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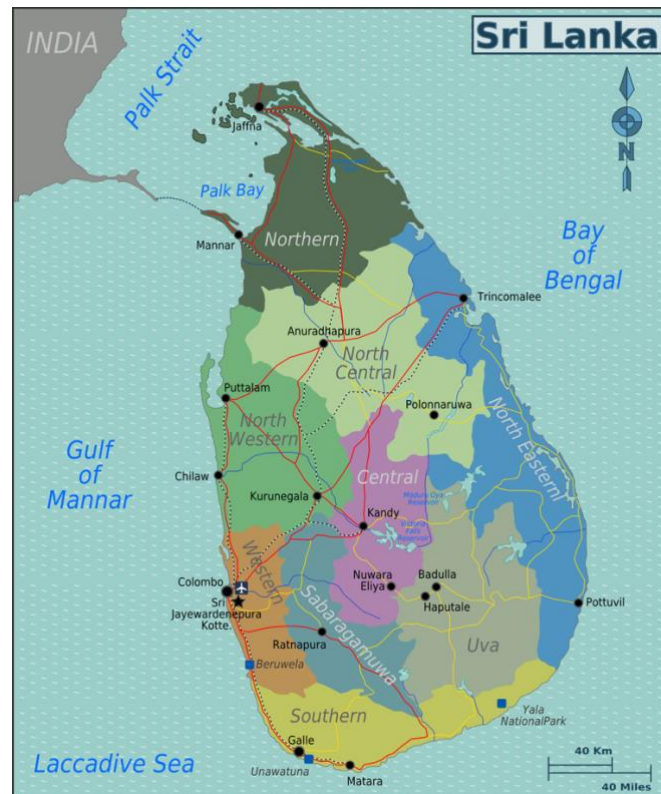


Cluster Development in Sri Lanka

A case study of the garment sector

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Cluster Development in Sri Lanka: A Case Study of the Garment Sector

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ABSTRACT

Sri Lanka's garment industry has played a central role in the country's export-led development, making its spatial organisation an important consideration for industrial policy. This paper analyses the pattern of industrial clustering across Sri Lanka's provinces between 2013 and 2023 and identifies the factors associated with regional concentration in the garment industry. Using panel econometric methods, the study evaluates the contribution of export processing zones (EPZs), transport infrastructure, regional economic development and path dependence to cluster formation. The results indicate that targeted industrial policies and infrastructure investment have been important in shaping the geography of the industry, while continued investment in innovation and productivity will be essential to strengthen export competitiveness and support more balanced regional development.

Keywords:

Clusters, Cluster Development, Economic Transformation, Economic Growth, Economic Development, Sri Lanka, Innovation, Export Processing Zones, EPZ, Industrial Parks,

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Executive summary

Why are clusters useful?

The post-crisis growth strategy requires structural transformation; this paper argues that industrial clustering is a credible pathway to facilitate this change. Clusters take advantage of high concentrations of interconnected firms within geographic areas, to generate agglomeration effects; knowledge spillovers, labour pooling, shared supplier networks, to raise productivity beyond what isolated firms can achieve. This paper attempts to show empirical application of this theory of clustering, describing the nature of clusters and their usefulness in structural transformation in Sri Lanka. By boosting a specific cluster, there are wide ranging spillover effects i.e. generation of financial capital, promotion of entrepreneurship, improvement in human capital. Key clusters tend to follow sectoral patterns in localised areas, so, we can attempt to diagnose regional garment clustering in Sri Lanka.

Methodology

The purpose of this paper is to find what factors are driving the pattern of industrial clustering in the garment sector in Sri Lanka. The empirical analysis uses a province-level panel dataset for Sri Lanka's nine provinces over 2013 - 2023, drawing primarily on Central Bank of Sri Lanka and Board of Investment data. Regional clustering is measured through four complementary metrics: (i) regional shares of garment Gross Value Added (GVA); (ii) Location Quotients (LQ), which compare a province's garment intensity to the national average; (iii) the Herfindahl–Hirschman Index (HHI) to capture overall concentration magnitude; and (iv) the Krugman Specialisation Index (KSI) to capture directional structural divergence across regions. The econometric model regresses LQ on EPZ presence, regional GDP per capita, road infrastructure, distance from Colombo, and a lagged dependent variable to test for path dependence. Breusch-Pagan LM and Hausman tests guide model selection towards a province fixed-effects specification.

Key findings

Firstly, spatial inequality remains persistent: Western dominance continues, Sabaragamuwa's recent rise and the Northern province as a high-potential opportunity. Lagged LQ is highly significant, meaning that clusters self-reinforce and persist over time, this persistence suggests possible path dependence. Additionally, EPZs are strongly correlated, this suggests that EPZs catalyse clustering however we cannot claim causality. Clustering is geographically structured; distance is negatively correlated suggesting a weak spatial disadvantage to clustering whilst roads networks are positively correlated suggesting that infrastructure supports expansion and clustering. Furthermore, the negative GDP per capita correlation suggests structural transformation, namely that richer regions diversify away from garment production. Fundamentally we can see that, clusters increase output and growth but can exacerbate inequality, clustering is partially policy driven (not purely market driven) and self-reinforcing.

Constraints and policy recommendations

Sri Lanka's cluster development faces several structural constraints, including weak infrastructure, labour market mismatches, brain drain, SME financing gaps, governance inefficiencies, environmental pressures and vulnerability to external demand shocks. These challenges are compounded by spatial inequality, uneven regional development, gendered labour dynamics and rising competition within global value chains. Therefore, policy plays a crucial role in supporting cluster development through both top-down and bottom-up approaches. Traditional top-down interventions include BOI-led zone upgrading, tax incentives, subsidies, infrastructure expansion and transport investment (particularly in

peripheral regions such as the North and East). At the same time, bottom-up policies focused on innovation ecosystems, university-industry collaboration, SME linkages and skills development are necessary to ensure long-run competitiveness and resilience. Sustainable cluster policy must integrate; (i) infrastructure investment, (ii) skills development, (iii) innovation ecosystems and (iv) green transition. In the short term, policy efforts should focus on data collection, institutional coordination and implementation of infrastructure/industrial policies. Further, policy focus should be on improved connectivity, export performance, employment generation and productivity gains. In the long run, successful cluster development can strengthen Sri Lanka's human capital, technological capabilities, financial systems and overall creative/industrial capacity.

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Introduction

Sri Lanka has recently bounced back from political and economic crisis, but for emerging markets and developing economies to grow in a sustained way, there must be increasing quality and quantity of human capital and industrial capacity. What are some ways that this can be promoted so that high levels of growth persistent? Different geographical locations have specific combinations of industries with differing amounts of GVA (Gross Value Added), production/consumption of goods and services. An increase in concentration of businesses can lead to clustering and related agglomeration effects. The post-crisis growth strategy requires structural transformation and clustering may help with this.

This paper applies the concept of clustering by looking at what factors are driving the pattern of industrial clustering in the garment sector in Sri Lanka over the last two decades. Furthermore, what policy pathways to use so that cluster policy can support economic transformation and sustainable development. From clustering, firms can benefit from spill-over effects through linkages amongst firms and even joint inputs, which results in higher productivity and efficiency than if they operated in isolation. The intent is not to say that there is a fixed model of cluster development that can be applied everywhere, or even that it should be applied everywhere, however as spatial inequality remains persistent in modern Sri Lanka, it is important to understand how and why clustering happens. Sustainable development through structural transformation means that an economy can improve living conditions, lifestyles and alleviate poverty. One of the ways to create and sustain this type of transformative growth is through cluster development, which enhances productivity in particular geographic areas. Building the foundation for a sustainable growth model supporting Sri Lanka's domestic manufacturing transformation.

This paper will analyse regional industrial clustering by outlining the spatial and structural dynamics in Sri Lanka's Garment industry. This will attempt to answer the questions: why is garment clustering in Sri Lanka important? Which provinces experience greater degrees in clustering? Has the pattern changed over time? What characteristics are associated with greater clustering of garment in provinces? This paper provides a range of descriptive statistics, combined with panel econometrics to understand this. There is a lack of data on specific clusters within towns and cities, instead, the type of data used in this paper will be panel data for provinces. By using this type of structural data, primarily from the Central Bank of Sri Lanka, we keep the strength of macro data whilst maintaining a geographic element, in an attempt to produce reliable results whilst fighting the limitations of data availability. The paper will include quantitative and qualitative analysis as well as presenting and analysing academic sources. It will also include some non-academic sources that are pertinent to answering the research question.

The structure of this paper: first section 2 provides a macroeconomic background, basic economic history and policy context and introduces the concept of clusters. Section 3 discusses the relevant economic theory on clusters, how clusters support development, as well as the development of clusters themselves. Then a comment on existing garment clusters, the different regions, the introduction of EPZs (Export Processing Zones), IPs (Industrial Parks) and TPs (Textile Parks) etc. Next, section 4, the core body of the paper, covers the garment cluster case study which includes the

historical evolution, the role of trade and supply chain linkages, the underlying spatial structure, comparison of textile-garment sector in neighbouring regions. Once this qualitative base has been set, we will conduct statistical analysis of clustering in the garment industry, using concentration ratios, location quotients, the Hirschman Index, Krugman Specialisation Index as metrics of regional clustering. We then move to an econometric analysis to examine which structural and macroeconomic variables explain clustering in the garment industry across different regions in Sri Lanka. The paper concludes in section 6 and 7 by discussing constraints and policy recommendations for cluster development. Policy recommendations discuss skills development, innovation policy, infrastructure investment. Finishing with a short assessment of important future research and next steps. Thus, the purpose of this paper is to define what clusters are, outline and analyse the garment clusters in Sri Lanka, show regional clustering using economic analysis and econometric evidence, evaluate the main constraints to foster cluster growth and finally propose policy to increase and enhance clustering. We will address the main research question of what (province level) factors are associated with the persistence and growth of garment sector concentration in Sri Lanka, and to what extent can these associations be interpreted as evidence of agglomeration and cluster dynamics?

2

Macroeconomic context

Post-crisis macroeconomic environment

Sri Lanka has moved from crisis (after a debt default in 2022) toward stabilisation, but debt stability and feasibility remain dependent upon continual reforms and restructuring. This economic crisis was caused by exogenous and endogenous factors, with internal issues being exasperated, causing scarcity and shortages in fuel, food and medicine where at least 500,000 lost their jobs (Wignaraja et al., 2025) (Ada Derana, 2023). Although macroeconomic indicators have stabilised since the 2022 crisis, household welfare remains fragile, with poverty still substantially above pre-crisis levels, with the World Bank (2025) reporting 24.5 percent in 2024. The government's response to crisis used tax rises, using a 17th IMF programme in addition to funds from India to stimulate the economy and repay debts. The IMF (2023) approved a 48-month fund for US\$3 billion. Sri Lanka's previous IMF loan occurred in 2016 when it received \$1.5 billion over three years. This loan only acted as a temporary stabiliser but not as a stimulus injection, which meant that growth and revenues continued to fall, further damaging the economy in the long run.

Subsequent IMF programme reviews (combined Fifth and Sixth EFF reviews in May 2026) have recognised the progress in fiscal consolidation, inflation stabilisation and accumulation of reserves (IMF, 2026). After this balancing and stabilisation, the economy experienced a recovery and the aim of Sri Lankan policy must turn from temporary growth to long run sustainable development by supporting the productive economy. Sri Lanka's post-crisis macroeconomic environment affects garment clustering through export competitiveness, labour market adjustments and the manufacturing capacity. This environment is essential to analyse as national trade policy conditions, market access,

FDI incentives, BOI administered zones and logistics infrastructure all shape garment clustering in Sri Lanka. These factors affect where people and business locate and whether existing garment districts expand. Therefore, industrial policy must increasingly operate within tighter fiscal constraints, thus placing a greater emphasis on productivity-enhancing policy rather than subsidies.

Historical evolution of the garment industry

Understanding current patterns of industrial clustering requires considering the historical development of Sri Lanka's garment industry. Sri Lanka's modern export-oriented garment industry emerged following the economic liberalisation reforms of 1977, when policy focus shifted from “protectionist import-substitution” policies to more open export-oriented industrialisation (Athukorala and Rajapatirana, 2000) (Dunham and Kelegama, 1994). Under the Multi-Fibre Arrangement (MFA), quota restrictions on major exporting countries created opportunities for smaller producers such as Sri Lanka. International brands increasingly established long-term sourcing relationships with Sri Lankan manufacturers, this integration meant quality upgrading and technology transfer. Although the expiry of the MFA in 2005 intensified competition, Sri Lankan firms increasingly specialised into higher-value apparel rather than competing solely on labour costs. This MFA phase-out triggered significant structural changes in the garment sector with the number of exporting firms declining from 817 in 2004 to 450 in 2011 (Athukorala and Ekanayake, 2017), this consolidation meant larger firms gained market share and concentrated economic power. The goal of Sri Lanka is to move up global value chains, maintaining the position in global supply chains and transition to a middle-income country. In order to achieve this, it is necessary to attract FDI, which is shown by Wignaraja (2008a), who suggests that increases in foreign equity leads to increases in exports.

The government attracted foreign investment through the creation of investment promotion zones and the establishment of EPZs e.g. Katunayaka in 1979 near Bandaranaike International Airport, Biyagama in 1986 in Colombo District, these zones incentivised investment through tax relief (Ross et al., 1988), which acted to integrate domestic manufacturers into global production networks. Historical overviews during the mid-1980s show that textile manufacturing was 80 percent of the manufacturing capacity was concentrated in Western Province, particularly Colombo. Additionally, the textile sector went from 10.5 percent of total output in 1980 to 29.2 percent in 1986 (Ross et al., 1988). Coordinated in part through institutions such as the Joint Apparel Association Forum (JAAF) and the Board of Investment (BOI), garment investments are spread along regional value and supply chains, but focused specifically in certain clusters. Throughout the 1980s and 1990s, international buyers increasingly relocated sourcing and production to Sri Lanka, encouraged by preferential market access and a reputation for higher-quality apparel production.

Current importance of the industry

With this macroeconomic background, the garment industry remains Sri Lanka's most important manufacturing export sector and therefore plays a central role in determining whether post-crisis recovery can translate into sustained structural transformation. As a major source of employment, exports and industrial production, can Sri Lanka capitalise the same way the Chinese took advantage of their manufacturing capacity to rapidly grow? Other countries e.g., Vietnam and Bangladesh have also experienced success in exporting manufacturing textiles and garments. The garment industry in Sri Lanka directly employs 350,000 people and an additional 350,000 people indirectly (EDB, 2024). As a major employer, particularly of women, the strength of this sector has broader social and macroeconomic implications. For instance, EPZs employ 83% of low-skilled workers in the manufacturing sector, playing a large role in national poverty reduction. These textile-garment

economic zones also have a workforce which is 60% female (Karunaratne & Abayasekara, 2013), providing essential income and employment for women to decrease inequality (Keane & te Velde, 2008). This role means it plays a crucial part, not just for economic development, but for equality and sustainability.

Current external environment

The external trade environment has become considerably more uncertain during 2025-26 following the introduction of higher United States tariffs on imports from a range of trading partners. Although Sri Lanka has not faced the highest tariff rates, changes in relative tariff structures will affect competitive positions in global supply chains and further increase uncertainty for the historic export-oriented industry. Thus, the modern garment industry has some degree of export dependence meaning greater vulnerability to trade and tariff shocks. The tariffs on a large variety of countries make trade harder and more expensive, the rapidly changing global geopolitical landscape means that there is the opportunity for new alliances to be formed and old alliances to be leveraged. For example, UK trade policy; changes to UK rules of origin under the DCTS may improve Sri Lanka's garment competitiveness by expanding the range of apparel exports eligible for tariff free access (British High Commission Colombo, 2025) these types of trade measures mean a longer term commitment to the region and industry. Additionally, continued access to the European Union market also depends upon the renewal of GSP+ trade scheme. While GSP+ continues to provide substantial tariff advantages for Sri Lankan apparel exports, however maintaining preferential access requires continued compliance with governance, labour rights and environmental standards. These types of reforms are beneficial for further production expansion enabling Sri Lanka to have a greater place in global trade.

Table 2.1 Sri Lanka's bilateral exports (% of total garment exports)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
USA	42.9	42.5	46.3	45.7	45.2	45.8	44.9	41.9	42.1	41.7	40.16	42.22
UK	21.1	19.3	17.9	18	16.9	14.9	14.4	14.3	13.3	12.7	13.84	14.88
Italy	9.6	10.7	7.8	7.6	9.1	9.3	8	9.2	8.8	9.4	12.62	10.63
Germany	4.4	3.9	4.3	4.2	4.3	5.3	6	6.3	6.2	6.2	5.04	5.64
France	2.7	3.5	2.5	1.6	1.4	1.3	1.3	1.8	1.8	1.9	2.63	2.65
Netherlands	1.4	1.9	2.1	1.9	2.1	2.6	3.4	3.8	4.8	4.6	4.01	4.91
Canada	1.8	1.6	1.8	2.1	2.2	2.1	2.6	3	3.6	4.4	3.98	4.42
Other	16.1	16.6	17.3	18.9	18.8	18.7	19.4	19.7	19.4	19.1	17.72	14.65

As can be seen in table 2.1, the majority of exports in the textile-garment industry, go to North America and Europe. The US is by far the largest recipient of garment manufactured and produced in Sri Lanka, with exports being in the low-mid 40 percent range, most countries saw a relatively stable rate except for the UK share which has nearly halved from 21.1 percent in 2013 to a low in 2022 of 12.7 percent. There have been some increases since growing, from 12.7 percent to 14.88 percent in 2024, signalling a retracement back to high levels of imports, with further increases possible due to the DCTS. There will be opportunities for increasing exports to other counties if Sri Lankan garments are cheap and good quality, e.g., Asia, Middle East and Africa. This could be achieved through advancements in domestic digital 'e-commerce' capabilities. One of the ways in which to increase this type of capacity is through clustering, where multiple different firms localise or one single firm diversifies along geographical lines, this can create the conditions leading to positive spillovers from agglomeration. An example of this could be a manufacturing hub that is positioned to produce in the centre of regional and global value chains, which creates further capacity for expansion. Recent geopolitical tensions in the Middle East have further highlighted the vulnerability of Sri Lanka's export model. Disruptions to Red Sea shipping routes have increased freight costs and transit times, reinforcing the importance of efficient domestic logistics and resilient transport networks within Sri Lanka.

Industrial policy and clustering

An example of this type of FDI could be into specialised export zones (SEZ) e.g. Port City Colombo, or the aforementioned EPZs, which prioritises increased production and manufacturing for increased, more efficient exports. These spatially targeted industrial policy instruments are designed to attract export oriented investment. These zones usually involve fiscal incentives with the goal of improving productivity and innovation capacity which act to further increase exports. However, industrial development does not just depend upon FDI but a deliberate effort to invest into technological capability through human capital (Wignaraja, 2002). Increasing production through increases in skills and education, creates the capacity for longer term, sustained development. This combined with localised linkages, labour pooling, networks of suppliers, knowledge spillovers etc., can lead to clustering. So, by measuring EPZs, they represent both a preference scheme with tax benefits as well as the infrastructure which can grow around it. Thus, EPZs can exist as a form of macroeconomic policy instrument to attract similar business to the same zone, to benefit from agglomeration and related spill-over effects. However, some EPZs may be business ‘enclaves’ with weak spillovers; EPZs do not automatically become clusters; they only act as a catalyst that may create the appropriate conditions.

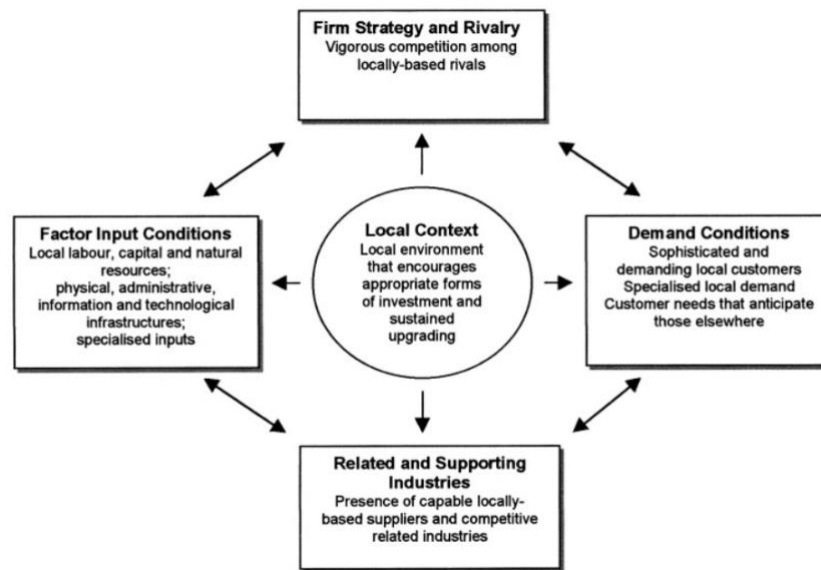
Domestic infrastructure resilience has also become increasingly important following Cyclone Ditwah, where over US\$ 206mn rapid financing was made available for reconstruction (IMF 2026), although damages exceed that number. Reconstruction investment provides an opportunity not only to restore damaged transport infrastructure but also to improve connectivity and strengthen logistics beyond the long-established concentration of economic activity in the Western Province. Such investments may influence future patterns of industrial production. Garment production is dispersed across the country depending on factors such as infrastructure, EPZ access, labour supply; the skills and capital needed for large scale industrial manufacturing means that there is a greater the concentration in one location. In order to create and improve existing supply chains, companies must build on, and improve existing production capabilities. Work by Dr. Ganeshan Wignaraja has been pivotal in describing economic transformation in Sri Lanka, from Wignaraja and Hüttemann (2020) which studied transformation pathways via sectoral analysis in Sri Lanka spanning 1977-2019, to more recent work with CEPA (Centre for Poverty Analysis), looking to the future of transformative growth in Sri Lanka from 2025-2030 (Wignaraja et al., 2025). This research is not just focused on temporary growth but economic transformation and productivity change in the economy. Thus, rather than viewing some of the macroeconomic external shocks from this section solely as risks, they can also reinforce the strategic importance of industrial upgrading. As labour-cost competition intensifies and trade conditions become more uncertain, Sri Lanka's comparative advantage is likely to depend increasingly upon productivity growth, higher-value apparel production, logistics efficiency and stronger industrial clusters capable of generating innovation and improving supply-chain resilience.

Conceptual review- impacts and drivers of clustering

The conceptual relevance of clusters in economic development

Cluster development is a method of analysing and propagating economic transformation and growth. Clusters are spatial concentrations of firms and institutions that interlink to generate productivity advantages through agglomeration economies. The definition by Porter is “A cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities.” (Porter, 1998). The exact magnitude of externalities coming from formation of clusters depends upon productivity spill-overs within the cluster, as well as other macroeconomic factors. These positive spill-over effects work to increase output either through vertical or horizontal linkages; clusters are then, the feedback loop of specialisation leading to workforce development, leading to higher productivity. Crucially, there is no definitive spatial limit of a cluster; simply there is concentration along spatial lines, leading to agglomeration with inter-firm linkages, spillovers and specialisation. Additionally, it is dependent on dynamic skill acquisition and transfers outside of the cluster. This creates an environment in which there is a general skills enhancement surrounding the cluster, primarily to service the needs of the bubble of businesses, which may lead to further future job creation and poverty reduction in the surrounding area due to occupational mobility (although this does lead to issues around furthering inequality). The velocity of skills transfer is typically quicker for skilled job to skilled job, than to train and create the capacity for low skilled to high skilled. The Below diagram shows Porter’s “competitive diamond” outlining the nature of local industrial clustering. What this diagram (fig 3.1) shows are the complex interlinkages between various actors in an economy coming together to form clusters, and the movement from simple Marshallian externalities for agglomeration to Porter clusters.

Fig. 3.1 Porters competitive diamond outline



Source: (Martin & Sunley, 2003)

Agglomeration and knowledge spill-overs

Clusters work because of concentrations of human capital, financial capital and the benefits associated with spill-overs. This creates and propagates core knowledge within a certain industry or skillset and creates further demand for skilled labour. A manufacturing cluster specialised in assembly of textiles, could be endogenously altered to work in manufacturing of garments and apparel when going up the supply chain through vertical integration. In addition to this, there can also be variety and diversification of production due to factor inputs being in place: skilled labour, capital expenditure in equipment, warehouses, assembly lines, shops fronts. Agglomeration benefits can lead to economies of scope/scale depending on the type of clustering, this allows the businesses within the cluster to attract further businesses as there is existing of trade and production around them. There is some evidence that firms in clusters are more productive and agglomeration effects are greater than congestion effects (the drawbacks from high concentrations of business) (Combes et al., 2012; Ciccone & Hall, 1993). Further, it is the competition between independent business that can be considered a primary driver of upgrading and development (Bloom & Van Reenen, 2007), which shows that clustering does not lead to monopoly or oligopoly market failures. It is well understood the positive correlation between employment and innovation in clusters (Delgado et al., 2014).

A classic example of the clustering effect is Silicon Valley, whereby for decades technology companies, specifically design and software located leading to this being a major technology hub for decades. The presence of other firms, attracts newer businesses who are "attracted by agglomeration economies" (Arthur, 1990), resulting in this remaining a hub. This agglomeration efficiency depends on urban vs rural clustering patterns as well as supporting logistics/industrial supply chains. Kline and Moretti (2014) studied the long term effects of clusters in America; they showed the effect of clusters in the continued industrialisation of the American agriculture sector. Their study showed that increases to employment in the agriculture sector reversed (after the subsidies in the programme ceased) however the effect was countered by the gains to overall manufacturing employment. This could suggest a stickiness in manufacturing skills that is not present in the agricultural industry, leading to the conclusion that this showed the agglomeration effects in manufacturing. Work by Baptista and Swann

(1998) studied industrial clustering in the UK during the 70s and 80s, a more relevant timescale in terms of industrial base to compare to Sri Lanka. They proved that there is more firm innovation if there is strong within-sector employment, even cancelling out benefits from diversification. Further asserting that despite agglomeration and positive externalities associated with knowledge spillovers, firms and regions cannot enjoy increasing returns indefinitely, indicating that there is a limit, if not diminishing returns to clustering.

One such limitation leading to diminishing returns is the distance between and within clusters; researchers such as Rosenthal and Strange (2004; 2008) focus heavily on negative effect of distance on agglomeration effects, with further research showing the correlation with roads networks (Duranton and Puga, 2013). This effect is supported by Wignaraja (2008b) showing that Sri Lankan clothing enterprises benefit if firms are nearer to Colombo. This is due to the lower transport costs to the main port and international airport e.g. suppliers, subcontractors, marketing, and government services. Knutsen (2003) state that due to the concentration of garment firms in the Western Province, both US and European firms set up buying offices in Colombo and several EPZs. This facilitated direct links between local manufacturers and global buyers, thus reducing transaction costs, showing quantifiable economic advantages of agglomeration. Additionally, on the notion of limitations of clustering, Lin et al. (2011) argues that there is an inverted U-shape relationship between agglomeration and firm productivity. This suggests that there can be temporary diminishing returns leading to diseconomies of scale, until there is a greater degree of cooperation and agglomeration. Delgado et al. (2014), explains this U-shape effect, by arguing there can be a "convergence effect" leading to diminishing returns to specialisation in a specific region, unless, or until, there are positive spill leading to the "impetus for agglomeration".

Fundamentally, there is a geographic difference in the distribution of economic activity, different regions will have varying employment rates and wages, influenced by the quality of local clusters (Porter, 2003). The key determinants of a cluster are geographical proximity and firm interdependence; textile-garment clusters are then interconnected textile-garment enterprises producing related products within a geographical area (Sonobe and Otsuka, 2006). By facilitating these linkages between private enterprises, the strengths of the existing business are preserved, whilst enhancing cooperation. Thus, gaining the advantages of flexibility of independent business and having the advantages of economies of scale. Manufacturing industries in developing countries, are also often clustered as they are led by SMEs with need for a higher degree of inter-enterprise trade and transactions (Otsuka and Sonobe, 2009) for example, to facilitate manufacturing with complex tooling and machinery.

Porter's cluster model is not without its critics, for example, Martin and Sunley (2003) who agree it has some analytical benefit of defining businesses as clustering however warn against cluster policy effectiveness as more of a brand than a tool. The notion of spill-overs, through leaks or deliberate corporate espionage in clusters is also discussed as "rampant imitation of innovations" (Otsuka and Sonobe, 2009). Whether deliberate or accidental, this imitation means that other firms can receive the benefits of others' innovation, reducing the rewards for the original innovator, raising the risks and disincentivising future innovation.

What drives the formation of clusters

One way for clusters to form, is a formal agreement between business and the local/general government in adopting specific policies, designed to stimulate development and incentivise investment e.g., building industrial parks, joint skills development, technology centres, business hubs etc. Another way is a tacit agreement between a grouping of businesses along spatial/geographical lines but not necessarily in the exact same industry, as different industries may connect to each other

through factor inputs. Clusters emerging from industrial parks or export processing zones take time especially in developing countries. Clustering as represented by EPZs can improve the performance of surrounding firms, not just within the zone, this spillover effects have greater significance in similar industries (Wu et al. 2020).

Prevalence of financial clusters, industrial parks, and other types of use-case zoning are examples of a city facilitating growth for a specific type of industry/sector. The purpose for business tends to be a type of economies of scale, especially in production and manufacturing due to clustering activities enabling effective joint use of energy, skills, supply chains etc. Clustering by nature requires closer private-public partnerships which can act through policy to create these zones. There are clear examples of this e.g. in Tianjin Economic Technological Development Area (TEDA) in China. As of 2022 it represented a total investment of \$15 billion with 3,300 foreign-invested firms (UNIDO, 2022). This zone has skilled workers, local supply of inputs, close availability of clean energy (Hoicka et al., 2025). These manufacturing zones cut out large transport costs and as Shi et al. (2010) asserts, this creates a complex industrial “symbiotic network” providing China with a manufacturing base that is competitive and also complementary. China has experienced rapid growth, which is in part due to industrial clusters, facilitated by the government (Zeng, 2011). This model of increased productivity within clusters can be copied by Sri Lankan manufacturers, but questions arise as to whether this should be a top-down approach by government or a bottom-up through firms choosing to agglomerate.

This garment industry creating a bottom-up model for economic development is seen in other countries as well e.g. Cambodia, Bangladesh, Vietnam (Yamagata, 2006), (Uddin & Jahed, 2007), (Mottaleb & Sonobe, 2011). This is primarily due to high levels of human capital; the entrepreneurs’ high education level, proving that an initial investment into human capital acts to increase the amount of other educated and skilled workers. This effect is interesting because it shows that human capital spillovers foster entrepreneurship and learning (Duranton & Puga, 2023) which can lead to further knowledge spill overs. Sri Lanka may have an advantage over other manufacturers in the region such as Bangladesh through better infrastructure and a greater educated workforce. Based on the other regional clusters, there are transferable lessons for policy design (governance models public-private collaboration) as some regions such as Vietnam are more advanced in this respect. Wignaraja (2008b) examines the factors contributing to clothing exports in Sri Lanka, proving the positive quantitative link between foreign ownership, technological capability and exports. This could be due to vertical integration with foreign owners meaning there is increased production due to decreased margins.

Why are industrial clusters primarily in these urban centres as opposed to rural? Otsuka and Sonobe (2009) answer this by asserting that urban centres have a high level of human capital (quality and quantity), the high degree of knowledge and skills mean that forming specialised clusters is easier. This is supported by Duranton and Puga (2004) who show that highly concentrated, denser economies facilitate increased learning through the flow of ideas and the sharing of invisible goods and services. These types of cities will then shift to specialising by business form and function; larger cities serving more business headquarters and their services, and smaller cities having more industrial plants (Duranton and Puga, 2005). Compared to this, the advantage of clusters in more rural areas is in the available quantity of low-wage labour force. Based on these definitions, it is complex to formalise a concrete analytical framework for diagnosing cluster performance. There are a variety of ways to diagnose a cluster and the conditions for its creation and proliferation. Clusters are not just a geographic concentration of business; they are instead concentrations of interconnected business which agglomerate to take advantage of localised effects. These agglomeration effects include; knowledge spillovers, labour pooling, specialised suppliers, reduced transaction costs, endogenous growth and innovation systems. The magnitude of externalities coming from formation of clusters

depend on productivity spill-overs within the cluster. The effects depend on factor/demand conditions as they contribute to the functioning on the business affecting firm strategy and structure. In addition, the related and supporting industries affect rivalry or interconnectedness between similar firms. Clustering can be enhanced by favourable policies from local government and institutions.

A key challenge in the empirical literature on clustering is distinguishing between agglomeration economies and firm selection effects. Observed spatial concentration may arise because more productive firms choose to locate together, rather than because clustering itself increases productivity. This distinction is particularly relevant in developing country contexts, where policy interventions such as EPZs and infrastructure investment may both respond to, and reinforce, existing industrial concentration.

4

Garment Clusters in Sri Lanka

4.1 EPZs in Sri Lanka

Sri Lanka's first EPZ was established in 1978 at Katunayake as an industrial zone to attract foreign investment (Karunaratne & Abayasekara, 2013), the major EPZs were mostly located in or near the Western coast due to better infrastructure and proximity to the port and international airport. What has the role been in attracting garments production and what do such zones look like? Different formats of EPZs can be produced via policy, one such example is textile parks; zones specifically focused on textile, garment, apparel linkages. Lopez-Acevedo and Robertson (2016) created a detailed diagram showing the breakdown of India's textile parks, The BOI has allocated 250 acres and an investment to "Create Dedicated Zone for Textile Manufacturing and Related Industries" which as of 2024 has a Project Value 1,962 LKR (Mn) (\$6 million USD). In addition, this cluster has duty free imports of capital goods and raw materials and enhanced capital allowance (Public finance, 2025) (BOI, 2025).

Fig 4.1 India's scheme for textile parks

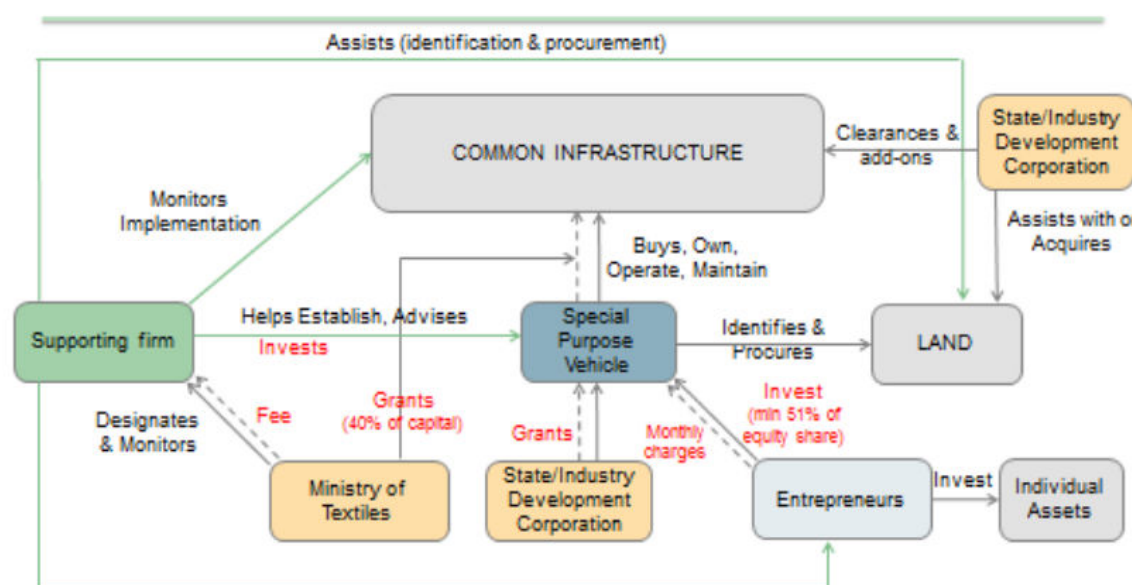


Figure 4.1 shows the relationship and interactions between government, businesses and entrepreneurs in creating a cluster focused on increasing production and then exports. The complex interactions between various co-operating agents forming links can be replicated in a multitude of countries. Aside from the exact quantitative figures shown (in red), this diagram is a top-down method for governments creating clusters, in this case specifically a textile park which could lead to clustering (it is not ipso facto a cluster). So how do these form in Sri Lanka? The BOI has the main role in these specialised zones and offers incentives to attract related business. Table 4.1 shows the capital benefits for operating in a BOI designated EPZ, leading to businesses moving production in order to take advantage (BOI, 2025). There is the risk that some business may locate offices to these EPZ's without actually having the majority of its manufacturing there, in order to unfairly gain the benefits, although this must be tested and examined. It also shows the need for regional incentives; due to historic underinvestment in the northern region there is an enhanced capital allowance.

Table 4.1 BOI special capital allowance

Total Investment Made Depreciable Asset (US\$ Mn)	Enhanced Capital Allowance		Period for Deducting Unrelieved Losses (Years)
	Northern Province	Other than Northern Province	
> 3 and ≤ 100	200%	100%	10
> 100 and ≤ 1,000	200%	150%	10
> 1,000	200%	150%	25

Specific clusters can arise from dedicated garment manufacturing zones, which simultaneously strengthens the supply chain and creates the support network needed to form linkages. Greater integration and cooperation mean lower costs for inputs and more efficient production. This is the first specialty textile zone in Sri Lanka with most being export processing zones, however they can develop

through specialisation as Zeng (2008) outlines that an exclusive Mauritian textile hub emerged from a typical EPZ. Research into the effectiveness of these EPZs in attracting investment has a long history. Abeywardene et al. (1994) suggests these zones create employment, increase human capital and technology. The labour market in these zones enjoy an increase in wages and demand for labour as compared to outside the zone.

Figure 4.2, from the Board of Investment (2024) shows the industrial parks and export processing zones in Sri Lanka in 2023. This map looks at actual investment via designated priority zones which shows the crucial stepping stone for private-public joint investment. In terms of employment overview, figure 4.3 from Ministry of Industries (2022) shows the concentration of textile-garment business by district in Sri Lanka in 2021. The main body for coordinating and facilitating this idea of a national collective of textiles and garments is the JAAF (Joint Apparel Association Forum). Although at the national level, these maps show clearly the regional disparity and concentrations. EPZs like Katunayake (1978), Biyagama (1986), Koggala (1991) and Kandy (1994) created classic examples of an industrial agglomeration, where firms benefit from shared infrastructure, labour and networks.

Fig 4.2 Industrial parks and export processing zones in Sri Lanka in 2023

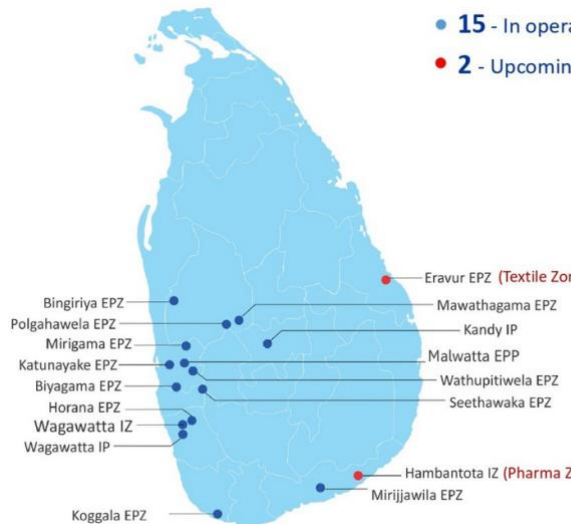
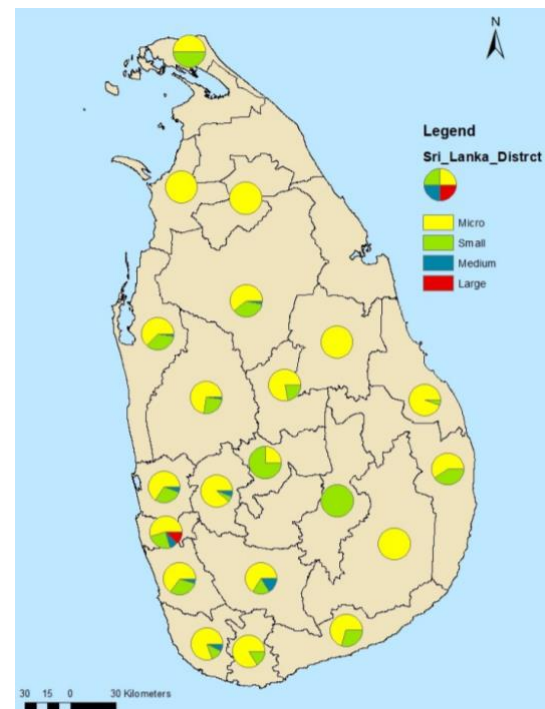


Fig 4.3 Concentration of textile-garment business by district in Sri Lanka in 2021



4.2 Methodology to explore clusters

This paper examines the determinants of regional clustering in Sri Lanka's garment sector using a short panel dataset of provinces over the period 2013 - 2023. The objective is to identify factors associated with spatial concentration and clustering, although given data constraints and the endogenous nature of cluster formation, it is hard to establish definitive causal relationships of these macro variables. After using descriptive measurements of spatial concentration using indices, we use panel regression analysis to estimate associations between clustering and key structural variables.

How to describe clustering?

Clustering is measured using Location Quotient (LQ) as a regional specialisation metric, which compares the share of garment gross value added (GVA) within a province relative to the province's total GVA against the corresponding national ratio. An LQ greater than one indicates that the textile–garment sector is overrepresented within a region relative to the national average, suggesting regional specialization and potential clustering effects. In addition to the LQ, several concentration metrics are used descriptively, including regional shares, the Herfindahl-Hirschman Index (HHI), and the Krugman Specialization Index (KSI), these metrics are explained below. This enables evaluation of the persistence, concentration and regional dynamics of garment sector clustering.

How to explain the development of clusters

The econometric analysis estimates the relationship between regional clustering and a series of structural and macroeconomic variables commonly associated with agglomeration dynamics. The baseline model treats the Location Quotient as the dependent variable and includes lagged clustering, Export Processing Zone (EPZ) presence, regional road infrastructure, and regional GDP per capita as explanatory variables. Lagged LQ is included to capture path dependence and persistence in industrial concentration; there is the possibility that historical clustering reinforces future clustering through cumulative agglomeration effects. EPZ presence is included as a proxy for policy-induced agglomeration and industrial zoning, while road infrastructure acts as a proxy for regional connectivity and transport accessibility. Regional GDP per capita is used to capture broader structural development and possible sectoral transformation effects. The empirical specification can therefore be expressed as:

$$LQ_{it} = \beta_1 EPZ_i + \beta_2 GDPpc_{it} + \beta_3 Roads_{it} + \beta_4 distance_i + \beta_5 LQ_{i,t-1} + a + \mu_i + \varepsilon_{it}$$

Where: LQ_i : Location Quotient (cluster proxy), $LQ_{i,t-1}$: lagged clustering (path dependence), EPZ_{it} : presence/number of Export Processing Zones (policy induced agglomeration), $Roads_{it}$: regional road network (infrastructure proxy), $GDPpc_{it}$: regional GDP per capita (structural development proxy), $Distance_i$: distance of each provincial main city to Colombo (lock-in effect proxy), μ_i : time-invariant region-specific effects, ε_{it} : idiosyncratic error term. These variables come from several different data sources; GDP data, population data, GVA data to compute the LQ variable and the road network comes from the Central Bank of Sri Lanka, EPZ numbers come from the Board of Investment, distance is measured manually. This model attempts to add a variable to take into account that factor inputs are not homogenous across Sri Lanka by adding the variable for relative share of GDP. This means is attempting to capture the relative differences of the provinces with a single variable although, as the earlier analysis of LQ shows there is relative variability that is not captured by a measure as simply as GVA therefore, it could be argued that the model would be more adequate if it takes into account other relative variables which would solve this issue of potential omitted variable bias. For example; utilities (water, energy), education, labour (output per worker). Additionally, it could be argued that a variable for railways would be more appropriate than measuring roads due to relative ongoing infrastructure investment however most garments are transported by trucks from factories, ports, airports etc., thus the relative road network helps explain relative transport costs and actability.

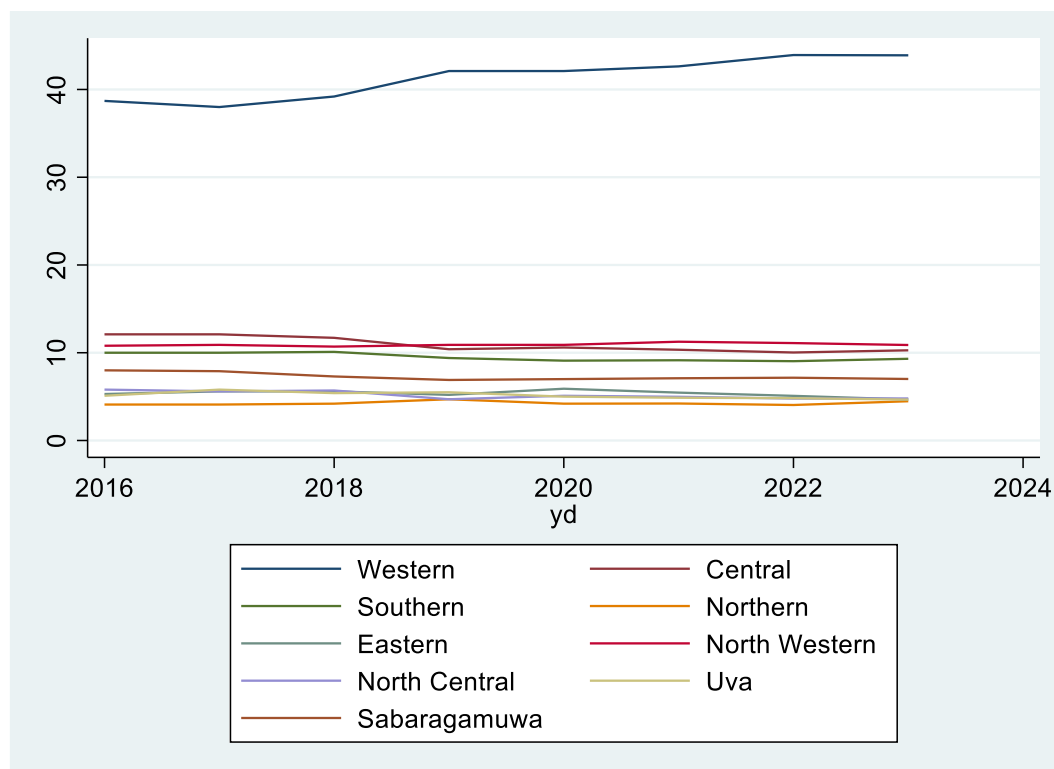
To determine model appropriateness, several diagnostic tests were conducted. Firstly, the BP-LM (Breusch–Pagan Lagrangian Multiplier) test for whether to use pooled OLS or panel then the Hausman test for random effects vs fixed effects. Variance Inflation Factor (VIF) analysis tests for multicollinearity among the explanatory variables, while Ramsey RESET tests for functional form bias (e.g. omitted variable). Despite these diagnostic procedures, several limitations remain; there may be the problem of endogeneity (variables such as infrastructure development and EPZ placement may themselves be influenced by pre-existing industrial concentration). More developed provinces are also more likely to

attract investment, transport infrastructure and policy support. This creates potential reverse causality and omitted variable bias issues. Nevertheless, the methodology provides a framework for analysing the persistence and spatial structure of Sri Lanka's garment-sector concentration given the limitations of available data.

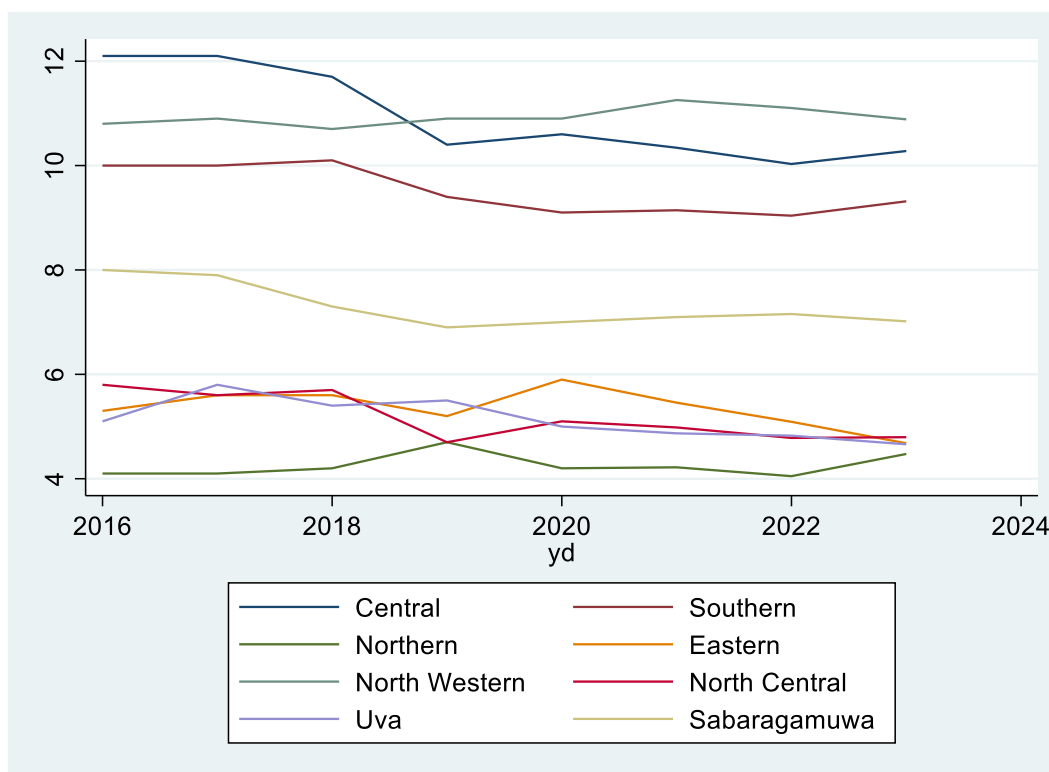
4.3 Data analysis

In order to analyse clustering in Sri Lanka, we start with descriptive regional statistics. Fig 4.4 shows the Regional GDP share and Fig 4.5 shows the GDP share minus Western region for ease of reading. Over the time period 2016 - 2023, we do not see all regions growing, or growing equally. The share of GDP gain is important in analysis as it starts to inform us on regional discrepancies. Whilst the western region is growing its share, all other regions stagnate or decline during the same time period. What we can see from this level of specificity is that concentration of production is roughly unchanging with the country growing on the whole but disparity staying the same. This shows the unequal nature of growth and also informs us that there have not been any advancements in terms of deliberate regional diversification.

Fig 4.4 Regional GDP share



4.5 Regional GDP share minus Western region



Given this regional disparity in GDP, it is important to understand the concentrations in different regions. We start by simply finding regional share of the total national garment GVA:

Table 4.3 Regional share of garment GVA

	Western	Central	Southern	Northern	Eastern	North Western	North Central	Uva	Sabaragamuwa
2013	60.76	7.28	6.02	0.07	0.48	19.27	1.32	1.15	3.65
2014	59.44	7.27	6.00	0.08	0.52	20.41	1.37	1.17	3.73
2015	56.51	7.64	5.85	1.20	0.45	20.20	2.57	0.98	4.61
2016	54.16	7.56	4.32	3.86	0.16	18.44	4.70	0.72	6.08
2017	75.08	6.22	1.69	0.81	0.19	9.07	1.05	1.04	4.84
2018	70.33	8.36	2.40	1.33	0.34	9.18	1.51	1.83	4.72
2019	65.97	9.32	2.64	2.03	0.40	11.93	1.13	2.11	4.46
2020	61.17	5.27	3.53	2.38	0.22	12.08	1.60	1.39	12.36
2021	59.95	4.97	3.50	2.71	0.22	13.00	1.67	1.34	12.64
2022	59.89	4.49	3.85	2.70	0.18	13.30	2.68	1.60	11.32
2023	58.51	4.48	4.21	2.76	0.19	13.29	2.54	1.49	12.54

Table 4.3 shows the concentration of garment GVA in each region as relation to the whole economy. This table shows that the Western region dominates at 54-75% of total GVA of garments, showing the prevalence and dominance of the Western region. Although there is fluctuation; to take an average snapshot over the whole decade, we can see which regions gained the largest share. We can see that

the Western region only declines by 2 percentage points despite its dominance, whilst there is rapid growth in the Northern region, from 0.07% to 2.76% and growth in Sabaragamuwa region from 3.65% to 12.54%.

Additionally, there is the seminal BOI scheme started in 1994 by the BOI; “200 Garment Factory Program”. This industrial policy initiative aimed to decentralise the country’s textile, garment and apparel industry away from the heavily concentrated Western Province (especially in Colombo). It incentivised investors to locate and build garment manufacturing plants in rural and semi-rural districts outside the main EPZs.

Table 4.4 Number of Registered Enterprises: GFP 200 from 2006 to 2017

Year	West ern	South ern	North West ern	Centr al	Sabaragam uwa	North Centr al	Uva	Easte rn	North ern	Total
2006	52	24	28	27	20	17	11	6	2	187
2007	52	18	26	24	18	12	7	4	2	163
2008	47	18	26	21	16	11	7	4	1	151
2009	45	16	23	20	14	10	5	6	0	139
2010	46	14	16	13	15	7	4	7	0	122
2011	43	14	14	13	16	7	1	7	0	115
2012	44	14	16	14	13	7	2	7	0	117
2013	43	14	14	14	13	6	2	8	0	114
2014	42	13	14	14	13	6	2	6	0	110
2015	41	12	14	13	13	5	2	6	0	106
2016	34	10	8	12	13	6	3	6	0	92
2017	33	8	8	11	12	5	2	6	0	85

This policy represents a state led drive into decentralisation, however, table 4.4 shows us that, provincial agglomeration persisted. The programme did not eliminate the dominance of the Western Province but instead acted more to shift production to rural areas. We can see below in fig 4.6 that this GFP programme is mildly correlated with existing share of garment GVA (table 4.3 + table 4.4).

Fig 4.6 Provincial GVA share vs provincial GFP firm share in 2017

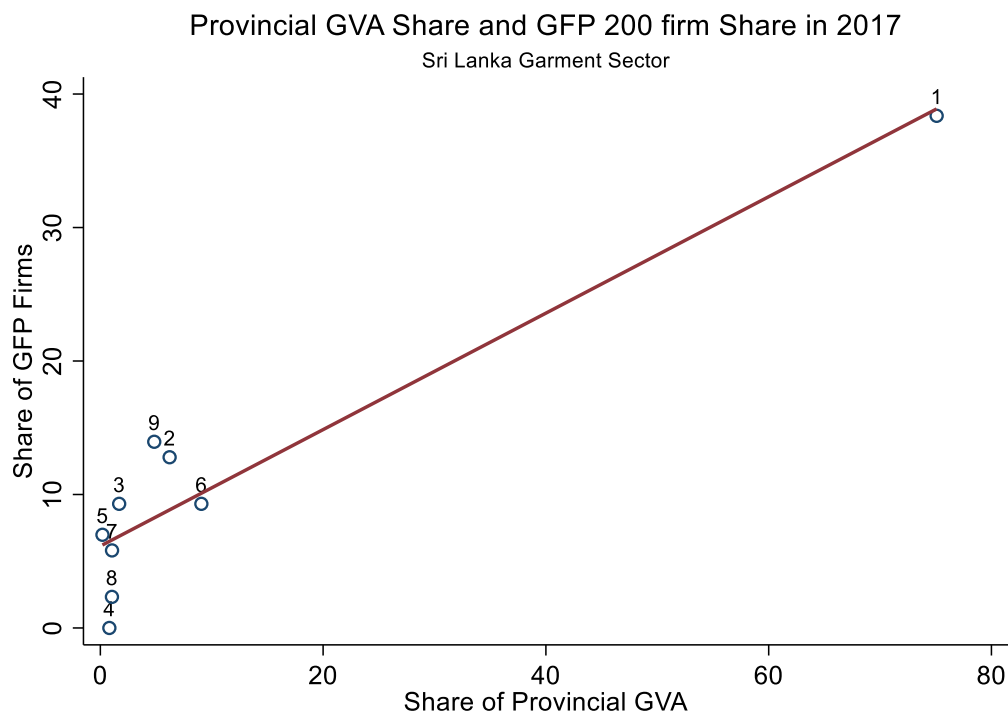


Fig 4.6 shows us a snapshot of the correlation between the share of garment GVA and the share of GFP firms, this suggests that there is no real dispersal effect on the provincial level. However, it is important to understand that it not appropriate to compare GFP 200 firms with EPZs or include in the major regression due to the underlying policy aiming at different inequalities; urban vs rural and across country.

HHI and KSI

We can use this information or national and regional shares to compute key metrics for clustering, the Herfindahl-Hirschman Index typically measures the size of firms in relation to the industry, showing how dense the industry is due to the square of the share giving greater weight to larger proportions. In this instance, we can use the HHI to measure regional concentrations using all regions;

$$HHI = \sum_{i=1}^n (RS_i)^2$$

Where RS = regional share

Fig 4.6 Herfindahl–Hirschman Index

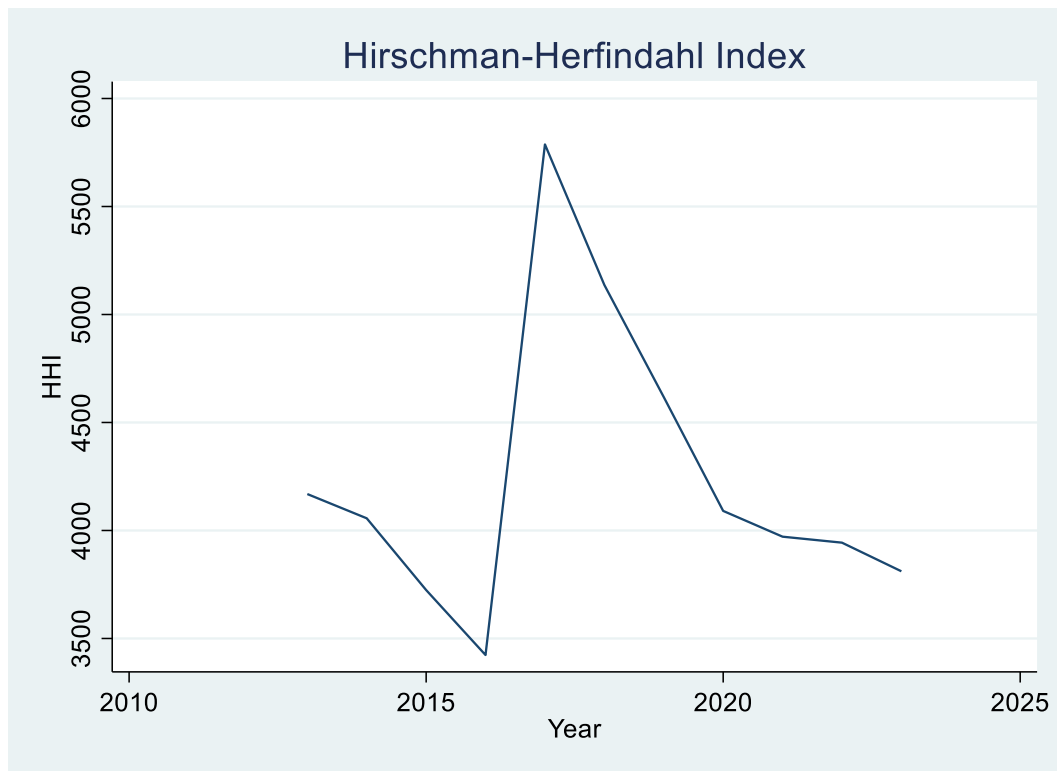
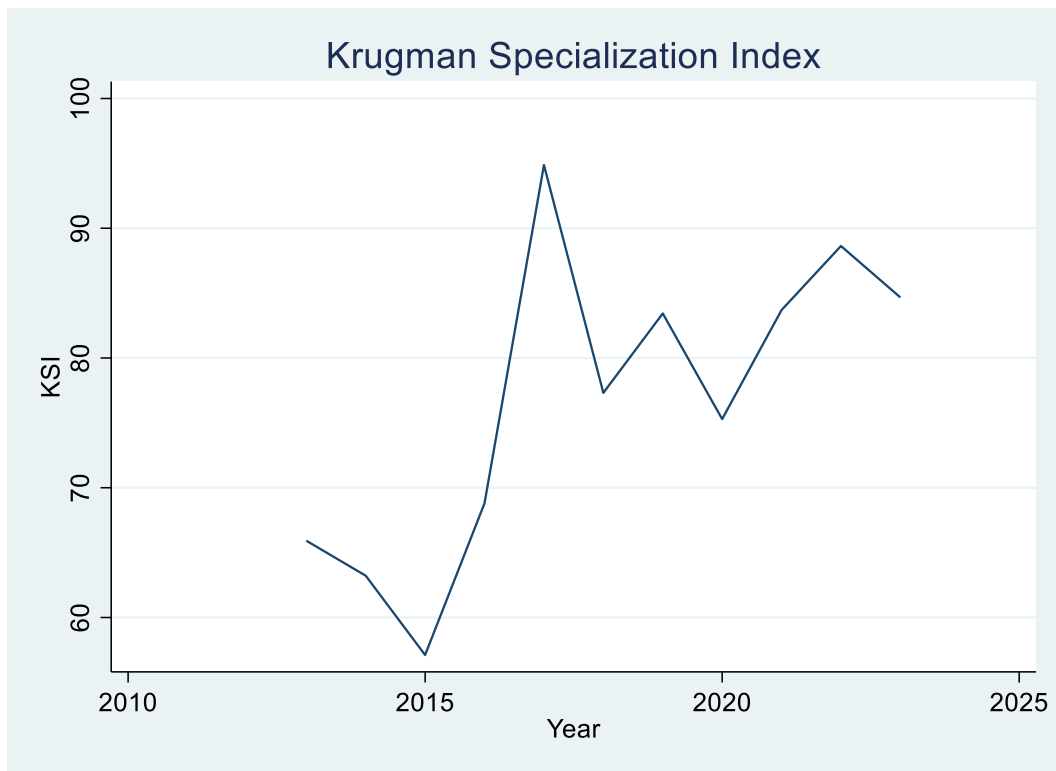


Fig 4.6 shows the Herfindahl–Hirschman Index for the regions in terms of garment GVA increasing HHI across time suggests deepening clusters. This chart shows us is that 2016-2017 there was a large movement towards clustering but then fell sharply through 2018, 2019, 2020. Thus, using this method, clustering increased but then decreased. Another similar metric is the Krugman Specialization Index which is purpose built for this type of regional specificity. It compares a region's industrial composition to the national structure. This is useful for proving structural divergence/convergence, where higher KSI implies stronger regional specialisation relative to the national average and thus regional clustering. The equation for the HHI is:

$$KSI = \sum_i |RS_{ij} - NS_i|$$

Where RS=Regional Share, NS=National share

Fig 4.7 Krugman Specialization Index



Given that this index was purpose built for regional specificity, it is more reliable for this type of analysis. Fig 4.7 shows the Krugman Specialization Index for Sri Lanka's garment sector, the KSI shows increasing value over time meaning greater clustering. To compare the two indexes, we can see is that the KSI is better at catching more shifts in trends due to it capturing a directional variable whereas HHI is better at capturing magnitude. Given this understanding of the varying macroeconomic factors affecting Sri Lanka, specifically the location quotients which suggest regional clustering, we can attempt to quantify the relationship between spatial concentration in garment manufacturing and several other variables. In order to test the dynamics and movement of the variables, we can use an econometric model.

LQ

With these regional shares and measurements, we can further quantify regional concentration by producing Location Quotient (LQ) measurements. LQ is a good measurement of whether a region specialises in goods or service, if a place has a relatively higher proportion of its economic activity relative to a benchmark, then the region has a specialisation. It is possible to use employment, businesses count etc. The benefit of this measure is that, there can be comparison across regions, if all LQs are close to 1 then the industry is equally spread over all regions, whereas an industry with a few high LQ's suggests concentration. We simply let x =local garment/local total GVA and y = total garment/total GVA. The purpose is to suggest that if $x>y$ then there is higher density than the average in Sri Lanka, suggesting overrepresentation. A greater ratio means specialisation and indicates clustering. By understanding the quotient, we can see which regions are overrepresented. The formula for LQ:

$$LQ_{it} = \left(\frac{GarmentGVA_{it}}{TotalGVA_{it}} \right) / \left(\frac{National\ GarmentGVA_t}{National\ TotalGVA_t} \right)$$

Where an LQ > 1 indicates regional specialisation i.e. clustering, and an LQ < 1 indicates that the industry is underrepresented in specific region.

Table 4.5 Location Quotient

	Western	Central	Southern	Northern	Eastern	North Western	North Central	Uva	Sabaragamuwa
2013	1.15	0.87	0.66	0.04	0.08	1.99	0.35	0.33	0.77
2014	1.20	0.93	0.70	0.04	0.08	1.78	0.36	0.25	0.65
2015	1.12	0.92	0.94	0.35	0.09	1.94	0.63	0.19	0.69
2016	1.24	0.90	0.72	0.83	0.04	1.89	1.09	0.07	0.66
2017	1.63	0.48	0.28	0.23	0.05	0.85	0.32	0.17	0.63
2018	1.43	0.68	0.36	0.37	0.09	1.00	0.47	0.34	0.71
2019	1.52	0.78	0.39	0.37	0.08	1.24	0.30	0.34	0.56
2020	1.29	0.53	0.54	0.63	0.03	1.08	0.47	0.30	1.90
2021	1.25	0.52	0.55	0.65	0.04	1.08	0.46	0.32	1.85
2022	1.20	0.51	0.61	0.63	0.04	1.15	0.64	0.40	1.69
2023	1.20	0.48	0.62	0.58	0.05	1.09	0.68	0.41	1.72

Table 4.5 shows this quotient method which shows the proportion of relative garment GVA. Thus, giving a firm notion of greater regional clustering than average by showing how concentrated garment output is relative to national average (a value greater than 1 indicates specialisation). Thus, it is the relative rankings which matter; using this method, we can make observations about specialisation and regional output. Firstly, the garment sector remains spatially concentrated; there is a persistent overrepresentation in Western & North-Western provinces. This could be due to the western province being the historical core perhaps due to superior infrastructure but also the “lock-in” effect. The prevalence of the North-Western Province may be due to manufacturing spillover over decades, with expansion into Sabaragamuwa after Covid possibly due to new tax and labour incentives and supply chain upgrading. Due to these regions being geographically close and in the Western part of the country, analysis is necessary to see if this distance is a factor leading to better garment production. The Northern province exhibited the strongest LQ change meaning that it is slowly, recently, beginning to manufacture garments at a greater rate, this is then an opportunity for investment if the trend continues. This is the primary observation, that increases in regional garment GVA means higher regional clustering, further to say that the higher the regional output, the greater the likelihood is that this will represent clustering through increased quotient. This can be correlated i.e. increasing one boosts the other, but this must be tested.

Regression

We examine which macroeconomic variables contribute to clustering. For this, we will take this primary observation and add macroeconomic control variables to make a full regression equation:

$$LQ_{it} = \beta_1 EPZ_i + \beta_2 GDPpc_{it} + \beta_3 Roads_{it} + \beta_4 distance_i + \beta_5 LQ_{i,t-1} + a + \mu_i + \varepsilon_{it}$$

When we run the model, as outlined in the methodology section we can use certain tests in order to increase specification and accuracy, initial checks suggest that there is a high correlation between LQ & garment GVA in a region which is to be expected. The BP-LM test (P = 0.0022) tells us to reject pooled OLS in favour of a panel model, and the Hausman test (P = 0.0000) indicates that we should reject

Random Effects and use Fixed Effects instead. This diagnostic test indicates that unobserved regional characteristics are correlated with the explanatory variables, thus province fixed effects are used. Additionally, Variance Inflation Factor (VIF) analysis indicated no significant multicollinearity and a crude Ramsey RESET test for omitted variable bias and functional form shows that without lag (Prob > F = 0.0154) and with lag (Prob > F = 0.2236) this result suggests that inclusion of lagged clustering variable substantially improves model specification and reduces omitted functional form bias.

Table 4.6 Macroeconomic determinants regression output (2013 – 2023)

Macroeconomic Determinants of Garment Clustering Across Sri Lankan Provinces			
Dependent variable: Location Quotient (LQ)			
Variables	Model (1) FE	Model (2) FE + Lagged	Model (3) FE+Additional
<i>EPZ</i>	0.118** (3.16)	0.0806* (2.21)	0.205*** (4.13)
<i>Distance</i>	-0.00191* (-2.38)	-0.000316 (-0.40)	-0.00112 (-1.22)
<i>Lagged LQ</i>	-	0.514*** (5.87)	-
<i>Roads</i>	-	-	0.000356** (2.87)
<i>Share GDP</i>	-	-	-1.141** (-2.66)
<i>Constant</i>	0.847*** (4.39)	0.259 (1.31)	0.381 (0.56)
Observations / R-squared	99 / 0.7185	90 / 0.8202	99 / 0.7580
Province fixed effects	Yes	Yes	Yes

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

The results shown in table 4.6 highlight models that have an overall R-squared between 0.72 – 0.82, which gives us several statistically significant variables. The identified macro factors do determine clustering empirically but by different amounts in different models, leading to correlation between LQ and the macroeconomic factors but not necessarily causation. EPZ count is significant and determines GVA and clustering, it is the strongest and most consistent determinant, as the proxy for policy it shows that Public-private cluster ecosystems correlate with clustering. Additionally, lagged LQ is significant thus shows that clusters self-reinforce and persist over time, however it should be noted that the inclusion of lagged LQ introduces potential statistical bias in short panels. Roads which is a proxy for Infrastructure is statistically significant, showing that firms cluster where there are already a supply base and infrastructure to take advantage of externalities. The negative and significant variable distance shows that there is a weak spatial disadvantage in terms of clustering for firms being further away from Colombo, although there are other factors which are more important. Additionally, it should be noted that this distance variable does not fully explain market access. The results of higher GDP per capita is unexpected, although it is significant and negative in all forms in all models run. It is unexpected because the literature suggests that higher welfare, higher GDP per capita leads to increase in output. The only explanation is that rather than an error, there is a significant negative correlation, namely higher GDP per capita means less garment specialisation, thus less garment clustering. A possible explanation is that higher physical and human capital (e.g., education, skills training, infrastructure) leads to diversification away from labour intensive manufacturing like

garments whereas poorer provinces retain this industry. Although this would mean that the lock-in effect persists and is even stronger than the growth in GDP per capita. These results show that EPZ presence is positively associated with higher clustering (though causality cannot be established due to potential location endogeneity), clusters persist over time, infrastructure supports expansion but clustering does not necessarily follow broader economic development patterns. Spatial concentration is not limited to the formation of industrial clusters (Abeyratne, 2016); there are many benefits and drawbacks with related concentration and spillover effects. We can suggest that clustering is self-reinforcing, but not purely market-driven as EPZ policy does appear to have played a role; the results are not conclusive enough to assert they are purely policy-driven.

5

Sustainability considerations from the impact of clustering

Labour and poverty effects

The goal of all sustainable growth models should be to advance green growth and reduce inequality. For the past few decades there has been progress in increasing the rights and welfare of workers and reducing the carbon footprint of the factories in Sri Lanka. It should first and foremost be noted that despite more women being employed, there have been concerns raised by researchers such as Hancock et al. (2015) on the nature of the employment in these clusters and the working standards. They showed that, female workers in the textile-garment industry receive lower earnings and are more likely to receive verbal abuse than in other factory types and sectors. Labour conditions in garment clusters reflect global pressures, where cost competitiveness can constrain wage growth and working conditions (despite employment expansion). Employment creation has a positive effect on clustering as well as decreasing poverty, however issues arise with job quality leading to segmentation and the prevalence of gendered labour outcomes. There is the fundamental assumption that clusters lead to positive spill-overs which leads to local development and poverty reduction. However, workers may commute meaning that local residents do not benefit from the increased flow of regional employment.

The goal is a fairer, greener, and more prosperous society; however, urban growth and development is unequal, and there are disproportionate progress and concentration of production in a few regions, whilst others may suffer. This can mean that simply by nature of where you are born and educated, you can expect different outcomes, this disparity can be further enhanced or eased by the creation of clusters (depending on implementation). A growing cluster can have positive spill-over effects leading to great advancements in the local community. Regional disparity and urban-rural divide are a useful analytical lens for poverty and structural transformation analysis. In rural areas, these clusters could enable the creation of road networks, water treatment plants, waste management, energy infrastructure, telecommunication infrastructure, to service the needs of the cluster. There are fundamental regional disparities which can act as a barrier to entry for SMEs and informal workers entering into clusters. This spatial inequality is enhanced by firms accruing the benefits, not

communities and larger firms crowding out smaller local SMEs. Furthermore, the capital requirements and network access act to limit linkages that SMEs can achieve. Within cities, there are spatial inequality across neighbourhoods, often risks of displacement and gentrification from cluster upgrading. In addition, as economic activity rises, the price of land use may also rise, which leads to further displacement.

There should be consideration to not tax the rural economy disproportionality or excessively. As technological advances increase, the proliferation of robots, AI and other factors will act as a substitute for low-skilled jobs in manufacturing, resulting in some losing out on opportunities to industrialise (Birdsall, 2025). Persistent regional poverty disparities and income inequality shape the potential for cluster participation, with a disproportionate negative impact on SMEs and rural firms. This leads to labour segmentation, widening inequality, decreasing upward mobility and a risk of permanent class divide especially on regional lines. There should be discussion on the nature of flexibility and wages in skilled vs low-skilled jobs or formal vs informal. Given the urban-rural income gap, adequate cluster policy means integrating the rural poor into urban labour markets, leading to poverty reduction.

Environmental externalities

A focus must be on inclusive and sustainable growth that takes the climate and climate crisis into account. A country or business can grow whilst still keeping to minimising emissions and using cleaner and greener energy (te Velde, 2025). Garment production is a resource intensive form of manufacturing with high demand for water, energy, chemicals etc. on top of this environmental upgrading is costly, this means that often green policies are not a core focus of business. However, Samudrika Wijayapala and Samarawickrama (2024), believe we should be hopeful for the future of sustainability and a greener future in the garment industry in Sri Lanka. There are issues of water scarcity, energy security and carbon emissions raised above, are combatted by a top-down planning structure which incorporates green supply chain management ensuring that different points in the production are keeping sustainability as a focus as well as continual waste reduction and recycling. Examples of this are the Hirdaramani (2024) Group with their focus on sustainable apparel and environmental conservation through their factories e.g., their flagship “Mihila” in Agalawatta reducing overall carbon footprint by 48 percent; with energy consumption down by 48 percent and water usage down by 70 percent. Green upgrading may lead to long term efficiency gains, therefore a whole of society approach to tackling the lasting problems, will lead to Climate Compatible Development. Clusters may facilitate environmental upgrading through shared infrastructure and scale economies, but they can also intensify local environmental pressures. Large scale industrial manufacturing leads to large energy costs, so it cheaper if private business invests into solar and wind for the reduction in costs. Simultaneously, the government should be investing in its national capacity by encouraging a green transition into renewables. By investing in greener and cleaner energy sources, the country is protected and energy can become cheaper.

As the climate crisis worsens, extreme weather events occur more frequently, agricultural production and food security depend on climate progress. Many countries in the global south are more vulnerable to ongoing climate change, when you combine this with these countries being heavily indebted and having relatively lower GDP, they end up paying the most. Any negative effects are maximised and spill-overs are harder to fight. Construction to repair damage or to increase resilience is then a relatively higher proportion of total resources meaning that prioritisation is a harder decision to make politically. As Sri Lanka is an island nation, there are relatively limited external trade routes; they are more vulnerable to the disruptions of extreme weather events e.g. floods, cyclones, rising sea level. When these events occur, road rail networks remain disrupted and areas can have power and telecommunications outages. There must be a greater focus on avoiding risks and destruction from

flooding like seen in Ditwah in 2025, this means a permanent and inclusive improvement to drainage systems, rebuilding and repairing damaged infrastructure quicker as well as investment into other types of resilient infrastructure to minimise loss of life.

The large companies in Sri Lanka can step up with investment and initiatives to reduce waste and emissions e.g. John Keells Group one of the largest companies in Sri Lanka, tackling plastic waste by launching an initiative called “Plasticcycle” (WEF, 2025) aimed at reducing waste, increasing recycling and promoting a circular economy. In China, where development zones are implemented, there are increases in land use eco-efficiency, Zhang et al. (2025). The focus on developing renewable energy is not simply to arbitrarily reduce the carbon footprint but to transition to renewable energy to achieve energy security. There can be a sustainable energy future by creating and deploying infrastructure that solves or attempts to fix regional energy connectivity issues. As is discussed in the above section on regional inequality, there is often correlating between regional inequality and energy accessibility; the poorest in society are often the most affected. Further climate vulnerabilities have disproportionate impacts of climate shocks on agriculture and coastal regions. Greener clusters lead to greater long term competitiveness through energy security gains and efficiency upgrades.

Clusters generate complex and often conflicting effects on labour, inequality, and the environment, and these outcomes depend on institutions and associated policy. This paper does not directly estimate poverty effects but discusses them as potential implications of observed clustering patterns. We can see that there may be a trade-off between growth and substantiality in terms of poverty and climate, the exact relationship between clustering and sustainability is ambiguous. While clusters can generate employment, facilitate knowledge diffusion, and enable shared infrastructure for environmental upgrading, they can also reinforce labour segmentation, intensify regional inequality, and concentrate environmental externalities. In export-oriented sectors such as garments, sustainability outcomes are often not shaped by clustering per se but more by global value chain governance, including buyer standards, compliance requirements, and cost pressures. As a result, clustering should not be assumed to produce inclusive or green outcomes without complementary policy interventions.

6

Constraints to cluster development

The benefits of clusters depend upon its implementation and related policy action, however there are factors which hold back the ability for cluster development and reduce the positive effects. Not all constraints to cluster development are empirically observable at the province level. As a result, the empirical analysis captures only part of the constraint environment. Cluster development is constrained by identifiable economic mechanisms: coordination failures, factor market frictions, spatial constraints, institutional weaknesses etc. Firstly, there are various coordination failures associated with clusters as they are about linkages and trust with interconnected business. Lapses in trust lead to failures to cooperate effectively and efficiently. Within the agglomeration, co-ordination failures can take place meaning that there is no advantage of clustering. Firms may underinvest in

training because workers can leave, underinvest in innovation because knowledge spills over etc. The degree of agglomeration depends heavily on multiple factors but this type of Informality and distrust limits spillovers and scaling.

These issues such as being unable to internalise spillovers, or underinvestment in shared inputs (training, R&D, infrastructure) can create issues for an export-oriented sectors such as Sri Lanka's garment industry. Intense price competition can create pressures for cost minimisation that may be in conflict with quality upgrading and compliance with international standards; a manufacturing plant can produce more goods at a quicker, more resource effective, cheaper way however the overall quality of the good being sold can start to slip. This can act as a constraint to cluster development because firms enter a 'race-to-the-bottom' of ever decreasing prices through competition. So, there must be a way to assure that in manufacturing, quality is also rising alongside productivity.

Another key mechanism of constraint is the factor market constraints; one issue within this is the labour market, there are consistent skills mismatches, underemployment and other labour rigidities which must be minimised. These types of labour market frictions, reduces productivity within clusters. There also exists the problem of 'brain-drain', where the best and brightest leave to pursue what they see as better options abroad. They may increase finance through remittances, however in order to utilise the clusters to gain positive externalities and other associated knowledge spill-over effects, the clusters must employ high skilled employees. This avoids issues of longer term limits in terms of production upgrades and high value manufacturing. Fernando et al. (2021) undertake a seminal quantitative analysis on the constraints of cluster development in several clusters in Sri Lanka, they find that the growth of clusters is biased by gender and education and conclude that the lack of access to formal financing sources creates a finance gap. Finance is needed for SMEs to grow and its absence hinders growth. Female labour segmentation affects wage structure and inclusion negatively and there should be measures to ensure this does not persist.

Capital and credit constraints limit firm entry and scaling, preventing the density required for agglomeration economies to emerge. SMEs can cluster, given incentives and infrastructure facilities; closing SME financing gaps can lead to greater output and innovation. This is supported by Sonobe and Otsuka (2006), which discusses the need for additional innovation in industrial clusters to facilitate growth, which could be supported through innovation systems, R&D, technology diffusion, and university–industry linkages. Additional development come through "upgrading product quality, production organization, and marketing methods". Thus, it is fair to say that financial constraints exist especially for SMEs within clusters (Corredera-Catalán et al., 2021) which may be further affected by regulatory uncertainty and policy inconsistency through weak governance. The critics to this type of innovation led for growth, make the argument that whether to pursue pure financial investment versus investment into innovation, depends on a countries stage of development (Acemoglu et al., 2006). Sri Lanka may still rely more on capability accumulation and process upgrading rather than innovation, which shapes the type of clustering that emerges. The investment strategy is different because there is less capacity for capital expenditure into R&D, thus changing the type of investment too early, limits long term investment into capacity and capability. Thus investment, infrastructure and logistics bottlenecks may limit cluster development.

Clustering depends on spatial and geographic constraints. For example, if there is no land availability or the land cannot be used to advance the cluster, then growth is limited. Some regions suffer from issues associated with complex land availability and zoning. Additionally, infrastructure and factor input constraints mean that there can be limited resources for business to share leading to greater competition and lack of clustering. Frequent issues can arise in transport, energy, logistics. Another associated issue to land usage and infrastructure is the actual historical lock-in in the garment industry.

This effect was actually tested and found in this paper; we can see the statistical significance of the lagged clustering as a measure of current clustering as well as the dominance of the historic centre in the western Province (Colombo). Thus, historical infrastructure concentration can lead to current EPZ placement, which is not necessarily the best case scenario for cluster placement as it can cause inefficiencies. Once clusters form, they attract more firms this leads to reinforcing and propagating concentration which further limits spatial diffusion.

There can be constraints arising from institutional and policy inefficiencies, one example is the quality of governance at both the local and national level. Alkon (2018) suggest a possible reason for lack of developmental spillovers is due to "incentive structures facing local politicians" which can undermine the effectiveness of policy; thus, focus must be in place to reduce corruption and increase governance. Weak institutional capacity may undermine cluster development through inconsistent policy implementation, rent-seeking in land allocation, and ineffective coordination between public agencies and private firms. These types of regulatory uncertainty and policy inconsistency limit business willingness to cooperate as the risks of cooperation rises. Finally, there are external and global constraints to cluster development, these persist through trade shocks and demand volatility. These persistent external risks affect macroeconomic instability, which cannot be easily overcome as these are issues facing all countries, also the possibility of greater climate impacts in the future.

Summary of the main constraints to developing clusters and capturing the benefits:

1. Labour markets: labour mismatches, brain drain
2. Capital markets: SME financing gaps
3. Spatial factors: infrastructure and land
4. Institutional factors: governance and policy consistency
5. External factors: global demand and climate risks
6. Data factors: limits empirical identification

7

Policy and research implications

The empirical analysis indicates that garment clustering is neither accidental nor entirely market driven. Instead, cluster formation reflects the interaction between historical industrial development, policy interventions and spatial economic fundamentals. Accordingly, policy should focus on strengthening these underlying determinants rather than attempting to relocate firms administratively. Given the evidence on garment clustering, and the analysis of the constraints in Section 6, what targeted and feasible policies can improve cluster performance, and are there any trade-offs? The policy recommendations presented here should be treated with caution given the limitations of the empirical analysis, thus the policies are informed both by the empirical findings and the broader literature on cluster development, rather than being solely derived from the econometric results in Section 4.

The econometric results provide the strongest support for policies that influence the spatial determinants of industrial location particularly EPZs, transport infrastructure and the persistence of existing industrial agglomerations. Whilst the wider policy recommendations build upon these findings using evidence from the broader cluster development literature. The main macro concerns identified in 2025 for the growth of Sri Lanka by the Executive Opinion Survey of the World Economic Forum (WEF, 2025) were:

1. Labour and/or talent shortage
2. Economic downturn (e.g. recession, stagnation)
3. Public debt
4. Poverty and inequality (wealth, income)
5. Inflation

So, given these macro risks and the above section 6; constraints to cluster development, what policies can be implemented to solve these risks and increase sustainable growth and development? First and foremost, it must be noted that data is scarce; understanding, measuring, data are essential to being able to solve problems. Which leads directly to macroeconomic and political stability, which acts as a necessary but not sufficient factors behind a growing economy. These need to be complemented by more targeted policies and strategic cluster policy. Policy makers, in addition to financing and gathering data, must focus on increasing transparency in order to reduce uncertainty, this enables reduction in volatility. This has the effect of strengthening the integrity of the political system, such that signals and policy expectations act in a positive and expected way.

The empirical findings also suggest differentiated regional policy. Provinces with high dependence upon garment employment may require targeted adjustment support during periods of external demand shocks. Temporary labour programmes, SME financing, local infrastructure can reduce regional vulnerability while allowing industrial restructuring to occur gradually. One possible cluster policy goal could be specifically on decentralising industrial growth, allowing for the growth of underutilised hubs such as clusters in Trincomalee and Hambantota. With top-down planned clusters, there can be improvements to trade, logistics, jobs around the country enabling the transition to middle-income. In order to utilise these hubs, there must be a coherent governance and consensus-building framework, which can exist at the city level but with formal coordination through central government i.e. performance monitoring in place. This should foster a culture where private-public partnerships are facilitated, so collaboration can occur between government, academia and private business to drive research, innovation and technological advancements.

There has been a recent boom in Asian economies, some economists such as Reda et al. (2025) believe this is due to their industrial policy. Due to the capacity for an expansionary manufacturing base, these countries are focusing on innovation and technology transformation in the manufacturing industry (with some shift towards service sector). This type of transition offers an example for developing countries, and specially manufacturing dependent countries to specialise and advance. Birdsall (2025) argues that the primary reason for explosive productivity growth was growth policies, investment in human capital, export focus arguing that Industrial policy programs only work when there is political and macroeconomic stability. However, as some regions grow and transform, there is the capacity for other countries to fill the gap left behind. As Dr. Wignaraja asserted (LKI, 2017), Sri Lanka can take advantage of international trade and global supply chains to fill gaps left by China's evolution to a technology exporter. Perhaps a lesson to be learned is to take the knowledge of EPZ and IP and to attract manufacturing of different types of goods, to decrease the independence on garment exports. However, whilst Chinese development zones provide useful lessons, the institutional and fiscal differences limit direct policy transferability.

The findings indicate that EPZ presence has a statistically significant relationship with clustering, suggesting that spatial industrial policy continues to shape firm location decisions alongside market forces. However, the findings do not imply that the government can create successful clusters irrespective of market forces. Rather, they suggest that policy and market incentives interact. Firms ultimately respond to profitability, labour availability and access to markets, however government will policy influence these incentives. Cluster policy should therefore be understood as shaping rather than replacing market-driven agglomeration. Cluster development in Sri Lanka must begin with identification of necessary land uses, which result in effective zoning and SEZ/EPZ reforms. This enables incentives to invest into industrial zones, but not just focused on the largest companies, ensuring there is also positive spillover effects for SMEs. This includes expanding industrial land use through industrial parks and EPZs on the peripheries of major cities, while strengthening rural–urban connectivity via roads, bridges and integrated logistics networks to link communities with key economic hubs. Future zone development should also diversify the industrial activities hosted within existing EPZs and SEZs. Rather than specialising exclusively in garments, zones could increasingly accommodate logistics, electronics assembly, business services, etc. Such diversification reduces concentration risk while preserving existing agglomeration economies. Thus, in addition to increasing EPZs and expanding industrial/textile parks, there can be zone upgrading through strengthening of backward linkages to domestic firms and ensuring infrastructure/input reliability. There can also be a greater integration of SMEs into supply chains; facilitating access to finance through better loans for SMEs can accelerate structural transformation, by increasing their productive capacity which enables firms to exploit economies of scale and resource efficiencies. However ineffective SME support may lead to reductions in efficiency compared to larger firms.

Long run transformation policies

Therefore, one type of long run transformative policy is to actively diversify. The findings of this paper show that garment firms prefer existing hubs (Colombo, Western Province) indicating possible path dependencies. Thus, there can be a major drive for shifting clusters to North/East (e.g. Trincomalee). However, attempts to force decentralisation can fail; spatially redistributing industrial activity must account for agglomeration advantages already present in established clusters, decentralisation may reduce the agglomeration efficiency. Thus, instead of moving whole clusters, deliberate infrastructure investments can be done in order to support weaker areas. Transport, communication and energy infrastructure improvements in the North and East of the country can promote development of industrial manufacturing that is predominantly happening in the west.

The empirical analysis demonstrates that transport infrastructure is positively associated with garment clustering. Consequently, infrastructure investment should be viewed not merely as regional development policy but as a mechanism through which government can invest to lead to real, measurable effects. With macroeconomic investment comes better urban transport, more affordable housing, green infrastructure investment and climate adaptation measures which are necessary for full middle income transition. To this end, subsidies, cheaper loans or tax reductions but can be used as strategic signalling on investment priorities, (Hove, 2024) to encourage private business investment rather than purely public government funded. By doing this, the incentive for R&D expenditure increases as there is the expectation that support will continue meaning that there is a reduction in risk due to government signalling. This intangible nature is one of the many things which government can easily address. Tailored growth plans for strategically important regions ensure cluster expansion which prioritise coordinated support for R&D and innovation alongside substantial investment in transport, utilities where necessary. However, this becomes more complicated when considering business investment and R&D within clusters, as Barrios et al. (2003) assert, the policy priority should

lean towards technology adoption, process upgrading, and capability building, rather than R&D alone. This means that there will be boosts performance and outputs, which raises competition but due to the nature of clusters, there is often knowledge spillovers which means that there can be reluctance to invest heavily due to first-mover disadvantage as people can take advantage of inefficiencies.

A further policy direction is investment in human capital, which supports sectoral transformation. There must be an increase in the quality of labour through improvements in labour productivity, this can come from an increase in skills and training, coming from quality education. Thus, there is the need for education and training to develop the skills to create the human resource base which supports a competitive and rapidly modernising economy. The government can play a large role in regional economic clusters, first to identify capacity for successful clusters, then to act as a catalyst through regional innovation hubs which take advantage of the growth opportunities and leverage the scarce resources. To achieve transformation, there must be entrepreneurial innovation which can come through the productivity spillovers associated with these innovation hubs as they attract venture capital. In this context, clusters are a self-perpetuating bubble of endogenous technological change.

The government's role is to aid innovation by creating the skills, development and vocational training; by encouraging business and entrepreneurial cooperation and competition, fostering the environment of strong labour market, which attracts skilled foreign workers as well as incentivise the upskilling of domestic population. This leads to benefits of labour pooling and better skill matching, these workforce mobility policies act to combine into poverty reduction policies. As an export-oriented economy, having stagnating wages can cause a decrease in costs and thus a short term increase in exports but at the expense of longer term productivity gains, thus long term growth. Skilled labour must be compensated or a region will suffer from brain-drain, retention requires not only higher wages but also credible career progression and firm-level upgrading. Ineffective wage increases may lead to reductions in competitiveness, at both the local and national levels. The future workforce must grow sustainably to provide opportunities, but not just in quantity but also quality, if this necessity for higher-skilled, higher-wage jobs is not met, then countless highly skilled workers may emigrate.

Future Research

Based on the findings, there are immediate areas of further study. Future research should deepen the understanding of cluster dynamics in Sri Lanka by further examining their impacts on social mobility, labour markets, and spatial inequality. The major gap for this type of clustering paper in Sri Lanka is the lack of open source micro level firm data. With this type of data, we can do better quantitative and econometric analysis; firm level survey analysis, within-city spatial clustering, innovation spillover measurements. In addition to this, future research can look more closely at how clusters shape social and economic outcomes, particularly in relation to climate risks and the shift toward greener production or for inequality exasperation. Greater attention is also needed on how clusters are governed and financed in practice, comparative work with micro data across clusters within Sri Lanka, would further strengthen the evidence base and help refine policy design. Key questions remain regarding whether clusters function as substantive economic zones or merely analytical labels, how these systems will evolve in the context of digital transformation, automation and AI, particularly for labour-intensive manufacturing sectors over the coming decades.

Policy pathways

Sustainable cluster policy must be designed to integrate infrastructure investment, skills development and innovation ecosystems in order to effectively leverage the positive externalities associated with clustering. The proposed steps for effective cluster policy are:

1. Improve data transparency & availability
2. Reduce macroeconomic & regulatory volatility
3. Provide better access to finance
4. Labour market & employment policy
 - Education & skills investment
 - Technical training incentives
 - Rural workforce upgrading
5. Targeted industrial/innovation policy
 - Incentivise textile park development
 - Strengthen BOI investment mechanisms
 - Innovation through R&D / Infrastructure upgrading
6. Green transition
 - Renewable energy incentives
 - Cleaner production

8

Conclusion

This paper examined the drivers of garment clustering across Sri Lankan districts using panel data. The results indicate that spatial concentration persists, with clustering remaining highly concentrated in the Western and North-Western regions, with some emerging expansion into Sabaragamuwa since Covid. The Northern region experienced the greatest relative change, signalling potential future investment opportunities. The econometric analysis suggests that lagged clustering and EPZs are significantly associated with clustering, while infrastructure through road networks show weaker or inconsistent relationships. The results suggest that clustering is persistent and new regions emerge slowly which indicates strong path dependence in Sri Lanka's garment sector, with historical concentration in the Western Province continuing to shape current spatial patterns. Past EPZ policy has also had a significant effect on clustering.

The benefits of cluster policy depend upon its implementation; how much of an essential policy do central and local government make them. By laying the foundations, business and investment will come, but, investment in human capital is key; by investing in education and training, good governance, jobs and entrepreneurship follow. This creates the capacity for growing businesses, a growing country, infrastructure investment. Human capital development is widely associated with long-run growth and may play a key role in enabling cluster upgrading. This study is subject to several limitations; the analysis relies on province-level data, which may not fully capture the localized nature of industrial clusters due to the lack of publicly available firm data. Additionally, the observational nature of the panel regression limits causal interpretation, as some explanatory variables may be endogenous to clustering outcomes. As a result, the findings should be interpreted as associations/correlations rather than definitive causal drivers.

Clusters increase output and growth in regions through concentrating production which can lead to a concentration in wealth. This can exacerbate regional inequality and lead to greater poverty, labour segmentation, limited SME access if not addressed properly. Sustainable growth also includes climate resilience; by increasing greener and cleaner energy inputs, Sri Lanka is more energy secure, better off, wealthier. A sustainable cluster policy must integrate; infrastructure investment, skills development, innovation ecosystems and a green transition. The central question is whether Sri Lanka can move beyond historically determined patterns of garment concentration toward a more intentional cluster strategy informed by evidence on productivity, spatial inequality, and structural constraints.

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Appendix

Other key clusters

In modern Sri Lanka, spatially concentrated industrial clusters act as a locus of economic activity thus further proliferating geographic concentration. Mapping the industry spread over several key clusters allows for a greater degree of specificity and thus analysis. Below are some key clusters both new and old. Firstly, there is the agriculture and Agri-processing, textile-garment, port and maritime logistics/services, Tourism and hospitality and the digital/IT.

To first consider the well-documented agricultural and Agri-processing clusters which are, involved in tea, rubber, coconut, cinnamon, spices etc. they are highly concentrated in rural regions, often focused around historical estate/plantation groupings. This type of cluster creates a crucial supply of jobs for rural employment and poverty reduction this includes growing, processing, distributing. Agriculture remains structurally essential to rural livelihoods, with a goal to move up in the value chain i.e. farming, processing, exporting. This shift from only raw commodity exports toward higher-value processing is essential for longer term development. With this increase in development comes the opportunity for branding i.e. these agricultural commodities are grown and developed in Sri Lanka. This should result in increased notoriety which can fund increases in supply-chain modernisation, and general productivity enhancement as workers and the cluster as a whole upskills. These rural areas are the most exposed to climate shocks so there should be a major focus on investment into climate resilience i.e. irrigation modernisation.

A recent, emerging cluster is the rapidly growing IT/digital bubble in central Colombo, exhibiting dynamic urban agglomeration. The growing Digital-IT cluster is essential in most capital cities in most countries; it provides the back bone for national infrastructure in the digital space. This is an essential part of everyday life for most, and as time goes on will become increasingly important. There will be a crucial tipping point whereby those left behind will suffer detrimentally in the long term. This cluster exhibits a comparative advantage in relatively strong human capital formation, with universities, technical institutes and think tanks as accelerators in knowledge. By focusing on education and training, this will result in higher value jobs in Sri Lanka which will also attracting foreign capital and labour. However, the constraints to developing this cluster are large, how best to increase competitiveness, skills whilst competition struggles.

Sri Lanka has several key ports; Colombo, Hambantota, Trincomalee, etc. these exist firstly as regional shipment hubs for shipping, freight, warehousing, existing in strategic location on major East - West shipping lanes. As Sri Lanka exists on the shipping lanes, it should position itself as a gateway by facilitating and financing itself as a transport hub. Thus, this port cluster should be reimagined as a logistics corridor. This then has great potential not just for growth, but for dominance, by using the advantage of location and by developing logistics can become the definitive port of South Asia. Given Sri Lanka's strategic location along critical sea lanes and there is the ability to exert influence over trade in the region; 80% of international trade volume is carried by sea. United Nations Trade and Development (UNCTAD). (2021). Review of Maritime Transport 2021. There are constraints to further development in capital and infrastructure, Sri Lanka can use its position in the global markets, for value addition and developing the capacity to extend the services offered. For instance, the focus on services upgrading and corridor integration rather than just expansion, creating routes for maritime finance

Tourism as a city cluster is an interesting study, all countries have tourism to varying degrees and all cities have tourism to varying degrees. Under the assumption that tourism is a good thing (issues of over-tourism in cities such as Amsterdam, Barcelona or Venice), a nations purpose should then be to

attract the maximum amount of people inwards as well as capturing greater benefits from each visitor. From that point, it is difficult to quantify the type of dispersal within a country. Tourism is clustered due to several towns and cities catering specifically to this type of sector, this means heavy spatial concentration of services. For most, Colombo acts as a gateway city, as tourists filter through, to other places in Sri Lanka. There is the opportunity for different types of tourism, whether it be through Ayurveda, healing & wellness type tourism, or a more cultural focused tourism, or the business MICE tourism. This enables localised services to that specific part of the tourism cluster. The goal is then to increase positive spillovers and decrease negative externalities of overtourism, this means higher-value sustainable tourism.