Fashion in turbulent times: new technologies meet new economic paradigms

Abstract

The fashion industry is experiencing structural change as new manufacturing and distribution technologies emerge. Simultaneously, the environmental impact of garment production and the sector's record on workers' rights provokes increasing disquiet. This article explores how new technologies for distributing and making clothes interact with a shifting industrial policy agenda as neoclassical and neoliberal economic paradigms lose their dominance, and state intervention becomes fashionable again.

Contemporary ready-to-wear production, which relies on manufacturing goods speculatively in hope that they will meet consumers' needs, is massively wasteful, and the sector has experienced a series of shocks as established brands fail to correctly anticipate demand. Online-bespoke – in which garments are made to the specifications of the customer – has emerged as a promising sector. In changing how we buy and produce garments, can we transform how we value our clothes, the resources from which they are composed, and how we value the people who make them?

This article argues that in order to reap the benefits of new and disruptive technologies, national governments and multilateral organizations must develop industrial strategies to shift current market incentives. Protections for fledgling sustainable and technologically innovative fashion brands, along with Pigovian taxation (taxation targeting negative externalities like pollution), are required to transform the industry.

Key words: sustainability, online-bespoke, slow fashion, new technologies, garment manufacture, industrial strategy, Pigovian taxation.

Introduction

This article explores how strategies drawn from development economics and policy discourse could contribute to the adoption of innovative approaches to making and distributing clothing and how, in turn, these might provide answers for the ethical dilemmas, issues of sustainability, and, indeed, the existential challenges faced by the fashion industry. By bringing together a set of conversations that have taken place in different corners of academia, public policy, business and sustainability (along with research of my own) the article synthesizes propositions drawn from diverse modes of intellectual enquiry to offer some solutions to our current impasse. The article commences with a historical contextualization 'Turbulent Times' before, in part 1, addressing the emergence of new techniques for making and distributing clothing and, subsequently, in part 2, discussing economic and industrial policy.

I ask if, by altering the ways that we buy and produce garments, whether we can also transform how we value and care for our clothes, the resources from which they are composed, and the people who make them. New approaches to making and selling clothing hold exciting possibilities, but my project is not to advance some form of techno-utopianism in which science has answers to all of humankind's woes. Whether emerging technologies do indeed exert a positive impact (or instead exaggerate the worst aspects of our current economic system) is as much a political and economic question as a technical one. National

governments have, to date, failed to come to terms with the realities of our changing climate, our continued over-reliance on fossil fuels and ecologically damaging processes, and the threat to skilled jobs of Artificial Intelligence and automation. It is in this context that discussions of the transforming fashion sector must take place: textile and garment production drove the industrial revolution and the emergence of modern consumer capitalism. Their transformation in this new millennium could herald the development of a new, more humane, social and economic model; we must hope it does.

This piece of work has been several years in the making, emerging out of my experience working with fashion students on issues of sustainability, ethics and manufacture, and out of my own interest in issues of public policy and economics. Dedicated to these inspiring future practitioners, the article explores issues of responsibility and agency – arguing that the innovations of designers, makers and entrepreneurs must be matched and supported by governmental (and intergovernmental) action to reshape market incentives away from polluting and exploitative modes of manufacture and towards more ethical ways of making.

Turbulent Times

The 1990s and the first decade of the new millennium saw fashion consumption expand very significantly as cheaper garments – often manufactured in low cost centers of production – brought down the price of clothing, and as retailers adapted design and distribution models to render them more responsive to consumer preferences and trends: quick-turnover “fast fashion” with its “agile”, flexible networks of production, data analysis, and low prices was born (Black 2010; McCarthy 2011; Briggs 2013). Notwithstanding shoppers’ shifting behaviors, this expansion of fashion retail – and the increasing emphasis on consuming rather than producing goods in wealthy industrialized countries – has been a very notable tendency of the late twentieth and early twenty-first centuries. Depending on your politics, this cornucopia of inexpensive clothing, booming retail sector and expansion of consumer credit represented either the hollowness, waste and decadence of market capitalism, or, alternatively, the bounty and success of a triumphant economic system. Today, however, conventional fashion retail – like late capitalism itself – is facing an uncertain future: malls, department stores, and high-street chains have struggled to adapt to changing consumer preferences, unable, in the face of online competition, to offer a sufficiently distinctive products or experiences to justify a visit (Baskin 2019; BOF 2019; Bloomburg 2019; Chen 2020). The Coronavirus pandemic has exaggerated a set of tendencies, in fashion retail, which were already visible prior to its emergence – most notably the expansion of internet-enabled shopping and the associated failure of some bricks-and-mortar stores: ‘online penetration’ of the apparel market significantly increased rising to 52% of purchases by value in the UK during 2020 according to analysts GlobalData (Stephens, 2021). Nevertheless, it is notable that even during a pandemic year in which physical shops were at times prevented from opening by law, the online market represented just over half of sales demonstrating the continued significance of shopping in person.

As we have seen, the fashion industry is experiencing rapid structural changes as new technologies of manufacture and distribution (especially those enabled by the internet) interact with evolving consumer behavior. At the same time, the enormously negative environmental impact of fashion and textile production – along with the sector’s abysmal record on workers’ rights – is provoking increasing disquiet not only amongst customers but

also amongst national governments and multilateral organizations. For example, the Environmental Audit Select Committee for the UK Parliament held an inquiry into the ethics and sustainability of the fashion industry in 2018 (Creagh 2018). Intriguingly, the report resulting from this investigation – a document yet to come into existence when this article was first penned – makes some similar recommendations to the solutions proposed here (House of Commons Environmental Audit Committee, 2019, 3). The Audit Committee's calls for greater state intervention in the fashion market have hardly been rapturously received by the current UK government[1] (Her Majesty's Government 2019), but they nevertheless signal a paradigm shift in policy discourse.

Retail in general, but especially the low margin fashion sector with its fluctuating patterns of demand, is in crisis. Meanwhile, according to the Ellen MacArthur Foundation's 2017 report, "total greenhouse gas emissions from textiles production, at 1.2 billion tonnes annually, are more than those of all international flights and maritime shipping combined" (Morlet et al. 2017, 3). Fashion production in its current form is in no sense of the word sustainable – it cannot and will not carry on functioning in the way that it currently does. Increasingly this fact is being recognized not only by labor activists, environmentalists and economists but also by large global fashion companies like Nike, H&M, Zara and the French luxury group Kering (Daveau 2017; Morlet et al. 2017).

Neoclassical and neoliberal forms of economic thought propagated by Chicago School economists, which became highly influential in the 1980s, favored the market as the most rational and efficient mechanism for allocating resources. But the experience of the last decade suggests otherwise. As we have seen in relation to Covid-19, those nations most resistant to intervening in the market, to redirecting companies to manufacture and distribute vital goods, and to keeping workers out of harm's way, have been worst hit. The complex supply chains of many essential products might make them cheaper, but they also render the supply of goods extremely vulnerable at times of crisis. As with the financial market crash of the previous decade, Covid-19 has demonstrated that a blind, quasi-religious trust in the 'hidden hand' of the market puts citizens and consumers in considerable danger. The marketplace is never really independent of government, and when markets fail – as they inevitably do – the state must step in. While this piece of work has grown out of a long process of research, debates pertaining to the government's role in pursuing industrial priorities have gained a particular urgency at the time of writing (in May 2020). The Covid-19 pandemic has emphatically underlined the lessons of the 2008 economic crash with tragic consequences.

Part 1: New Technologies

This section of the article will consider emerging technologies and their potential impacts on making and distributing fashion: more bespoke forms of production – incorporating 3D scanning; new pattern making systems; and small-scale online entrepreneurship are all discussed. Some of the pressures that might encourage this change to take root – particularly scarcity of resources – are also explored, while shifts in dominant economic paradigms that shall be more extensively analyzed in the latter part of the article are foreshadowed. The argument, in what follows, is not that these technologies will inevitably or immediately displace the status quo in fashion manufacture, but rather that if combined with policy levers

that change the balance of incentives, they could offer technical solutions to the vexed ethical and environmental problems that currently plague the garment industry.

A. Mass-customization and the prosumer

The advent of online fashion retail has transformed the fashion industry. The relationship between buyer and seller is fundamentally reconfigured on the Internet; customers search, buy, and browse differently; and online-retailers are able to collect information on their behavior much more easily. New technologies of making, including automated sewing and knitting machinery, body scanning, and 3D visualization software also offer new possibilities to fashion designers and entrepreneurs. In this context, a number of new models of fashion purchase, production, and even leasing of clothing, are appearing. Along with "data driven design" and the notion of the "sharing economy[2]", online-bespoke – in which garments are made to the precise specifications of the customer – has emerged as a promising and growing sector.

In November 2016, Forbes Magazine published an article focused on a London based startup "Unmade", whose business model allows consumers to customize knitwear designs using a digital interface – the resulting garment specially knitted-up to meet the shopper-designer's specifications (Arthur 2016).

Both "mass-customization" – the (automated) personalization of inexpensive consumer goods – and the "prosumer" – the consumer-producer who is closely involved in the goods they buy, perhaps to the extent of designing them – have been predicted for some time (Larsson 2012). Over a decade ago the sociologist Collin Campbell was already discussing the "craft consumer" who brought "skill, knowledge, judgment and passion" to their buying behavior and who might also be involved in making or customizing the products that they use (2005). Indeed, the term "prosumer" and the notion that the line between production and consumption was becoming increasingly blurred dates back to the early 1970s as futurologists predicted that new technologies would allow buyers to take on the role of designers (McLuhan and Nevitt 1972; Toffler 1980).

In some senses, then, the porosity of the boundaries between designer, maker and consumer is nothing new: buying a paper-pattern and making a garment from a cloth you have selected yourself, or going to a tailor or dressmaker to commission an outfit of your own conception are examples of prosumer behavior that existed long before this neologism entered into our vocabularies.

But in fashion, at least until recently, consumer behavior instead of moving towards mass-customization has instead moved in the opposite direction. Just-in-time supply chains, aggressive cost-saving measures, and low-wage centers of production – both at home and abroad – have rendered standardized, ready-made garments cheaper and cheaper for consumers (Sull and Turconi 2008, 5-11; McCarthy 2011, 541-546; O'Connor 2018). Why produce something yourself (or have a seamstress do so) when you can buy a made-up garment for less than the price of the fabric?

However, the artificially low-cost of high street clothing may be coming to an end. Factories that neglect minimum ethical standards; the underpayment and mistreatment of machinists; the polluting, carbon and water intensive nature of textile production – all these factors exert costs, not on the consumer at the point of sale, but on the environment, on communities, and

ultimately on the public purse (Fletcher 2014, 167; Hepburn 2010, 117-136). As supranational organizations like the World Bank, the International Monetary Fund (IMF), and United Nations (UN) move away from neoclassical and Hayekian economic paradigms[3], it seems likely that these externalities may find themselves costed-in to the price of finished goods through mechanisms like carbon pricing. Institutions that once preached the primacy of the free market now argue for redistributive and Pigovian forms of taxation as necessary to ensure stable (and sustainable) economic growth: Pigovian taxes – named after the economist Arthur Pigou[4] – are taxes levied on activities that exert a negative impact on society, health, or the environment (what economists refer to as 'negative externalities'). A 2017 report from the IMF suggested that:

> Advanced economies with relatively low levels of progressivity in their personal income tax may have scope for raising the top marginal tax rates without hampering economic growth. Emerging markets and low-income developing countries should focus on gradually expanding the coverage of [income tax] and raising indirect taxes [on] items that generate negative externalities, such as fossil-fuel-based energy, alcohol, and tobacco – to generate funding for progressive spending. (IMF Executive Board 2017)

Fashion conglomerates such as the Kering Group – who have invested extensively in sustainability audits, significantly altering their manufacturing processes as a result – are pre-empting the disruption of meeting externally mandated standards (when these eventually arrive) while simultaneously securing sustainable supply chains (Daveau 2017). Increasing competition for water, natural fibers, oil and coal means that brands will need to work in a leaner, more efficient way or risk going out of business, and it makes sense for big players in the industry to put in place less resource-hungry methods of production sooner rather than later. As the regulatory environment changes and resources become more scarce, understanding every step in the supply chain, their inputs and outputs, represents a potentially significant strategic advantage.

B. Back to the Future

> "Fashion is often very old-fashioned" (Haag 2011 cited in Black 2019, 113).

The current high street model of fashion production, design and distribution relies on manufacturing goods speculatively in the hope that they will meet consumers' wants, needs and desires and then throwing this stuff at the market. Of course, various systems designed to track and anticipate consumers' preferences have been developed – from Benetton and Inditex's pioneering point-of-sale IT systems, to contemporary data-driven-design – but none of these methods are foolproof (Briggs 2013, 188-189). After all, how often as a shopper have you bought a garment that wasn't quite right somehow, that didn't quite fit, but was the nearest thing available to the item you had imagined and really wanted or needed? And how often are shops left with rack upon rack of garments that they have to unload at a loss? An enormous waste of effort, time and precious resources is expended in this process, as designers and buyers gamble with vast sums of money in the hope of correctly anticipating shifting consumer desires.

To a great extent, the 'cut-make-trim' garment manufacturing industry still relies on a set of essentially nineteenth century technologies and processes: the sewing machine and cutting machinery[5], and the section system of manufacture – in which each machinist performs a different operation are nineteenth century innovations. The production of ready-to-wear garments graded to standard sizes is an earlier development, but one that was massively popularized in the nineteenth century (Lemire 1997; Godley 1997; Deceulaer 2000)[6]. A Victorian sewing-machinist who – having travelled through time – walked into a contemporary clothing factory in Leicester or Dhaka would find much that was familiar (including the low pay and poor working conditions that remain endemic in the sector). As scholars of fashion production such as Adam Briggs (2013, 186-199) have noted, the developments during the 1990s and early 2000s that enabled low cost but highly trend driven and responsive "fast fashion" to emerge as the dominant model of high street production owed more to new information technologies (enabling buyers and designers to respond to sales data in real time) than they did to new techniques for making garments.

Today, however, a new set of technologies is emerging in fashion. Body scanners, vector based and 3D pattern-cutting systems allowing garments to be cut to the exact specifications of consumers are introducing a new form of affordable bespoke. Simultaneously, developments in artificial intelligence allow brands to analyze consumer trends and generate data-driven design in ever more sophisticated ways. Sew-bots (automated sewing machinery), having recently emerged onto the market, may begin to displace the sewing machine and machinist in some large industrial sites producing standardized garments: but, at least for the moment, sew-bots lack the dexterity and flexibility of human machinists (and represent a large, risky fixed cost).

The impact of these new technologies is increasingly being felt by a fashion industry that, historically, has been slow to innovate at the level of production (Black 2019, 113-112). For example, the New York men's tailoring brand Acustom Apparel operates according to a co-creator business model: the client's body is scanned at the show-room, notes are made on their fitting preferences, and the customer is able to choose from a range of fabrics, collar, pocket and lapel styles in order to produce an individualized design with the finished product posted to their home (Acustom Apparel 2018).

The growing influence of body scanning to the apparel industry is reflected by the proliferation of technologies now available. Perhaps more significant than systems that rely on booths – and therefore necessitate cumbersome specialist equipment – is the advent of software (such as Bodi.Me and 3-D A Porter) that exploit inexpensive motion-caption devices found in X-box video game equipment or even smart phone cameras. For instance, an app for the online brand, MTailor allows customers to scan their bodies using an i-phone, to specify their fit preferences, and to customize elements like shirt collars as they order (Mtailor.com, 2018).

Just as significant as scanners themselves are the grading, visualization and pattern-making software that enables customers' vital statistics to be quickly translated into customized pattern pieces[7] (Baytar 2017). As three-dimensional imaging and virtual prototyping technologies have become cheaper, easier to use, and able to produce higher quality on-screen visuals, these applications have increasingly entered into the fashion industry: software such as "Clo-3D" allows practitioners to edit and create patterns while displaying life-like renderings of resultant garments on an onscreen figure. Today, a designer or pattern cutter using Clo-3D or "Modaris 3D Fit" software – the latter developed by the French

company Lectra – can create an avatar of a scanned individual, develop garments draped onto their virtual body, and generate a pattern which can then be sent to print or to an automated cutting machine[8] (Surville 2010; Lectra.com 2018). While digital methods may not be as tactile and intuitive as physically draping on the stand to create a toile (prototype); combined with more traditional approaches they can resolve problems of grading, sizing and fit (for example by removing the necessity of undertaking a fitting in person). At present, these new approaches to cutting patterns and draping garments are mostly used by large companies to perfect ready-to-wear production, but innovative new players such as Acustom and Mtailor demonstrate the potential for such technologies to be used in the manufacture of bespoke or customized garments.

C. High-tech and low-tech solutions

Industrial knitting machines linked up to digital interfaces (as seen at Unmade) and body-scanning apps on our phones represent two technologies that are currently recalibrating the relationship between consumer and producer in fashion. At present, these systems – as well as the 3D visualization, pattern making and automatic cutting technologies pioneered by Clo-3D, Lectra and Gerber – require a significant capital outlay. But over time, software and equipment is becoming cheaper, and it will become increasingly possible for small-scale designer-makers and entrepreneurs with limited funds to benefit from similar techniques.

Nevertheless, the digital context has already hugely transformed the fashion industry by developing new approaches to retailing and distributing products online. Internet based retailers both at the high end and in the mass market have built convenient online shopping experiences, and avoided the outgoings associated with physical shops while benefitting from a rich seam of data that can be scraped from shoppers search, browsing and purchasing activities. But as well as big businesses – like Net-a-porter, Mr Porter, ASOS and Boohoo – small start-ups, independent craftspeople and designer-makers have also increasingly used the Internet to promote their wares and to sell directly to customers.

Retailing via traditional boutiques presents up-and-coming designers with logistical, financial and creative problems. The upfront manufacturing costs incurred in preparing a collection (in a range of sizes) is considerable: and since many stores operate on a sale-or-return basis, these costs may never be recouped. Unwanted garments are either discounted, or sent back to the atelier – boutiques are notoriously slow in paying, and designers therefore face significant cash-flow problems. Moreover, physical stores generally reach a geographically limited customer base, and their demands for particular types of garment (or for repeats of best-sellers) may distort the creative aims of the designer.

Online retail environments like NJAL (Not Just a Label), Etsy and ASOS marketplace allow independent designers to connect to a global client base. Not only does this – at least potentially – increase the chance of sales, but it also means that the geographical location of the designer becomes less important. And they may therefore choose to base themselves outside large centers of fashion consumption in which rents are high. In this sense, while the fashion design, pattern-cutting and sampling industries tend to cluster (agglomerate) in cities with a strong fashion “scene,” at least for the moment, the advent of the online platform has further undermined the hegemony of a few dominant fashion capitals (Paris, Milan, London, New York, Seoul and Shanghai). While agglomeration economies still operate, design is becoming increasingly global and international just as manufacture did in twentieth century.

It is also noteworthy that many practitioners promoting their wares via platforms such as NJAL or Etsy are essentially manufacturing commissioned one-off pieces. Much like traditional couture, a sample collection is presented (photographically) with garments and accessories produced to size when ordered. These methods of manufacture and purchase, in some ways, replicate traditional forms of garment production via seamstresses and tailors: but they also provide the creative innovation and choice associated with contemporary fashion. Catering to individual consumers, in this way, significantly lessens the waste inherent to ready-to-wear production. And shoppers are likely to buy fewer, higher quality garments if they can be confident of getting exactly what they want. The technical and environmental complexities of delivering goods to consumers (particularly the fuel consumption and congestion caused by home delivery) remain, but, in future, the use of hubs at railway stations or in physical stores may help to resolve some of these issues (Davis 2019).

Part 2: New Economic Paradigms

This section of the article explores public policy debates to consider how economic and industrial policy can be applied to fashion markets to encourage sustainable and ethical manufacture. Highlighting shifting economic orthodoxies, this section outlines how policies designed to incentivize strategically advantageous forms of industry – not least well-paid green jobs – are remerging in public policy circles and could be applied to fashion and textile manufacture. More interventionist and / or 'mixed' approaches to the economy in which the state supports fledgling industries – including both financing of desirable activities and taxation targeting polluting or exploitative enterprises are advocated, and the applicability of Pigovian taxation to elements of the fashion industry is discussed. I argue that bar-code type technologies, enabling the entire value-chain to be traced, may help to guide policy levers. I also suggest that support for industries providing well-remunerated employment and sustainable production in developed economies must not come at the cost of developing economies for whom cut-sew-trim remains an important sector.

Ethics & economies

"To be truly radical is to make hope possible, rather than despair convincing" (Williams 1989, 118).

These technological developments in the production of fashion clearly suggest exciting possibilities: possibilities that might help to dissolve the boundaries between makers and designers and between designers and consumers; possibilities that suggest an alternative both to manufacture by exploited workers operating in the semi-legal domestic economy, or to exporting manufacture to low paid centers of production. But what wider economic shifts might these new approaches to making imply?

In *Stitched Up: the anti-capitalist book of fashion* (2014) the journalist and campaigner Tansy Hoskins argues that our response to the exploitation of workers and degradation of the environment wrought by textile and garment production ought to be one of "permanent revolution". And while it is certainly true that radical change is needed, it is difficult to know what this prescription means in concrete, practical terms. The Fashion Praxis Collective (von Busch et al. 2014) in their book *The Fashion Condition* offer some constructive approaches to reshaping fashion as an industry and as a social practice, but these too sometimes seem to be rather limited in their application. Guerrilla mending and hand knitting flash-mobs are welcome and positive ways for activists to engage with issues of production and

sustainability – and I certainly wouldn't dismiss the significance of small, community-based actions and enterprises. But alone, these seem unlikely to meet the complex challenges of making and distributing clothing sustainably on a mass scale, in sufficient quantities to meet citizens' practical and aesthetic needs.

Today, more than vague utopian yearnings, we need new models of making that are located in economic and sociological realities. Models for the manufacture of consumer goods that resist the logic of the market face some major challenges. After the industrial revolution, William Morris, an early proponent of ethical manufacture, rightly saw nineteenth century mass-production as a force that alienated the worker from their labor and that exploited and degraded him or her. Nevertheless, despite Morris' achievements in elevating the pay and conditions of his employees, the Arts and Crafts approach was destined to remain a niche form of manufacture catering mostly to a small élite.

In the twentieth century, nominally Communist societies attempted to provide citizens with the goods that they needed through centrally planned economies. But one doesn't have to be an acolyte of Hayek to see the inefficiencies (and the denial of agency) implied by an economic system that often failed to supply citizens with the basic necessities, much less their aesthetic desires.

The coming of the sewbots, and other incipient processes of automation, certainly threaten jobs in South Asia and elsewhere with significant and worrying implications (Ruvo 2018). But emergent technologies also have the potential to move Western consumers away from a reliance on artificially cheap clothing manufactured in an under-regulated, semi-legal economy (whether at home or at points distant from its consumption). As the Saboteurs[9] and Luddites learnt to their cost, throwing our clogs at the jacquard machines will not hold back the advent of new and disruptive technologies: we must, instead, find a way of making them work to promote sustainable, humanist goals.

These challenges are perhaps particularly acute for poorer countries, as garment manufacture, due to its low set-up costs, has historically offered a first step in industrialising developing economies (Amsden 1989). The economist and development specialist Quiller Brooke has worked with governments in East Africa aiming to grow their garment manufacture industries. In a personal interview he explained that, despite the inward investment associated with an expanding garment sector, cut-sew-trim operations, in which factories work as contractors for foreign firms, render developing nations vulnerable to fluctuating trade conditions and demand, while also capturing only a tiny slice of the profits to be made at either end of the supply chain. It is notable that nations like Bangladesh, for example, have made considerable efforts to increase 'backward linkages' so that a greater number of fibre processing and textile milling processes are carried out domestically thereby capturing more profit (Balchin and Calabrese 2019).

> In order to develop a more robust and profitable garment/fashion/textile industry, governments of developing nations must aim to build capabilities in the spinning and processing of fibres, and weaving of textiles (though this requires higher capital outlay and technical knowledge) as well as, ultimately, increasing domestic demand as wages gradually increase. (Brooke, 2020 [personal interview])

In recent years 'reshoring' in developed economies (bringing back the domestic manufacture of products currently made in cheaper, distant centres of production) has shot up the political

agenda (House of Commons Environmental Audit Committee, 2019). Such developments point to the necessity of moving, as quickly as possible, away from competing on price alone and towards more highly differentiated products. This relies upon developing the skills of workers and the technological capabilities of the textile and fashion industries in developing nations. Recent work in the field of political economy suggests this might already be happening.

In his 2020 study Ashok Kumar suggests that production in developing economies may be moving towards an 'oligopolistic' phase as producers expand across supply / value chains and buy up rivals. Rather than competing principally on price via low cost labour, as in earlier phases of globalization, the increasing integration of these operations pushes out smaller firms and achieves advantages through economies of scale (the dominance of a market by fewer big players is known as an oligopoly). Kumar claims that the vertical integration of manufacturers such as Yue Yuen and Arvind – oligopolies in training shoe and denim production respectively – renders brands more reliant on full package service (Kumar, 2020, 89-143). As manufacturers have taken greater control of the supply chain in recent years the balance of power between (mostly Western) brands and manufacturers (often based in Asia) has started to shift, and, indeed, such manufacturers have also started producing more own-brand goods.

Transforming our relationship to garments, our behavior as consumers – and valuing garments more highly as a result – may also imply valuing the people who make them and the processes by which they are made. Recent shifts in branding, fashion and lifestyle industries seem to point towards a demand for greater transparency and a prioritization of ethics amongst consumers. But we cannot rely on technology alone to achieve these goals. Techno-utopianism of various stripes has been proven wrong on numerous occasions: "the economic possibilities for our grandchildren" predicted by John Maynard Keynes in 1930 (Keynes 2010 [1930], 321-322) have conspicuously failed to arrive; the internet as imagined in the 1990s as an inherently democratic and collaborative space has been revealed to be a fantasy; while Jeff Bezos's Amazon has alienated and exploited workers just as efficiently as the traditional sweatshop. Moreover, slow food, slow fashion, and buying a few carefully chosen pieces each season all sounds very lovely, but it remains out of reach of many consumers (and is therefore easily caricatured as, for example, the practice of upper-middle-class hippies pretending to be Provençale peasants).

Indeed, the sustainability researcher Kate Fletcher (2010), writing a decade ago, addressed the emergence of "slow fashion" discourses in which durable, carefully crafted, and classic pieces were promoted as a potential solution to overconsumption. Cautioning against simplistic solutions, she argued that – rather than primarily being an issue of tempo – fast fashion's problems instead related to volume. In other words, the notionally time-based nature of fast fashion belies a logic of multiplication and growth in the volume of products produced and in the size and profitability of the clothing sector (Fletcher 2010, 261-262). While buying less frequently and wearing clothes for longer is certainly positive, the potential limitations of slow fashion as an idea is that while the speed of the trend cycle might abate, at least for some, the market incentives to sell ever more remain.

Nevertheless, the widespread recognition that the fashion industry is too prolific and that the volume of products is unsustainable – not only for the globe and environment, but also for an oversaturated marketplace – has come to the fore in recent years. As industry oracle the *Business of Fashion* has repeatedly warned, the current way of doing things is no longer

working. This current historical moment therefore represents an opportunity for significant systemic change (Baskin 2019; BOF, 2019; Bloomburg, 2019; Ahmed and Berg, 2020; Chen, 2020).

I have already alluded to the shift away from the dominance of neo-classical and neo-liberal economic paradigms that remained hegemonic throughout the 1990s and up until the 2008 financial collapse. But, this shift has a longer history, particularly in development economics. In the early 2000s economists such as Amartya Sen (2001) and Ha-Joon Chang (2002) were using their empirical work to argue for a fundamental rethink of global trade and the relationship between the economy and the state. For example, in the aftermath of the failed 2003 World Trade Organization negotiations in Cancún, Chang explored why developing countries had rejected the demands of Western nations to remove the industrial tariffs that protected their fledgling industries. He explained how the then economic orthodoxy of industrially developed countries assumed that decreasing barriers to trade would inevitably benefit developed and developing states alike. However, as Chang argues, this self-serving assumption ignored how formerly economically under-developed countries have successfully industrialized over the course of history: namely, by protecting and building nascent industries through close partnerships between government and private enterprise – with generous loans and tariff protections thrown into the mix. Such measures as, Chang demonstrates, enable the strategic development of skills and infrastructure that allow economies to move from low value-added products to much more sophisticated high value-added exports (in the process massively increasing productivity and living standards). As Chang suggests:

> Today's developed countries were well aware of the unsuitability of free-trade economics at the early stage of economic development: virtually all of them, starting from Britain in the eighteenth century and the United States in the nineteenth century down to South Korea and Taiwan in the late twentieth century, protected and nurtured their industries when they were starting their industrialization. (Chang 2003, 11)

Chang's 2002 book *Kicking Away the Ladder* powerfully makes the case that development economics needs to learn from those nations that have successfully developed from low to high income, high productivity[10] economies (rather than relying on abstract neo-classical models). But this analysis can be extended to explore the challenges of industrial and so called "post-industrial" economies and the global economy more generally.

The major challenges of unsustainable production and consumption are not going to be magically solved either by the market or by technology alone. Instead, savvy governments will need to protect, nurture and develop new modes of manufacture and distribution of garments as a strategic priority. As we have seen in this article, the development of potentially revolutionary fiber, cloth, and garment technologies and modes of distribution is already underway – protecting, developing, and nurturing these innovations has the capacity to pay dividends economically, in terms of social justice, and in terms of sustainability. But to achieve the scale and transformation of the garment sector that is required, governments will need to dispense with some of the economic orthodoxies that have shaped attitudes to global trade up until very recently. Pigovian taxation that accounts for negative externalities, as well as protection of nascent industries and sectors will surely be required.

As Sandy Black has argued (2010, 252-260) the complexity of global supply chains along with the prevalence of subcontracting, means that it is very difficult to know exactly where

and by whom one's clothes are made. This lack of transparency not only reflects the intricate interconnections of ultra-globalized contemporary late capitalism, but also the power imbalances between makers and buyers. Brands based in wealthy nations demand garments be produced at prices that cannot be delivered safely or without exploitation, while opaque supply chains provide a veneer of plausible deniability enabling clothing companies to claim that they bear no responsibility for this exploitation (since they do not own or operate the factories and workshops in question). All this is well known and widely understood by all but the most willfully obtuse consumers – especially after endless documentaries have repeatedly "exposed" what anyone buying a £2.00 T-shirt must surely have already intuited (Morgan, 2015; Onono 2019). More optimistically, Ashok Kumar (2020) has argued that a gradual shift towards oligopolistic manufacturing in developing economies is disrupting the power balance between brands and vendors in favour of the latter. In this context, workers may able to win concessions more readily using strike action as capital (having invested in large fixed cost facilities) becomes less mobile.

Industry organizations such as the Ethical Trading Initiative (ETI) – which seek to improve pay conditions and environmental standards in the sector – provide some welcome pledges, aims as well as some enforcement actions. Many ethical and environmentally based labels also make use of organic and/or Fair Trade certification initiatives especially in their sourcing of fabrics, yarns and fibers (Black 2010; Black and Anderson 2010). These schemes enable consumers to have greater confidence in products' ethical credentials. But the inability of discretionary approaches to challenge the endemic exploitation and over-production of contemporary garment manufacture *at scale* is indicative of the limitations of voluntary schemes and the necessity of broader systemic change (especially governmental engagement in the industry and trade union organization).

Demands on retailers to account for the entire production cycle of the garment have amplified as disquiet surrounding exploitation abroad and at home has gathered pace. It is my sense that companies like Puma, Kering, and even H&M – all of whom have made significant changes to their approach to contracting, traceability, and carbon costing in recent years – are doing so neither primarily for publicity nor for altruistic reasons, but because they predict a change in the policy environment both locally and globally. Let us hope they are right.

In order to design policy initiatives that will effectively shift incentives away from exploitative employment practices and environmentally unsound modes of manufacture it is necessary to understand the supply chain and the impact of each process along it. "The complexity of textile and fashion product value chains has served as a convenient excuse for inaction on the part of legislators" argues Brooke (2020 [personal interview]). But the food sector, in which barcode technologies are used to track raw materials as they progress through to finished products, demonstrates that supply chains can be rendered more transparent, and therefore accurate data on each process can be gathered. Moreover, fashion companies like Kering have pioneered techniques for tracking each stage of the value chain in order to measure the carbon intensity of each process and material used with a high degree of accuracy.[11] While some fashion brands have recently begun to use QR codes to improve the traceability of their products (Huber 2021).

Perhaps then, the first step to developing Pigovian taxes to target and 'cost in' negative externalities (as well as schemes for subsidising or providing cheap capital to innovative businesses) is to introduce legislation obliging companies to account for each step in the

value chain. Indeed, this may have a positive impact in and of itself by making it harder to hide exploitative practices.

The case for subsidising or otherwise supporting more environmentally friendly production of fibres, textiles and garments is compelling. But developed economies must also provide support for industrialising nations for whom garment production is a key strategic sector, in this way preventing the dumping of subsidised goods on poor countries and concomitant suppression of domestic production. The real world impacts of targets, state support, and fiscal measures must also be carefully monitored to prevent the introduction of unintended perverse incentives. All of this represents a significant departure from the *laissez faire* approach that has pertained to the textile, fashion and garment sectors in recent decades. Difficult though the design of fiscal and legislative instruments and inspection regimes may be, given the size of the sector, its enormous carbon footprint, and the number of workers engaged in cloth and garment production, even relatively modest improvements could yield a very significant positive impact.

Concluding thoughts

To this extent, what has been missing from debates surrounding fashion industry ethics, at least until recently, was a discussion of how technological developments and consumer behavior are shaped by a broader public policy context, by national and international regulation and by industrial strategy. The aim of this article is to stimulate these wider discussions both through an exploration of a variety of exciting and disruptive manufacturing technologies and by engaging with economic discourses. Prosumer technologies – which allow the consumer to customize garments to fit their body, needs and aesthetic desires – have the potential to challenge the cycle of over-production and over-consumption that currently characterizes fashion. But I argue that without shifting the market incentives, these new approaches may exert only a gradual positive impact (or, in some cases could even make things even worse). The ways in which the fashion market is currently organized keep the social and environmental costs of garment production off the price tag paid by the consumer. Governments, aid agencies, trade unions and environmental organizations may attempt to mop up pollution or drive up labor standards, but the dynamic of the market – as it is currently organized – mitigates against these attempts and acts, in some ways, to subsidize malpractice. The efficacy of costing-in negative externalities in the tobacco and increasingly in the food and drink industries has been well attested (Harrison et al. 2011): making producers and/or consumers pay for the negative health-outcomes associated with products has been shown to change the kinds of products offered by manufacturers, and to alter consumer behavior. Combining this approach with a broader set of protections for fledgling sustainable, ethical and technologically innovative fashion brands has the potential to reshape both the industry and the way in which consumers relate to their garments.

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[1] The government response to the audit committee ignores most of the substantive recommendations

raised, and instead reiterates that voluntary schemes to encourage sustainability (SCAP) already exist, that enforcement agencies have the right to challenge illegally low pay, and that young people should be educated to value longer lasting clothes. The fact that these existing approaches are failing to achieve their stated outcomes is not addressed. There is a more meaningful engagement with issues of modern slavery, but the solutions suggested remain rather vague and deferred.

[2] The "sharing economy" has come to describe the ways in which individuals and companies (such as Airbnb, Uber, Spotify, Netflix or Zipcar) monetize assets like apartments, spare rooms, music, films or cars not by selling these assets, but by leasing them (or by providing subscription access to them) typically via Internet based technologies. Increasingly fashion concerns are also moving into this sector: the American company "Rent the Runway" was founded in 2007, and a number of other providers such as "For Days" have emerged in recent years. Of course, renting garments is not a completely new idea – eveningwear and party costumes have long been offered in this way – but the hope is that by allowing customers to frequently change their style (and to access higher-end clothing) fashion rental companies could provide an answer to the wastefulness of fast fashion: we shall see. A connected though distinct phenomenon is the growing popularity and modish nature of online second hand marketplaces such as Depop which similarly allow consumers to rapidly cycle through styles.

[3] Friedrich Hayek understood markets as sophisticated information systems that communicate the prices of goods and labour, in his view, more effectively and efficiently than governments or planners are able to do. He argued, "in a system where the knowledge of the relevant facts is dispersed among many people prices can act to coördinate the separate actions of different people" (Hayek, 1945: 526). His distrust of central planning was combined with a broader political anxiety that the involvement of the nation state in the economy would lead to authoritarianism (Hayek, 1944). In the immediate post war context these ideas were unfashionable: state intervention was widely accepted as necessary to rebuild countries and economies shattered by conflict. But Hayekian precepts returned to prominence on the political right during the 1970s and were used to argue for privatisation, the shrinking of the welfare state, and the toleration of much higher levels of economic inequality. As I have argued in this article, while markets remain very useful mechanisms for distributing products and services, where they are left to function without oversight and regulation, collective goods (like the maintenance of the environment) are severely compromised, and power is concentrated in the hands of too few people with dangerous consequences.

[4] The economist Arthur Pigou developed and formalised the concept of the "externality" (sometimes also known as a "spillover effect"). Externalities are side effects of an economic activity caused, but not paid for by, the producer or economic actor in question: for instance, factory pollution is a negative externality. In *The Economics of Welfare* ([1920] 2013) Pigou argued that governments should discourage economic activities that have a negative impact on the wider community using taxation, while subsidies should be used to encourage those activities that benefit society. These ideas formed part of a Pigou's broader discussion of how the economy can be managed to maximise the wellbeing and economic welfare of the population in general.

[5]" Straight knives" are hand-held band-saws used for cutting through multiple layers of cloth and, therefore, allowing many garments to be cut out in one go, both these and hand-held rotary knives are nineteenth century inventions that speed up ready-to-wear production.

[6] Ready-to-wear garments were being produced by the late seventeenth century in England – originally to clothe an expanding military, and subsequently for the production of low-cost smocks and workwear (off-the-peg garments may perhaps have been in use a little earlier in urban centres of the Low Countries). By the early nineteenth century, these methods of manufacture were extended to produce more fashion-oriented garments such as waistcoats and breeches (Godley 1997, 5). Such methods of manufacture were to expand rapidly in the nineteenth and early twentieth centuries first in menswear and subsequently in womenswear. Nevertheless, since fashion products are subject to rapid change, many garment factories lack the highly standardised production line systems of other more

mechanised sectors, as machinists need to be able to turn their hands to a variety of operations and processes and be able to handle a variety of fabrics.

[7] The American company Gerber Technologies was a pioneer of computer-based pattern making systems (the first of which was released onto the market in 1988). 3D imaging and prototyping software has taken a longer time to be absorbed into fashion design and manufacture. By 1990 3D software was already widely used in the engineering and aeronautical industries, but these technologies had to undergo significant development to be applicable to the garment industry (Gerbertechnology.com 2018).

[8] A number of competitor programmes including V-Stitcher by Browzwear, 3D Virtual Prototyping and 3D Suite, by Optitex; and Tuka3D by Tukatech are also widely used (Baytar and Ashdown 2015).

[9] Sabot is the French for clog, and thus a saboteur is an industrial worker who wears clogs while engaged in activism or violent struggle, or who employs their clogs in said struggle. The precise etymology of the word is disputed, but it is generally accepted to relate to French weavers threatened by the advent of the Jacquard loom.

[10] It is sometimes mistakenly thought that 'increasing productivity' must necessarily equate to producing more stuff. This is wrong. In fact, increased productivity in economic terms is about producing more 'value' from the same or fewer resources.

[11] One method to measuring the impact of value chains (and indeed of products once they enter into the marketplace) is Life Cycle Assessment or LCA. A flaw in the way that LCAs are sometimes used is that they often measure the average impact of a kilogramme of beef of tonne of steel (trade associations are particularly apt to employ LCAs in this way). This is problematic, because the carbon intensity of a tonne of steel produced using the cleanest technologies available may well be radically different from that produced using the dirtiest. This flattening out and averaging of data can compromise the accuracy of policy making, and therefore value chain and LCA metrics are best disaggregated (Brooke, 2020 [personal interview]).