Archive, 2017a). However, not only was the case put forward by the US Federal Trade Commission dismissed, Coca-Cola Co and other soft drink companies (including PepsiCo) managed to successfully lobby for a specific antitrust law—the Soft Drink Interbrand Competition Act—to protect them from further regulatory scrutiny (Vestal, 1993).

Relatedly, the 'central' UPF corporations all possess considerable financial economies of scale insofar as they tend to generate huge cash flows, while also being in a position to access capital at cheaper rates than smaller companies (Hendrickson et al., 2008). They also all have subsidiaries based in globally recognised tax havens (Nestlé

FIGURE 7 The profitability of the global ultra-processed food (UPF) industry (including the 'central' UPF corporations), global food retail, and global food production and primary processing industries on (a) return on assets and (b) net profit margins, 1989–2019. *Source:* Data sourced from Compustat accessed via Wharton Data Research Services (WRDS). There may be some missing data in the datasheets extracted from Compustat, as well as discrepancies between data sourced from Compustat and data from official company filings and reports. Return on assets = net income/value of total assets. 'Central' UPF corporations = Nestlé, PepsiCo, Unilever, Coca-Cola Co, Danone, Fomento Económico Mexicano (data from 1993), Mondelez (data from 2001) and Kraft Heinz Co.

is also incorporated in a recognised tax haven), which can be exploited to minimise tax obligations via practices such as transfer pricing (Farnsworth & Fooks, 2015; Pritchard, 2000).

In many contexts, the 'central' UPF corporations hold a dominant position in their respective food supply chains, something which they can leverage to sell products with high profits margins (Baker et al., 2020; Moodie et al., 2021; Wood, Williams, Nagarajan, & Sacks, 2021). Such dominance, for instance, can manifest as the systematic driving down of labour and production costs, including through both legal and illegal avenues (Wood, Williams, Nagarajan, & Sacks, 2021). It can also facilitate considerable control of their retail and distribution channels. For example, large UPF corporations are often able to secure optimal retail shelf space in supermarkets, a particularly formidable barrier to market entry in contexts in which supermarkets have become major sites of food purchases (Baker et al., 2020). A key reason for this is that the so-called 'must stock' brands of large UPF corporations face a much lower risk from being displaced by supermarket own brands compared with the lesser known brands owned by their smaller competitors (Wood, Williams, Nagarajan, & Sacks, 2021). In addition, large UPF corporations are more likely to gain 'category captaincy' and/or be able to pay slotting fees, both of which are anti-competitive practices designed to secure prime retail shelf space (Carameli, 2004; Jennings et al., 2001).

3.3 | Profitability and shareholder returns

3.3.1 | Profitability

Our data show that, between 1989 and 2019, the global UPF industry was consistently more profitable (return on assets) and had much higher aggregated net profit margins than both the global food production and primary processing industry and the global food retail industry (Figure 7). The 'central' UPF corporations demonstrated particularly high levels of profitability and net profit margins that considerably exceeded those of the aggregate global UPF industry over the period analysed. The peak seen around 2010 in Figure 7a,b was likely due to a surge in Nestlé's net income resulting from its sale of Alcon to Novartis for US\$28.3 billion (Nestlé, 2010).

3.3.2 | Shareholder returns

Between 1989 and 2019, we estimated that the global UPF industry distributed approximately US\$1.3 trillion to their shareholders in real terms (Figure 8). US\$860 billion was distributed by the 'central' UPF corporations, an amount similar to that distributed by the global food production and primary processing industry and the global food retail industry combined (approximately US\$220 billion and US\$640 billion, respectively). In addition, Figure 8b shows that the percentage of shareholder returns relative to total revenue was substantially higher for 'central' UPF corporations compared with the other examined industries, with the gap increasing considerably over the analysed period. Over the 5-year period between 1989 and 1993 (inclusive), the ratio of shareholder returns to total revenue for the 'central' UPF corporations was approximately 3.4%, jumping to 13.7% between 2015 and 2019. In comparison, we estimate that the ratio for the global food production and primary processing industry and the global food retail industry was 1.9% and 1.3%, respectively, between 2015 and 2019.

4 | DISCUSSION

Likely originating around the mid-to-late 1800s, the global UPF industry has grown and penetrated capitalist food systems to the extent that, today, the entire system appears to be heavily geared towards the production and consumption of UPFs. Oftentimes enabled by diverse historical and contemporary institutions (e.g., trade and investment agreements) and systemic processes (e.g., liberalisation and urbanisation), a key explanatory factor behind this trend is that a group of dominant UPF corporations have managed to develop a large and

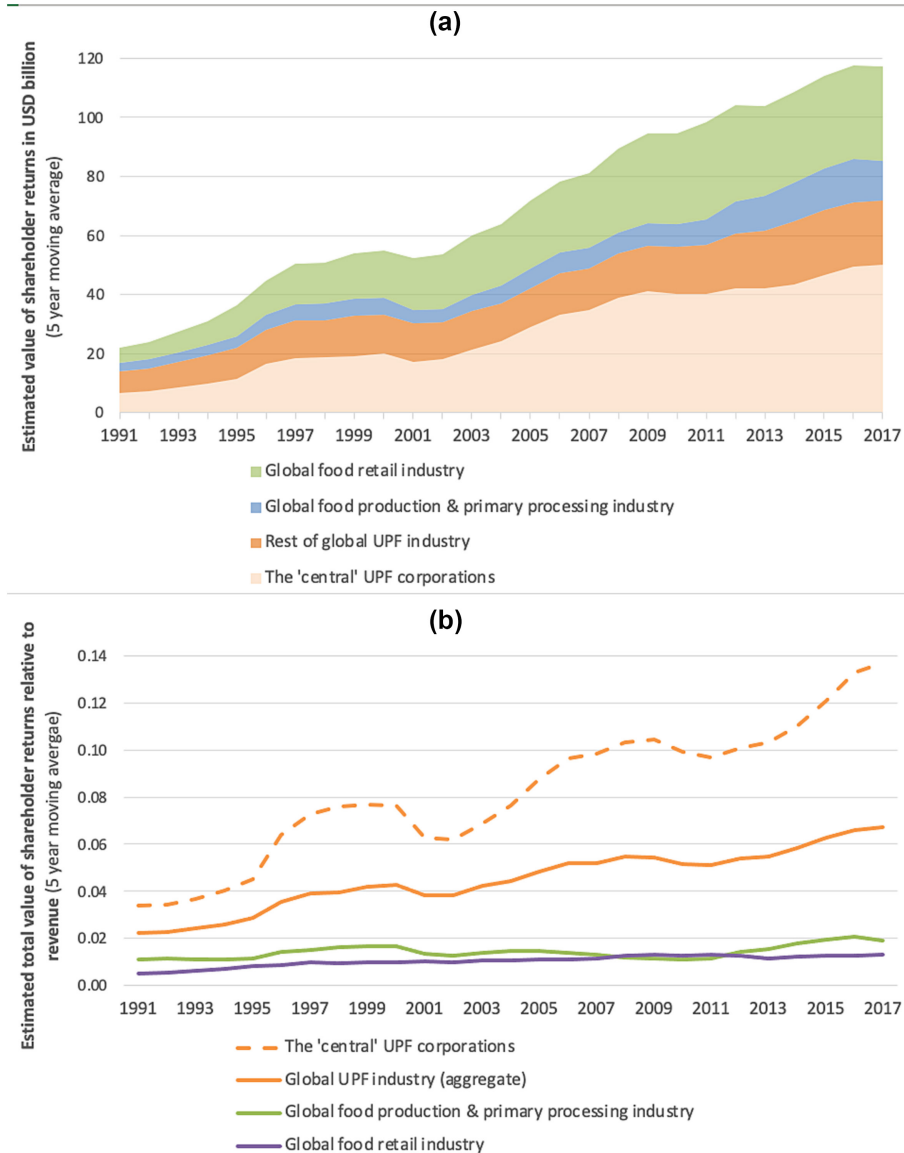


FIGURE 8 The shareholder returns paid out, in (a) absolute terms and relative to (b) revenue, by the global ultra-processed food (UPF) industry, global food retail, and global food production and primary processing industries, 1989–2019. *Source:* Data sourced from Compustat accessed via Wharton Data Research Services (WRDS). There may be some missing data in the datasheets extracted from Compustat, as well as discrepancies between data sourced from Compustat and data from official company filings and reports. Shareholder returns = dividends paid + share buybacks. Share buyback data from Compustat may include data on purchase of preferred stock. 'Central' UPF corporations = Nestlé, PepsiCo, Unilever, Coca-Cola Co, Danone, Fomento Económico Mexicano (data from 1993), Mondelez (data from 2001) and Kraft Heinz Co.

extensive network of oligopolies spanning much of the world. As our study indicates, this global network of UPF oligopolies has been, and continues to be, highly conducive to the generation of substantial 'monopoly profits' and shareholder capital. Yet the rather remarkable financial performance of the global UPF industry has come, and continues to come, with considerable social and ecological costs, not least those related to the global UPF dietary transition.

Our study also strongly suggests that, since the 1980s, the 'central' UPF corporations have been increasingly prioritising the financial interests of their shareholders above other interests and concerns. This is a major public health concern for various reasons. First, by virtue of the ways in which shareholder capital is distributed, the pursuit of 'maximising shareholder value' in this manner directly contributes to widening socio-economic inequalities, which, in turn, adversely influence many population health outcomes (Wood, McCoy, Baker, et al., 2021). Furthermore, that the 'central' UPF corporations appear to be prioritising the interests of their shareholders suggests that they have become increasingly structured and compelled to subjugate normative and moralistic arguments against deploying harmful strategies (e.g., systematic marketing of products in violation of national laws and international norms) to the short-term material argument in favour of deploying these strategies. The recent dismissal of Danone's CEO Emmanuel Faber illustrates this point. In 2021, Faber was reportedly terminated as a result of an 'activist' campaign led by investors who argued that Faber's focus on sustainability was jeopardising the company's short-term financial performance (Van Gansbeke, 2021). As another illustrative example, in 2011, then-CEO of PepsiCo Indra Nooyi reportedly increased the company's strategic focus on so-called 'better for you' products, in doing so taking support and focus away from the company's core products, especially Pepsi Cola (Warner, 2013). Shortly afterwards, Pepsi Cola's sales declined, which prompted several powerful investors to pressure management into rethinking its 'better for you' strategy. In response, Nooyi redistributed large sums of money and resources back into strengthening marketing for the company's flagship brands (Warner, 2013).

The above examples of Danone and PepsiCo speak to another important finding, which is the considerable extent of common ownership (of shares) by large institutional investors in the global UPF industry. Although this trend is not unique to the global UPF industry (Clapp, 2019), or the global economy more broadly, the consequences of common ownership likely vary according to the structure and nature of the industry in question. Common ownership, for instance, is theorised to lessen competition, especially in highly concentrated markets like carbonated soft drinks and baby food. One of the potential mechanisms behind this is that investors likely have an incentive to foster market and political collusion between large corporations in order to maximise the value of their entire portfolio rather than the value of any given firm (Brooks et al., 2018; Elhauge, 2016; OECD, 2017). Relatedly, in harmful industries such as the global UPF industry, a rise in common ownership means that large and powerful institutional investors increasingly stand to lose in financial terms from industry-wide public health regulations.

It is beyond the scope of this paper to provide a comprehensive set of solutions and theories of change detailing how the 'capitalist engine' of the global UPF industry can be reprogrammed to better protect and promote population health and health equity. Our analysis suggests, though, that technology or market 'forces' (e.g., new market entrants and the growth of Chinese UPF manufacturers) appear to have limited potential to disrupt the economic and political influence of the 'central' UPF corporations. It is also very unlikely that such disruption will come from policy actions, such as support for reformulation, that seek to shift consumption from one group of UPFs to another (Dickie et al., 2018). Instead, what will likely be required is a robust framework of 'ecological regulation'—a framework of synergistic measures that cut across various regulatory domains, underpinned by principles relating to the subjugation of profit-making and capital accumulation to other social and environmental relations (Northcott et al., 2023; Parker & Haines, 2018; Parker & Johnson, 2019). Such measures could include, for instance, policies that support local and circular food systems (e.g., progressive public procurement policies; the development and strengthening of local food system infrastructure such as produce markets) (IPES-Food, 2019; Mooney, 2018; Parsons & Hawkes, 2018; Pingali, 2012). At least at the local level, measures like these have the potential to achieve numerous health, environmental and welfare policy objectives, including through promoting the consumption of less processed foods in a sustainable and equitable manner. Measures that seek to curb the excessive financial, economic and political influence of the ultra-processing regime's powerful actors, including the 'central' UPF corporations, also need to be considered. In this respect, potential examples include abolishing agricultural subsidies that promote large-scale commodity crop production, taxing the advertising of harmful products like UPFs and reinterpreting unsustainable business practices as abuses of market dominance subject to antitrust enforcement (Gortmaker et al., 2015; Holmes & Meagher, 2022; IPES-Food, 2017b).

A key strength of this study is that it drew from theories, concepts and metrics from a range of literature, including industrial organisation, strategic management and international political economy, and sourced and analysed a large amount of data from diverse sources seldom integrated in public health research.

The paper has several important limitations. First, primarily due to reasons of data availability and currency exchange issues, we were not able to capture data from all publicly listed companies, nor from major non-listed business entities (e.g., Cargill). This includes those in the informal sector, which is likely more important for the food production and retail industries compared with the UPF manufacturing industry. Nevertheless, it is reasonable to assume that the data extracted captured a large proportion of the global industries we examined in terms of revenue, assets, profits and market capitalisation. In addition, it was beyond the scope of this project to verify the data extracted from Compustat. As such, there may have been instances of missing data, duplicated data and discrepancies between the extracted data and data from official company filings and reports, especially for companies listed on stock exchanges outside of North America. Moreover, a caveat to note is that currency exchange rate fluctuations would have likely influenced some of the trends seen in our analysis to some degree.

As another limitation, we were unable to account for the fact that many food corporations are active in multiple industries. Specifically, we recognise that many UPF manufacturers are also involved in both food production and primary processing operations, and vice versa. Similarly, many food retailers have their own home-brand UPF products (often made by manufacturers under contract). The aggregated industry data used in our quantitative analyses should therefore be interpreted as pertaining to the *primary* operations of firms, as opposed to their *entire* operations. To help partly address this limitation in future research, further work could look at assessing the compatibility of different industry classification systems with the NOVA classification system.

We also did not analyse the role that corporate actors active in other industries, particularly the fast-food restaurant industry, have played in building and sustaining the UPF system. Dominant corporations across all levels of the capitalist food system, however, likely profit from UPFs in some way, albeit to varying degrees. Furthermore, it was beyond the scope of this paper to comprehensively analyse the institutional and governance arrangements that form the framework of the UPF system, how these have changed over time and how they vary across different contexts. A potential direction for future research could be to examine these important and interconnected research and knowledge gaps.

5 | CONCLUSION

Bound by the profit motive and propelled by technological change, the global UPF industry arose during the 19th century. Since this time, the industry has been instrumental in transforming capitalist food systems to the extent that many are now far more geared towards the consumption and production of UPFs compared with unprocessed or less processed food products. Over the course of the late 19th, 20th and early 21st centuries, a 'central' group of UPF corporations constructed and maintained a network of oligopolistic markets spanning much of the world conducive to high and sustained levels of profits. At least since the 1980s, these corporations have also become some of the largest distributors of shareholder capital within the entire global food system. It follows that reversing the global UPF dietary transition will likely require, among other things, substantial changes to the structural and regulatory conditions under which food systems around the world operate, such that population and planetary health are actively promoted and incentivised.

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CONFLICT OF INTEREST STATEMENT

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from third parties. Restrictions apply to the availability of these data, which were used under license for this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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