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Exporting out of China or out of Africa?

Automation versus Relocation in the Global Clothing Industry

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support backward integration and also regional integration as special provisions often allow for the use of regionally produced inputs. Restrictive ROOs may however hinder market access in particular for low-income countries, given the capital- and scale-intensive nature of textile production that makes establishing competitive textile sectors challenging.

Although trade preferences are crucial in the clothing sector, they are eroding due to generally decreasing tariffs through trade negotiations at different levels and access to tariff preferences for more countries. In particular at the bilateral level, the United States and the European Union are negotiating preferential trade agreements with an increasing number of countries, which makes preferential market access less valuable; but some countries may also lose beneficiary status as they graduate out of the LDC group. This might be the case for Bangladesh which is likely to lose LDC status within the next five years. Preferential market access relying on unilateral market access stipulations such as EBA for the European Union and AGOA for the United States might also be changed or even stopped unilaterally by importing countries. This is a particular concern for AGOA that is only installed for a limited time period, although so far it has been repeatedly renewed.

For Sub-Saharan African countries, preferential market access to the European Union and the United States is of crucial importance. This issue will be taken up again in Section 5.

4 Chinese textiles and clothing manufacturing: really moving to Africa?

So far, we have reviewed current and prospective technological trends in the clothing industry (Section 2) as well as main drivers of the industry's competitiveness, which are shaping its international division of labour (Section 3). Against this backdrop, in Section 4 we move to the perspective of Chinese clothing manufacturers. How are they likely to respond to new technological scenarios and relocation options? A brief profile of China's textiles and clothing industry and its recent development is followed by a discussion of the coping strategies of clothing companies faced with rapidly rising wages at home (subsection 4.1). The findings of available studies on this question are complemented by three case studies at firm level (subsection 4.2).

4.1 Coping with rising wages: recent trends in China's textiles and clothing industry

Globally, China is the largest manufacturer of textiles and garments with large-scale production capability, strong export competitiveness and comprehensive value chains. As shown in Table 5, employment in the textiles and the clothing industry, respectively, is almost identical, reaching a combined level of close to eight million. At the same time, the textiles industry has a higher number of firms and a sales volume of about 1.7 times that in the clothing sector. While privately-owned firms clearly dominate the industry (relatively stronger for textiles than for garments), a comparatively high share of foreign-owned firms is noteworthy for the garment sector where the 20 per cent of foreign-owned firms generate almost one-third of employment and more than one-quarter of sales.

In 2017, Chinese exports of textiles and clothing reached USD 110 billion and USD 158 billion, respectively, which translates into global export shares of 37 per cent and 34 per cent (WTO database). In terms of firm size, the sector covers the full spectrum from large

companies with export levels above USD 50 million, which contribute 30 per cent of all exports, to SME (small and medium enterprise) clusters accounting for over 40 per cent of industrial revenue (Zhang, 2018; CCCT [China Chamber of Commerce for Import and Export of Textile and Apparel], 2018).

Table 5: Contribution of state-owned enterprises (SOEs), privately owned Chinese and foreign firms in China's textiles and clothing industries (2017)

Textiles industry				Clothing industry		
Number of firms	18,726	SOEs	0.9%	14,600	SOEs	1.3%
		Private Chinese firms	70.6%		Private Chinese firms	58.5%
		Foreign firms	11.4%		Foreign firms	19.9%
Employment	3.91 million	SOEs	3.3%	3.87 million	SOEs	2.2%
		Private Chinese firms	53.9%		Private Chinese firms	44.4%
		Foreign firms	16.6%		Foreign firms	31.7%
Sales volume	3,611 billion RMB	SOEs	2.3%	2,089 billion RMB	SOEs	1.0%
		Private Chinese firms	54.6%		Private Chinese firms	47.5%
		Foreign firms	13.4%		Foreign firms	26.1%

Note: Data based on firms with annual sales over 20 million RMB.

Source: National Bureau of Statistics of China, 2018

A recent survey undertaken by the Overseas Development Institute in the United Kingdom and the Peking University Institute of New Structural Economics (Xu, Gelb, Li, & Zhao, 2017) confirms that rising labour costs (mostly due to rising wages but also to increases in non-wage labour costs) are perceived as the most serious challenge by firms currently operating in China's Eastern provinces. More specifically, this was also the response of close to 50 per cent of highly export-oriented light manufacturing firms (home appliances, textiles, clothing, footwear and toys) in the Yangtze and Pearl River Deltas. From a survey regularly undertaken for more than 200 Pearl River Delta firms (with slightly more than 50 per cent active in electronics manufacturing and the remainder in clothing, plastics, toys and furniture), broadly similar results emerge and are not surprising, given that wages on average account for 22 per cent of total costs (Standard Chartered Bank, 2017).

In principle, there are two basic options in terms of firm-level coping strategies vis-à-vis rising wages: either relocating to more cost-competitive locations, or upgrading technology with a view to increasing productivity. The former may imply moving west to low-cost provinces within China or moving production to other countries. For such foreign investment, low-cost Asian countries have been the customary choice while various sub-

Saharan African countries have recently appeared on the radar screen and broadened the options for new investment locations. What does the empirical evidence tell us on these coping strategies?

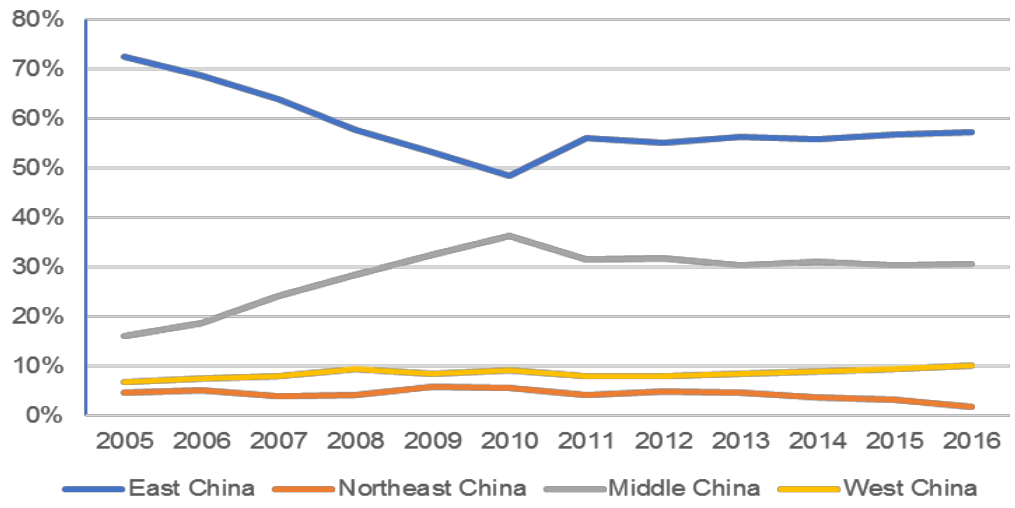
In 2009, the Textile Industry Promotion Plan put forward by the Chinese Ministry of Industry and Information Technology (MIIT) encouraged the regions in Middle and West China to actively seek industrial relocation from East China.[25] This policy acknowledged a relocation trend already visible in the preceding years (see Figure 1). From 2005 to 2010, the textiles and clothing investments in East China sharply declined from almost three-quarters to less than one-half (from 72.6 to 48.6 per cent) of the national total. In contrast, the share of Middle China more than doubled (from 16 to 36.4 per cent). However, after 2010 (with wages also gradually rising in Western Provinces), the westward relocation slowed down and regional investment shares have remained relatively stable since 2011.

As confirmed in Table 6, the gradual westward movement of the textiles and clothing industry has not fundamentally challenged the dominance of the Eastern region. The latter still accounts for more than three-quarters of all firms (76 per cent) and generates the lion's share of exports (83 per cent). To date, it still hosts the headquarters, technology and design centres of the largest companies as well as the vast majority of industrial clusters in the sector. In 2017, 164 out of 209 clusters identified by the China National Textile and Apparel Council (CNTAC) were located in East China with 75 per cent of the total located in the five coastal provinces alone (CNTAC [China National Textile and Apparel Council], 2018). In essence, a gradual relocation to the Western provinces has taken place, which however has lost some of its earlier momentum in recent years (see Figure 1).[26]

25 East China includes 10 provinces: Zhejiang, Jiangsu, Shanghai, Fujian, Guangdong, Shandong, Beijing, Tianjin, Hebei and Hainan. Middle China includes six provinces: Anhui, Jiangxi, Henan, Hunan, Hubei and Shanxi. West China includes 12 provinces: Guangxi, Chongqing, Sichuan, Gansu, Qinghai, Tibet, Ningxia, Inner Mongolia, Guizhou, Xinjiang, Yunnan and Shaanxi. Northeast China includes three provinces: Heilongjiang, Jilin and Liaoning.

26 Putting this picture into perspective, the textiles and clothing sector's investments undertaken in East China in 2017 alone (USD 117 billion, based on CNTAC online data) were about 12 times higher than its total FDI stock accumulated over the 2003-2018 period.

Figure 1: Investment in fixed assets of China's textiles and garment industries (2005-2016)



Source: CNTAC, 2018; all rights reserved, used with permission

Table 6: Regional distribution of China's textile and clothing industries (2015)

Region	Firms	Revenue	Profit	Export value
East China	76.0%	75.0%	73.2%	83.2%
Middle China	17.5%	18.1%	19.7%	11.7%
West China	4.2%	5.1%	6.0%	2.6%
Northeast China	2.3%	1.8%	1.1%	2.5%

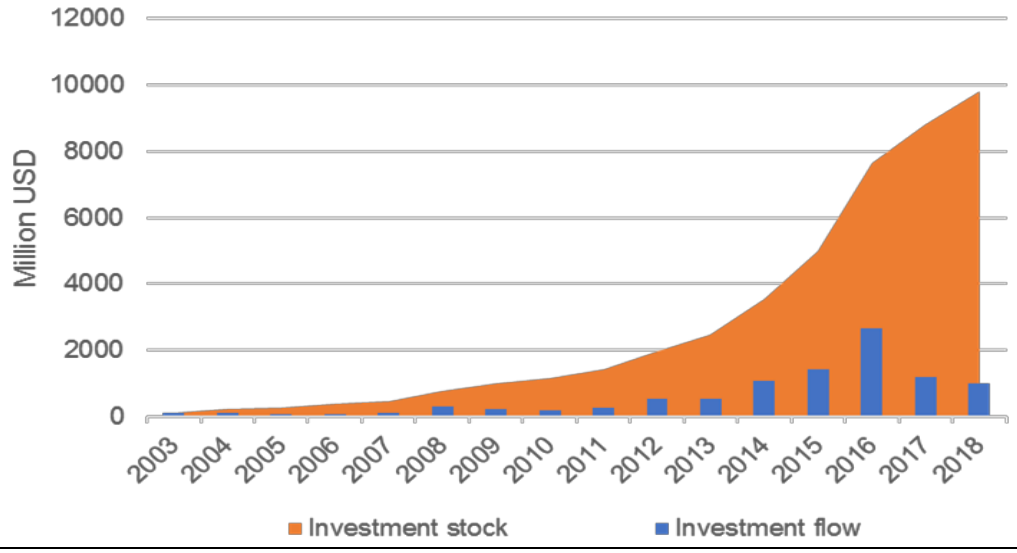
Source: CNTAC, 2018

Let us next take a look at foreign investments: In 2012, the Chinese government (through MIIT) adopted The Twelfth Textile Industry Development Plan, which officially called for a "going-out strategy" for this sector and encouraged the leading firms to build up overseas operations. In the following years, China's textiles and clothing industry became one of the largest sources of outward investment flows (see Figure 2). The sector's total FDI had reached a stock of close to USD 10 billion, with annual outflows peaking in 2016 at USD 2.7 billion before declining to less than USD 1 billion in 2018. In sectoral terms (figures for 2017), most of the outward investment occurred in the textiles industry (63 per cent) followed by clothing manufacturing (26 per cent) and chemical fibres (10 per cent). In regional terms, Southeast Asian countries were the main investment destinations accounting for more than half (56 per cent) of the accumulated FDI stock from 2003 to 2014 (Fan & Liu, 2018). Between 2013 and 2018, China's textiles and clothing FDI in Vietnam, Cambodia, Myanmar, Laos and Thailand together reached USD 1,770 million (China Garment, 2019). This trend is corroborated by Chen and Li (forthcoming) who analysed trade data. Their study shows that China's clothing exports started to decline around 2013 whereas exports from neighbouring Asian countries received an enormous boost at exactly

the same date, indicating a shift of production. Relative to the peak value observed in 2013, the authors estimate that about 25-35 per cent of clothing manufacturing (in terms of the value of exports) has shifted from China to other countries, mainly Cambodia, Vietnam, Myanmar and Bangladesh. For footwear, this figure is around 15 per cent (Chen & Li, forthcoming).

In recent years, Africa has gained in importance as a new investment location. China's textiles and clothing FDI in Africa increased from USD 19 million in 2015 to a peak of USD 110 million in 2017 and then fell to USD 64 million in 2018. Ethiopia and Egypt were the two largest recipients, with the investment stocks of USD 185 million and USD 147 million respectively in 2018 (Xu, 2019a, 2019b). However, the African region is still trailing far behind Southeast Asia.

Figure 2: Foreign direct investment of Chinese textiles and clothing industries (2003-2018)



Source: MOFCOM, 2019 and the authors' calculations based on various CNTAC news, all rights reserved, used with permission

In this context, it is noteworthy that wage cost differentials are obviously not the main determinant of relocation strategies as wage costs alone would have called for an even stronger trend to move production to locations outside China: While wage levels in Vietnam, Bangladesh and Ethiopia are at roughly one-half, one-third and one-tenth of those in China respectively (see Table 3), within China in 2014 wages were only 21 per cent lower in Central Provinces compared to Eastern Provinces.[27] Again, this indicates the importance of other relocation drivers as well as the generally high thresholds for investments in "unknown territory". However, according to the Standard Chartered Bank (2017), for the first time in 2017, more firms were considering to relocate overseas (17 per cent) than to move inland to China's Western provinces (10 per cent).

Finally, what is the evidence on technological innovation as a coping strategy? In a recent survey of export-oriented light manufacturing firms in the Yangtze and Pearl River Deltas, close to three-quarters (73 per cent) indicated that technology upgrading was an essential

27 Calculated from Gelb & Calabrese (2017, Table 5) for clothing and footwear industries in 2014.

part of their response strategy while only 7 per cent had engaged in relocation. Within the small number of firms engaging in production relocation, only very few (3 per cent of the total surveyed) stated that a move to other countries was their top priority. However, the adoption of relocation as a coping strategy was positively correlated with labour-intensity thus making it more attractive for garment and in particular footwear firms (Wang, Xia, & Xu, 2019; Xu, Gelb, Li, & Zhao, 2017). Similarly, there is evidence that high-end manufacturers preferred to respond by investing into automation whereas low-end manufacturers exhibited a higher preference for relocating production (Standard Chartered Bank, 2017)

Hence, in a stylised perspective, a distinct hierarchy of coping strategies can be detected. Under pressure from rapidly rising wages, investing in Western China to seek cheap labour was a popular choice among Chinese light manufacturing firms especially before 2010. However, as the wage cost differentials between the various Chinese regions started to narrow down and the industrial support infrastructure in Western regions started to develop more slowly than expected, many firms in Eastern China turned to technological innovation. This may imply optimisation and efficiency enhancements of existing processes and/or the introduction of new processes based on digital automation. Only a relatively small number of firms engaged proactively in identifying and implementing overseas investments and if so, preferred the beaten path of moving to neighbouring Asian countries over venturing into Sub-Saharan African countries. The latter are not the natural choice but still go against the grain making it necessary to overcome several layers of resistance. So far, the frequent claims of Africa being a magnet for Chinese export-oriented light manufacturing firms do not stand up to scrutiny.

This may be partly explained by the fact that the considerable business risks accompanying a cost-driven relocation of production to African countries create a collective action problem. Individual firms often shy away from leaving China because this implies a delinking from existing business networks and supply chains. Production is mostly embedded in larger sector-specific clusters of firms, which collectively serve as component suppliers, assemblers or subcontractors for larger lead firms and thus benefit from advantages of proximity. Hence, there is a strong economic case for entire clusters, or at least interconnected groups of companies, moving to new locations thus de-risking investments for individual firms. Such coordinated relocation would most likely be driven by big lead firms obliging their main suppliers to follow them to a new location. This is a fairly common pattern, for instance in the automotive and electronics industries (Altenburg & Meyer-Stamer, 1999), and it might be a game changer for African locations. While some large fashion companies are already pushing their suppliers to move to Africa in order to become more independent from China, such developments are still at an incipient stage (see also the case of the Dalang sweater cluster below and Box 5 on the evidence of “follow sourcing” in Ethiopia).

4.2 Three case studies: Shenzhou International Group, Esquel Group and Dalang sweater cluster

The existing surveys show that few firms consider relocating abroad, and even fewer moving to Africa. Yet, these surveys do not tell much about the determinants of such decisions. It makes a big difference, for example, whether companies remain in China

because they are closely networked with neighbouring firms or because they cannot assess country risks abroad. Also, the surveys leave open how strategic considerations vary across subsectors with different labour requirements. For this reason, we conducted in-depth firm-level interviews in China to better understand the underlying determinants of firms' strategies. The case studies presented below provide a summary of key findings from interviews carried out between November 2018 and March 2019 (see Annex Table A1). To ensure a degree of diversity, interviews with two large internationally operating companies were complemented by interviews with various stakeholders in one of China's largest industrial clusters composed mostly of SMEs. The profiles of the selected cases are summarised in Table 7.

Table 7: Case study profiles

Case	Type	Ownership	Market	Products	Main characteristics
Shenzhou International Group	Large-scale firm	Listed on Hong Kong Stock Exchange	Domestic and overseas	From fabrics to knitwear	One of the largest knitwear producers and exporters globally with extensive industrial relocation experience
Esquel Group	Large-scale firm	One family from Hong Kong (SAR)	Domestic and overseas	From cotton seeds to shirts	One of the largest cotton-shirt makers and exporters globally with extensive digital automation experience and worldwide operations
Dalang Sweater Cluster	Industrial cluster	Private entrepreneurs from Mainland China	Domestic and overseas	Woollen sweaters	One of China's largest export-oriented sweater clusters with successful automation and E-business

Source: Authors

Case 1: Shenzhou International Group[28]

Established in 1989 in Ningbo City (Zhejiang Province), Shenzhou International Group is China's largest export-oriented garment firm and one of the largest vertically-integrated knitwear manufacturers in the world. The Group was listed on the Hong Kong Stock Exchange in 2005 and assessed as one of the most profitable firms in its industry in recent years.[29] It is principally engaged in the original equipment manufacturing and original design manufacturing of high-end knitwear. The Group is a top supplier for major international brands including Nike, Uniqlo, Adidas and Puma. In 2018, the company had 82,700 employees, produced about 400 million pieces of knitwear and close to 190,000 tons

28 Unless stated otherwise, data for the three cases are derived from company publications and interviews.

29 In 2018, it reached a 21.4 per cent net profit margin, namely more than 3.5 times the average level of Chinese firms in this field (Shenzhou International's profit rate, 2019).

of fabrics, with total sales of 21 billion RMB (approximately EUR 2.7 billion) (China 30 per cent; Europe 18 per cent; United States and Japan 16 per cent each).

From 2005 onwards, Shenzhou rapidly expanded its operations in parallel both within China and in other Asian countries. In China, this included garment factories in Anhui Province (2008) and Zhejiang Province (2009). As early as 2005 a first foreign garment factory was established in Cambodia while in 2019 construction for another downstream garment factory began, which is expected to commence production in mid-2020. In parallel, production in Vietnam gained momentum between 2014 and 2018 with a number of fabric and garment factory investments. By 2018, the Group's regional distribution of employment and non-current assets, respectively, was 63 per cent and 54 per cent in China; 22 per cent and 41 per cent in Vietnam; and 15 per cent and 3 per cent in Cambodia.

According to Shenzhou's management, decisions on new production locations were determined by three main factors.

- The first determinant was responsiveness to the demands of strategic business partners on both the demand and the supply side. On the one hand, major global buyers put pressure on Shenzhou as a supplier to meet their requirements in terms of both the volume and the in-time delivery of products. On the other hand, the Shenzhou Group had to ensure synergies between its own production facilities and its main suppliers of yarn with a view to reaping cost, logistics and time benefits of co-location. This was one of several reasons to favour Asian over African countries when investing in new factories.

- Secondly, in view of the Group's massive resource requirements,[30] great importance was attached to the availability and prices of labour, land, water and electricity within stable conditions. Here again, Asian investment locations were prioritised over African alternatives. A premium was placed on the generally higher productivity, clarity of land ownership, stability of energy supply, and superior infrastructure.

- Thirdly, policy incentives related to taxes, costs of finance, tariffs and administrative efficiency played an important role. Such incentives were decisive for both domestic and foreign locations. For instance, the 2008 investment in Anhui Province was largely due to the preferential treatment offered in Wangjiang Textile Industry Park. Similarly, it was a sizable policy dividend that determined the 2018 investment in Vietnam despite a productivity disadvantage of 40-50 per cent compared to China. Moreover, the investments in Cambodia and Vietnam have to be seen in the broader perspective of their integration in the One Belt and One Road Initiative (BRI). While some African countries have also joined the BRI, Shenzhou had limited confidence in their policy implementation capabilities.

At the same time, the strategic importance of Shenzhou's original production base in Ningbo has remained undisputed. Employment in Ningbo has been kept stable at about 40,000, yet production capabilities have continuously grown in recent years. Ningbo's position as

30 In 2018, the Shenzhou Group consumed 586 million kWh of electricity and 32 million tons of water while its production facilities covered over 5.3 million m^2 of land and 3.3 million m^2 of factory floor. At the same time, staff costs of its more than 82,000 employees accounted for roughly one-quarter of turnover.

Shenzhou's headquarters and R&D centre is unchallenged for communicating with strategic clients, designing product styles, creating new fabrics, research on technological innovation potentials, improving corporate management and manufacturing higher-end products. Moreover, the Ningbo base is indispensable for serving the rapidly growing domestic market [31] and ensuring fast delivery and flexible responses to changing consumer preferences. This is underpinned by state-of-the-art IoT (Internet of Things)-based, real-time data and logistics management in Shenzhou's central warehouse. The high-rise warehouse can store 15,000 tons of fabrics with a daily cargo handling capacity of 1,200 tons. Each shelf and each piece of cloth are labelled with a barcode, which is permanently scanned by automated guide vehicles for transportation. The planning department can accurately monitor how many fabrics are stored and when they should be delivered, so as to achieve zero fabric inventory. This new digitised information management and the concomitant process optimisation have enabled Shenzhou to cut down delivery time to 15 days, no matter if the order amounts to 4,000 or 2 million pieces of garment.

Further productivity-enhancing measures include the introduction of a modular production approach, which was also pioneered at Ningbo headquarters before being disseminated and applied in all Shenzhou factories worldwide. The modularisation of production steps had the greatest impact in labour- and skill-intensive sewing operations where it led to reduced training costs, higher quality consistency, and improved productivity.[32] While the adoption of modularity deskills certain processes, it also creates new demands in areas such as coordination and innovation expertise, process standardisation, module design and template manufacturing for garment production.

Finally, the company introduced a wide range of automatic "intelligent" machines, such as digital printers and automated guided vehicles. Specifically, Textalk digital printers perform 10 times faster than traditional printers, which highly increased Shenzhou's production flexibility and productivity. Similarly, automated guided vehicles for fabrics supply in the workshops not only replace manual porters, but also increase the accuracy rate to close to 100 per cent thus avoiding waste and increasing efficiency. Entirely new automated machinery is at times introduced first in new overseas operations, mostly in Vietnam, to increase productivity. In contrast, at headquarters, Shenzhou prefers to replace conventional machinery gradually, with a view to extending the latter's economic lifetime and avoiding abrupt negative effects on employment. For instance, this applies to digital printers and automated guided vehicles.

In essence, the Shenzhou Group demonstrates how closely intertwined automation and relocation processes proceed and how a web of production locations both in China and abroad is strategically built up to create value chains that can simultaneously serve the domestic and foreign markets. It also reveals a distinct preference of Asian over African locations. In the words of Ma Renhe, Vice President of Shenzhou Group:

> China has unique advantages of technological experience and industrial systems in the textiles and garment industry. If we compare Shenzhou's production system to

31 From 2008 to 2018, the Shenzhou Group's share of domestic sales increased from 19 to 30 per cent.

32 For example, traditionally, new workers needed at least three months of training to produce shirt pockets at a stable output volume of 20 pieces/day. However, with the application of modular templates, the workers were able to produce at least 200 pockets per day after a few hours of training.

> a human body, we will maintain the head within China for R&D and system management and extend the limbs into other locations wherever we find advantages for manufacturing. The key is to keep our production system well integrated and highly efficient within complete industrial chains. So far, we think the Southeast Asian countries, especially Cambodia and Vietnam, are more suitable than African countries for our industries. (Ma Renhe, Vice President of Shenzhou Group)

Case 2: Esquel Group

The Esquel Group is one of the largest cotton-shirt makers and exporters in the world. Established in 1978 by a Hong Kong entrepreneur, Esquel is a fully vertically-integrated firm with operations ranging from cotton seed research to product branding and retailing. Since 2014, it has been continuously recognised by the Foshan Intellectual Property Association as a leading holder of industrial patents. In 2018, it had more than 55,000 employees producing 100 million pieces of shirts with a sales value of USD 1.3 billion (approximately EUR 165 million) (regional sales breakdown: United States 39 per cent; Europe 27 per cent; China 15 per cent; and Japan 5 per cent). It supplies products to the largest global fashion brands, including Ralph Lauren, Tommy Hilfiger, Hugo Boss, Muji and Anta, and in addition caters to its own brands (PYE and DETERMINANT).

Esquel already started its global outreach in 1978, when it acquired garment companies in Malaysia and Mauritius. This was followed during the 1980s and 1990s by setting up more garment factories in Malaysia, Sri Lanka and other countries. In parallel, the first mainland-Chinese Esquel company in Foshan City, Guangdong Province was established in 1988 with further garment factories in Foshan, Ningbo and Changzhou City in Jiangsu Province following in the 1990s. Since 1995, Esquel has continuously invested in Xinjiang for seed research, cotton farming, ginning and spinning. During the 2010s, garment production expanded to additional locations both inside and outside China. Esquel's global production footprint currently covers Coastal and Western provinces in China, various Southeast Asian countries (Malaysia, Sri Lanka, Vietnam) and Mauritius. In choosing overseas locations, trade policies were a major determinant, initially in response to the availability of quotas under the Multifibre Arrangement or to benefit from tariff preferences under various trade agreements, such as AGOA. Investments in Vietnam are to tap into the country's competitive labour force, while the newest investments into spinning and garment making in Guilin are aimed at pursuing a new development model that demonstrates environmental and social sustainability.

The evolution of the Esquel Group is broadly similar to that of the Shenzhou Group in that both rely on a three-pronged strategy with a strong Chinese base at the core, coupled to a growing number of overseas operations, and simultaneously investing in technology innovation and upgrading. However, in response to demands from major buyers, Esquel expanded earlier to Africa (Mauritius). The lower productivity levels and longer delivery times were compensated by allocating orders with less manufacturing complexity and less delivery pressure to those factories. At the same time, the Group scaled up its operations in Eastern China where it found the necessary skills to produce high-end products that could justify higher wages than in other Chinese regions.

In recent years, Esquel has placed special emphasis on pushing technological innovation with a view to fully capitalising on digital automation potentials. Together with a long-established Research & Development Department that focuses on the chemistry of materials, dyestuff, and water treatment, a combined expenditure target of up to 3 per cent of the Group's sales revenues is envisaged. An Engineering Excellence team undertakes the innovation efforts both independently (for example, on auxiliary tools like folders, attachments and moulds) and in partnership with advanced digital machinery suppliers in terms of pooling resources and expertise in developing customised robots.

In addition to developing fully automated spinning mills,[33] Esquel's main focus is on introducing digital technologies in garment manufacturing to enhance the stability of product quality and eliminate unsafe or low value-add tasks by a combination of adjusted product designs, standardised work procedures, restructured production lines and deployment of robots. Progress has been significant and is expected to continue at a fast pace. Of the 52 operations needed in woven shirt production, 71 per cent were automated by 2018 and the remaining operations not yet automated are under further study.

Similar to Shenzhou, Esquel also emphasises the crucial importance of its presence in coastal China as an indispensable base for production and innovation, above all in serving the needs of international and domestic high-end consumers through innovative fabric development, sophisticated product design, and fast delivery. Moreover, the Group's base in Foshan acts as a pioneer for digital innovation and as a demonstration facility for the latter's gradual introduction in overseas operations.

Within Esquel's management, the impact of digital automation on relocation decisions is clearly recognised. However, this is not considered a binary "either-or" decision but rather a force that will gradually shift the relative weights between domestic upgrading and foreign investments:

> With the development and adoption of new digital technology, the textiles and garment industries are becoming increasingly capital- and technology-intensive. Automation is an inevitable trend for future production. Its successful application will reduce the urgency to relocate production facilities outside China. (Zhang Yugao, R&D Director, Esquel).

If developing economies in Southeast Asia and Africa want to remain relevant as garment producers, "they will have to invest heavily in upgrading the required skills and mindsets of their workers, technicians, managers and engineers so as to be prepared for the job transformations in the years to come" (Oun Purin Kaowsiri, General Manager of Esquel's Hoa Binh garment company, Vietnam).

33 The new mill in Changji City, Xinjiang, adopted global first-class automation equipment as well as IoT and an integrated software system, with significant customisation by Esquel. Based on worker-machine interaction, just 45 staff can control 30,000 spindles over three shifts, whereas with conventional technology 150 workers were required. At the same time, the automated mill's productivity was three times higher and product quality was more consistent.

Case 3: Dalang sweater cluster

Dalang Sweater Cluster is one of the largest export-oriented sweater clusters in China. Located in Dongguan City in Guangdong Province, the cluster is part of one of the earliest regions in mainland China to develop a garment industry. After more than four decades, Dalang's sweater industry has evolved into a comprehensive industrial cluster, including R&D, manufacturing, material and accessory supply, washing and printing, logistics, trade and retail of woollen sweaters. Above 90 per cent of the cluster's firms are SMEs[34] closely cooperating in exchanging information, sharing orders, relying on a joint labour pool and fostering specialisation. Currently, the cluster features more than 10,000 SMEs with 100,000 employees, 1.2 billion pieces of annual output and RMB 60 billion (roughly EUR 7.7 billion) of annual sales revenue. Around 70 per cent of products are exported to more than 80 countries (among others United States, Russia, Italy and Brazil) while the remainder serves the domestic market.

Since the early 2000s, the Dalang cluster has been suffering from shortages of skilled labour and rapid increases in labour costs. While relocation was initially considered as an option, it has not materialised. On the one hand, the cluster's myriad of relatively small companies lacked the necessary financial resources and managerial skills for relocation. Given their dependence on well-established domestic value chains and their embeddedness in social and economic networks in Dalang, the motivation for a risky strategic relocation was also low and suffered from the usual limitations of collective action. On the other hand, the development of new technologies and the adoption of new business models have emerged as an alternative option for the cluster to enhance its competitiveness without large-scale relocation.

Technological innovation through automation has played a significant role and was proactively supported by the local government. As of 2005, special investment funds were made available and subsidy schemes introduced for SMEs to promote the use of automated knitting machines. Within one decade, this led to the fully automated weaving of sweater parts and resulted in a sevenfold increase in productivity compared to the earlier manual weaving. Currently, the Dalang cluster operates nearly 50,000 labour-saving CNC knitting machines thus greatly reducing relocation pressure. At the same time, the final step of sewing several woven segments has remained a labour-intensive process for which Dalang companies rely on nearsourcing from low-cost inland provinces.[35]

Progress in automation has been accompanied more recently by a transformation in business models. Since 2015, the local government has encouraged SMEs to capitalise on their advantages of cluster flexibility, move into e-business and respond to the growing consumer preferences for fast fashion cycles and customisation. Technical and financial support is

34 The Chinese Bureau of Statistics defines large enterprises as having more than 1,000 employees and revenues above RMB 4 million (approximately EUR 0.5 million).

35 Sophisticated whole-garment knitting machines are being offered by leading textiles machinery producers (such as Shima Seiki in Japan). However, they remain far too expensive for small companies and, above all, are not yet cost-effective. In an interview with Cixing company, it was estimated that a machine-sewn sweater costs RMB 180 (or about EUR 23) as compared to just RMB 8 (approximately EUR 1) for a hand-sewn sweater.

available to collaborate with Alibaba on setting up Taobao[36] factories. In 2018, close to 4,000 Dalang firms were engaged in e-business with a combined sales revenue of RMB 8.2 billion (approximately EUR 1 billion). They can benefit from Alibaba's data on customer preferences, access to larger markets and matching of orders with a maximum number of suppliers as well as draw on technical support to improve their internal processes and supply chain management:

> The platform economy helped SMEs to coordinate their production more efficiently at lower costs. In the future, clusters like Dalang are more likely to move towards high value-added market segments and near-source labour-intensive production segments with a view to concentrating on core capabilities and quick delivery. (Chen Jingdong, Dongguan Association of Woollen Textiles Industry)

In terms of relocating to foreign countries, the hurdles are clearly rising:

> The successful adoption of new e-business models in China depends on the existence of complete industrial value chains and a well-developed digital and logistics infrastructure. African countries still have a long way to go to establish these foundations before they can become part of the booming e-business. (Hu Xu, Senior Operation Advisor, Alibaba)

Furthermore: "collective relocation is a very difficult endeavour for SMEs" (Yang Jun, Vice Secretary-General, CNTAC).

5 Challenges and opportunities for Sub-Saharan Africa: spotlight on Ethiopia and Madagascar

The previous sections have shown that technological innovation is opening up far-reaching new digital upgrading options in the clothing industry. While these new opportunities are seized upon by large corporations in regions ranging from Europe to the United States and China, the outsourcing of clothing manufacturing to low-cost locations has remained a strong parallel trend. While it is difficult to predict to which degree automation will substitute human labour in the clothing industry and when exactly this change will kick in, our analysis has shown that a window of time remains open for SSA countries to take advantage of rising labour costs in China and engage in export-oriented clothing production. Preferential Trade Agreements may help to attract investments to SSA countries.

Still, challenging conditions need to be met in order to succeed. At a first level, low wages, a modicum of technical skills, a favourable investment climate, efficient transport infrastructure, and stable energy supplies must be in place to create a production and trading environment capable of attracting foreign investors. At a second level, if SSA countries do not want to remain at the lowest end of the global textile and clothing value chain, more specific public policies are needed: to develop high-quality infrastructure; to woo investors into higher-value functions and segments of the clothing industry; to shorten lead times to

36 Taobao is an online shopping marketplace owned by Alibaba and is currently the world's largest e-commerce website.

particularly in low-value synthetic products where Chinese companies see potential to benefit from cheap but skilled workers who can start with reasonable productivity levels. The clothing sector in Madagascar has only been growing in recent years again because Mauritian investment has been relocating to Madagascar at an increasing rate but it is likely that this transition will become complete over the next five years. If the Mauritian-driven Textile City should prove a success, it could spur more investment – also from other countries, including China. At the same time, large locally-owned firms in Madagascar as well as Mauritian firms are also looking at Ethiopia as a potential future investment location in parallel to, or in replacement of, their Madagascar investments.

6 Conclusions and outlook

Industry-led development paths, in particularly those based on light manufacturing exports, such as clothing, footwear or electronics assembly, have historically played an important role in latecomer development. As pioneering firms evolved into broader clusters of exporters, they enabled agrarian countries to build up basic manufacturing capabilities and created massive employment for unskilled workers, thereby driving productivity growth and spreading its benefits to previously marginalised low-income groups.

This traditional route to economic and social development has been pursued by a large number of developing countries, most successfully those in East and Southeast Asia. This changed, however, when China emerged as the global export hub for light manufactures. China offered low wages, good infrastructure, political stability and economies of scale and scope. This combination increased productivity rapidly, making China so uniquely competitive that the economic space for other latecomers to successfully export clothing and similar light manufactures narrowed down significantly. In particular, exports from SSA countries have remained marginal. More recently, however, rapidly rising industry wages in China have fuelled hopes in Africa that substantive investments in light manufacturing investments may now flow into the region and provide a springboard for industry-led development.

The research findings presented in this paper focus on emerging trends in the global clothing industry and show that such developments can in fact be observed, albeit starting from a very low level. At the same time, they demonstrate that a whole range of factors – both technological and economic, both global and domestic – challenge the prospects of the incipient clothing export industry in SSA.

First and foremost, technological innovation, that is, rapid digitalisation and the introduction of robotics in manufacturing processes, is about to redefine the future economic landscape and division of labour in the global clothing industry. However, as our field research shows, this process is gradual, not disruptive. We estimate that in light of a considerable gap between the technological feasibility of new robotic technologies (in particular in sewing operations) and their commercial viability, SSA countries are likely to have a time window of 10-15 years to push industrialisation based on clothing exports. Also, technological upgrading in established production locations and relocation to low-wage countries are not mutually exclusive and indeed, are often pursued simultaneously by leading clothing firms. The frequently portrayed dichotomy of relying either on low-wage labour or robots does not reflect the complexity of the real world.

At the same time, our empirical research in China reveals that the country's clothing manufacturers are reluctant to move to SSA, which for many companies remains uncharted territory compared to neighbouring Asian low-cost locations. While full-fledged robotisation of clothing assembly is not yet economically viable, certain product groups and processes can be automated and these potentials are used by Chinese firms at home to reduce their wage bills. In particular, the advantages of agglomeration and proximity in home-grown industrial clusters (that is, collective efficiency) act as a strong deterrent to relocation.

Importantly, digital technological innovation is accompanied by, and indeed enforcing, a trend towards new business models based on shorter fashion cycles, customisation and the reduction of lead times for production. Ultimately, time-to-market becomes more important than wage costs thus favouring nearshoring at least for high-end clothing. This benefits countries that are close to the major consumer markets and can offer efficient logistics; in the case of Europe, countries like Portugal, Turkey or Morocco stand to gain from this trend. However, in principle the emphasis on nearshoring may also favour a country like Ethiopia – as a hub for Africa-Europe flights – over China

Whether or not SSA countries will be able to compete in this emerging global clothing scenario depends on many factors. Essentially, the question is if wage cost advantages will be translated into productivity gains and hence lower unit costs, in particular in comparison with low-cost Asian countries. While Ethiopia stands out as a country combining very low labour costs with a huge domestic labour market, its future success as a clothing exporter hinges on the capability to create and maintain the required transport/logistics, energy and water infrastructure as well as the conducive political environment to attract a critical mass of potent foreign investors and support local firms and domestic supply linkages.

This leads us straight into the role of industrial policy. Several policy dimensions need to be distinguished:

Firstly, the creation of dedicated spaces in terms of industrial parks offering infrastructural services as well as fiscal, financial and trade preferences is relatively easy. In countries lacking proactive industrial policies and/or the necessary financial resources, this can also be achieved with privately operating park developers. In conjunction with low wages and a basic level of political stability, the existence of such industrial parks is often sufficient to attract simple assembly operations and create a modicum of industrial jobs.

Secondly, additional efforts are required to deepen the industrial structure, move into higher value-added activities and create interlinked, locally embedded industrial export clusters. This calls for strategic and targeted investment promotion in which governments, key investors and global buyers have to work hand in hand to build up and strengthen value chains, for instance, co-producing fabrics and clothing in the same park, sourcing domestic cotton or attracting investment into ancillary supporting industries and services. To this end, it is crucial to attract global lead firms that in turn can pull in their key first-tier suppliers and support local firms and inter-firm linkages. Succeeding or failing to attract such "follow sourcing" may indeed be the make or break factor in taking off as a clothing export country. The Ethiopian government is proactively moving in this direction and deliberately works in tandem with global manufacturers and buyers to forge a joint investment drive and portray a consistent image of an attractive rising export location. This public-private investment partnership has been a unique feature in achieving such "follow sourcing" in some (albeit

still limited) cases and in turning Ethiopia into the "hot" new sourcing destination for clothing in Africa.

Thirdly, timing matters. As stated above, about 10-15 years remain to exploit labour cost advantages in the clothing industry years before automation kicks in decisively. African countries need to act quickly to build up infrastructure as well as a reliable, skilled and productive workforce. Also, they need to monitor technology and market trends closely to be able to adapt before the time window closes. Even if automation levels in SSA clothing production are likely to remain partial for some time to come – that is, even if robots will not fully replace labour – new strategies will be needed to keep the industry afloat. One option may be to reduce lead time to gain competitiveness in shorter fashion cycles; another one to shift to original brand manufacturing for the emerging middle classes in a widening African Free Trade Area. Relying on labour-intensive sewing alone will not be a sustainable business model.

In addition to industry-specific policies, two broader success factors need to be in place: On the one hand, preferential trade agreements – which so far have been critically important for directing investment flows to low-income countries in both Asia and Africa – need to stay alive to compensate for productivity shortcomings. This applies in particular to EBA and AGOA, the future of which is subject to political uncertainties. On the other hand, political stability remains the main domestic challenge in potential investment locations. As the cases of Ethiopia and Madagascar have shown, foreign buyers and investors respond with great sensitivity to perceived risks of political turmoil and conflict.

In the final analysis, we want to end on a cautiously optimistic note for SSA countries. While the massive relocation of clothing production capacities to Africa is not yet happening, there are clear opportunities to put the continent on the global map of export-oriented light manufacturing. The biggest risk for this scenario is not technological but political.

References

Abdoolla, R. (2013). *Upgrading, learning opportunities and skill development in the textile and clothing sector: Case study of Mauritius* (Masters half dissertation). University of Cape Town, School of Economics, Cape Town.

Abernathy, F., Volpe, A. & Weil, D. (2006). The future of the apparel and textile industries: Prospects and choices for public and private actors. *Environment and Planning* A *38*(12), 2207-2232.

Abnett, K. (19 May 2016). The robot opportunity. *Business of Fashion*. Retrieved from https://www.businessoffashion.com/articles/fashion-tech/the-robotics-opportunity-manufacturing-efficiencies

ADB (Asian Development Bank). (2018). *Asian development outlook 2018. How technology affects jobs.* Manila: Author.

Akamatsu, K. (1962). A historical pattern of economic growth in developing countries. *The Developing Economies*, *1*(s1), 3-25.

Altenburg, T., & Melia, E. (2014). Kick-starting industrial transformation in sub-Saharan Africa. In J. Salazar-Xirinachs, I. Nübler, & R. Kozul-Wright (Eds.), *Transforming economies: Making industrial policy work for growth, jobs and development* (pp. 355-378). Geneva: International Labour Office (ILO).

Altenburg, T. & Meyer-Stamer, J. (1999). How to promote clusters: Policy experiences from Latin America. *World Development*, *27*(9), 1693-1713.

Arntz, M., Gregory, T., & Zierahn, U. (2016). *The risk of automation for jobs in OECD countries: A comparative analysis* (Social, Employment and Migration Working Paper 189). Paris: Organisation for Economic Co-operation and Development (OECD).

Ancharaz, V. D. & Kasseeah, H. (2012). *Surviving Chinese competition in a post-Multi-Fibre Agreement world: Experience of clothing exports from Mauritius*. Paper prepared for the final workshop of the project "Adjusting to Chinese Ascendency in the Global Clothing Industry" at the African Clothing and Footwear Research Network (ACFRN), University of Nairobi, Kenya.

Andersson, J., Berg, A., Hedrich, S., Ibanez, P., Janmark, J., & Magnus, K. (2018). *Is apparel manufacturing coming home? Nearshoring, automation, and sustainability – establishing a demand-focused apparel value chain.* London: McKinsey Apparel, Fashion & Luxury Group.

Anderson, P. & Tushman, L. (1990). Technological discontinuities and dominant design: A cyclical model of technological change. *Administrative Science Quarterly 35*(1), 604-633.

Apparel Resources. (2017). *Is 'robotic sewing' a promising step for the garment industry? Softwear Automation has the answer!* Retrieved from https://apparelresources.com/technology-news/industry-4-0/is-robotic-sewing-a-promising-step-for-the-garment-industry-softwear-automation-has-the-answer/

Bain, M. (2018a). *A German company built a "Speedfactory" to produce sneakers in the most efficient way. Quartz*. Retrieved from https://classic.qz.com/perfect-company-2/1145012/a-german-company-built-a-speedfactory-to-produce-sneakers-in-the-most-efficient-way/

Bain, M. (2018b). *The world's largest clothing maker isn't betting on automation replacing human labour. Quartz*. Retrieved from https://qz.com/1169397/crystal-group-is-investing-in-low-wage-labor-not-robots-after-its-ipo/

Baldwin, R. (2016). *The great convergence. Information technology and the new globalization*. Cambridge, MA: The Belknap Press of Harvard University Press.

Banga, K. & te Velde, D. (2018). *Digitalization and the future of manufacturing in Africa.* London: Overseas Development Institute (ODI), Supporting Economic Transformation (SET) Programme.

Barbieri, P., Ciabuschi, F., Fratocchi, L. & Vignoli, M. (2017). *Manufacturing reshoring explained: An interpretative framework of ten years of research*. In A. Vecchi (Ed.), *Reshoring of manufacturing. Drivers, opportunities and challenges* (pp. 3-38). Basel: Springer International Publishing.

Barrett, B. M. & Baumann-Pauly, D. (2019). *Made in Ethiopia: Challenges in the garment industry's new frontier* (Report). New York, NY: NY Stern Center for Business and Human Rights:.

BCG (Boston Consulting Group). (2016). *Inside OPS. Are your operations ready for a digital revolution*? Retrieved from http://media-publications.bcg.com/BCG-Inside-OPS-Jul-2016.pdf

Berg, A., Hedrich, S., Lange, T., Magnus, K. & Mathews, B. (2017). *The apparel sourcing caravan's next stop: Digitization* (McKinsey Apparel CPO Survey 2017). London: McKinsey Apparel, Fashion & Luxury Group.

Berger, T., & Frey, C. (2017). Robots and the return of the 'machinery question'. In UNIDO (Ed.), *Accelerating clean energy through Industry 4.0: Manufacturing the next revolution*. Vienna: United Nations Industrial Development Organization (UNIDO).

Bernard, M. & Ravenhill, J. (1995). Beyond product cycles and flying geese, *World Politics*, *47*(2), 171-209.

Bräutigam, D. & Tang, X. (2014). "Going global in groups": Structural transformation and China's special economic zones overseas. *World Development 63,* 78-91.

Bräutigam, D., Tang, X., & Xia, Y. (2018). *What kinds of Chinese "geese" are flying to Africa? Evidence from Chinese manufacturing firms.* (SAIS-CARI Working Paper 17). Washington, DC: John Hopkins University.

Bräutigam, D., Weis, T., & Tang, X. (2018). Latent advantage, complex challenges: Industrial policy and Chinese linkages in Ethiopia's leather sector. *China Economic Review 48,* 158-169.

Brenton, P., & Özden, C. (2009). Trade preferences for apparel and the role of rules of origin: The case of Africa. In M. Maurizio Bussolo & R. E. De Hoyos (Eds.), *Trade preference erosion* (pp. 401-424). Washington, DC: World Bank.

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age. Work, progress, and prosperity in a time of brilliant technologies*. New York: W.W. Norton & Company.

Butler, S. (2018). Is fast fashion giving way to the sustainable wardrobe? *The Guardian.* Retrieved from https://www.theguardian.com/business/2018/dec/29/fast-fashion-giving-way-sustainable - wardrobe

CCCT (China Chamber of Commerce for Import and Export of Textile and Apparel). (2018). *2017-2018 Annual Report on China's International Trade in Textile and Apparel* (internal report). Beijing: Author.

Ceglowski, J., Golub, S., Mbaye, A. & Prasad, V. (2018). Can Africa compete with China in manufacturing? The role of relative unit labour costs. *The World Economy, 41*(6), 1508-1528.

Chandy, L. (Ed.). (2016). *The future of work in the developing world* (Brookings Blum Roundtable 2016, post-conference report). Washington, DC: Brookings Global.

Chang, J. & Rynhart, G. (2017). *How technology is changing jobs and enterprises. Sector brief: An analysis of how automation will impact the apparel sector value chain.* Geneva: International Labour Organization (ILO), Bureau for Employers' Activities. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_579563.pdf

Chang, J., Rynhart, G. & Huynh, P. (2016). *ASEAN in transformation. Textiles, clothing and footwear refashioning the future* (Working Paper 14). Geneva: International Labour Organization (ILO), Bureau for Employers' Activities.

Chen, W. & Li, J. (forthcoming). *Estimating the scale of relocation of labor-intensive manufacturing from China: Facts and potentials* (NSE Discussion Paper Series). Beijing: Peking University, Institute of New Structural Economics (INSE).

Cling, J. P., Razafindrakoto, M. & Roubaud, M. (2005). Export processing zones in Madagascar: A success story under threat? *World Development, 33*(5), 785-803.

CNTAC (China National Textile and Apparel Council). (2018). *Report on the development strategy of regional coordination in textile industry* (internal report). Beijing: Author.

Collier, P. & Venables, A. J. (2007). *Rethinking trade preferences to help diversify African exports* (CEPR Policy Insight 2). Oxford: Centre for Economic Policy Research (CEPR).

De Backer, K., DeStefano, T., Menoni, C. & Ran Sun, J. (2018). *Industrial robotics and the global organization of production* (OECD Science, Technology and Industry Working Papers 2018/03). Paris: OECD Publishing.

De Backer, K. Menoni, C. Desnoyers-Jamesi, I. & Moussiegti, I. (2016). *Reshoring: Myth or reality?* (OECD Science, Technology and Industry Policy Papers 27). Paris: OECD Publishing.

Device Plus. (2018). *SewBot is revolutionizing the clothing manufacturing industry*. Retrieved from https://www.deviceplus.com/connect/sewbot-in-the-clothing-manufacturing-industry/

Devine, S. (2018). *Fabric gripping for future automation*. Presentation given at the ITA Textile 4.0 Conference, 6-8 November, Amsterdam.

Dinh, H. T., Palmade, V., Chandra, V., & Cossar, F. (2012). *Light manufacturing in Africa. Targeted policies to enhance private investment and create jobs.* Washington, DC: World Bank.

Donaldson, T. (22 October 2018). Levi's proves automation in denim manufacturing could substantially speed up supply chains. *Sourcing Journal*. Retrieved from https://sourcingjournal.com/denim/ denim-innovations/levis-laser-automation-denim-124738/

Donnan, S. (2018). Levi Strauss to replace workers with lasers. *Financial Times.* Retrieved from https://www.ft.com/content/b95da4ec-1b75-11e8-aaca-4574d7dabfb6

Ellen MacArthur Foundation. (2017). *A new textiles economy: Redesigning fashion's future*. Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy_Full-Report_Updated_1-12-17.pdf

Ellram, L. M. (2013). Offshoring, reshoring and the manufacturing location decision. *Journal of Supply Chain Management, 49*(2), 3-5.

Engman, M., Onodera, O. & Pinali, E. (2007). *Export processing zones. Past and future role in trade and development* (OECD Trade Policy Papers 53). Paris: Organisation for Economic Co-operation and Development (OECD).

Fan, Y. & Liu, W. (2018). Spatial pattern of foreign direct investment of China's textile enterprises. *Progress in Geography*, *37*(3), 418-426.

Farole, T. (2011). *Special economic zones in Africa. Comparing performance and learning from global experiences*. Washington: World Bank.

Farole, T. & Moberg, L. (2014). *It worked in China, so why not in Africa? The political economy of special economic zones* (WIDER Working Paper 152/2014). Helsinki: United Nations University World Institute for Development Economics Research (UNU-WIDER).

Ford, M. (2015). *The rise of the robots. Technology and the threat of a jobless future.* New York, NY: Basic Books.

Frederick, S. & Staritz, C. (2012). Developments in the global apparel industry after the MFA phaseout. In G. Lopez-Acevedo & R. Robertson (Eds), *Sewing Success? Employment, Wages, and Poverty following the End of the Multi-Fibre Arrangement* (pp. 41-85). Washington, DC: World Bank.

Fukunishi, T. & Ramiarison, H. A. (2012). Madagascar's Garment Industry: Success of Africa's Garment Exports? In T. Fukunishi and C. Houkokusho (Eds.), *Dynamics of the Garment Industry in Low Income Countries: Experiences of Asia and Africa* (pp. 213-242). s. l.: IDE-JETRO and Palgrave Macmillan.

Gebreeyesus, M. (2013). *Industrial policy and development in Ethiopia: Evolution and present experimentation* (Working Paper 125). Helsinki: United Nations University World Institute for Development Economics Research (UNU-WIDER).

Gebreeyesus, M. & Demile, A. (2017). *Why export promotion efforts failed to deliver? Assessment of the export incentives and their implementation in Ethiopia* (Working Paper 17). Addis Ababa: Ethiopian Development Research Institute (EDRI).

Gebrewolde, T. (2019). *Special economic zones. Evidence and prerequisites for success.* (Policy Brief May 2019). London: International Growth Centre (IGC).

Gelb, A., Meyer, C., Ramachandran, V. & Wadhwa, D. (2017). *Can Africa be a manufacturing destination? Labour costs in comparative perspectiv* (CDG Working Paper 466). Washington DC: Center for Global Development (CDG).

Gelb, S. & Calabrese, L. (2017). *Chinese manufacturing and outward foreign direct investment into Africa and Asia* (Background Paper, October). London: Overseas Development Institute (ODI), Supporting Economic Transformation (SET) Programme.

Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics, 48*(1), 37-70.

Gereffi, G. & Frederick, S. (2010). *The global apparel value chain, trade and the crisis – challenges and opportunities for developing countries* (Policy Research Working Paper 5281). Washington DC: World Bank.

Ghani, E. & O'Connell, S. (2014). *Can service be a growth escalator in low income countries?* (World Bank Policy Research Working Paper 6971). Washington, DC: World Bank.

Green, D. (2018). Adidas just opened a futuristic new factory – and it will dramatically change how shoes are sold. *Business Insider*. Retrieved from https://www.businessinsider.de/adidas-high-tech-speedfactory-begins-production-2018-4?r=UK

Gries, T. & Lutz, V. (2018), Application of robotics in garment manufacturing. In R. Nayak, & R. Padhye (Eds.), *Automation in garment manufacturing* (pp. 179-197). Amsterdam: Woodhead Publishing.

Guizzo, E. (2018). *Your next t-shirt will be made by a robot.* IEEE Spectrum 5 January 2018. Retrieved from https://spectrum.ieee.org/robotics/industrial-robots/your-next-tshirt-will-be-made-by-a-robot

Hallward-Driemeier, M. & Nayyar, G. (2018). *Trouble in the making? The future of manufacturing-led development*. Washington, DC: World Bank.

Heikkilä, J., Martinsuo, M., & Nenonen, S. (2018). Backshoring of production in the context of a small and open Nordic economy. *Journal of Manufacturing Technology Management, 29*(4), 658-675.

Heinemann, T. (2018). *Digitalisation in the textile, apparel and footwear industry – a threat to industrialising and developing market economies?* (KfW Research Focus on Economics 214). Frankfurt am Main: KfW Bankengruppe, KfW Research.

Herranz, A. (2018). *How Jeanologia is changing the way the world produces denim.* Retrieved from https://en.reset.org/blog/how-jeanologia-changing-way-world-produces-denim-03132018

Hoffman, K. (1985). Microelectronics, international competition and development strategies: The unavoidable issues – Editor's introduction. *World Development, 13*(3), 263-272.

Iimi, A., Humphrey, R. & Melibaeva, S. (2015). *Firm productivity and infrastructure costs in East Africa* (World Bank Policy Research Working Paper 7278). Washington DC: World Bank.

Innovation in Textiles. (2019). *Softwear automation launches sewbots-as-a-service.* Retrieved from https://www.innovationintextiles.com/softwear-automation-launches-sewbotsasaservice/

Jana, P. (2017). *Vision sewing: Technology for the 'automated' future.* Retrieved fromhttps://apparelresources.com/technology-news/industry-4-0/vision-sewing-a-technology-with-a-future/

Jana, P. (2018). *Automation in sewing technology.* In R. Nayak & R. Padhye (Eds.), *Automation in garment manufacturing* (pp. 199-236). Amsterdam: Woodhead Publishing

Jiang, R., Kleer, R. & Piller F. (2017). Predicting the future of additive manufacturing: A Delphi study on economic and societal implications of 3D printing for 2030. *Technological Forecasting & Social Change 117*(C), 84-97.

Jovanovic, B. & Rousseau, P. (2005). General purpose technologies. In P. Aghion, & S. Durlauf (Eds.), *Handbook of economic growth* (Vol.1, Part B), (pp. 1181-1224). Amsterdam: Elsevier.

Kaplinsky, R. (1985). Electronics-based automation technologies and the onset of systemofacture: Inplications for Third world industrialization, *World Development, 13*(3), 423-439.

Kaplinsky, R. & Morris, M. (2006). *Dangling by a thread: How sharp are the Chinese scissors?* (DFID report). London: Department for International Development (DFID) and Institute of Development Studies (IDS).

Kaplinsky, R. & Morris, M. (2008). Do the Asian drivers undermine export-oriented industrialization in SSA? *World Development*, *36*(2), 254-273.

Kinyondo, A., Newman, C. & Tarp, F. (2016). *The role and effectiveness of special economic zones in Tanzania (*WIDER Working Paper 2016/122). Helsinki: United Nations University World Institute for Development Economics Research (UNU-WIDER).

Krenz, A., Prettner, K., & Strulik, H. (2018). *Robots, reshoring, and the lot of low-skilled workers* (Discussion Paper 351). Göttingen: University of Göttingen, Center for European, Governance and Economic Development Research (CEGE).

Krugman, P. (1991). *Geography and trade.* Cambridge MA: Massachusetts Institute of Technology Press.

Kucera, D. (forthcoming). Robotics and reshoring: The apparel and footwear industry. In F. Barcia de Mattos, S. Dasgupta, D. Kucera & X. Jiang (Eds), *Robotics and reshoring* (forthcoming), Geneva: International Labour Organization (ILO).

Lin J. (2011). *From flying geese to leading dragons. New opportunities and strategies for structural transformation in developing countries* (Policy Research Working Paper 5702). Washington DC: World Bank.

Lin, J. (2012). *The quest for prosperity. How developing economies can take off*. Princeton: Princeton University Press.

Link, J. (2018). *Material handling through advanced automation.* Retrieved from https://www.wtin.com/article/2018/january/150118/material-handling-advancements-through-automation/?freeviewlinkid=79010

Lodefalk, M. (2017). Servicification of firms and trade policy implications. *World Trade Review, 16*(1), 59-83.

Lütkenhorst, W. (2018). *Creating wealth without labour? Emerging contours of a new techno-economic landscape* (Discussion Paper 11/2018). Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

Mayer-Schönberger,V. & Ramge, T. (2018). *Reinventing capitalism in the age of big data*. New York, NY: Basic Books.

McAfee, A. & Brynjolfsson, E. (2017). *Machine. Platform. Crowd. Harnessing our digital future*. New York: W.W. Norton & Company.

McKinsey & Company. (2016). *Style that's sustainable: A new fast-fashion formula*. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Style%20thats%20sustainable%20A%20new%20fast%20fashion%20formula/Style-thats-sustainable-A-new-fast-fashion-formula.ashx

McKinsey & Company. (2019). *The state of fashion 2019*. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Industries/Retail/Our%20Insights/ The %20State%20of%20Fashion%202019%20A%20year%20of%20awakening/The-State-of-Fashion-2019 -final.ashx

McKinsey Global Institute. (2010). *Lions on the move: The progress and potential of African economies*. New York, NY: McKinsey & Company.

McKinsey Global Institute. (2016). *Lions on the move II: Realizing the potential of Africa's economies.* New York, NY: McKinsey & Company.

McKinsey Global Institute. (2017). *A future that works: Automation, employment, and productivity.* New York, NY: McKinsey & Company.

McMillan, M. & Harttgen, K. (2014). *What is driving the 'African growth miracle'?* (Working Paper Series, No.209). Tunis Belvédère: African Development Bank Group.

Minian, I., Martinez, A. & Ibanez, J. (2016). Technological change and the relocation of the apparel industry. *Problemas del Desarrollo. Revista Latinoamericana de Economía, 48*(88), 139-164.

Mihretu, M. & Llobet, G. (2017). *Looking beyond the horizon: A case study of PVH's commitment to Ethiopia's Hawassa industrial park*. Washington DC: World Bank.

Mitchell, O. (2018). *Sewing a mechanical future.* Retrieved from https://robotrabbi.com/2018/01/22/robosew/

MOFCOM (Chinese Ministry of Foreign Trade and Commerce). (2019). *MOFCOM Open Data*. Retrieved from http://www.mofcom.gov.cn.

Morris, M., Plank, L. & Staritz, C. (2016). Regionalism, end markets and ownership matter: Shifting dynamics in the apparel export industry in sub-Saharan Africa. *Environment and Planning, 48*(7), 1244-1265.

Morris, M. & Staritz, C. (2014). Industrialization trajectories in Madagascar's export apparel industry: Ownership, embeddedness, markets, and opgrading, *World Development 56*(C), 243-257.

National Bureau of Statistics of China. (2018) *China Statistical Year Book 2018*. Beijing: China Statistics Press.

Nayak, R. & Padhye, R. (2018a). Introduction to automation in garment manufacturing. In R. Nayak & R. Padhye (Eds.), *Automation in garment manufacturing* (pp. 1-27). Amsterdam: Woodhead Publishing.

Nayak, R. & Padhye, R. (2018b). *Artificial intelligence and its application in the apparel industry.* In R. Nayak & R. Padhye (Eds.), *Automation in garment manufacturing* (pp. 110-137). Amsterdam: Woodhead Publishing.

Newman, C. & Page, J. (2017). *Industrial clusters. The case for special economic zones in Africa (*WIDER Working Paper 2017/15). Helsinki: United Nations University World Institute for Development Economics Research (UNU-WIDER).

Norton, A. (2017). *Automation and inequality. The changing world of work in the global south*. (IIED Issue Paper, August). London: International Institute for Environment and Development (IIED).

OECD (Organisation for Economic Co-operation and Development). (2015). *Data-driven innovation: Big data for growth and well-being*. Paris: OECD Publishing. Retrieved from http://dx.doi.org/10.1787/9789264229358-en

OECD. (2017a). *The next production revolution: Implications for governments and business.* Paris: OECD Publishing.

OECD. (2017b). *The future of global value chains; business as usual or "a new normal"?* (OECD Science, Technology and Innovation Policy Papers 41). Paris: OECD Publishing.

Oxford Martin School & Citi GPS. (2016, January). *Technology at work v2.0: The future is not what it used to be*. Retrieved from

https://www.oxfordmartin.ox.ac.uk/downloads/reports/ Citi_GPS_Technology_Work_2.pdf

Ozawa, T. & Bellak, C. (2011). Will the World Bank's vision materialize? Relocating China's factories to Sub-Saharan Africa, flying geese style. *Global Economy Journal 11*(3), 1-18.

Raphael, R. (2017). *Is this sewing robot the future of fashion?* Retrieved from https://www.fastcompany.com/3067149/is-this-sewing-robot-the-future-of-fashion

Ritzer, U. (2019). Adidas schließt seine Speedfactories. Süddeutsche Zeitung online, 11. November 2019. Retrieved from https://www.sueddeutsche.de/wirtschaft/adidas-speedfactory-1.4676111

Rodrik, D. (2015). *Premature deindustrialization*. Retrieved from http://drodrik.scholar.harvard.edu/files/dani-_rodrik/files/premature_deindustrialization_revised2.pdf

Rodrik, D. (2016). An African growth miracle? *Journal of African Economies* 2016, 1-18. doi: 10.1093/jae/ejw027

Rodrik, D. (2018). *New technologies, global value chains, and the developing economies (*Pathways for Prosperity Commission Background Paper Series, 1/September). Oxford: Blavatnik School of Governance and Oxford University.

Schmitz, H. (1995). Collective efficiency: Growth path for small-scale industry. *Journal of Development Studies*, *31*(4), 529-566.

Signé, L. (2018). *The potential of manufacturing and industrialization in Africa. Trends, opportunities, and strategies.* Retrieved from https://www. brookings.edu/wp-content/uploads/2018/09/Manufacturing-and-Industrialization-in-Africa-Signe-20180921.pdf

Shenzhou International's profit rate was close to Tencent's figure. (2019). *Ningbo Evening.* Retrieved from http://www.168tex.com/2019-07-29/1021849.html

Standard Chartered Bank (2017). *Shop talk – China, ASEAN and the future* (Special Report). Retrieved from https://av.sc.com/corp-en/content/docs/2017-Reinventing-through-rebotics.pdf

Staritz, C. (2011). *Making the cut? Low-income countries and the global clothing value chain in a post-quota and post-crisis world* (World Bank Study). Washington, DC: World Bank.

Staritz, C. & Frederick, S. (2012). *FDI and global value chains in Sub-Saharan Africa: Understanding the factors that contribute to integration and spillovers* (Apparel Sector Paper/Report). Washington, DC: World Bank.

Staritz, C. & Morris, M. (2013). *Local embeddedness and economic and social upgrading in Madagascar's export apparel industry* (Capturing the Gains Working Paper 2013/21). Manchester: University of Manchester.

Staritz, C., Plank, L., & Morris, M. (2016). *Global value chains, industrial policy, and sustainable development – Ethiopia's apparel export sector* (Country Case Study). Geneva: International Centre for Trade and Sustainable Development (ICTSD).

Staritz, C. & Whitfield, L. (2019). Light manufacturing in Ethiopia: The case of the apparel export industry. In F. Cheru, C. Cramer & A.Oqubay (Eds.), *The Oxford handbook of the Ethiopian economy*, Oxford: Oxford University Press.

Stentoft, J., Olhager, J., Heikkilä, J. & Thoms, L. (2016). Manufacturing backshoring: A systematic literature review. *Operations Management Research, 10*(3), 1-10.

UBS. (2016). *Extreme automation and connectivity: The global, regional, and investment implications of the fourth industrial revolution* (UBS White Paper for the World Economic Forum Annual Meeting 2016). Zurich: Author.

UN Comtrade. (2019). *International Merchandise Trade Statistics (IMTS*). New York: United Nations Statistics Division. Retrieved from http://comtrade.un.org/db/

UNDESA (United Nations Department of Economic and Social Affairs). (2017). *The impact of the technological revolution on labour markets and income distribution* (Frontier Issues). New York: United Nations.

UNIDO (United Nations Industrial Development Organization). (2018). *International yearbook of industrial statistics 2018*. Vienna: Author.

UNIDO. (2019). *Competitive industrial performance report 2018*. Vienna: Author.

Vashisht, P. & Rani, N. (2019). *Automation and future of garment sector jobs: A case study of India* (Working Paper 385). New Dehli: Indian Council for Research on International Economic Relations (ICRIER).

Wad, A. (1982). Microelectronics: Implications and strategies for the Third World. *Third World Quarterly, 4*(4), 677-697

Wang, F., Xia, J. & Xu, J. (2019). To upgrade or to relocate? Explaining heterogeneous responses of Chinese light manufacturing firms to rising labour costs. *China Economic Review* (accepted manuscript). Retrieved from https://doi.org/10.1016/j.chieco.2019.101333

WEF (World Economic Forum). (2018). *The global competitiveness report 2018*. Geneva: Author.

Weinswig, D. (2015). *Enter design, exit sweater. 3-D printing in the fashion industry.* Retrieved from https://www.fbicgroup.com/ sites/default/ files/Quick%20Take%20on%203D%20Garment%20Printing%20by%20FBIC%20Global%20Retail%20Tech%20Aug.%2020%202015.pdf

Weinswig, D. (2017). *Deep dive: An overview of the digitalization of the apparel supply chain*. Retrieved from https://www.fung globalretailtech.com/wp-content/uploads/2017/03/Digitalization-of-the-Supply-Chain-Overview-March-3-2017.pdf

Whitfield, L. & Staritz, C. (2018). *Local firms in Madagascar's apparel export sector: Technological capabilities and participation in global value chains (*CAE Working Paper 2018:3). Denmark: Roskilde University, Center of African Economies (CAE).

Whitfield, L. & Staritz, C. (forthcoming). Apparel and textile hubs in Africa. In A. Oqubay & J. Lin. (Eds.), *The Oxford handbook on industrial hubs and economic development*. Oxford: Oxford University Press.

Whitfield, L., Staritz, C. & Morris, M. (forthcoming). Challenges to Industrializing through Apparel Global Value Chains: Experiences from Ethiopia's Apparel Export Sector, *Development and Change*.

Whitfield, L., Therkildsen, O., Buur, L., & Kjær, A. M. (2015). *The Politics of African Industrial Policy: A Comparative Perspective*. Cambridge: Cambridge University Press.

World Bank Group. (Various years). *Doing Business* (A World Bank Group Flagship Report). Retrieved from www.doingbusiness.org

World Bank. (Various years). *Logistics Performance Index.* Retrieved from https://lpi.worldbank.org/

WTIN (World Textile Information Network). (2018). *Digital transformation outlook. Global textile and apparel value chain survey 2018*. Retrieved from

https://www.iafnet.com/2016_01_22/wp-content/uploads/2019/01/WTiN-Digital-Transformation-Sur vey - Report.pdf

WTO (World Trade Organization). (2019). *World trade statistical review 2019*. Geneva: World Trade Organization.

WTO, IDE-JETRO (Institute of Developing Economies-Japan External Trade Organization), OECD, University of Business and Economics (UIBE) & World Bank Group. (2019). *Global value chain development report 2019. Technological innovation, supply chain trade, and workers in a globalized world*. Geneva: World Trade Organization (WTO).

Xu, Y. (2019a). *Africa is the investment new oasis for Chinese textile industry*. Retrieved from http://info.texnet.com.cn/detail-764624.html.

Xu, Y. (2019b). *Territory of Chinese ODI on textile industry*. Available from http://www.ccpittex.com/ xwzx/yw /69380.html..

Xu, J., Gelb, S., Li, J., & Zhao, Z. (2017). *Adjusting to rising costs in Chinese light manufacturing. What opportunities for developing countries?* London: Overseas Development Institute (ODI), Supporting Economic Transformation (SET) Programme.

Yuan Sun, I. (2017). *The next factory of the World. How Chinese investment is reshaping Africa.* Boston, MA: Harvard Business Review Press.

Zeng, D. (2019). *Special economic zones: Lessons from the global experience* (PEDL Synthesis Paper Series, 1.). London: Centre for Economic Policy Research (CEPR) and the Department for International Development (DFID), Private Enterprise Development in Low Income Countries (PEDL).

Zhang, G. (24 September 2018). Textile clusters need to break through bottlenecks for transformation. *China Textile News*.