

**Upgrading Trajectories in South Africa:  
Exploring the Roles of Customer and  
Supplier Link Types in Manufacturers'  
Economic, Social and Environmental  
Upgrading**

**Rachel Alexander and Aarti Krishnan**

SARChI Industrial Development Working Paper Series

WP 2023-09

August 2023



**Upgrading Trajectories in South Africa:  
Exploring the Roles of Customer and Supplier Link Types in Manufacturers' Economic,  
Social and Environmental Upgrading**

DSI/NRF SOUTH AFRICAN RESEARCH CHAIR IN INDUSTRIAL DEVELOPMENT

**Rachel Alexander and Aarti Krishnan**

SARChI Industrial Development Working Paper Series

WP 2023-09

ISBN 978-0-6398363-6-2

August 2023

### About the South African Research Chair in Industrial Development (SARChI-ID)

The DSI/NRF South African Research Chair in Industrial Development conducts research, builds capacity and undertakes public and policy engagement in the field of industrial development. Activities focus on research projects; training and supervision of graduate students; hosting postdoctoral fellows and research visitors; and various projects, often in conjunction with partners, such as conferences, workshops, seminars, training courses, and public and policy engagements. SARChI Industrial Development is hosted at the University of Johannesburg, where it operates as a centre located in the College of Business and Economics.

### Funding acknowledgement

The South African Research Chairs Initiative (SARChI) was established in 2006 by the then Department of Science and Technology (DST), now known as the Department of Science and Innovation (DSI), and the National Research Foundation (NRF). The Chairs are designed to attract and retain excellence in research and innovation at South African public universities. The funding support of the DSI and the NRF through Grant Number 98627 and Grant Number 110691 for the South African Research Chair in Industrial Development has made this working paper series possible.

### Recommended citation

Alexander, R. and Krishnan, A. (2023). Upgrading Trajectories in South Africa: Exploring the Roles of Customer and Supplier Link Types in Manufacturers' Economic, Social and Environmental Upgrading. SARChI Industrial Development Working Paper Series WP 2023-09. SARChI Industrial Development, University of Johannesburg.

### Disclaimer

The Working Paper series is intended to stimulate policy debate. Working papers express the views of their respective authors and not necessarily those of the South African Research Chair in Industrial Development (SARChI-ID), the University of Johannesburg (UJ), the Department of Science and Innovation (DSI) or the National Research Foundation (NRF).

Working Papers can be downloaded from <https://www.uj.ac.za/faculties/college-of-business-and-economics/schools/school-of-management/south-african-research-chair-in-industrial-development/working-paper-series/> in PDF (Adobe Acrobat) format.

## Abstract

This study explores determinants of firms' economic, social and environmental upgrading and downgrading trajectories in South Africa, with a focus on the manufacturing sector. Specifically, it considers connections between firms' buyer and supplier relationships and their upgrading outcomes. Data is drawn from the World Bank Enterprise Surveys of 2007 and 2020 and analysed using social network and econometric analysis.

**Keywords:** production, cost, capital, total factor and multifactor productivity, capacity, transactional relationships, contracts and reputation, networks, industry studies: manufacturing, wages, compensation and labour costs, environment and development, environment and trade, sustainability, environmental accounts and accounting, environmental equity, population growth

**JEL codes:** D24, L14, L60, J30, Q56

## About the Authors

**Rachel Alexander**, Copenhagen Business School & University of Johannesburg

E-mail: [ral.msc@cbs.dk](mailto:ral.msc@cbs.dk)

**Aarti Krishnan**, University of Manchester

E-mail: [aarti.krishnan-2@manchester.ac.uk](mailto:aarti.krishnan-2@manchester.ac.uk)

## Acknowledgements

Support for this research was received under the project 'Community of Practice in Industrialisation and Innovation' (grant number 110691), hosted by the DSI/NRF South African Research Chair in Industrial Development (grant number 98627), University of Johannesburg. In addition, we thank the Enterprise Analysis Unit of the Development Economics Global Indicators Department of the World Bank Group for making the data available.

## Table of Contents

List of Tables .....	v
List of Figures .....	vi
1. Introduction.....	1
2. Background and Context .....	2
2.1 Upgrading in Value Chains .....	3
2.2 Network Governance in Value Chains.....	4
3. Research Design and Methodology.....	5
3.1 Data Collection and Methodology Used .....	5
3.2 Data Analysis .....	6
3.2.1 Measuring upgrading and downgrading.....	7
3.2.2 Measuring governance links .....	10
3.3 Limitations.....	13
4. Sectoral and Manufacturing Sub-Sector Upgrading and Downgrading Trajectories.....	13
5. Relationship between Governance Links and Upgrading or Downgrading .....	17
5.1 Existence of Links .....	17
5.1.1 Customer links .....	17
5.1.2 Supplier links.....	20
5.2 Strong Links and Upgrading or Downgrading .....	23
5.2.1 Strong customer links .....	23
5.2.2 Strong supplier links.....	26
5.3 Global- versus Domestic-Led Links.....	29
5.4 Heterogeneity of Links .....	31
6. Trajectories of Upgrading and Downgrading across Time: Changes in Governance Links	33
6.1 Changes in the Existence of Links .....	33
6.2 Changes to the Extent of Links.....	38
7. Discussion and Conclusion .....	41
7.1 Patterns in Upgrading within Sectors and Manufacturing Sub-Sectors .....	41
7.2 Relationship Between Governance Links and Upgrading.....	42
7.3 Relationship Between Changes in Governance Links and Upgrading.....	45
7.4 Areas for Further Research .....	46
7.5 Implications .....	46
References .....	47

Annexure A: Supplementary Data .....	51
Annexure B: Link Heterogeneity and Sub-Sector Upgrading Trajectories.....	59
B.1 Network Governance and Economic Upgrading.....	59
B.2 Network Governance and Social Upgrading.....	62
B.3 Network Governance and Environmental Upgrading.....	65

## List of Tables

Table 1: Upgrading indicators.....	9
Table 2: Measures of link existence.....	11
Table 3: Domestic-led and global-led links .....	12
Table 4: Measures of heterogeneity.....	12
Table 5: Measures of changes in links .....	13
Table 6: Connections between the existence of manufacturers' 2007 customer links and upgrading levels in 2007 .....	18
Table 7: Connection between the existence of manufacturers' 2020 customer links and upgrading levels in 2020 .....	19
Table 8: Connections between the existence of manufacturers' supplier links in 2007 and upgrading levels in 2007 .....	21
Table 9: Connection between the existence of manufacturers' supplier links in 2020 and upgrading levels in 2020 .....	22
Table 10: Connections between strong customer links for manufacturers in 2007 and upgrading levels in 2007 .....	24
Table 11: Connection between strong customer links for manufacturers in 2020 and upgrading levels in 2020 .....	25
Table 12: Connections between strong supplier links for manufacturers in 2007 and upgrading levels in 2007 .....	27
Table 13: Connections between strong supplier links for manufacturers in 2020 and upgrading levels in 2020 .....	28
Table 14: Connections between domestic-led links for manufacturers in 2007 and upgrading levels in 2007 .....	29
Table 15: Connections between domestic-led links for manufacturers in 2020 and upgrading levels in 2020 .....	30
Table 16: Connections between global-led links for manufacturers in 2007 and upgrading levels in 2007 .....	30
Table 17: Connections between global-led links for manufacturers in 2020 and upgrading levels in 2020 .....	31
Table 18: Level of heterogeneity of manufacturers' links in 2007 .....	31
Table 19: Level of heterogeneity of manufacturers' links in 2020.....	32
Table 20: Correlation between heterogeneity of manufacturers' links and upgrading or downgrading in 2007 .....	32

Table 21: Correlation between heterogeneity of manufacturers' links and upgrading or downgrading in 2020 .....	32
Table 22: Correlation of changes in link existence for manufacturing sub-sectors and upgrading trajectories.....	37
Table 23: Changes in link strength for manufacturing sub-sectors and upgrading trajectories .....	41
Table 24: Summary of key findings.....	43
Table A1: Sectoral upgrading trajectories from 2007 to 2020 .....	51
Table A2: Averages for sub-sector link existence in 2007 and 2020 .....	52
Table A3: Changes in sub-sector average link existence and upgrading trajectories from 2007 to 2020 .....	53
Table A4: Averages of sub-sector link strength in 2007 and 2020 .....	56
Table A5: Changes in average sub-sector link strength and upgrading trajectories from 2007 to 2020 .....	57
Table B1: Clusters of relationships between link heterogeneity and quality.....	60
Table B2: Clusters of relationships between link heterogeneity and economic efficiency ....	61
Table B3: Clusters of relationships between link heterogeneity and job security.....	63
Table B4: Clusters of relationships between link heterogeneity and wages paid.....	64
Table B5: Clusters of relationships between link heterogeneity and energy efficiency .....	66

## List of Figures

Figure 1: Industry value added 2019 .....	2
Figure 2: Economic growth in South Africa .....	3
Figure 3: Sectoral upgrading trajectories from 2007 to 2020 .....	14
Figure 4: Manufacturing sub-sector upgrading trajectories from 2007 to 2020 .....	16
Figure 5: Changes in manufacturing sub-sector customer links between 2007 and 2020 .....	35
Figure 6: Changes in manufacturing sub-sectors supplier links between 2007 and 2020 .....	36
Figure 7: Extent of manufacturers' customer link changes between 2007 and 2020.....	39
Figure 8: Extent of manufacturers' supplier link changes between 2007 and 2020.....	40
Figure A1: Relationship between a change in the number of links to global buyers and social upgrading (job security) .....	54
Figure A2: Relationship between a change in the number of links to global buyers and environmental upgrading (energy efficiency) .....	54
Figure A3: Relationship between a change in the number of links to global suppliers and social upgrading (job security) .....	55
Figure A4: Relationship between a change in the number of links to foreign technology suppliers and social upgrading (job security) .....	55
Figure A5: Relationship between a change in the strength of links to domestic suppliers and social upgrading (job security) .....	58
Figure A6: Relationship between a change in the strength of links to global suppliers and social upgrading (job security) .....	58

## 1. Introduction

South African firms face challenges in relation to upgrading economically, socially and environmentally in a context in which their relationships are changing, including the development of increasing connections to global value chains (Mondliwa et al. 2021; Tregenna and Tsela 2012). A key factor in connection with the country's limited upgrading potential that has been identified by previous research is the nature of firms' governance systems (Alford and Phillips 2018). To help create a better understanding of upgrading challenges, this study explores the connections between network governance = and economic, social and environmental upgrading. Drawing on the definition by Coe et al. (2008), network governance is defined in this paper as pressures originating from a firm's relationships with other actors (e.g., buyers, government, civil society, sub-contractors) that shape the firm's behaviour and experiences. Focusing on South African firms, this study explores the key question: 'how does network governance connect to economic, social and environmental upgrading?' Importantly, by focusing specifically on firms' buyer and input supplier relationships, the study is able to provide a nuanced analysis of the implications of commercial relationships on upgrading and to explicate which types of network governance structures are connected to higher levels of upgrading.

To explore buyer and supplier relationships, we use data from the World Bank Enterprise Surveys (WBESs) of 2007 and 2020 (World Bank 2007, 2020). We first consider cross-sectoral dynamics, and then zoom in on the manufacturing sector. We focus on manufacturing because growth in manufacturing has been seen as a key driver of developing countries' economies (Andreoni et al. 2021; Tregenna 2008). Specifically, to answer the main research question, we ask three sub-questions. The first sub-question is 'what are the upgrading or downgrading trajectories of South African firms?' The second is 'to what extent do manufacturing firms' network links (governance) have connections to upgrading or downgrading?' The third is 'are *changes* in manufacturing firms' network links (governance) connected to upgrading trajectories?'

The findings are developed by drawing on social network and econometric analysis. The study generated several key findings. One finding is that, from 2007 to 2020, South African firms in manufacturing, construction, and wholesale, retail trade and repairs<sup>1</sup> experienced economic downgrading, mixed outcomes for social upgrading (a slight increase in job security and a decrease in wages paid), and environmental upgrading. Hotels and restaurants had the same pattern, except they showed a high increase in one of our measures of economic upgrading (output per worker) and a small amount of environmental downgrading. Another key finding is that global links are associated with elements of upgrading across economic, social and

---

<sup>1</sup> The category is called 'wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods'.



environmental dimensions, and local links are associated with higher job security. In addition, being connected to more diverse sets of buyers and suppliers is associated with economic and environmental upgrading and mixed results for social upgrading (reduced job security and higher wages). The body and annexures of this report provide multiple types of analysis that demonstrate these connections.

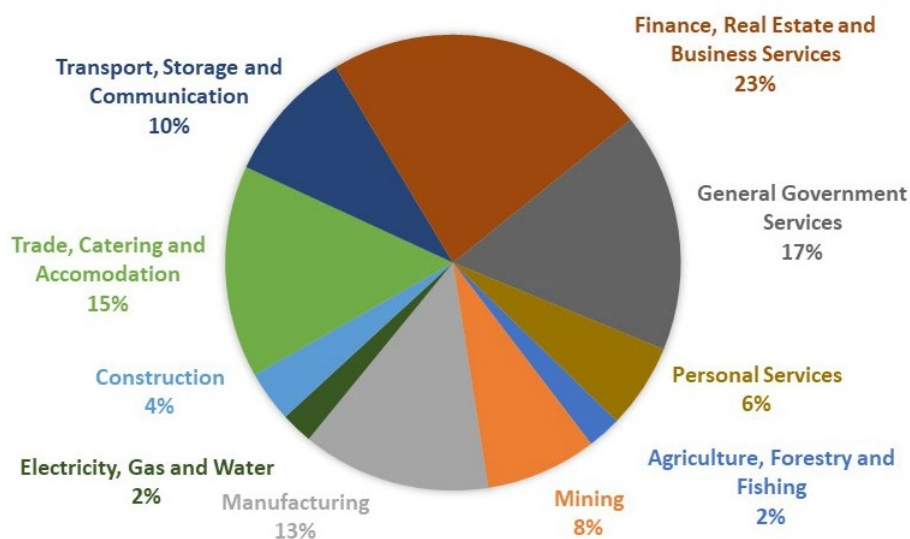
A significant contribution of this study is that it provides a novel way to measure and map network governance drawing on social network analysis. This enables an understanding of the extent to which upgrading or downgrading are connected to network governance, thus providing insightful empirical findings. Furthermore, it is one of the first studies that simultaneously unpacks economic, social and environmental upgrading and downgrading trajectories in South African manufacturing.

The rest of this paper proceeds as follows. Section 2 provides background and contextual information about South Africa's economy and the concepts used in this study. Section 3 outlines the research design and methodology. Sections 4, 5 and 6 present empirical findings related to each sub-question, while Section 7 provides a discussion and conclusion.

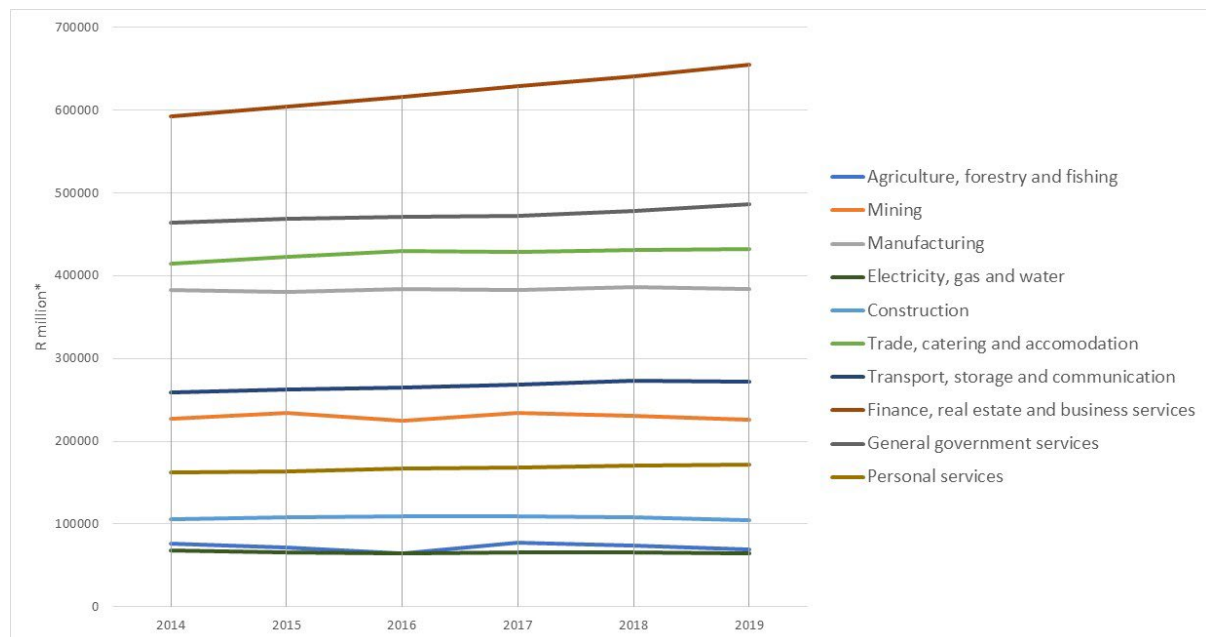
## 2. Background and Context

South Africa is one of the largest economies in sub-Saharan Africa. The industries contributing the most value to GDP are finance, real estate and business services; general government services; trade, catering and accommodation; manufacturing; transport, storage and communication; and mining (see Figure 1). The industries that have seen positive growth since 2014, in terms of value, are manufacturing; trade, catering and accommodation; transport, storage and communication; finance, real estate and business services; general government services; and personal services (see Figure 2).

**Figure 1: Industry value added 2019**



Source: Stats SA (2020)

**Figure 2: Economic growth in South Africa**

Source: Stats SA 2020; \* constant 2010 prices, seasonally adjusted and annualised

Across its economy, South Africa faces diverse challenges, such as high unemployment and falling wages (Naidoo and Vanek 2020) and increases in carbon emissions (Karombo 2020). One way that these challenges can be combated is through firm upgrading (Ponte 2020). Upgrading is often conceptualised as taking place within value chains or production networks. These systems, value chains and production networks, include a set of firms and actors (e.g., governments, civil society) involved in producing a product, from initial production to last mile delivery and consumption (Gereffi et al. 2005; Henderson et al. 2002).<sup>2</sup> Much of past research on upgrading in value chains has focused on the impact of lead firms on their suppliers and neglected other types of firms and relationships (Alexander 2022; Murphy 2012). The current study contributes to filling this gap by looking more deeply at how a variety of types of actors shape firms' upgrading experiences. The paper represents an attempt at unpacking upgrading implications connected to firms' diverse and often overlapping relationships.

## 2.1 Upgrading in Value Chains

Early conceptions of upgrading in value chains focused on economic perspectives, with Gereffi (1999) defining the process as moving to higher value-added activities. Now there are three commonly discussed types of upgrading. First, economic upgrading, which has been considered as having four forms: process – adopting improved production methods; product – developing more sophisticated outputs; functional – adding new functions such as packaging or abandoning old functions; and intersectoral – moving into new areas (Humphrey

<sup>2</sup> Each term has been associated with different research approaches in the extant literature. In the rest of the paper we use the term 'value chains'.

and Schmitz 2002). Secondly, social upgrading, which has been considered in terms of measurable aspects (e.g., skill, wages, permanency of employment, working hours) and enabling rights (e.g., freedom of association) (Barrientos et al. 2003). Thirdly, environmental upgrading, which has been defined as a change in production systems, moving towards more environmentally friendly products and processes (De Marchi et al. 2013), or “a process by which actors modify or alter production systems and practices that result in positive (or reduce negative) environmental outcomes” (Krishnan 2017:117).

Research exploring the dynamics of economic (e.g., Sako and Zylberberg 2019; Schmitz 2006) and social (e.g., Lee and Gereffi 2013) upgrading has been growing, and researchers have begun to consider the links between these dimensions of upgrading (e.g., Barrientos et al. 2011; Bernhardt and Milberg 2011). However, environmental upgrading, in particular, has been researched insufficiently (De Marchi et al. 2019), with only a few papers that have begun to explore this topic (e.g., Krishnan and Foster 2018; Krishnan et al. 2023; Poulsen et al. 2018). Furthermore, the interactions between all three have rarely been considered, but this issue is emerging as an important new direction for research (e.g., Golini et al. 2018; Krishnan 2017; Lund-Thomsen 2022).

## 2.2 Network Governance in Value Chains

Three forms of governance are often discussed in value chain analysis (Gereffi and Lee 2016). The first is private governance. Value chains are often dominated by large buyers, such as multinational retailers (Gereffi 1999), with the rules on how to participate set by these lead firms through explicit standards or private codes of conduct or other forms of power. Supplier firms (often based in the Global South) experience pressure to comply with these rules (Alexander 2020). In addition, in some cases, suppliers play governance roles in shaping the activities of buyers, such as in situations where suppliers are large and powerful firms selling to small buyers (Alexander 2022). The second governance type is public governance, which is explicated in terms of the role of public sector organisations at multiple scales (e.g., regional governments or global institutions) in facilitating or hindering the functioning of value chains (Horner and Alford 2019). This type of governance is often enacted through industrial, agricultural or social policies targeting various actors in the value chain, or through government agencies acting as buyers (Horner 2017). The third governance type is social, linked to how civil society influences actors within value chains (e.g., Mayer and Pickles 2012). Through its focus on buyer and supplier links, this study focuses on public and private governance. Significant research has shown that network governance effects firms’ upgrading pathways (e.g., Alexander 2020; Barrientos 2019; Horner 2017). However, the evidence has primarily been focused on supplier firms in lead firm-supplier relationships, or state-supplier relationships (Raj-Reichert et al. 2022). Furthermore, governance approaches have seldom been quantified within value chain analysis. And when they have been, the focus has typically been on the stability of suppliers’ relationships with their buyers, lead firms’ technical support

in production and sales, and the size of a firm's buyer-supplier network (e.g., Brancati et al. 2017; Glückler 2005; Gulati 1995). This study attempts to use quantitative methods to unpack the implications of network governance (provided by diverse actors) for upgrading.

### 3. Research Design and Methodology

This study measures network governance as a function of firms' social networks, and how these networks are connected to the trajectories of economic, social and environmental upgrading for manufacturing firms. We assess 'connection', rather than impact, because the study is exploratory and does not attempt to show causality. To deepen our understandings of value chain governance, we unpack the interactions and inter-layering of the relationships firms have with private and public value chain actors. Private actors, involved in creating interfirm governance, include suppliers and customers on the global and local scales, and the public actors considered in this study are government agencies as customers.

Network governance can involve diverse elements of firms' networks. For example, it can include connections to financial institutions and investors. However, as noted above, this study focuses specifically on the networks that link firms to their buyers and suppliers. The analysis aims to unpack the connections between links – to different types of buyers (e.g., government, global and local buyers) and to input suppliers upstream in the value chain (e.g., material and technology providers) – and firm upgrading.

#### 3.1 Data Collection and Methodology Used

The main sources of data for this study were two rounds of WBES collected in 2007 and 2020. The WBES 2007 consists of 931 small, medium and large-scale firms. Of these, 673 (72%) were manufacturing firms; 179 (19%) were 'wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods'; 60 (6%) were hotels and restaurants; and the remaining 19 (2%) were 'real estate, renting and business activities', construction and 'transport, storage and communications'.<sup>3</sup>

The WBES 2020 consists of 1 096 firms. Of these, 349 (32%) were manufacturing firms; 336 (31%) were 'wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods'; 217 (20%) were hotels and restaurants; 126 (11%) were construction; 47 (4%) were transport storage and communications; and 21 (2%) were real estate, renting and business activities. Many manufacturing sub-sectors are covered in the available data. The sub-sectors that were included in the largest numbers (three or more firms in both years) are as follows:

- 15 – food products and beverages (111 in 2007; 49 in 2020)

---

<sup>3</sup> Categories are based on ISIC REV 3.1.

- 17 – textiles (17 in 2007; 13 in 2020)
- 18 – wearing apparel; dressing and dyeing of fur (93 in 2007; 44 in 2020)
- 19 – tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (18 in 2007; 5 in 2020)
- 20 – wood and products of wood and cork, except furniture; articles of straw and plaiting materials (25 in 2007; 12 in 2020)
- 21 – paper and paper products (10 in 2007; 13 in 2020)
- 22 – publishing, printing and reproduction of recorded media (18 in 2007; 12 in 2020)
- 24 – chemicals and chemical products (84 in 2007; 25 in 2020)
- 25 – rubber and plastics products (22 in 2007; 24 in 2020)
- 26 – other non-metallic mineral products (8 in 2007; 5 in 2020)
- 28 – fabricated metal products, except machinery and equipment (91 in 2007; 50 in 2020)
- 29 – machinery and equipment not elsewhere classified (n.e.c.) (42 in 2007; 22 in 2020)
- 31 – electrical machinery and apparatus n.e.c. (21 in 2007; 18 in 2020)
- 34 – motor vehicles, trailers and semi-trailers (15 in 2007; 20 in 2020)
- 36 – furniture; manufacturing n.e.c. (91 in 2007; 17 in 2020)

### 3.2 Data Analysis

In order to answer the main research question, ‘how does network governance connect to economic, social, and environmental upgrading?’, this study uses different methods to answer each of the three sub-questions.

*Sub-question 1: What are the upgrading or downgrading trajectories of South African firms?*

- To identify upgrading trajectories, we developed five indicators to explore heterogeneous and dynamic upgrading trajectories across economic, social and environmental dimensions for firms, which are described in Section 3.2.1.

*Sub-question 2: To what extent do manufacturing firms’ network links (governance) have connections to upgrading or downgrading?*

- To explore the governance firms experience based on their network positions, the characteristics of individual firms’ direct connections (ego networks) were identified in relation to customers and input suppliers. Networks were explored using social network analysis, which is a methodological approach that has been seen to have potential for exploring issues in economic geography (Ter Wal and Boschma 2009). The link types that were considered are described in Section 3.2.2.

Sub-question 3: Are changes in manufacturing firms' network links (governance) connected to upgrading trajectories?

- To answer sub-question 3, changes in firms' links over time were considered, i.e., a firm's immediate links with different types of actors in 2007 and 2020. To explore changes over time in relation to this sub-question, we considered the average link characteristics found in each manufacturing sub-sector in each time period.<sup>4, 5</sup>

Multiple data points were considered in exploring answers to these three sub-questions. The main indicators and the methods used to analyse the data are outlined below.

### 3.2.1 Measuring upgrading and downgrading

We used multiple measures for upgrading. The five elements we used, namely Economic: International Recognised Quality Certification (Quality), Economic: Sales per Employee (Efficiency), Social: Proportion of Permanent Workers (Job Quality/Security), Social: Spending on Employees per Employee (Wages), and Environmental: Electricity Use Per Sales Value (Energy Efficiency/Emissions), are outlined in Table 1. These measures represent different aspects of economic, social and environmental upgrading and downgrading.

For economic upgrading, we utilised two commonly used indicators, the first of which is standards (e.g., Barrientos 2019; De Marchi et al. 2019; Ponte 2019). To measure standards, we considered whether firms had been certified by international certification schemes, as collated in the WBESs. The standards include international standards, certifications and private codes of conduct. Some common examples are ISO 140001, ISO 9000, and GlobalGAP. Standards are often used as a barometer to explicate an improvement in processes and products due to adherence to third-party requirements. The second indicator we used is a ratio of annual sales to total employees (e.g., Ivarsson and Alvstam 2011); the higher the values, the more the expected economic upgrading.

We also used two indicators for social upgrading (Barrientos and Smith 2007; Barrientos et al. 2011). The first is the percentage of permanent employees vis-à-vis total employees, which is considered a good indicator of social upgrading, as it represents the percentage of a firm's workforce with job security. In addition, longer term contracts can make it easier for workers to be represented by unions. The second indicator used is the ratio of total labour cost to total employees to create a proxy measure for wages paid. In both cases, higher values of the indicators indicate better possibilities of social upgrading.

---

<sup>4</sup> We considered sub-sectors that had at least three firms in both years.

<sup>5</sup> We did not use the panel data provided by the World Bank that linked firms in each year of the survey due to several coding issues. Instead, we compared individual years' aggregates, which we believe provides a more accurate depiction of firms' experiences.

We used one measure for environmental upgrading, namely energy efficiency. To measure this level, we combined the WBES data with values related to historic electricity costs from Labuschagne (2020). To determine measures of energy efficiency, we utilised a ratio of the total number of electricity units used by a firm to the annual sales.<sup>6</sup> Such an indicator has been used in studies that explore environmental upgrading (e.g., Angelis-Dimakis et al. 2016; Khoshnevisan et al. 2020). In our results, the numbers, that are related to level of energy used, are presented as a negative value, so that a higher number indicates less energy used (i.e., a better environmental performance).

Key steps in the analysis of upgrading were:

1. Calculating firm-level economic, social and environmental upgrading/downgrading in 2007 and 2020.
2. Computing means of manufacturing sub-sector economic, social and environmental upgrading/downgrading in 2007 and 2020 by averaging firm-level data computed in the previous step.
3. Calculating the net values of upgrading/downgrading between 2007 and 2020 for manufacturing sub-sectors.

---

<sup>6</sup> This ratio was multiplied by 10 000 to make it easier to read.

**Table 1: Upgrading indicators**

Upgrading element	Upgrading at single points in time		Sub-sector upgrading trajectories	
	Upgrading indicators	Calculation for upgrading <sup>+</sup>	Trajectory (from 2007 to 2020)	Calculation for upgrading trajectory
Economic: Certification (Quality)	Economic: Certification 2007, 2020	Firm: Binary variable of whether or not firms have certification  Sub-sector: Sub-sector average for 2007, 2020	Economic: Certification trajectory	Difference between 2020 and 2007 sub-sector averages
Economic: Sales per employee (Efficiency)	Economic: Efficiency 2007, 2020	Firm: Ratio of annual sales to total employees (permanent + temporary) by firm  Sub-sector: Sub-sector average for 2007, 2020	Economic: Efficiency trajectory	Difference between 2020 and 2007 sub-sector averages
Social: Proportion of permanent workers (Job quality)	Social: Job security 2007, 2020	Firm: Ratio of permanent workers to total employees (permanent + temporary)  Sub-sector: Sub-sector average for 2007, 2020	Social: Job security trajectory	Difference between 2020 and 2007 sub-sector averages
Social: Spending on employees per employee (Wages)	Social: Wages 2007, 2020	Firm: Ratio of sales to annual spend on employees (permanent + temporary) by firm  Sub-sector: Sub-sector average for 2007, 2020	Social: Wages trajectory	Difference between 2020 and 2007 sub-sector averages
Environmental: Electricity use per sales value (Emissions)	Environmental: Efficiency 2007, 2020	Firm: Ratio of 10 000 x electricity units used (annual spend on electricity units divided by average annual cost of a unit of electricity) to annual sales  Sub-sector: Sub-sector average for 2007, 2020	Environmental: Efficiency trajectory	Difference between 2020 and 2007 sub-sector averages

+ Monetary values in 2020 were divided by 2.02 to account for inflation.



### 3.2.2 Measuring governance links

We considered governance links in two ways. The first is identifying attributes of individual firms' self-reported links. The second is measuring changes to average attributes of links within manufacturing sub-sectors when comparing 2007 and 2020.

#### Attributes of links

We used multiple approaches for measuring links (network governance). These were all based on considering different qualities of relationships with customers (buyers) and suppliers (see Tables 2 to 5). Key considerations were:

- Link existence: The first measure, as can be seen in Table 2, indicates whether a link exists or not. In other words, whether firms are connected to the identified types of downstream actors (customers) and upstream actors (input suppliers). This is a binary variable (yes/no).
- Link strength: Table 2 also shows our measure of strong links, where link strength is understood as the level of dependence or reliance on specific types of actors. Links are considered to be strong if they are over a cut-off point. This cut-off point for each link was calculated inductively based on relative thresholds using the WBES data for 2007 and 2020. This is a common method used to allow for context-specific selection criteria (e.g., Pasquali et al. 2021). This is also a binary variable based on an assessment of whether or not a strong link exists.<sup>7</sup>
- Domestic-led or global-led links: We also consider whether firms' sets of links are domestic-led or global-led (see Table 3). These two related variables are also binary, as they are based on thresholds of the strengths of firms' domestic and foreign links. Considering these variables can help to identify characteristics associated with being in domestic value chains and global value chains.
- Link heterogeneity: Table 4 explicates measures of the heterogeneity of ties. By this, we mean the total number of types of actors to which firms report being connected. This is a count variable.

---

<sup>7</sup> Comprehending the strength of links is important for multiple reasons. One is that strong ties can create possibilities for long-term relationships that engender the transfer of knowledge and promote upgrading (McDermott and Corredoira 2010). However, it is also important to note that there can be benefits to weak ties (Granovetter 1983). Furthermore, developing strong ties with one type of actor at the expense of creating connections to other types of actors can create vulnerability.

**Table 2: Measures of link existence**

Link type	Description of survey data	Link exists variable	Criteria for identifying a link	Strong link variable	Criteria for identifying a strong link <sup>+</sup>
<b>Customers</b>					
L1	2007: Proportion of sales coming from government buyers 2020: Government contract secured in the last year	C_Government2007_Exists, C_Government2020_Exists	2007: Value over 0 2020: Firms reported “yes”	C_Government2007_Strong25 <sup>++</sup>	25% or more
L2	Proportion of sales coming from selling intermediate products and services as inputs in purchasers’ production processes	C_Producers2007_Exists <sup>+++</sup>	Value over 0	C_Producers2007_Strong20 <sup>++++</sup>	20% or more
L3	Proportion of sales going to national buyers	C_Domestic2007_Exists, Domestic2020_Exists	Value over 0	C_Domestic2007_Strong80, C_Domestic2007_Strong80	80% or more
L4	Proportion of sales going to export market, through direct sales or intermediaries	C_International2007_Exists, International2020_Exists	Value over 0	C_International2007_Strong10, C_International2007_Strong10	10% or more
<b>Suppliers</b>					
L18	Proportion of establishment’s material inputs and/or supplies of domestic origin	S_Local2007_Exists, S_Local2020_Exists	Value over 0	S_Local2007_Strong50, S_Local2020_Strong50	50% or more
L19	Proportion of establishment’s material inputs and/or supplies of foreign origin, purchased directly or through intermediaries	S_ForeignMaterials2007_Exists, S_ForeignMaterials2020_Exists	Value over 0	S_ForeignMaterials2007_Strong50, S_ForeignMaterials2020_Strong50	50% or more
L21	Establishment uses technology licensed by a foreign-owned company	S_ForeignTech2007_Exists, S_ForeignTech2020_Exists	Firms reported “yes”	..+++++	--

+ Calculated inductively; ++ 2020 data on government link strength (L1) was not available; +++ 2020 data on producer links (L2) was not available; ++++ 2020 data on producer links (L2) was not available; +++++ data was not available on level of reliance on foreign technology (L21)

**Table 3: Domestic-led and global-led links**

Network profile	Description	Criteria for classifying a firm <sup>+</sup>
Domestic-led links	Strong links to domestic inputs and domestic customers	80% or more sold domestically, and 50% or more dependence on domestic suppliers
Global-led links	Strong links to international inputs and international customers	10% or more sold globally, and 50% or more dependence on foreign suppliers

+ Calculated inductively from the data available

**Table 4: Measures of heterogeneity**

Variables	Description	Calculation
Number of link types: Customers	Count of whether each customer link exists (e.g., government, producers, local and international), with the highest value being 4 for 2007 and 3 for 2020	Firm: Number of customer link types that exist Sub-sector: Sub-sector average for 2007, 2020
Number of link types: Suppliers	Count of whether each customer link exists (e.g., local input suppliers, foreign material suppliers and foreign tech-licensing suppliers), with the highest value being 3 for 2007 and 2020	Firm: Number of customer link types that exist Sub-sector: Sub-sector average for 2007, 2020

### Changes in links over time

After establishing the attributes of individual firms' links, we attempted to unpack how links have changed between 2007 and 2020 at the sub-sector level. This allowed us to comprehend how firms in different sub-sectors have changed their network governance structures over time.

- Change in link existence: Table 5 outlines changes in the existence of sub-sectors' links from 2007 to 2020.<sup>8</sup> These changes are measured for both customers and input suppliers. For these calculations, we considered the average number of links reported by firms in each manufacturing sub-sector in each year.<sup>9</sup> For instance, some links with government have been continued over time, while others have been lost.

<sup>8</sup> Values for L2: Producers were not available for 2020.

<sup>9</sup> Sub-sector averages were calculated when there are at least three firms in the sub-sector sample in each year.

- Changes in link strength: We also looked at the ‘extent’ of link change over time. Table 5 also shows how we measured changes in the average level of reliance (for sales or purchases) that firms have on each type of link for each sub-sector.

**Table 5: Measures of changes in links**

Link type	Change in existence of links between 2007 and 2020	Extent of link changes from 2007 to 2020
<b>Customers<sup>+</sup></b>		
L1	Sub-sector: Difference between average proportion of firms in sub-sector with links in 2020 and average proportion of firms in sub-sector with links in 2007	NA
L3		Sub-sector: Difference between average level of reliance of firms in the sub-sector on link in 2020 and average level of reliance of firms in the sub-sector on link in 2007
L4		
<b>Suppliers<sup>+</sup></b>		
L18	Sub-sector: Difference between average proportion of firms in sub-sector with links in 2020 and average proportion of firms in sub-sector with links in 2007	Sub-sector: Difference between average level of reliance of firms in the sub-sectors on link in 2020 and average level of reliance of firms in the sub-sector on link in 2007
L19		
L21		NA

+ Links of firms in sub-sectors with the specified actor

### 3.3 Limitations

This study has data-related limitations, which include:

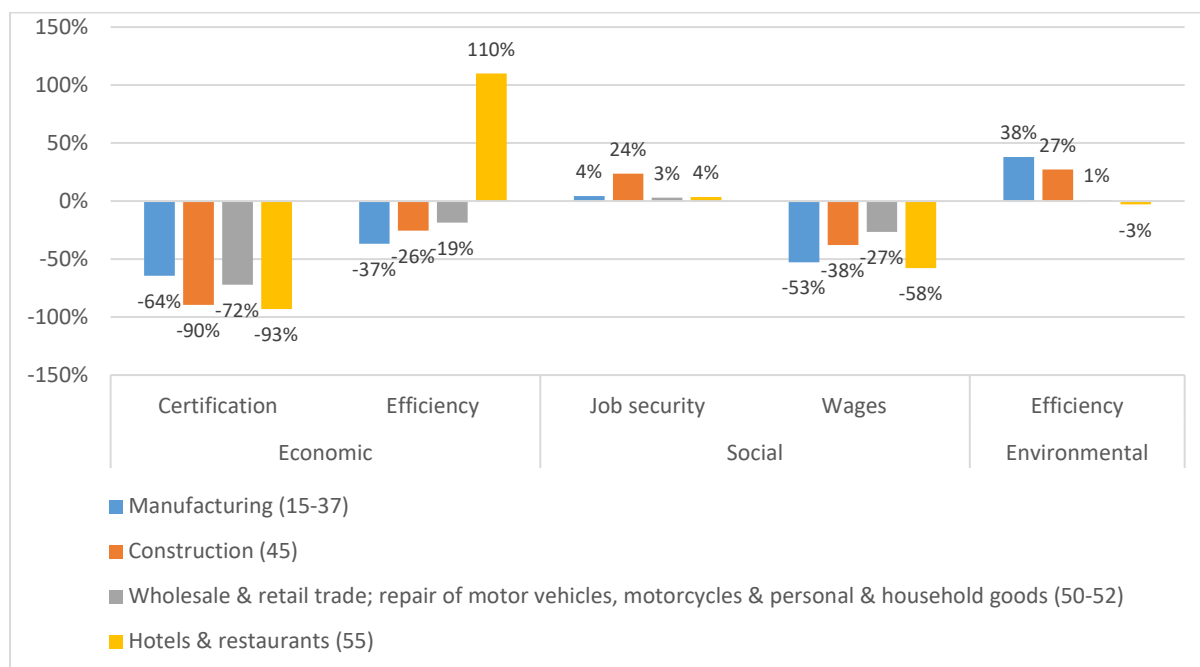
- The WBES data itself may have bias, as it is self-reported.
- The second round was conducted during COVID-19, a shock to the norm of business operations. The crisis may have affected all variables in the sense of increased uncertainty, a potential for higher loss of links, probability of lower levels of upgrading and more chances of downgrading due to various local and international restrictions, and supply chain issues.

## 4. Sectoral and Manufacturing Sub-Sector Upgrading and Downgrading Trajectories

First, we unpack the overall upgrading and downgrading patterns for firms in four sectors. That is, upgrading trajectories between 2007 and 2020 are considered.

Our study shows mixed results for economic, social and environmental upgrading trajectories across sectors over the 13 years between the surveys (see Figure 3).<sup>10</sup> Economic upgrading generally shows a downward trajectory, with the exception of economic efficiency of hotels and restaurants, which show a high level of upgrading. Social upgrading shows a mixed picture based on our indicators. Job security appears to be improving, with firms in almost all sectors reporting an increase in the proportion of permanent workers, but these results may be hiding the fact that casual workers were laid off during the global pandemic. However, when taking into account inflation, companies across the board reported spending less per worker on average in 2020 than they did in 2007. Environmental upgrading trajectories are positive for manufacturing and construction, with ‘wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods’ relatively stable, and hotels and restaurants showing a slight decrease in reported energy efficiency. The overall trend towards increased energy efficiency may be related to changing uses of technology (see, e.g., Winkler and Marquand 2009), and the decrease in energy efficiency found for hotels and restaurants may be related to an increase in services provided, as these businesses also indicated a large increase in revenue per employee (see Strambach and Surmeier 2013; Surmeier 2020). While we focus on manufacturing in this paper, more research is needed to explore these broader sectoral trends.

**Figure 3: Sectoral upgrading trajectories from 2007 to 2020**



Source: Authors' construction from the data

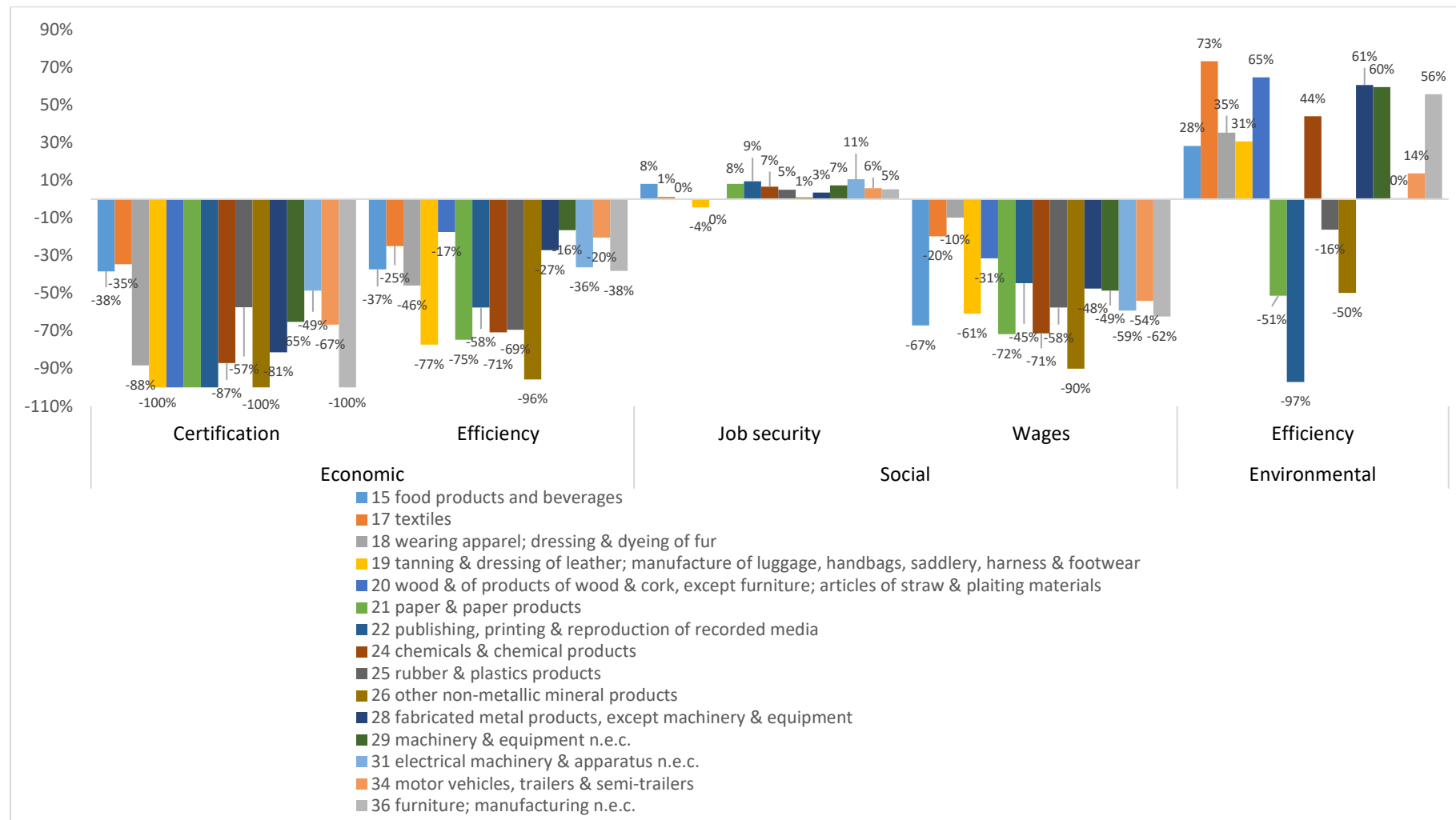
<sup>10</sup> This data is also displayed in tabular form in Table A1 in Annexure A.

Zooming in on manufacturing (see Figure 4), the sub-sectors that have data have similar trajectories to manufacturing as whole.<sup>11</sup> One difference is that, in relation to job security, ‘tanning and dressing of leather; luggage, handbags, saddlery, harness and footwear’ (19) experienced downgrading. In addition, several manufacturing sub-sectors showed a decrease in energy efficiency; these include paper and paper products (21); publishing, printing and production of recorded media (22); rubber and plastics products (25); and other non-metallic mineral products (26).

---

<sup>11</sup> This data is also displayed in tabular form in Table A1 in Annexure A.

Figure 4: Manufacturing sub-sector upgrading trajectories from 2007 to 2020



Source: Authors' construction from the data

## 5. Relationship between Governance Links and Upgrading or Downgrading

This section focuses on manufacturing firms. We first look at network governance structures by fleshing out what kinds of links exist. We look at both buyers for a firm's product, i.e., firms' customers, which include governments, other producers (who use products as inputs for further manufacturing), domestic buyers and global buyers. We also examine supplier links, which include local suppliers of inputs, suppliers of foreign-made inputs and licensors of foreign technology. We then calculate the average upgrading that occurred when these network governance structures existed or not. Following this, we seek to explicate whether the connection between links and upgrading changes when only considering stronger links compared to considering just whether a link exists or not, as past research (e.g., Frederick and Gereffi 2011; Giuliani et al. 2005) indicates that link strength can be connected to upgrading. Then we compare firms that are more globally oriented, i.e., have a higher proportion of buyers and suppliers that are global/foreign, to those that are locally oriented to explore potential differences in upgrading associated with each of these network types. Finally, we explore connections between firms that have a higher or lower number of links with diverse types of buyers and suppliers, and upgrading levels.

Statistically significant relationships are identified in the discussion. For many tests, the 2020 results are not significant for pairs of variables that are found to be significantly related in 2007. This is likely due to the fact that the 2020 sample of manufacturers is a much smaller size than the 2007 sample. Correspondingly, many relationships described are found only in the 2007 data. In the one test where the nature of statistically significant relationships differed between 2007 and 2020, it is explicitly mentioned.

### 5.1 Existence of Links

To understand whether a link exists or not, we consider whether a firm reported selling to each type of customer and acquiring from each type of (input) supplier.

#### 5.1.1 Customer links

First, we consider the existence of customer links. Table 6 displays results from 2007 and Table 7 shows results from 2020. The tables provide the results from the comparison between levels of link existence and indicators of economic, social and environmental upgrading.<sup>12</sup>

---

<sup>12</sup> Colours in the tables are used to indicate significant positive (green) or significant negative (red) differences associated with having each link.



**Table 6: Connections between the existence of manufacturers' 2007 customer links and upgrading levels in 2007**

Upgrading 2007	Link <sup>+</sup>	L1: Government				L2: Producers				L4: Global			
		N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
<b>Economic: Certification</b>	No	497	0.33	0.47	0.02	460	0.30	0.46	0.02	471	0.27	0.44	0.02
	Yes	173	0.48***	0.50	0.04	213	0.53***	0.50	0.03	202	0.63***	0.48	0.03
<b>Economic: Efficiency</b>	No	497	442 304.28	544 592.60	24 428.32	460	426 325.11	638 741.96	29 781.50	471	377 050.75	477 521.32	22 003.02
	Yes	173	579 002.45**	922 400.87	70 128.84	213	592 943.73***	704 318.31	48 259.10	202	716 909.21***	927 667.88	65 270.48
<b>Social: Job security</b>	No	495	0.93	0.12	0.01	458	0.93	0.13	0.01	469	0.93	0.12	0.01
	Yes	173	0.87***	0.14	0.01	213	0.89***	0.13	0.01	202	0.88***	0.15	0.01
<b>Social: Wages</b>	No	495	84 185.79	93 878.74	4 219.54	458	81 213.49	92 641.04	4 328.83	469	73 509.63	87 616.52	4 045.75
	Yes	173	78 145.18	85 231.34	6 480.02	213	86 363.32	90 454.87	6 197.87	202	104 530.43***	98 041.97	6 898.21
<b>Environmental: Efficiency</b>	No	497	-10.62	10.39	0.47	460	-11.08	10.72	0.50	470	-10.80	10.80	0.50
	Yes	172	-10.08	11.28	0.86	212	-9.16**	10.27	0.71	202	-9.70	10.12	0.71

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests; + Details for L3 are not included, as only one firm indicated not having domestic customers

**Table 7: Connection between the existence of manufacturers' 2020 customer links and upgrading levels in 2020**

Upgrading 2020	Link <sup>+</sup>	L4: Global			
		N	Mean	Std dev	Std error mean
Economic: Certification	No	251	0.09	0.29	0.02
	Yes	88	0.26***	0.44	0.05
Economic: Efficiency	No	252	244 234.48	420 209.81	26 470.73
	Yes	84	478 738.99**	928 287.58	101 284.48
Social: Job security	No	253	0.95	0.12	0.01
	Yes	88	0.96	0.13	0.01
Social: Wages	No	248	34 800.91	48 743.67	3 095.23
	Yes	84	49 368.84**	61 137.03	6 670.60
Environmental: Efficiency	No	249	-6.56	9.62	0.61
	Yes	82	-6.35	9.75	1.08

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests; + Details for L1 are not included, as only two firms indicated having governmental customers, L2 data is not available for 2020, and details for L3 are not included, as only one firm indicated not having domestic customers.

As shown in Tables 6 and 7, the first type of customer link we considered was whether the firms sold any of their products to government buyers (if firms received government contracts). We found a significant connection with this type of link and firms being more likely to display higher levels of economic upgrading. However, this link was also connected with social downgrading. This downgrading involved firms with governmental buyers having smaller proportions of permanent workers than those that did not.

The second type of customer link we considered was whether firms sold any of their outputs to other producers to be used as inputs for further manufacturing processes (i.e., as intermediary inputs). This type of link was connected to the same upgrading and downgrading patterns as having a link to government buyers, i.e., economic upgrading and some social downgrading. In addition, selling to producers was associated with environmental upgrading.

The third type of customer link we considered was whether firms sold to domestic buyers. However, almost all firms in both years reported selling to domestic buyers. Hence, we were not able to assess the impact of this link.

Finally, the fourth type of buyer link we considered was whether manufacturers sold their products to global buyers. Selling to global buyers is associated with higher levels of economic upgrading. However, this link is associated with mixed results in relation to social upgrading. It was associated with paying more in wages, but having lower proportions of permanent workers.

### 5.1.2 Supplier links

We also looked at the connections between the existence of supplier links and upgrading (see Table 8 for 2007 and Table 9 for 2020). The first supplier link we considered was whether firms reported buying inputs from local suppliers. We found that reporting the use of local suppliers was not significantly connected with any of the upgrading measures.

The second supplier link we considered was whether firms reported buying foreign-made inputs. We found this link to be connected to higher levels of economic and environmental upgrading. However, it had a mixed relationship with social upgrading. It was associated with downgrading by having lower proportions of permanent workers, but with upgrading in terms of higher spending on wages.

Finally, the third supplier link we considered was whether firms reported using foreign-licensed technology. Firms that reported this link had similar upgrading outcomes to firms that bought foreign inputs. They were more likely to experience economic and environmental upgrading, as well as social upgrading (paying higher wages). However, a significant connection was not found between this link and having lower proportions of permanent workers.

**Table 8: Connections between the existence of manufacturers' supplier links in 2007 and upgrading levels in 2007**

Upgrading 2007	Link	L18: Domestic				L19: Global				L21: Foreign technology			
		N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
<b>Economic: Certification</b>	No	13	0.31	0.48	0.13	396	0.28	0.45	0.02	575	0.31	0.46	0.02
	Yes	660	0.38	0.48	0.02	277	0.51***	0.50	0.03	98	0.77***	0.43	0.04
<b>Economic: Efficiency</b>	No	13	529 680.90	801 251.29	222 227.13	396	411 333.03	580 916.97	29 192.18	575	430 500.95	550 601.96	22 961.69
	Yes	660	478 061.68	661 925.01	25 765.40	277	575 879.72***	758 440.07	45 570.25	98	763 964.45***	1 080 041.72	109 100.69
<b>Social: Job security</b>	No	13	0.90	0.14	0.04	394	0.93	0.12	0.01	574	0.92	0.13	0.01
	Yes	658	0.91	0.13	0.01	277	0.89***	0.14	0.01	97	0.90	0.12	0.01
<b>Social: Wages</b>	No	13	74 198.13	43 214.55	11 985.56	394	74 949.38	84 196.98	4 241.78	574	76 954.04	84 094.21	3 510.02
	Yes	658	83 019.13	92 629.40	3 611.07	277	94 083.43**	100 991.82	6 068.01	97	117 727.31***	123 764.22	12 566.35
<b>Environmental: Efficiency</b>	No	13	-12.40	8.33	2.31	396	-11.59	11.93	0.60	574	-10.77	10.99	0.46
	Yes	659	-10.43	10.65	0.41	276	-8.87***	8.10	0.49	98	-8.72**	7.82	0.79

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

**Table 9: Connection between the existence of manufacturers' supplier links in 2020 and upgrading levels in 2020**

2020 Upgrading	Link <sup>+</sup>	L19: Global				L21: Foreign technology			
		N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
Economic: Certification	No	280	0.13	0.34	0.02	312	0.14	0.35	0.02
	Yes	56	0.18	0.39	0.05	17	0.12	0.33	0.08
Economic: Efficiency	No	281	295 085.54	599 307.07	35 751.66	307	302 803.07	604 686.82	34 511.30
	Yes	53	354 214.53	595 436.29	81 789.46	16	498 490.85	629 746.56	157 436.64
Social: Job security	No	284	0.96	0.12	0.01	310	0.95	0.13	0.01
	Yes	54	0.94	0.14	0.02	16	0.94	0.13	0.03
Social: Wages	No	279	34 923.17	48 004.17	2 873.93	305	38 364.42	53 108.96	3 041.01
	Yes	50	59 893.21**	70 186.67	9 925.89	13	77 649.30*	70 725.77	19 615.80
Environmental: Efficiency	No	278	-6.68	9.91	0.59	305	-6.34	9.65	0.55
	Yes	51	-5.62	8.23	1.15	13	-3.32	5.67	1.57

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests; + Details for L18 are not included, as only three firms indicated not having local suppliers

## 5.2 Strong Links and Upgrading or Downgrading

In addition to considering how the existence of links is related to upgrading and downgrading trajectories, we also considered whether link strength is a factor connected to upgrading.

### 5.2.1 Strong customer links

Tables 10 and 11, depicting data from 2007 and 2020 respectively, consider the same questions asked in '5.1.1. Customer Links', but based on whether firms report strong links. When we consider the strength of links, we find additional significant connections between customers and upgrading and downgrading trajectories, while the significance of the relationships disappears in some cases. This may be related to weak ties having particular effects, or be a consequence of the small size of the dataset.

Assessing strong government links, these links, as with our measures of link existence, continue to have an association with higher levels of international certification and lower levels of job security. However, the level of economic efficiency for those with strong government links is not significantly different to the level of those without these links.

The second type of strong connection we considered was to producers as customers. For this link, we only found a significant relationship with economic certification. Firms with strong links to producers as customers were more likely to have higher levels of certification.

The third link was sales to local customers. Strong relationships involved at least 80% being sold to local customers. The results show that having a strong link with local buyers was connected with economic downgrading. Firms with strong connections to local buyers were more likely to have lower levels of international certification and to have less revenue per worker. The relationship with social upgrading was mixed. Firms with strong links to local buyers were more likely to have larger proportions of permanent workers, while being more likely to spend less per employee.

As with selling to government agencies and producers, selling higher levels of outputs to international customers was also connected to economic upgrading. A mixed picture emerged for social upgrading. Strong global links were related to paying more in wages. However, strong links to global buyers had a different connection to job security in each time period. In 2007, this type of link was associated with having fewer permanent workers. In 2020, it was associated with having greater numbers of permanent workers. While the 2007 result aligns with the findings related to the existence of links to global customers, the 2020 result shows a different pattern. This result may be a statistical anomaly and requires further research.

**Table 10: Connections between strong customer links for manufacturers in 2007 and upgrading levels in 2007**

Upgrading 2007	Strong link	L1: Government				L2: Producers				L3: Domestic				L4: Global			
		N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
<b>Economic: Certification</b>	No	601	0.36	0.48	0.02	591	0.35	0.48	0.02	72	0.71	0.46	0.05	526	0.30	0.46	0.02
	Yes	69	0.48*	0.50	0.06	82	0.55***	0.50	0.06	601	0.33***	0.47	0.02	147	0.65***	0.48	0.04
<b>Economic: Efficiency</b>	No	601	462 834.01	624 861.66	25 488.64	591	474 173.61	682 146.59	28 059.76	72	683 406.20	1 011 057.89	119 154.32	526	435 515.09	606 360.42	26 438.57
	Yes	69	606 223.39	941 682.15	113 365.21	82	514 267.82	519 002.87	57 314.28	601	454 577.90*	606 258.64	24 729.81	147	634 868.21***	822 962.80	67 876.83
<b>Social: Job security</b>	No	599	0.92	0.13	0.01	589	0.92	0.13	0.01	72	0.85	0.16	0.02	524	0.92	0.12	0.01
	Yes	69	0.84***	0.14	0.02	82	0.90	0.12	0.01	599	0.92***	0.12	0.01	147	0.87***	0.15	0.01
<b>Social: Wages</b>	No	599	83 304.49	92 935.49	3 797.24	589	80 767.83	88 333.38	3 639.71	72	91 087.29	82 772.29	9 754.81	524	80 706.71	95 450.00	4 169.75
	Yes	69	76 691.21	80 462.40	9 686.53	82	97 791.62	113 947.06	12 583.35	599	81 857.90	92 969.26	3 798.62	147	90 481.97	77 844.68	6 420.52
<b>Environmental: Efficiency</b>	No	600	-10.39	10.36	0.42	590	-10.62	10.88	0.45	72	-10.39	12.10	1.43	525	-10.55	10.62	0.46
	Yes	69	-11.24	12.75	1.53	82	-9.42	8.36	0.92	600	-10.48	10.43	0.43	147	-10.19	10.60	0.87

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

**Table 11: Connection between strong customer links for manufacturers in 2020 and upgrading levels in 2020**

Upgrading 2020	Strong link	L1: Government <sup>13</sup>	L2: Producers <sup>14</sup>	L3: Domestic				L4: Global			
		N	N	N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
Economic: Certification	No	--	--	40	0.33	0.47	0.08	262	0.09	0.28	0.02
	Yes	--	--	299	0.11***	0.31	0.02	77	0.30***	0.46	0.05
Economic: Efficiency	No	--	--	37	501 690.31	944 331.58	155 247.16	262	262 860.23	472 364.21	29 182.76
	Yes	--	--	299	278 256.26*	535 832.08	30 987.97	74	444 483.56**	900 288.55	104 656.42
Social: Job security	No	--	--	39	0.96	0.13	0.02	264	0.95	0.13	0.01
	Yes	--	--	302	0.95	0.12	0.01	77	0.97*	0.10	0.01
Social: Wages	No	--	--	37	52 581.08	59 605.91	9 799.15	258	35 783.36	49 432.17	3 077.51
	Yes	--	--	295	36 719.01*	51 317.08	2 987.80	74	47 912.18*	61 260.49	7 121.39
Environmental: Efficiency	No	--	--	37	-6.78	12.14	2.00	258	-6.48	9.60	0.60
	Yes	--	--	294	-6.48	9.30	0.54	73	-6.62	9.86	1.15

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

<sup>13</sup> L1 strength data is not available for 2020.

<sup>14</sup> L2 strength data is not available for 2020.



### 5.2.2 Strong supplier links

Table 12, showing 2007 figures, and Table 13, showing 2020 figures, consider the same questions that were asked in '5.1.2. Supplier links'. When we explored supplier link strength, we also saw differences in the results compared to solely considering link existence.

Notably, while buying inputs from local suppliers was not significantly connected with any of our upgrading measurements, firms that bought 50% or more of their inputs from local suppliers were more likely to have worse outcomes in our measures of economic upgrading.

In addition, the relationship between buying global material inputs and economic upgrading continued to be significant when we considered firms that bought 50% or more global inputs. The positive relationship between global buyers and paying more in wages also continued to be significant. However, the negative relationship between buying globally sourced material inputs and the proportion of permanent workers did not remain significant when we considered firms that bought 50% or more globally sourced material inputs. Nor did the positive relationship between global buyers and environmental upgrading continue to be significant.

**Table 12: Connections between strong supplier links for manufacturers in 2007 and upgrading levels in 2007**

Upgrading 2007	Strong link <sup>+</sup>	L18: Domestic				L19: Global			
		N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
Economic: Certification	No	76	0.58	0.50	0.06	569	0.35	0.48	0.02
	Yes	597	0.35***	0.48	0.02	104	0.52***	0.50	0.05
Economic: Efficiency	No	76	679 142.83	894 494.32	102 605.53	569	454 927.37	634 815.23	26 612.84
	Yes	597	453 587.45**	625 300.59	25 591.85	104	611 085.45*	797 037.43	78 155.95
Social: Job security	No	76	0.90	0.14	0.02	567	0.92	0.12	0.01
	Yes	595	0.92	0.13	0.01	104	0.89	0.15	0.01
Social: Wages	No	76	90 296.36	76 205.63	8 741.39	567	81 488.80	93 141.91	3 911.59
	Yes	595	81 896.88	93 746.33	3 843.23	104	90 259.80	84 964.34	8 331.44
Environmental: Efficiency	No	76	-9.05	7.61	0.87	568	-10.70	11.06	0.46
	Yes	596	-10.65	10.92	0.45	104	-9.20	7.63	0.75

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests; + L21 strength data is not available

**Table 13: Connections between strong supplier links for manufacturers in 2020 and upgrading levels in 2020**

Upgrading 2020	Strong links <sup>+</sup>	L18: Domestic				L19: Global			
		N	Mean	Std dev	Std error mean	N	Mean	Std dev	Std error mean
<b>Economic: Certification</b>	No	15	0.27	0.46	0.12	306	0.13	0.34	0.02
	Yes	321	0.13	0.34	0.02	30	0.20	0.41	0.07
<b>Economic: Efficiency</b>	No	14	348 311.35	364 194.46	97 335.06	305	292 851.53	590 289.40	33 799.87
	Yes	320	302 550.15	606 669.15	33 913.84	29	426 644.46	675 045.82	125 352.86
<b>Social: Job security</b>	No	15	0.90	0.19	0.05	308	0.96	0.12	0.01
	Yes	323	0.96	0.12	0.01	30	0.94	0.14	0.03
<b>Social: Wages</b>	No	13	70 453.96	89 893.44	24 931.95	301	36 131.49	48 917.37	2 819.55
	Yes	316	37 412.42	50 327.22	2 831.13	28	66 523.12*	78 624.52	14 858.64
<b>Environmental: Efficiency</b>	No	14	-4.39	5.67	1.51	300	-6.68	9.76	0.56
	Yes	315	-6.61	9.80	0.55	29	-4.82	8.61	1.60

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests; + L21 strength data is not available

### 5.3 Global- versus Domestic-Led Links

We also considered if there were differences between firms that had stronger global links (for customers and suppliers) and those that had stronger domestic links (see Tables 14, 15, 16 and 17). Firms with domestic-led links were found to be more likely to have lower levels of economic upgrading and mixed results in relation to social upgrading. Job security was higher, with firms having a higher percent of permanent workers, while wages paid were lower.

It was found that having global-led links was significantly connected with having higher levels of economic upgrading, which was the opposite of domestic-led links. However, no significant relationships were found in relation to social and environmental upgrading.

In sum, this suggests that global-led links promote economic upgrading, while domestic-led links are connected to economic downgrading. Domestic-led links are also connected to mixed outcomes in relation to social upgrading. Neither global- nor domestic-led links showed any significant results in relations to environmental upgrading.

**Table 14: Connections between domestic-led links for manufacturers in 2007 and upgrading levels in 2007**

Upgrading 2007	Domestic-led links	N	Mean	Std dev	Std error mean
Economic: Certification	No	131	0.62	0.49	0.04
	Yes	542	0.32***	0.47	0.02
Economic: Efficiency	No	131	679 263.93	920 395.64	80 415.34
	Yes	542	430 669.72***	576 542.17	24 764.61
Social: Job security	No	131	0.88	0.15	0.01
	Yes	540	0.92***	0.12	0.01
Social: Wages	No	131	92 093.07	82 202.89	7 182.10
	Yes	540	80 605.51	94 055.54	4 047.51
Environmental: Efficiency	No	131	-9.84	10.18	0.89
	Yes	541	-10.62	10.71	0.46

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

**Table 15: Connections between domestic-led links for manufacturers in 2020 and upgrading levels in 2020**

Upgrading 2020	Domestic-led links	N	Mean	Std Dev	Std error mean
Economic: Certification	No	49	0.29	0.46	0.07
	Yes	287	0.11**	0.32	0.02
Economic: Efficiency	No	46	465 045.80	857 759.34	126 469.71
	Yes	287	279 447.01	544 016.10	32 112.26
Social: Job security	No	48	0.95	0.14	0.02
	Yes	290	0.96	0.12	0.01
Social: Wages	No	45	56 655.57	70 300.06	10 479.71
	Yes	284	35 875.79*	48 809.77	2 896.33
Environmental: Efficiency	No	46	-6.06	11.05	1.63
	Yes	283	-6.59	9.44	0.56

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

**Table 16: Connections between global-led links for manufacturers in 2007 and upgrading levels in 2007**

Upgrading 2007	Global-led links	N	Mean	Std dev	Std error mean
Economic: Certification	No	632	0.35	0.48	0.02
	Yes	41	0.73***	0.45	0.07
Economic: Efficiency	No	632	467 835.70	641 854.07	25 531.58
	Yes	41	652 058.56*	938 235.36	146 527.75
Social: Job security	No	630	0.91	0.13	0.01
	Yes	41	0.89	0.13	0.02
Social: Wages	No	630	82 447.39	93 108.11	3 709.52
	Yes	41	89 007.63	71 774.64	11 209.32
Environmental: Efficiency	No	631	-10.50	10.71	0.43
	Yes	41	-10.00	9.04	1.41

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

**Table 17: Connections between global-led links for manufacturers in 2020 and upgrading levels in 2020**

Upgrading 2020	Global-led links	N	Mean	Std dev	Std error mean
<b>Economic: Certification</b>	No	321	0.13	0.33	0.02
	Yes	18	0.28	0.46	0.11
<b>Economic: Efficiency</b>	No	320	290 543.91	578 888.32	32 360.84
	Yes	17	522 713.12	850 677.38	206 319.57
<b>Social: Job security</b>	No	323	0.96	0.12	0.01
	Yes	18	0.95	0.14	0.03
<b>Social: Wages</b>	No	315	37 022.49	51 145.46	2 881.72
	Yes	17	65 619.09	68 846.60	16 697.75
<b>Environmental: Efficiency</b>	No	314	-6.52	9.59	0.54
	Yes	17	-6.30	10.85	2.63

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using T-tests

#### 5.4 Heterogeneity of Links

Another way we explored how links are connected to upgrading was by considering if the number of different types of links to different types of actors that a firm reported (link heterogeneity) was connected to their upgrading levels. Table 18, displaying 2007 data, and Table 19, displaying 2020 data, provide the frequency of the number of types of customer and input supplier links of the manufacturing firms in 2007 and 2020. The results show that 76% of firms in 2007 had one or two types of links with customers. When considering supplier links in 2007 and both types of links in 2020, more than 90% had just one or two types of links. There were only a marginal number of firms that had three or more types of links with either customers or input suppliers.

**Table 18: Level of heterogeneity of manufacturers' links in 2007**

Number of link types	Customer links		Supplier links	
	Frequency	Percent	Frequency	Percent
1	292	43.6	362	53.8
2	219	32.7	260	38.6
3	114	17.0	51	7.6
4	45	6.7	--	--
Total	670	100.0	673	100.0

Source: Authors' construction from the data

**Table 19: Level of heterogeneity of manufacturers' links in 2020**

Number of link types	Customer links		Supplier links	
	Frequency	Percent	Frequency	Percent
1	253	74.0	269	83.0
2	88	25.7	42	13.0
3	1	0.3	13	4.0
Total	342	100.0	324	100.0

Source: Authors' construction from the data

To deepen our understanding of the connection between the heterogeneity of links (exposure to diverse forms of governance) and upgrading, we calculated correlations between the trajectories of upgrading and heterogeneous links. This allowed us to understand the association and trend between the two variables of interest. In the correlation results in Tables 20 and 21 below, a positive value of the correlation coefficients suggests that the number of link types and trajectories of upgrading moved in tandem. So, having more types of links is connected to having more upgrading, and vice versa.

**Table 20: Correlation between heterogeneity of manufacturers' links and upgrading or downgrading in 2007**

Upgrading trajectory	Customer links	Input supplier links
Economic: Certification	0.337***	0.372***
Economic: Efficiency	0.215***	0.192***
Social: Job security	-0.255***	-0.121***
Social: Wages	0.073*	0.170***
Environment: Efficiency	0.075*	0.142***

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using Pearson tests

**Table 21: Correlation between heterogeneity of manufacturers' links and upgrading or downgrading in 2020**

Upgrading trajectory	Customer links	Input supplier links
Economic: Certification	0.190***	0.009
Economic: Efficiency	0.159***	0.047
Social: Job security	0.050	-0.046
Social: Wages	0.114**	0.1748***
Environment: Efficiency	0.013	0.045

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively using Pearson tests

The results indicate that having more types of customer links is associated with higher economic (in terms of both certifications and efficiency), social (in terms of wages paid) and environmental upgrading. However, having more diverse links has a negative correlation with job security.

The results show similar patterns of upgrading in relation to supplier link heterogeneity. In relation to input supplier links, the data suggests a positive association across economic,

social and environmental dimensions. Thus, if firms have more diverse links with customers or input suppliers, it could lead to broad-based upgrading. However, the relationship between social dimensions and suppliers is similar to that with customer links, showing connections to both social upgrading and downgrading. Having more diverse links is connected to upgrading related to wages and downgrading related to job security. Therefore, having more diverse links of either type is also associated with elements of social downgrading. Annexure B contains further exploration of the relationship between link heterogeneity and upgrading.

## 6. Trajectories of Upgrading and Downgrading across Time: Changes in Governance Links

This section also focuses on manufacturing firms, and discusses the change in governance links vis-à-vis upgrading and downgrading trajectories in 2007 and 2020. The information in this section considers the average link characteristics in each manufacturing sub-sector. As discussed in Section 3.2, the change in governance links was calculated in two ways: link existence and link strength.

### 6.1 Changes in the Existence of Links

The first way in which link changes were considered was whether links existed or not. In other words, was there a change in the average number of links in a sub-sector between 2007 and 2020, in terms of a gain or a loss. This relationship is shown in Figures 5 and 6 below.<sup>15,16</sup> Overall, the results show that most links with government buyers were lost across sub-sectors between 2007 and 2020. The level of links to international buyers also declined for most sub-sectors. However, several sub-sectors showed a gain in international buyers: textiles (17); tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19); motor vehicles, trailers and semi-trailers (34); and furniture; manufacturing n.e.c. (36). There was very little change in relation to domestic customers. Almost all firms in both periods reported this link, except for a small number of firms in 'tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear' (19) in 2007.

Figure 6 shows that, on average, changes in links with input suppliers were much more mixed than those with customers across sub-sectors. The data suggests that, in relation to domestic suppliers, most link levels stayed the same. Small increases were found in textiles (17); tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19); wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20); chemicals and chemical products (24); fabricated metal products, except machinery and equipment (28); and fabricated metal products, except machinery and

---

<sup>15</sup> See Table A2 in Annexure A for full details.

<sup>16</sup> Sub-sector averages are only calculated when there are at least 3 responses for the sub-sector in each year.



equipment (36). Also, a small loss occurred in 'wearing apparel; dressing and dyeing of fur' (18). Most sub-sectors displayed links lost in 2020 in relation to foreign suppliers, with the exception of textiles (17) and other non-metallic mineral products (26). Notably, both paper and paper products (21) and publishing, printing and reproduction of recorded media (22) lost all links to international suppliers during the period. Firms across most sub-sectors also experienced declining links with foreign technology suppliers, with some sub-sectors losing all reported links. However, the exception is 'tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear' (19), which saw a large increase in the proportion of firms using foreign technology.

The results from considering the correlation between changes in the average proportion of a sub-sectors' firms that have a link to their upgrading trajectories from 2007 to 2020 are indicated in Table 22.<sup>17</sup> There is a negative correlation between sub-sectors with higher numbers of links with global buyers, global suppliers and foreign technology licensors and job security. In addition, there is a positive correlation between selling to global buyers and environmental upgrading.

---

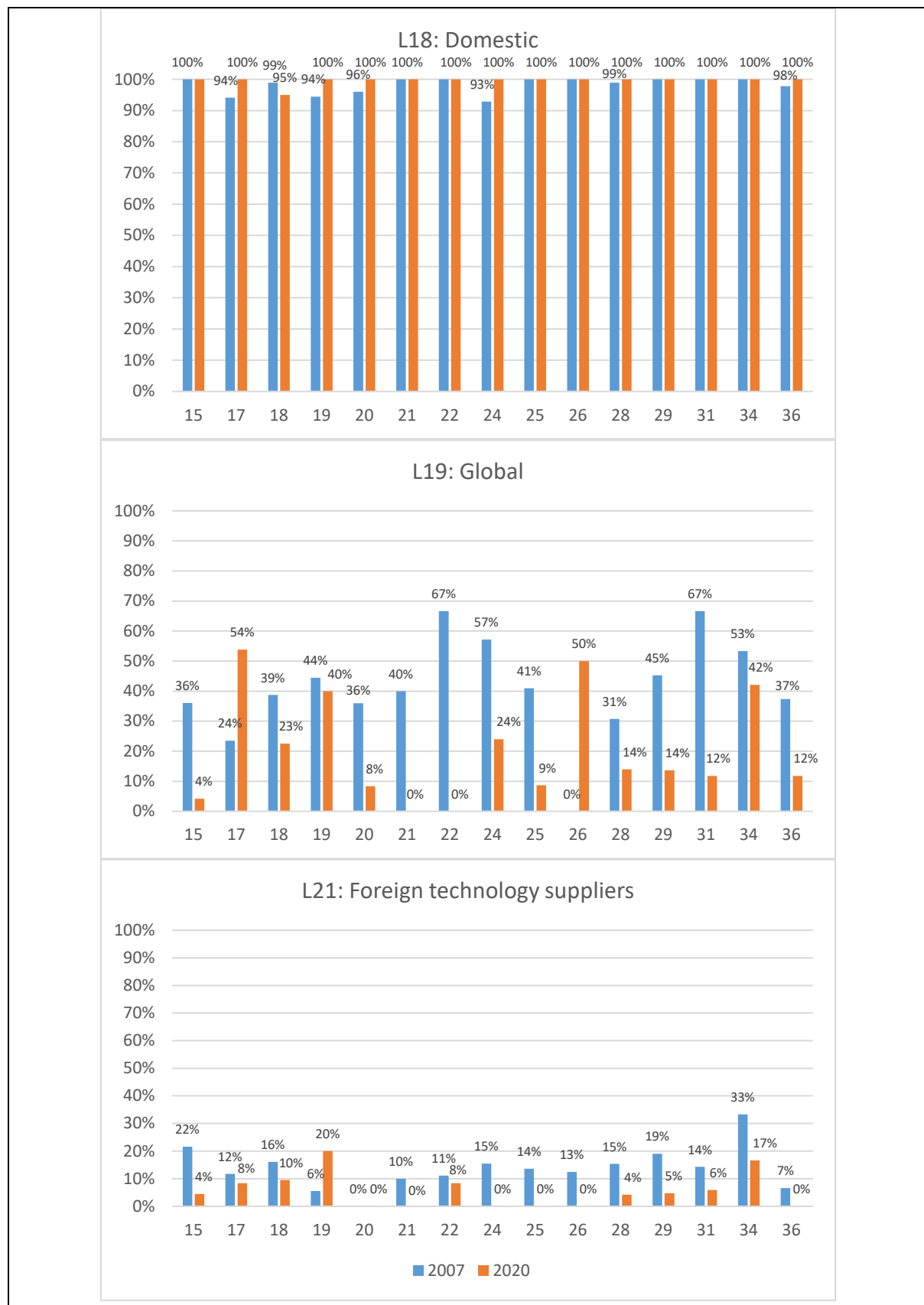
<sup>17</sup> Table A3 in Annexure A shows the data used in Table 22, and Figures A1, A2, A3 and A4 in Annexure A visually display the significant relationships in Table 22.

Figure 5: Changes in manufacturing sub-sector customer links between 2007 and 2020



Source: Authors' construction from the data

Figure 6: Changes in manufacturing sub-sectors supplier links between 2007 and 2020



Source: Authors' construction from the data

**Table 22: Correlation of changes in link existence for manufacturing sub-sectors and upgrading trajectories**

Upgrading trajectory 2007 to 2020 <sup>+</sup>	L1: Government	L4: Global	L18: Domestic	L19: Global	L21: Foreign Technology
<b>Economic: Certification</b>	-0.091	0.278	-0.035	0.033	-0.390
<b>Economic: Efficiency</b>	0.193	0.144	-0.044	-0.188	-0.133
<b>Social: Job security</b>	-0.388	-0.553**	-0.312	-0.662***	-0.630**
<b>Social: Wages</b>	0.055	0.241	-0.087	-0.043	0.295
<b>Environmental: Efficiency</b>	0.288	0.475*	0.411	0.223	0.065

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively; + L3 was not tested, as there was very little variation in links across sectors

## 6.2 Changes to the Extent of Links

The second way in which connections between changes in links and upgrading are calculated is based on understanding the ‘extent’ to which an increase or decrease in the ‘value’ of the link is connected to upgrading trajectories. The data in the WBESs allowed us to calculate the extent of link changes for customers – local and international, and for domestic and foreign input suppliers. Figure 7 below shows the average link strengths for manufacturing sub-sectors in 2007 and 2020.<sup>18,19</sup>

These results show mixed experiences across sub-sectors. They show an increased reliance on domestic customers (and decreased reliance on global customers) for: wearing apparel; dressing and dyeing of fur (18); tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19); other non-metallic mineral products (26); machinery and equipment n.e.c. (29); and electrical machinery and apparatus n.e.c. (31). The reverse change was found in food products and beverages (15); textiles (17); publishing, printing and reproduction of recorded media (22); rubber and plastics products (25); fabricated metal products, except machinery and equipment (28); and furniture; manufacturing n.e.c. (36). Finally, several sub-sectors’ customer links remained relatively stable, namely wood and products of wood and cork, except furniture; articles of straw and plaiting materials (20); paper and paper products (21); chemicals and chemical products (24); and motor vehicles, trailers and semi-trailers (34).

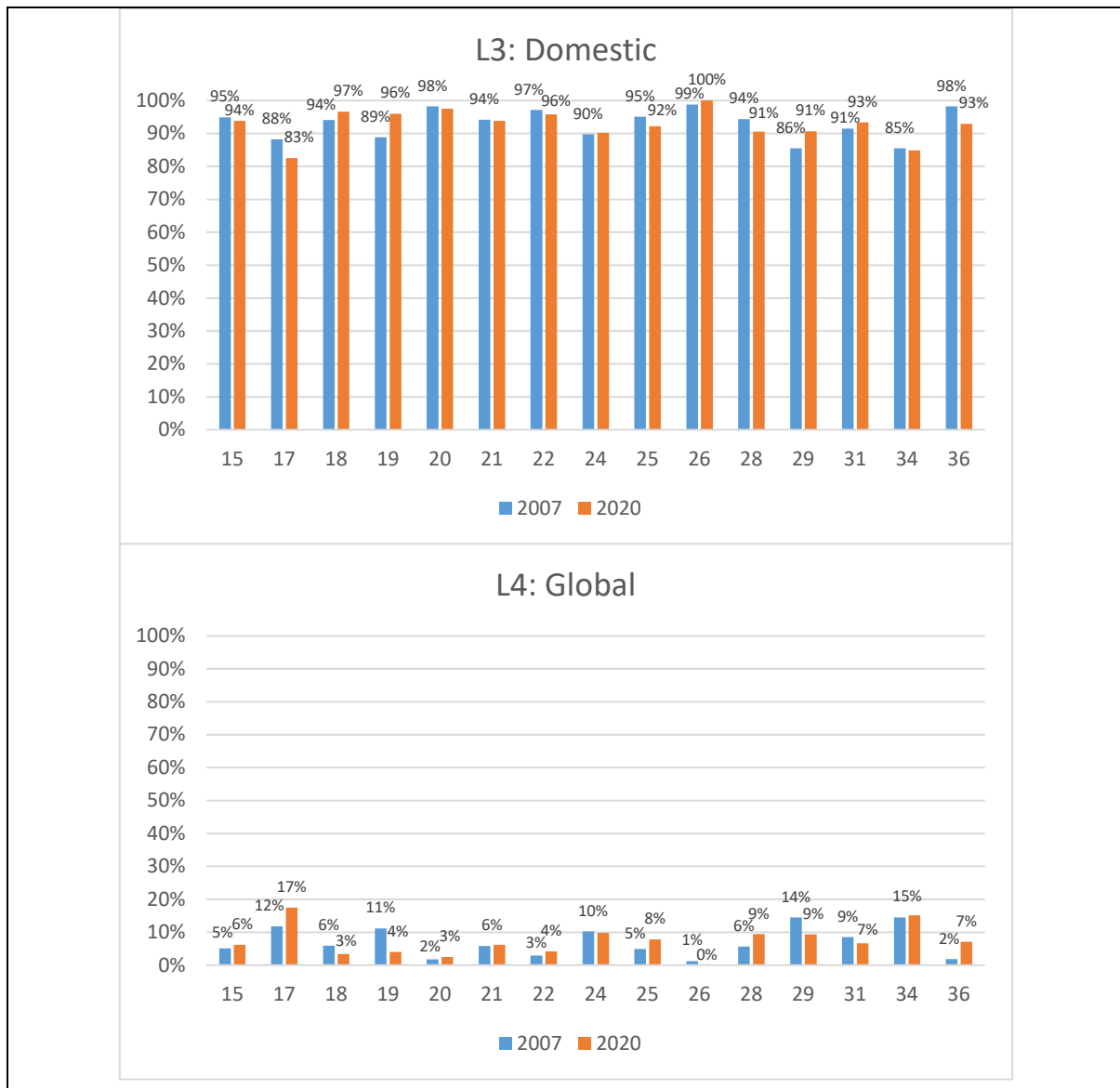
Overall, the changes in strengths were larger in relation to suppliers compared to customers. Nevertheless, sub-sectors’ supplier links also show mixed experiences. Most sub-sectors experienced an increase in reliance on domestic suppliers (and a decrease in reliance on global suppliers). However, two experienced the opposite development, which were textiles (17) and other non-metallic mineral products (26).

---

<sup>18</sup> See Table A4 in Annexure A for full details.

<sup>19</sup> Sub-sector averages are only calculated when there are at least three responses for the sub-sector in each year.

Figure 7: Extent of manufacturers' customer link changes between 2007 and 2020



Source: Authors' construction from the data

Figure 8: Extent of manufacturers' supplier link changes between 2007 and 2020



Source: Authors' construction from the data

The results in relation to changes in the extent of links and upgrading trajectories from 2007 to 2020 are displayed in Table 23.<sup>20</sup> There is a positive correlation between the average level of sub-sector supplies that are sourced from local suppliers and job security. Inversely, there is a negative correlation between the average level of sub-sector supplies that are sourced from global suppliers and job security.

<sup>20</sup> Table A5 in Annexure A shows the data used in Table 23, and Figures A5 and A6 in Annexure A visually display the significant relationships in Table 23.

**Table 23: Changes in link strength for manufacturing sub-sectors and upgrading trajectories**

Upgrading trajectory 2007 to 2020	L3: Domestic	L4: Global	L18: Domestic	L19: Global
<b>Economic: Certification</b>	-0.223	0.223	-0.028	0.028
<b>Economic: Efficiency</b>	-0.251	0.251	0.210	-0.210
<b>Social: Job security</b>	-0.211	0.211	0.675***	-0.675***
<b>Social: Wages</b>	-0.138	0.138	0.048	-0.048
<b>Environmental: Efficiency</b>	-0.084	0.084	-0.265	0.265

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively

## 7. Discussion and Conclusion

This study explored the overarching question of 'how does network governance connect to economic, social and environmental upgrading?' The findings of the study provide several insights in relation to the connections between customer and supplier links to economic, social and environmental upgrading. The relationships found are complex and show that buyer and supplier links can be connected to upgrading and downgrading trajectories across different upgrading dimensions. In this section we begin by presenting our general findings in relation to each of the research sub-questions. This is followed by a discussion of areas for future research and a discussion of the implications of the findings.

### 7.1 Patterns in Upgrading within Sectors and Manufacturing Sub-Sectors

Overall, we found that, from 2007 to 2020, South African firms in the WBESs experienced economic downgrading (with the exception of hotels and restaurants, which experienced an increase in economic efficiency), mixed results for social upgrading (an increase in job security and a decrease in money paid in wages), and environmental upgrading (with the exception of hotels and restaurants). In terms of sub-sectoral upgrading within manufacturing, the picture was similar. Differences include 'tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear' (19), which experienced a decrease in job security, and several sub-sectors showing decreases in energy efficiency: paper and paper products (21); publishing, printing and production of recorded media (22); rubber and plastics products (25); and other non-metallic mineral products (26).

More research is needed to explore the reasons for these trajectories. Our analysis below helps to identify how buyer and supplier links may be connected with these outcomes. A key factor that may be important to consider is that there has been an increasing turn towards domestic customers and domestic suppliers; however, further case study research is required to better understand the outcomes. These increasingly local value chain structures might have different governance dimensions to global networks. For example, all actors are working within the same national regulatory environment. In addition, domestic buyers may have standards that are less stringent than high-income country standards.



## 7.2 Relationship Between Governance Links and Upgrading

We found diverse relationships connecting governance links and upgrading trajectories. Table 24 provides the generalised findings across the dataset to show overarching trends in upgrading across links.<sup>21</sup> This table shows the upgrading and downgrading trajectories associated with the existence of links and the presence of strong links. As discussed below in Section 7.3, the table also shows upgrading and downgrading trajectories associated with changes in links over time.

In the case of government customers, having a link facilitates economic upgrading, especially in relation to certifications. In contrast, having government customers is connected to elements of social downgrading (in terms of job security). Past research exploring social downgrading and the role of public governance has considered the existence of specific government support in the form of subsidies and training support provided for firms to meet international certification requirements (e.g., Das Nair and Mncube 2012), and also the fact that government policies create no specific mandate to increase the numbers of permanent staff or increase wages to meet living standards (e.g., Alford et al. 2021). Our findings focus on the role of government as a customer. As connections are found to exist between this relationship and social downgrading, more research is needed to understand the dynamics of the relationship.

In the case of producers as customers, the results are similar to those in our assessment of government as a customer. This link was found to be connected to economic upgrading and to social downgrading in terms of the proportion of permanent workers. In addition, this type of link was found to be connected to environmental upgrading. This suggests that participation in value chain production can be associated with positive environmental outcomes. Further research is necessary to explore the governance drivers related to this link.

Links with domestic buyers were connected to economic downgrading. This is an intuitive finding, as local buyers may be less likely to require international certification. Furthermore, there may be less pressure to be efficient when selling to local markets, particularly as customers may have incentives to purchase from local suppliers. The fact that firms selling to domestic buyers have lower upgrading levels is not necessarily indicative of a problem, as these firms may be participating in upgrading processes. More research is necessary to understand the dynamics of the firms that fall into this group. In contrast to government and producers as buyers, selling to local buyers is connected to social upgrading in terms of job security. However, selling to domestic customers was found to be associated with paying less in wages. This behaviour may be connected to these firms' lower level of economic efficiency.

---

<sup>21</sup> The colours in the boxes indicate where significant relationships were found, with green representing positive links and red representing negative links.

Table 24: Summary of key findings

Link type	Measure	Economic		Social		Environmental
		Certification	Efficiency	Job security	Wages	Efficiency
L1: Government customers	Exists	***	**	***	--	--
	Strong	*	--	***	--	--
	Number increase	--	--	--	--	--
	Strength increase	--	--	--	--	--
L2: Producer customers	Exists	***	***	***	--	**
	Strong	***	--	--	--	--
	Number increase	--	--	--	--	--
	Strength increase	--	--	--	--	--
L3: Domestic customers	Exists	--	--	--	--	--
	Strong	***, ***	*	***	*	--
	Number increase	--	--	--	--	--
	Strength increase	--	--	--	--	--
L4: Global customers	Exists	***, ***	***, **	***	***, **	--
	Strong	***, ***	***, **	***, *	*	--
	Number increase	--	--	**	--	*
	Strength increase	--	--	--	--	--
L18: Domestic suppliers	Exists	--	--	--	--	--
	Strong	***	**	--	--	--
	Number increase	--	--	--	--	--
	Strength increase	--	--	***	--	--
L19: Global suppliers	Exists	***	***	***	** **	*
	Strong	***	*	--	*	--
	Number increase	--	--	***	--	--
	Strength increase	--	--	***	--	--
L21: Foreign technology	Exists	***	***	--	*** *	**
	Number increase	--	--	**	--	--

Source: Authors' construction from the data; \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level respectively, based on the results presented in Section 5 and Section 6

Finally, selling to international buyers is connected to economic upgrading, both in terms of certification and efficiency. This relationship indicates that connecting to global value chains can have positive effects for manufacturing. However, in most of our tests, selling to international buyers was connected with social downgrading in relation to reduced job security. In one test, which explored the connection between strong links and global customers in 2020, a positive link was found with job security. As this link was only significant at the 10% level, it may be an anomalous result. Further research is necessary to explore this link. What is noteworthy is that selling to global buyers was connected to higher wages. This finding aligns with the finding that having strong links to local customers is connected to lower wages. However, it is important to note that individual firms can sell to both types of buyers.

Moving on to consider the impact of supplier links, the results suggest that, when considering local supplier links, this connection is associated with economic downgrading. This indicates that firms that use a high proportion of local suppliers are less likely to have international certification and to have lower levels of economic efficiency. This finding sits alongside the finding that using global suppliers is associated with economic upgrading.

Together, these findings show that connecting to global value chains is associated with positive economic outcomes. Significant results were not found in relation to the connection between having local suppliers and experiencing social or environmental upgrading or downgrading. Nevertheless, connecting to global suppliers was found to be associated with mixed results for social upgrading. Firms with global suppliers had lower proportions of permanent workers but paid more in wages. Furthermore, firms with global suppliers were found to be more energy efficient. This further adds to the finding mentioned above, that selling to producers is connected to better environmental outcomes in that it indicates a connection between participating in (global) value chains and environmental upgrading.

In relation to foreign technology suppliers, the results show that the existence of a link is connected to multiple forms of upgrading. These include economic, social (only wages) and environmental forms. This result shows that firms that can include global technology have better outcomes in multiple dimensions. It also reinforces the findings related to firms that reported using global material input suppliers to show that connecting to global value chains is connected to upgrading.

On the whole, our findings were similar in our assessment of connections between upgrading outcomes and link existence, and our assessment of the connection to strong links. More research is needed on this topic.

Our assessment of firms that we deemed to have global-led links versus firms that had domestic-led links reinforced our findings related to specific links. We found that firms with global-led links had stronger connections to positive economic upgrading outcomes than firms with domestic-led links. However, mixed results were found in relation to social

upgrading. Being domestic-led was connected to higher levels of job security (proportion of permanent workers) and lower levels of wages. We did not find any significant results related to being global- or domestic-led and environmental upgrading.

Furthermore, when considering link heterogeneity, firms with a higher number of types of customers and a higher number of types of suppliers had similar upgrading patterns. Link heterogeneity was associated with firms being more likely to experience economic and environmental upgrading. However, having diverse links is also connected with mixed outcomes for social upgrading. Heterogeneity is connected to paying more in wages, while providing less job security.

Overall, the results indicate that connecting to global value chains (through selling to producers and global customers, sourcing from global suppliers, having overall 'global-led' links, and having diverse types of suppliers and buyers) and governments as buyers are connected to economic upgrading. However, these types of links are associated with mixed results when it comes to social and environmental upgrading. In particular, being linked to global value chains and governments as buyers are connected to reduced job security, while being connected to paying more in wages. The reduction in job security may be related to an increasing prevalence of flexible and irregular working schedules for businesses focusing on economic efficiency. In addition, selling to producers and having global suppliers are associated with environmental upgrading.

Accordingly, local connections are associated with economic downgrading. Furthermore, being connected to local customers and having local-led links are connected to mixed social upgrading outcomes, with job security being higher and wages paid being lower. These occurrences of downgrading beg the question whether firms are 'adversely incorporated' (e.g., Du Toit 2004) into some links. In other words, are their current positions generating and reinforcing downgrading trajectories? It should not be assumed, however, that the experience of downgrading is the outcome of connecting with certain actors (links). As link heterogeneity was found to have overarching connections to upgrading, firms may benefit from diversifying their customer and supplier links.

### **7.3 Relationship Between Changes in Governance Links and Upgrading**

In our consideration of links changing over time, we explored correlations between link changes and upgrading outcomes. A summary of the results is shown in Table 24. With our small data set of average sub-sector characteristics, we did not find many statistically significant results. However, we did identify several connections. We found a negative correlation between selling to increased numbers of global buyers and social upgrading (job security). We also found a negative correlation between increased global supply links (using global suppliers and getting licenses from foreign technology providers) and job security. We also found a negative correlation between strengthening connections to global suppliers and

job security, and a corresponding positive correlation between strengthening connections to domestic suppliers and job security. Furthermore, we found a positive correlation between selling to more global buyers and environmental upgrading.

#### **7.4 Areas for Further Research**

This research is novel as it empirically compares upgrading trajectories based on links with buyers and suppliers. Notably, it develops new indicators to categorise and quantify connections with social networks (particularly classifying elements of governance) and upgrading. This approach can be replicated across multiple countries.

This study looked at the existence of connections and inductively calculated thresholds for stronger levels of connections. Further research could explore the effects of different strengths of connections. There potentially are specific thresholds that may be connected to higher levels of upgrading or downgrading.

Future research could also study the different implications of links for upgrading when accounting for firm size, location-specific differences and firm capabilities. These factors can significantly affect how firms participate in production networks and interact with actors.

Further studies could also unpack the social content of links. In other words, this could involve examining the quality of the links in terms of whether there is reciprocity (give and take), the ease/support or contestations in the relationships, and the types of knowledge and technological transfer involved, among others, to better understand the nature of the ties. For example, one methodological option would be to divide global links into different country groups.

#### **7.5 Implications**

Understanding the experiences of firms in different sectors can provide lessons for increasing opportunities for value addition and upgrading, as well as creating supportive (e.g., stable, trust-rich and dense) social networks. The outcomes of this research will be helpful to policymakers seeking to promote industrial upgrading across economic, social and environmental dimensions. This study will also be useful for contributing to public discourse on upgrading and identifying areas that need further research.

This research is particularly valuable for policymakers, as it facilitates an understanding of where the 'choke points' are (i.e., which links are connected to downgrading trajectories). Such information can help improve regulation to tackle specific choke points.

## References

- Alexander, R. (2020). Emerging roles of lead buyer governance for sustainability across global production networks. *Journal of Business Ethics*, 162: 269-290.
- Alexander, R. (2022). Limits of buyer-driven governance for sustainability: Inherent challenges of fragmented supplier networks. *Journal of Economic Geography*, 22(4): 801-828.
- Alford, M. & Phillips, N. (2018). The political economy of state governance in global production networks: Change, crisis and contestation in the South African fruit sector. *Review of International Political Economy*, 25(1): 98-121.
- Alford, M., Visser, M. & Barrientos, S. (2021). Southern actors and the governance of labour standards in global production networks: The case of South African fruit and wine. *Environment and Planning A: Economy and Space*, 53(8): 1915-1934.
- Andreoni, A., Mondliwa, P., Roberts, S. & Tregenna, F. (2021). *Structural transformation in South Africa: The challenges of inclusive industrial development in a middle-income country*. Oxford: Oxford University Press.
- Angelis-Dimakis, A., Alexandratou, A. & Balzarini, A. (2016). Value chain upgrading in a textile dyeing industry. *Journal of Cleaner Production*, 138: 237-247.
- Barrientos, S. (2019). *Gender and work in global value chains: Capturing the gains?* Cambridge, UK: Cambridge University Press.
- Barrientos, S. & Smith, S. (2007). Do workers benefit from ethical trade? Assessing codes of labour practice in global production systems. *Third World Quarterly*, 28(4): 713-729.
- Barrientos, S., Dolan, C. & Tallontire, A. (2003). A gendered value chain approach to codes of conduct in African horticulture. *World Development*, 31(9): 1511-1526.
- Barrientos, S., Gereffi, G. & Rossi, A. (2011). Economic and social upgrading in global production networks: A new paradigm for a changing world. *International Labour Review*, 150(3-4): 319-340.
- Bernhardt, T. & Milberg, W. (2011). Does economic upgrading generate social upgrading? Insights from the horticulture, apparel, mobile phones and tourism sectors. Capturing the Gains, Working Paper 6. Brooks World Poverty Institute, University of Manchester, Manchester, UK.
- Brancati, E., Brancati, R. & Maresca, A. (2017). Global value chains, innovation and performance: Firm-level evidence from the Great Recession. *Journal of Economic Geography*, 17(5): 1039-1073.
- Coe, N. M., Dicken, P. & Hess, M. (2008). Global production networks: Realizing the potential. *Journal of Economic Geography*, 8(3): 271-295.
- Das Nair, R. & Mncube, L. (2012). The role of information exchange in facilitating collusion: Insights from selected cases. In K. Moodaliyar & S. Roberts (eds), *The development of competition law and economics in South Africa* (pp. 181-206). Cape Town: HSRC Press.
- De Marchi, V., Di Maria, E. & Ponte, S. (2013). The greening of global value chains: Insights from the furniture industry. *Competition & Change*, 17(4): 299-318.
- De Marchi, V., Di Maria, E., Krishnan, A. & Ponte, S. (2019). Environmental upgrading in global value chains. In S. Ponte, G. Gereffi & G. Raj-Reichert (eds), *Handbook on global value chains* (pp. 310-323). Cheltenham, UK: Edward Elgar Publishing.
- Du Toit, A. (2004). Forgotten by the highway: Globalisation, adverse incorporation and chronic poverty in a commercial farming district of South Africa. Chronic Poverty Research Centre Working Paper No. 49. PLAAS Chronic Poverty and Development Policy Series No. 4, University of the Western Cape, Cape Town.
- Frederick, S. & Gereffi, G. (2011). Upgrading and restructuring in the global apparel value chain: Why China and Asia are outperforming Mexico and Central America. *International Journal of*

- Technological Learning, Innovation and Development*, 4(1-3): 67-95.
- Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, 48(1): 37-70.
- Gereffi, G., Humphrey, J. & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1): 78-104.
- Gereffi, G. & Lee, J. (2016). Economic and social upgrading in global value chains and industrial clusters: Why governance matters. *Journal of Business Ethics*, 133(1): 25-38.
- Giuliani, E., Pietrobelli, C. & Rabellotti, R. (2005). Upgrading in global value chains: Lessons from Latin American clusters. *World Development*, 33(4): 549-573.
- Glückler, J. (2005). Making embeddedness work: Social practice institutions in foreign consulting markets. *Environment and Planning A*, 37(10): 1727-1750.
- Golini, R., De Marchi, V., Boffelli, A. & Kalchschmidt, M. (2018). Which governance structures drive economic, environmental, and social upgrading? A quantitative analysis in the assembly industries. *International Journal of Production Economics*, 203: 13-23.
- Granovetter, M. (1983). The strength of weak ties: A network theory revisited. *Sociological Theory*, 1: 201-233.
- Gulati, R. (1995). Social structure and alliance formation patterns: A longitudinal analysis. *Administrative Science Quarterly*, 40(4): 619-652.
- Henderson, J., Dicken, P., Hess, M., Coe, N. & Yeung, H. W-C. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy*, 9(3): 436-464.
- Horner, R. (2017). Beyond facilitator? State roles in global value chains and global production networks. *Geography Compass*, 11(2): e12307.
- Horner, R. & Alford, M. (2019). The roles of the state in global value chains. In S. Ponte, G. Gereffi & G. Raj-Reichert (eds), *Handbook on global value chains* (pp. 555-569). Cheltenham, UK: Edward Elgar Publishing.
- Humphrey, J. & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters? *Regional Studies*, 36(9): 1017-1027.
- Ivarsson, I. & Alvstam, C. G. (2011). Upgrading in global value-chains: A case study of technology-learning among IKEA-suppliers in China and Southeast Asia. *Journal of Economic Geography*, 11(4): 731-752.
- Karombo, T. (2020, 15 December). South Africa, already the continent's biggest polluter, saw a rise in carbon emissions last year. *Quartz*. Available from: <https://qz.com/africa/1946022/south-africa-saw-a-rise-in-carbon-emissions-in-2019#:~:text=South%20Africa%2C%20which%20is%20often,a%20study%20published%20this%20month.&text=South%20Africa%20tops%20Africa%27s%20big,up%20from%20464.4%20million%20MtC>
- Khoshnevisan, B., Tabatabaei, M., Tsapekos, P., Rafiee, S., Aghbashlo, M., Lindeneg, S. & Angelidaki, I. (2020). Environmental life cycle assessment of different biorefinery platforms valorizing municipal solid waste to bioenergy, microbial protein, lactic and succinic acid. *Renewable and Sustainable Energy Reviews*, 117: 109493.
- Krishnan, A. (2017). Re-thinking the environmental dimensions of upgrading and embeddedness in production networks: The case of Kenyan horticulture farmers. PhD Thesis, The University of Manchester.
- Krishnan, A. & Foster, C. (2018). A quantitative approach to innovation in agricultural value chains: Evidence from Kenyan horticulture. *The European Journal of Development Research*, 30(1): 108-135.

- Krishnan, A., De Marchi, V. & Ponte, S. (2023). Environmental upgrading and downgrading in global value chains: A framework for analysis. *Economic Geography*, 99(1): 25-50.
- Labuschagne, H. (2020). *Eskom electricity prices – 1994 to 2020*. Available from: <https://mybroadband.co.za/news/energy/362660-eskom-electricity-prices-1994-to-2020.html>
- Lee, J. & Gereffi, G. (2013). The co-evolution of concentration in mobile phone global value chains and its impact on social upgrading in developing countries. Capturing the Gains Working Paper 25. Brooks World Poverty Institute, University of Manchester, Manchester, UK.
- Lund-Thomsen, P. (2022). *Rethinking global value chains and corporate social responsibility*. Cheltenham, UK: Edward Elgar Publishing.
- Mayer, F. & Pickles, J. (2012). Re-embedding governance: Global apparel value chains and decent work. Global Development Institute Working Paper Series ctg-2010-01. The University of Manchester, Manchester, UK.
- McDermott, G. A. & Corredoira, R. A. (2010). Network composition, collaborative ties, and upgrading in emerging-market firms: Lessons from the Argentine autoparts sector. *Journal of International Business Studies*, 41(2): 308-329.
- Mondliwa, P., Roberts, S. & Ponte, S. (2021). Competition and power in global value chains. *Competition & Change*, 25(3-4): 328-349.
- Murphy, J. T. (2012). Global production networks, relational proximity, and the sociospatial dynamics of market internationalization in Bolivia's wood products sector. *Annals of the Association of American Geographers*, 102(1): 208-233.
- Naidoo, P. & Vanek, M. (2020, 12 November). South Africa News: South Africa's unemployment rate swings back to 17-year high. *Bloomberg*. Available from: <https://www.bloomberg.com/news/articles/2020-11-12/south-africa-s-unemployment-rate-swings-back-to-17-year-high#xj4y7vzkg>
- Pasquali, G., Krishnan, A. & Alford, M. (2021). Multichain strategies and economic upgrading in global value chains: Evidence from Kenyan horticulture. *World Development*, 146: 105598.
- Ponte, S. (2019). *Business, power and sustainability in a world of global value chains*. London Bloomsbury Publishing.
- Ponte, S. (2020). The hidden costs of environmental upgrading in global value chains. *Review of International Political Economy*, 29(3): 818-843.
- Poulsen, R. T., Ponte, S. & Sornn-Friese, H. (2018). Environmental upgrading in global value chains: The potential and limitations of ports in the greening of maritime transport. *Geoforum*, 89: 83-95.
- Raj-Reichert, G., Staritz, C. & Plank, L. (2022). Conceptualizing the regulator-buyer state in the European Union for the exercise of socially responsible public procurement in global production networks. *JCMS: Journal of Common Market Studies*, 60(3): 759-782.
- Sako, M. & Zylberberg, E. (2019). Supplier strategy in global value chains: Shaping governance and profiting from upgrading. *Socio-Economic Review*, 17(3): 687-707.
- Schmitz, H. (2006). Learning and earning in global garment and footwear chains. *The European Journal of Development Research*, 18(4): 546-571.
- Stats SA. (2020). *Statistical Release P0441: Gross domestic product Fourth quarter 2019*. Pretoria: Statistics South Africa.
- Strambach, S. & Surmeier, A. (2013). Knowledge dynamics in setting sustainable standards in tourism – The case of 'Fair Trade in Tourism South Africa'. *Current Issues in Tourism*, 16(7-8): 736-752.
- Surmeier, A. (2020). Dynamic capability building and social upgrading in tourism – Potentials and limits of sustainability standards. *Journal of Sustainable Tourism*, 28(10): 1498-1518.



- Ter Wal, A. L. & Boschma, R. A. (2009). Applying social network analysis in economic geography: Framing some key analytic issues. *The Annals of Regional Science*, 43(3): 739-756.
- Tregenna, F. (2008). The contributions of manufacturing and services to employment creation and growth in South Africa. *South African Journal of Economics*, 76: S175-S204.
- Tregenna, F. & Tsela, M. (2012). Inequality in South Africa: The distribution of income, expenditure and earnings. *Development Southern Africa*, 29(1): 35-61.
- World Bank. (2007). *South Africa Enterprise Survey 2007* [Data set]. World Bank. Available from: <http://www.enterprisesurveys.org>
- World Bank. (2020). *South Africa Enterprise Survey 2020* [Data set]. World Bank. Available from: <http://www.enterprisesurveys.org>
- Winkler, H. & Marquand, A. (2009). Changing development paths: From an energy-intensive to low-carbon economy in South Africa. *Climate and Development*, 1(1): 47-65.

## Annexure A: Supplementary Data

**Table A1: Sectoral upgrading trajectories from 2007 to 2020**

Sectors <sup>++</sup>	Economic <sup>+</sup>		Social <sup>+</sup>		Environmenta l <sup>+</sup>
	Certificatio n trajectory	Efficiency trajectory	Job security trajectory	Wages trajectory	Efficiency trajectory
Manufacturing (15-37)	-64.29%	-36.76%	4.44%	-52.71%	38.10%
Food products & beverages (15)	-38.33%	-37.31%	8.14%	-67.03%	28.30%
Textiles (17)	-34.62%	-24.88%	1.13%	-19.70%	73.25%
Wearing apparel, dressing and dyeing of fur (18)	-88.26%	-45.88%	0.03%	-9.88%	35.29%
Tanning and dressing of leather; luggage, handbags, saddlery, harness and footwear (19)	-100.00%	-77.24%	-4.45%	-60.83%	30.65%
Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)	-100.00%	-17.40%	-0.29%	-31.43%	64.68%
Paper and paper products (21)	-100.00%	-74.64%	8.15%	-71.72%	-51.26%
Publishing, printing and reproduction of recorded media (22)	-100.00%	-57.63%	9.47%	-44.70%	-97.09%
Chemicals and chemical products (24)	-87.08%	-70.74%	6.69%	-71.27%	43.96%
Rubber and plastics products (25)	-57.49%	-69.45%	5.04%	-57.58%	-16.19%
Other non-metallic mineral products (26)	-100.00%	-95.75%	0.95%	-90.06%	-49.81%
Fabricated metal products, except machinery and equipment (28)	-81.33%	-27.08%	3.48%	-47.52%	60.67%
Machinery and equipment n.e.c. (29)	-65.22%	-16.47%	7.31%	-48.58%	59.51%
Electrical machinery and apparatus n.e.c. (31)	-48.53%	-36.20%	10.56%	-59.15%	0.45%
Motor vehicles, trailers & semi-trailers (34)	-66.67%	-20.49%	5.79%	-54.08%	13.63%
Furniture; manufacturing n.e.c. (36)	-100.00%	-38.14%	5.27%	-62.32%	55.66%
Construction (45)	-89.50%	-25.60%	23.71%	-37.96%	27.31%
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (50-52)	-72.13%	-18.51%	2.99%	-26.50%	0.72%
Hotels and restaurants (55)	-93.02%	110.00%	3.55%	-57.67%	-2.97%

Source: Authors' construction from the data; + These are the percentage changes in values from 2007 to 2020; ++ Sub-sectors were included if they had at least three firms in each time period

**Table A2: Averages for sub-sector link existence in 2007 and 2020**

Sub-sector	Customer links						Supplier links					
	L1: Government		L3: Domestic		L4: Global		L18: Local		L19: Global		L21: Foreign technology	
	2007 (%)	2020 (%)	2007 (%)	2020 (%)	2007 (%)	2020 (%)	2007 (%)	2020 (%)	2007 (%)	2020 (%)	2007 (%)	2020 (%)
15	21.818	0	100	100	24.325	23.404	100	100	36.036	4.166667	21.622	4.444
17	29.412	0	100	100	23.529	53.846	94.11765	100	23.529	53.84615	11.765	8.333
18	26.882	2.272727	100	100	21.505	14.286	98.92473	95	38.710	22.5	16.129	9.524
19	35.294	0	94.444	100	22.222	40	94.444	100	44.444	40	5.556	20
20	16	0	100	100	24	16.667	96	100	36	8.333333	0	0
21	50	0	100	100	40	15.385	100	100	40	0	10	0
22	33.333	0	100	100	33.333	8.333	100	100	66.667	0	11.111	8.333
24	26.190	0	100	100	40.476	32	92.857	100	57.143	24	15.476	0
25	31.818	0	100	100	31.818	21.739	100	100	40.909	8.695652	13.636	0
26	12.5	0	100	100	12.5	0	100	100	0	50	12.5	0
28	20.879	2.041	100	100	32.967	24	98.901	100	30.769	14	15.385	4.167
29	35.714	0	100	100	64.286	31.818	100	100	45.238	13.63636	19.048	4.762
31	45	0	100	100	47.619	33.333	100	100	66.667	11.765	14.286	5.882
34	13.333	0	100	100	40	50	100	100	53,333	42.105	33.333	16.667
36	24.176	0	100	100	12.088	17.647	97.8022	100	37.363	11.765	6.593	0

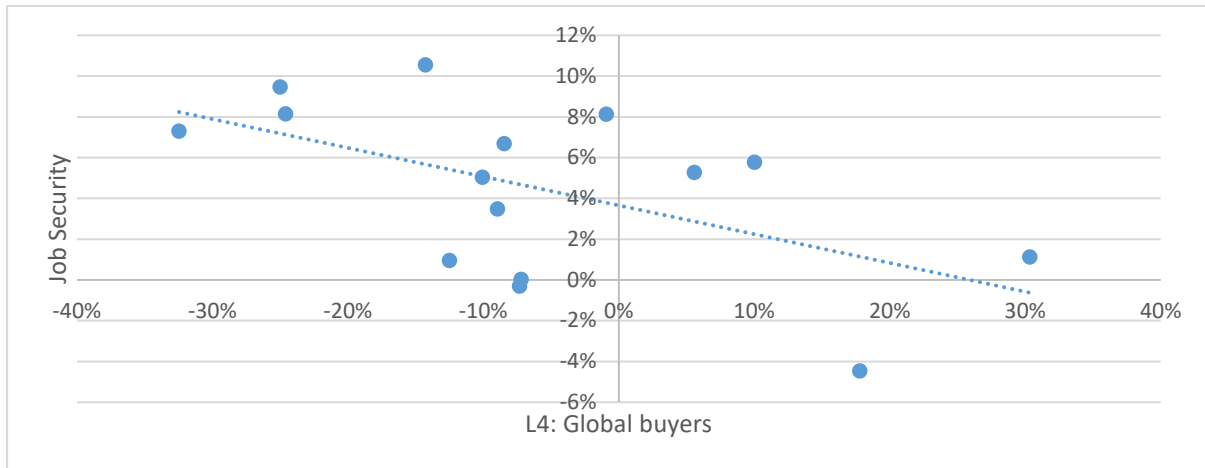
Source: Authors' construction from the data

**Table A3: Changes in sub-sector average link existence and upgrading trajectories from 2007 to 2020**

Sub-sector	Customers			Suppliers			Upgrading trajectory				
	L1: Government	L3: Domestic	L4: Global	L18: Domestic	L19: Global	L21: Foreign Technology	Economic: Certification	Economic: Efficiency	Social: Job security	Social: Wages	Environmental: Efficiency
15	-0.218	0.000	-0.009	0.000	-0.3187	-0.172	-0.383	-0.373	0.081	-0.670	-0.283
17	-0.294	0.000	0.303	0.059	0.3031	-0.034	-0.346	-0.249	0.011	-0.197	-0.733
18	-0.246	0.000	-0.072	-0.039	-0.1621	-0.066	-0.883	-0.459	0.000	-0.099	-0.353
19	-0.353	0.056	0.178	0.056	-0.0444	0.144	-1	-0.772	-0.045	-0.608	-0.306
20	-0.160	0.000	-0.073	0.040	-0.2767	0.000	-1	-0.174	-0.003	-0.314	-0.647
21	-0.500	0.000	-0.246	0.000	-0.4000	-0.100	-1	-0.746	0.081	-0.717	0.513
22	-0.333	0.000	-0.250	0.000	-0.6667	-0.028	-1	-0.576	0.095	-0.447	0.971
24	-0.262	0.000	-0.085	0.071	-0.3314	-0.156	-0.871	-0.707	0.067	-0.713	-0.440
25	-0.318	0.000	-0.101	0.000	-0.3221	-0.136	-0.575	-0.694	0.050	-0.576	0.162
26	-0.125	0.000	-0.125	0.000	0.5000	-0.125	-1	-0.957	0.010	-0.901	0.498
28	-0.188	0.000	-0.090	0.011	-0.1677	-0.112	-0.813	-0.271	0.035	-0.475	-0.607
29	-0.357	0.000	-0.325	0.000	-0.3160	-0.143	-0.652	-0.165	0.073	-0.486	-0.595
31	-0.450	0.000	-0.143	0.000	-0.5490	-0.084	-0.485	-0.362	0.106	-0.592	-0.004
34	-0.133	0.000	0.100	0.000	-0.1123	-0.167	-0.667	-0.205	0.058	-0.541	-0.136
36	-0.242	0.000	0.056	0.022	-0.2560	-0.066	-1	-0.381	0.053	-0.623	-0.557

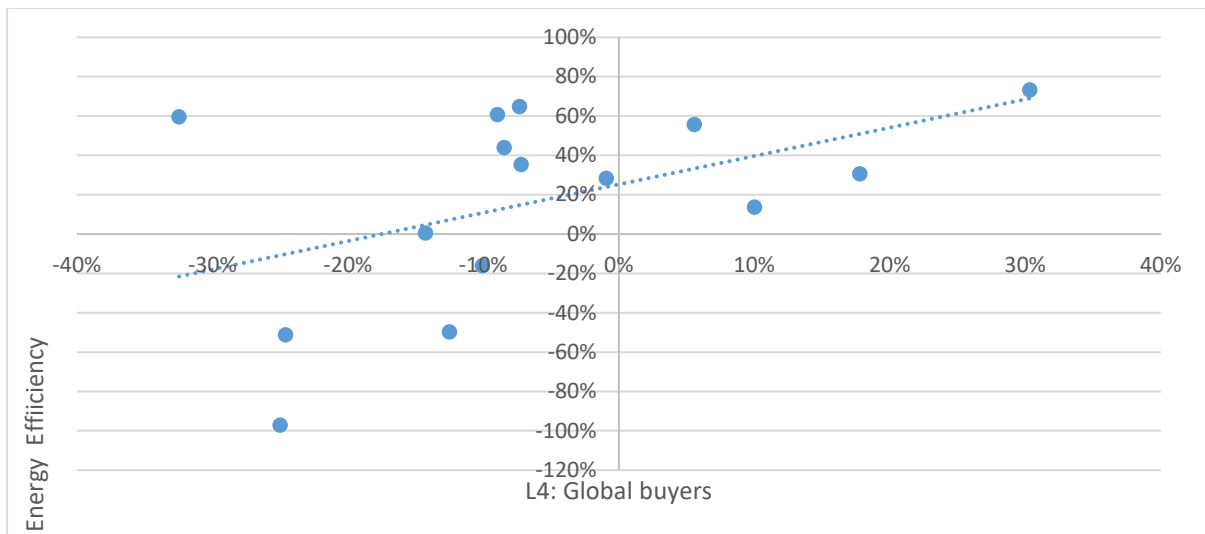
Source: Authors' construction from the data

**Figure A1: Relationship between a change in the number of links to global buyers and social upgrading (job security)**



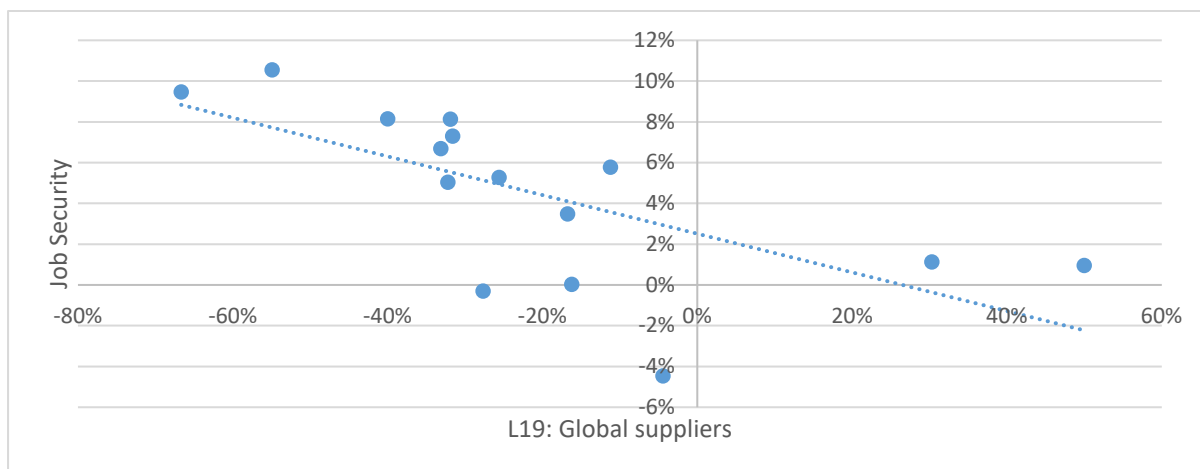
Source: Authors' construction from the data

**Figure A2: Relationship between a change in the number of links to global buyers and environmental upgrading (energy efficiency)**



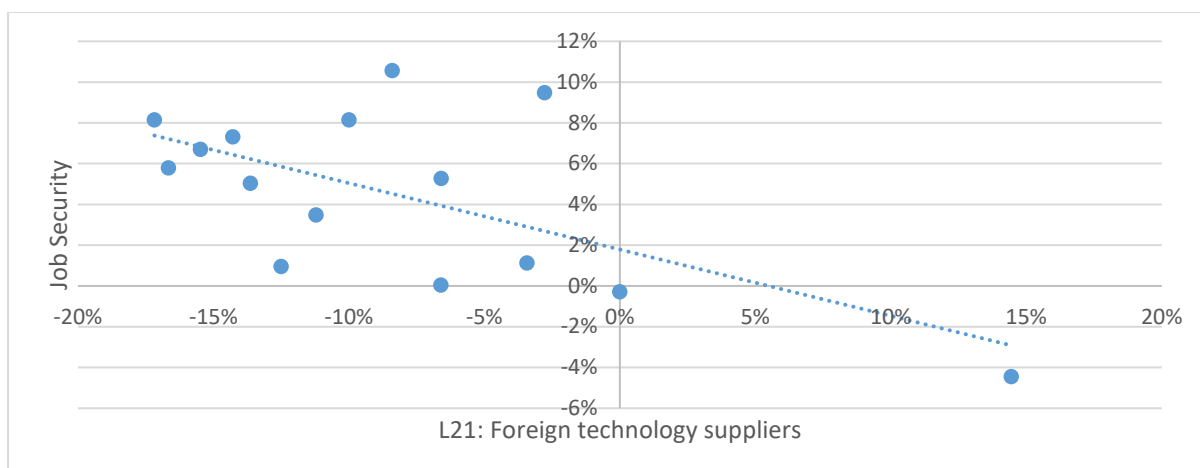
Source: Authors' construction from the data

**Figure A3: Relationship between a change in the number of links to global suppliers and social upgrading (job security)**



Source: Authors' construction from the data

**Figure A4: Relationship between a change in the number of links to foreign technology suppliers and social upgrading (job security)**



Source: Authors' construction from the data

**Table A4: Averages of sub-sector link strength in 2007 and 2020**

Sub-sector	Customers				Suppliers			
	L3: Local		L4: Global		L18: Local		L19: Global	
	2007 (%)	2020 (%)	2007 (%)	2020 (%)	2007 (%)	2020 (%)	2007 (%)	2020 (%)
15	94.919	93.851	5.081	6.149	88.351	98.75	11.649	1.25
17	88.235	82.538	11.765	17.462	80.882	74.231	19.118	25.769
18	94.097	96.643	5.903	3.357	83.763	87.875	16.237	12.125
19	88.833	96	11.167	4	81.944	86	18.056	14
20	98.24	97.5	1.76	2.5	86.36	96.667	13.64	3.333
21	94.2	93.846	5.8	6.154	78.5	100	21.5	0
22	97.111	95.833	2.889	4.1667	70.056	100	29.944	0
24	89.786	90.2	10.214	9.8	75.476	91.6	24.524	8.4
25	95.045	92.174	4.955	7.826	89.773	96.087	10.227	3.913
26	98.75	100	1.25	0	100	78.75	0	21.25
28	94.385	90.6	5.615	9.4	90.407	93.8	9.593	6.2
29	85.512	90.682	14.488	9.318	82.607	95.364	17.393	4.636
31	91.429	93.333	8.571	6.667	72.857	95.588	27.143	4.412
34	85.467	84.9	14.533	15.1	70.6	84.579	29.4	15.421
36	98.198	92.942	1.802	7.059	86.956	94.118	13.044	5.882

Source: Authors' construction from the data

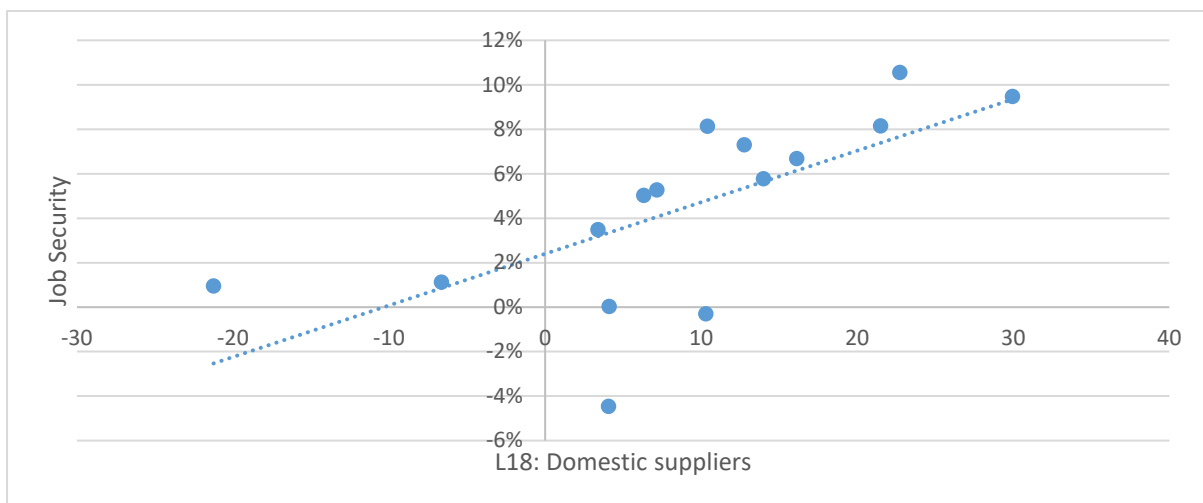
**Table A5: Changes in average sub-sector link strength and upgrading trajectories from 2007 to 2020**

Sub-sector	Customers		Suppliers						
	L3: Domestic	L4: Global	L18: Domestic	L19: Global	Economic: Certification	Economic: Efficiency	Social: Job security	Social: Wages	Environmental: Efficiency
15	-1.068	1.068	10.399	-10.399	-0.383	-0.373	0.081	-0.670	-0.283
17	-5.697	5.697	-6.652	6.652	-0.346	-0.249	0.011	-0.197	-0.733
18	2.546	-2.546	4.112	-4.112	-0.883	-0.459	0.000	-0.099	-0.353
19	7.1667	-7.167	4.056	-4.056	-1	-0.772	-0.045	-0.608	-0.306
20	-0.740	0.740	10.307	-10.307	-1	-0.174	-0.003	-0.314	-0.647
21	-0.354	0.354	21.500	-21.500	-1	-0.746	0.0815	-0.717	0.513
22	-1.278	1.278	29.944	-29.944	-1	-0.576	0.095	-0.447	0.971
24	0.414	-0.414	16.124	-16.124	-0.871	-0.707	0.067	-0.713	-0.440
25	-2.872	2.872	6.314	-6.314	-0.575	-0.694	0.050	-0.576	0.162
26	1.250	-1.250	-21.250	21.250	-1	-0.957	0.010	-0.901	0.498
28	-3.785	3.785	3.393	-3.393	-0.813	-0.271	0.035	-0.475	-0.607
29	5.170	-5.170	12.756	-12.756	-0.652	-0.165	0.073	-0.486	-0.595
31	1.905	-1.905	22.731	-22.731	-0.485	-0.362	0.106	-0.592	-0.004
34	-0.567	0.567	13.979	-13.979	-0.667	-0.205	0.058	-0.541	-0.136
36	-5.257	5.257	7.162	-7.162	-1	-0.381	0.053	-0.623	-0.557

Source: Authors' construction from the data

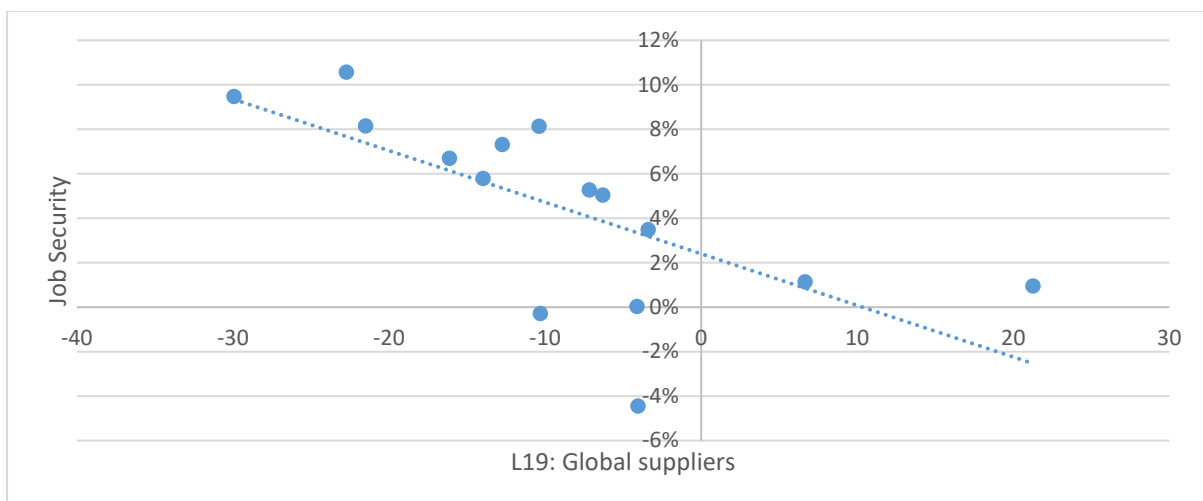


**Figure A5: Relationship between a change in the strength of links to domestic suppliers and social upgrading (job security)**



Source: Authors' construction from the data

**Figure A6: Relationship between a change in the strength of links to global suppliers and social upgrading (job security)**



Source: Authors' construction from the data

## **Annexure B: Link Heterogeneity and Sub-Sector Upgrading Trajectories**

To gain a deeper understanding of how network structures are connected to upgrading or downgrading, we did a preliminary analysis to identify patterns in characteristics of manufacturing sub-sectors' links. To carry out this process, we used a hierarchical cluster analysis.<sup>22</sup> The aim was to understand if there are similarities in economic, social and environmental upgrading when manufacturing firms in specific sub-sectors have specific network structures.

In this preliminary analysis, we considered the role of link heterogeneity. We developed a new indicator to explore total buyer and supplier link heterogeneity. The value obtained is a summation of all the different types of links (both customer and supplier). This indicator was used to calculate firm averages at the manufacturing sub-sector level.

By carrying out a hierarchical cluster analysis, we identified distinct clusters of sectors that each have similar levels of heterogeneity and similar upgrading outcomes. Some sectors tend to cluster across multiple tests, such as machinery and equipment n.e.c. (29) and electrical machinery and apparatus n.e.c. (31). More research is necessary to identify and explore potential clusters of sectors that share specific link characteristics and upgrading outcomes. Building on such an analysis, potential areas to consider are policies shaping cluster members' behaviour, and other similarities within the clusters, such as firm size.

### **B.1 Network Governance and Economic Upgrading**

Considering the clusters related to link heterogeneity and economic upgrading in the form of achieving international certification, the cluster analysis results in Table B1 show four main clusters that emerged from the 2007 and 2020 data. The sectors within each cluster are similar in both samples. It is notable that Cluster 4 includes both the highest number of links and the highest upgrading level.

As shown in Table B2, we see a different picture when looking at economic upgrading in terms of efficiency. The clusters are noticeably different in 2007 and 2020. More analysis is needed to better identify potential patterns in relation to network (governance) structures and economic upgrading.

---

<sup>22</sup> We used a hierarchical model, with average and weighted linkages, and Euclidean distance.

**Table B1: Clusters of relationships between link heterogeneity and quality**

Cluster	2007			2020		
	Sub-sectors	Average scores		Sectors	Average scores	
		Number of links	Economic upgrading: Certification		Number of links	Economic upgrading: Certification
1	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> </ul>	3.334	0.328	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> </ul>	2.464	0.074
2	<ul style="list-style-type: none"> <li>• rubber and plastics products (25)</li> </ul>	3.591	0.409	<ul style="list-style-type: none"> <li>• rubber and plastics products (25)</li> </ul>	2.292	0.208
3	<ul style="list-style-type: none"> <li>• textiles (17)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• other non-metallic mineral products (26)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	3.001	0.213	<ul style="list-style-type: none"> <li>• textiles (17)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• other non-metallic mineral products (26)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	2.505	0.038
4	<ul style="list-style-type: none"> <li>• paper and paper products (21)</li> <li>• chemicals and chemical products (24)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	3.926	0.568	<ul style="list-style-type: none"> <li>• paper and paper products (21)</li> <li>• chemicals and chemical products (24)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	2.543	0.184

Source: Authors' construction from the data

**Table B2: Clusters of relationships between link heterogeneity and economic efficiency**

Cluster	2007			2020		
	Sectors	Average scores		Sectors	Average scores	
		Number of links	Economic upgrading: Efficiency		Number of links	Economic upgrading: Efficiency
1	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• textiles (17)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• other non-metallic mineral products (26)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	3.180	419 937.5	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• textiles (17)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> </ul>	2.608	301 071.5
2	<ul style="list-style-type: none"> <li>• wearing apparel; dressing and dyeing of fur (18)</li> </ul>	3.237	280 382.7	<ul style="list-style-type: none"> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• paper and paper products (21)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• chemicals and chemical products (24)</li> <li>• rubber and plastics products (25)</li> </ul>	2.313	176 726.9
3	<ul style="list-style-type: none"> <li>• paper and paper products (21)</li> <li>• chemicals and chemical products (24)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> </ul>	3.935	716 861.2	<ul style="list-style-type: none"> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• other non-metallic mineral products (26)</li> </ul>	2.7	49 423.79
4	<ul style="list-style-type: none"> <li>• rubber and plastics products (25)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	3.805	599 740.8	<ul style="list-style-type: none"> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31) motor vehicles, trailers and semi-trailers (34)</li> </ul>	2.563	450 229.1

Source: Authors' construction from the data

## **B.2 Network Governance and Social Upgrading**

We also identified patterns related to link heterogeneity and social upgrading. Table B3 shows results in relation to job security. These results show that, in both years, Cluster 4 had the highest number of links and the lowest level of job security.

The results for the wages dimension are shown in Table B4. It can be noted that machinery and equipment n.e.c. (29) is in the best-performing cluster in terms of wages paid in both 2007 and 2020. As with environmental upgrading, these results provide preliminary insights but more analysis is necessary to understand broader patterns.

**Table B3: Clusters of relationships between link heterogeneity and job security**

Cluster	2007			2020		
	Sectors	Average scores		Sectors	Average scores	
		Number of links	Social upgrading: Job security		Number of links	Social upgrading: Job security
1	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• wearing apparel; dressing and dyeing of fur (18),</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> </ul>	3.334	0.912	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• paper and paper products (21)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• rubber and plastics products (25)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	2.244	0.961
2	<ul style="list-style-type: none"> <li>• textiles (17)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• other non-metallic mineral products (26)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	3.001	0.911	<ul style="list-style-type: none"> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• other non-metallic mineral products (26)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> </ul>	2.416	0.907
3	<ul style="list-style-type: none"> <li>• paper and paper products (21)</li> <li>• chemicals and chemical products (24)</li> <li>• rubber and plastics products (25)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	3.763	0.906	<ul style="list-style-type: none"> <li>• chemicals and chemical products (24)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> </ul>	2.52	0.976
4	<ul style="list-style-type: none"> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> </ul>	4.083	0.892	<ul style="list-style-type: none"> <li>• textiles (17)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	3.026	0.939

Source: Authors' construction from the data

**Table B4: Clusters of relationships between link heterogeneity and wages paid**

Cluster	2007			2020		
	Sectors	Average scores		Sectors	Average scores	
		Number of links	Social upgrading: Wages		Number of links	Social upgrading: Wages
1	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• rubber and plastics products (25)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	3.498	87558.09	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• paper and paper products (21)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	2.439	24558.87
2	<ul style="list-style-type: none"> <li>• textiles (17)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• other non-metallic mineral products (26)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	3.067	69442.37	<ul style="list-style-type: none"> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• chemicals and chemical products (24)</li> <li>• rubber and plastics products (25)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	2.452	40023.35
3	<ul style="list-style-type: none"> <li>• wearing apparel; dressing and dyeing of fur (18)</li> </ul>	3.237	42636.37	<ul style="list-style-type: none"> <li>• textiles (17)</li> <li>• machinery and equipment n.e.c. (29)</li> </ul>	2.788	60011.53
4	<ul style="list-style-type: none"> <li>• paper and paper products (21)</li> <li>• chemicals and chemical products (24)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> </ul>	3.957	115392.9	<ul style="list-style-type: none"> <li>• other non-metallic mineral products (26)</li> </ul>	2.4	7240.716

Source: Authors' construction from the data

### **B.3 Network Governance and Environmental Upgrading**

Finally, we considered patterns between link heterogeneity and environmental upgrading. The cluster analysis in Table B5 shows that Cluster 3 had the highest number of links and the most energy efficiency in 2007. In 2020, on the other hand, Cluster 2 had the second lowest link heterogeneity and the most energy efficiency. As with all of the preliminary cluster analysis results presented above, more analysis is necessary to better explore these relationships.



**Table B5: Clusters of relationships between link heterogeneity and energy efficiency**

Cluster	2007			2020		
	Sectors	Average scores		Sectors	Average scores	
		Number of links	Environmental upgrading: Efficiency		Number of links	Environmental upgrading: Efficiency
1	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• chemicals and chemical products (24)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	3.441	-9.930	<ul style="list-style-type: none"> <li>• food products and beverages (15)</li> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• paper and paper products (21)</li> <li>• rubber and plastics products (25)</li> <li>• motor vehicles, trailers and semi-trailers (34)</li> </ul>	2.527	-7.761
2	<ul style="list-style-type: none"> <li>• Textiles (17)</li> <li>• wearing apparel; dressing and dyeing of fur (18)</li> <li>• tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• machinery and equipment n.e.c. (29)</li> </ul>	3.347	-12.519	<ul style="list-style-type: none"> <li>• Textiles (17)</li> <li>• wood and of products of wood and cork, except furniture; articles of straw and plaiting materials (20)</li> <li>• fabricated metal products, except machinery and equipment (28)</li> <li>• furniture; manufacturing n.e.c. (36)</li> </ul>	2.515	-3.856
3	<ul style="list-style-type: none"> <li>• paper and paper products (21)</li> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> </ul>	3.829	-5.919	<ul style="list-style-type: none"> <li>• chemicals and chemical products (24)</li> <li>• machinery and equipment n.e.c. (29)</li> <li>• electrical machinery and apparatus n.e.c. (31)</li> </ul>	2.52	-5.212
4	<ul style="list-style-type: none"> <li>• rubber and plastics products (25)</li> <li>• other non-metallic mineral products (26)</li> </ul>	3.233	-7.831	<ul style="list-style-type: none"> <li>• publishing, printing and reproduction of recorded media (22)</li> <li>• other non-metallic mineral products (26)</li> </ul>	2.283	-11.723

Source: Authors' construction from the data

DSI/NRF South African Research Chair in  
Industrial Development (SARChI-ID)  
31 Henley Road, Auckland Park,  
Johannesburg, South Africa

General enquiries:  
Koketso Manyane-Dlangamandla  
Email: [koketsom@uj.ac.za](mailto:koketsom@uj.ac.za)  
Tel: +27 011 559 7454

