The Fibrous Plant Industry in South Africa: A Product Space Mapping

Presented by Robert Hill

Haroon Bhorat
Caitlin Allen
Robert Hill
Christopher Rooney
Francois Steenkamp

Development Policy Research Unit
School of Economics
University of Cape Town
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Outline

1. Economic Complexity: A Background
   - The theory of complexity
   - The product space
2. Applying Complexity to Fibrous Products
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   - The fibrous product space
   - The Fibrous Complexity Index (FCI)
3. Fibrous Futures: Frontier Products
   - Identifying frontier products
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I. Economic Complexity: A Background

1.1 The Theory of Complexity

Measuring Economic Complexity

- Hausmann & Hidalgo (2011) develop a way to measure the productive knowledge in society – the measure of **economic complexity**
- Two important concepts:
  - **Diversity**: how diverse is the export portfolio of the country?
  - **Ubiquity**: how commonly produced is a particular product?
- Economic complexity is more than just diversity or ubiquity
- Consider medical machinery and diamonds.
  - Ubiquity is low – both goods are produced by very few countries
  - BUT the countries producing medical machinery have much more diverse export portfolios. Thus, higher diversity.
  - Thus, we need to refine the notion of ubiquity by considering diversity.

Diversity and Ubiquity: An Example

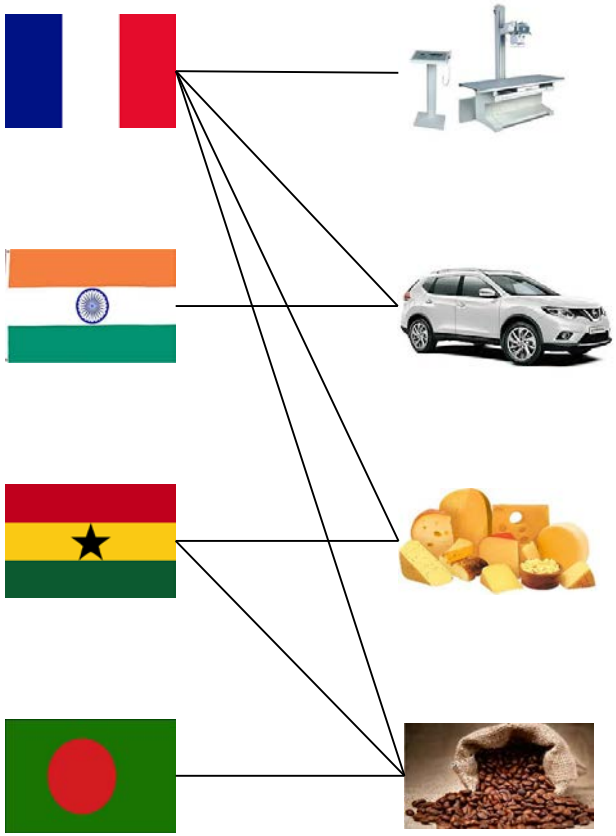
Diversity

$k_{c1,0} = 4$

$k_{c2,0} = 1$

$k_{c3,0} = 2$

$k_{c4,0} = 1$



Ubiquity

$k_{p1,0} = 1$

$k_{p2,0} = 2$

$k_{p3,0} = 2$

$k_{p4,0} = 3$

M	X-ray	Car	Cheese	Coffee
FRA	1	1	1	1
IND	0	1	0	0
GHA	0	0	1	1
BGD	0	0	0	1

Then calculate the average diversity of countries that produce each product, etc.

The ECI and the PCI

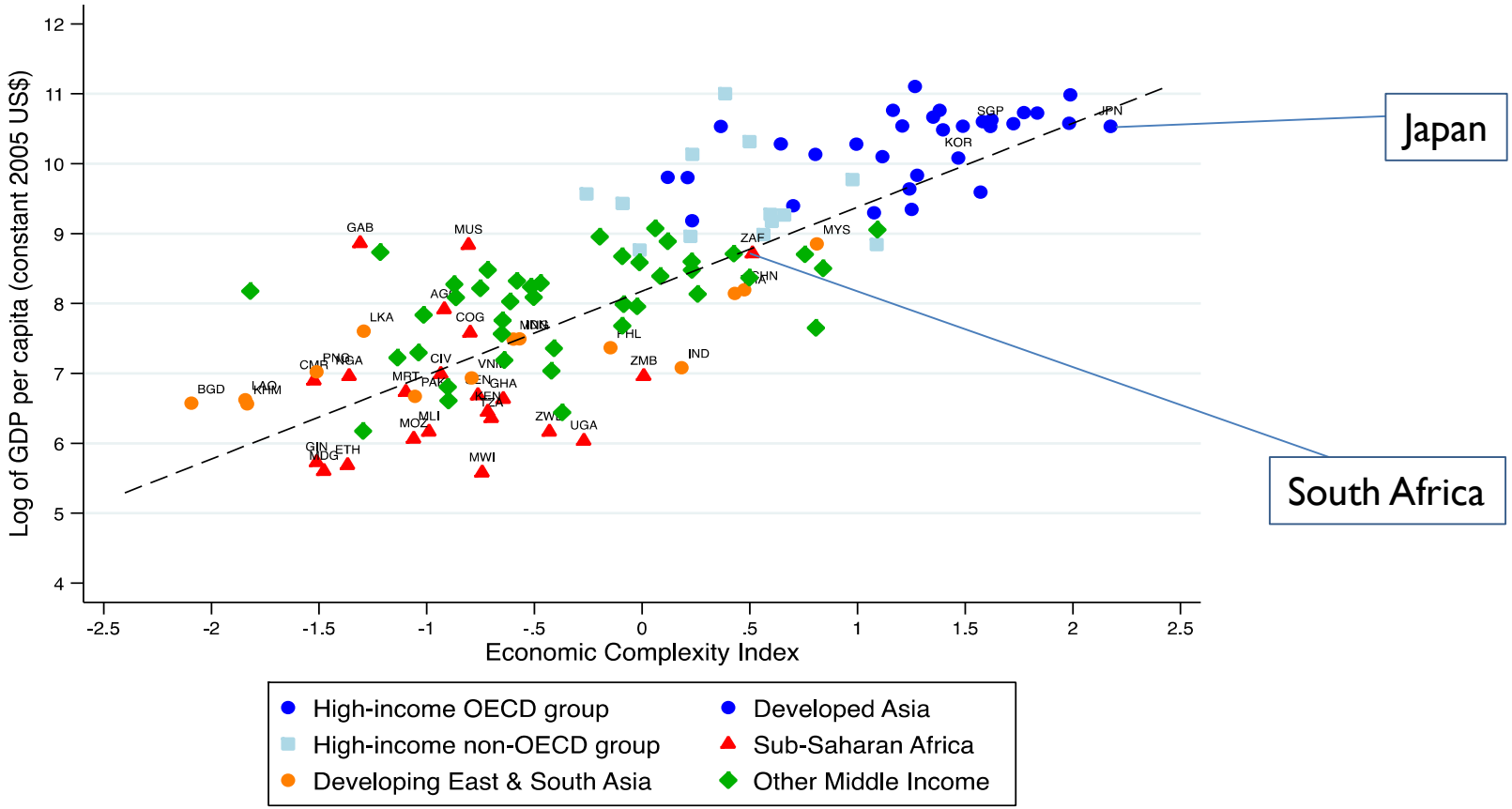
Through the **Method of Reflections**, we obtain some important measures related to economic complexity:

- **PCI** – A measure of how complex a given **product** is. This depends on the ubiquity of the product as well as on the diversity of the country exporting the product
- **ECI** – A measure of the level of economic complexity for a country (can be thought of as the average PCI for those products exported with $RCA \geq 1$)

And some other measures that we won't talk about here: e.g. distance, opportunity gain,

Building Economic Complexity

Economic Complexity (ECI) and the Log of GDP per capita by analytical group, 2013



Source: Own calculations using trade data from BACI data (HS 6-digit revision 1992) and GDP per capita data from the World Development Indicators.

Notes: The sample of countries is reduced to those for which we estimate complexity measures.

1.2 The Product Space

How to grow complexity?

Growing complexity requires producing more complex products. In order to produce new products, you need to accumulate new capabilities.

BUT, the accumulation of capabilities is complicated by the **chicken and egg problem**…

- You can't produce products that require capabilities that you do not have.
- **BUT** there is no incentive to accumulate capabilities if the industries that demand them, do not exist.

This is especially the case if the capabilities required by a new industry/product are numerous.

How to grow complexity?

How do countries accumulate capabilities, and thus produce the new products that require such capabilities?

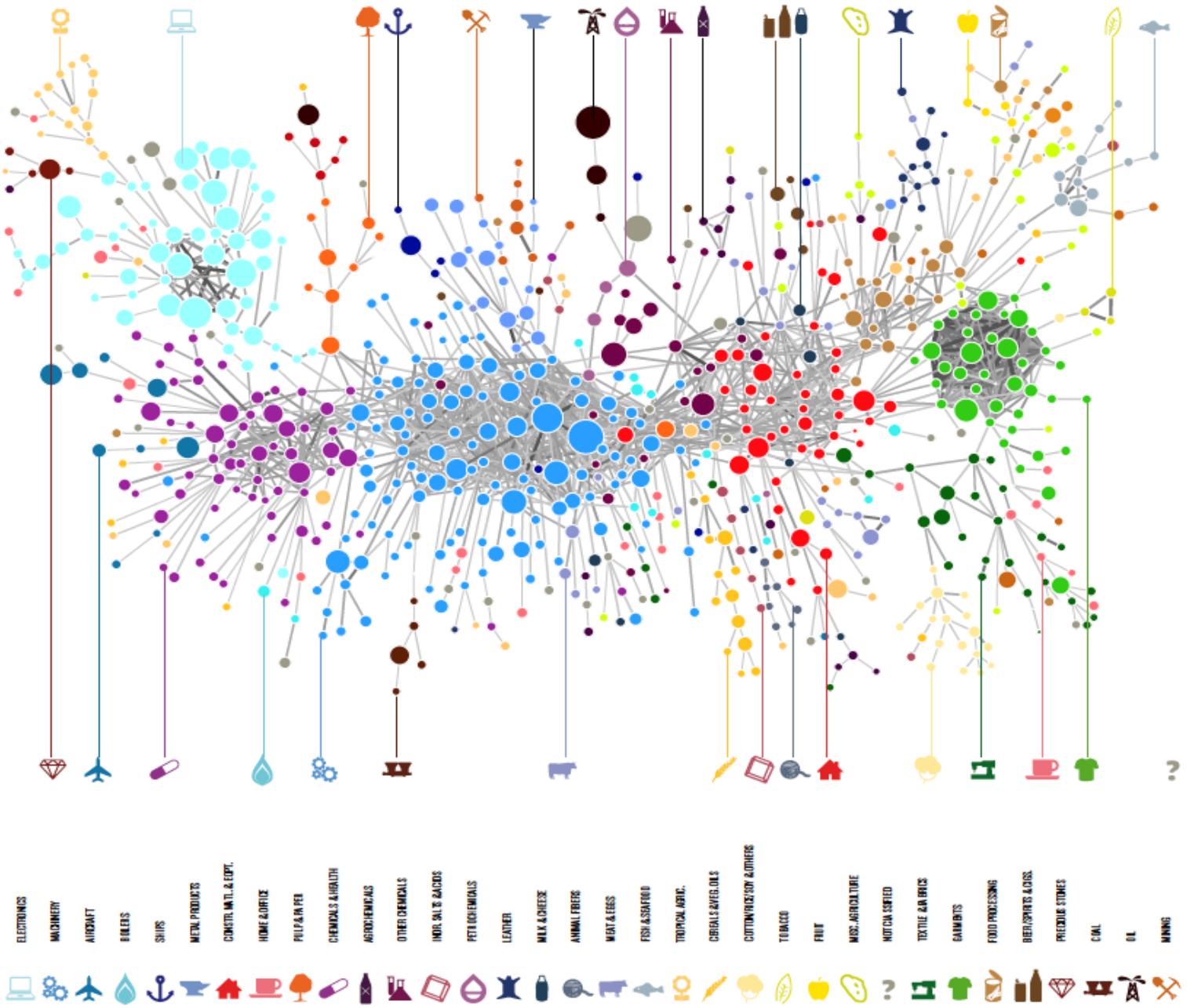
- Combine existing capabilities with new capabilities
- Move to products that use existing/similar capabilities

For example: You produce shirts. It is easier to move to producing blouses than to jet engines.

Relationships between products are built up in a network.

This network is visualised as the **Product Space**

Visualising the Product Space



What the Product Space can tell us

Structure of a country's product space tells us how easily it can increase its complexity.

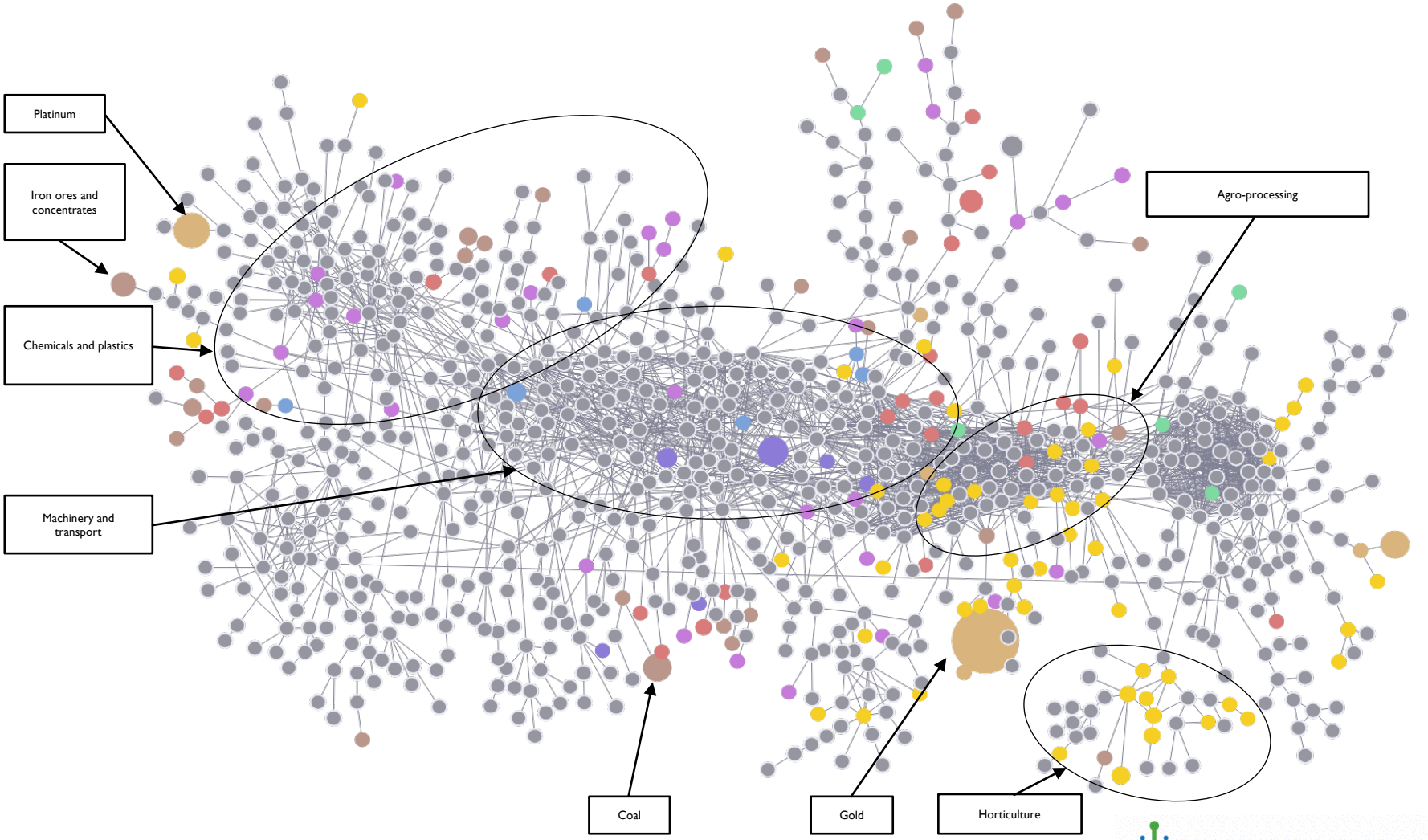
- In the **core** – more connected; easier to diversify
- In the **periphery** – less connected; harder to diversify

Structural transformation is a path dependent process. Countries find it easier to move to 'nearby' products

Countries seeking to develop complexity should aim to diversify into the core of the product space.

South Africa's Product Space, 2015

Quite peripheral and resource-based



Source: CID (2018)

Notes: Product groupings or clusters are represented by the following colours: Textiles & Furniture (light green); Vegetables, Foodstuffs & Wood (yellow); Stone & Glass (light brown); Minerals (dark brown); Metals (red); Chemicals & Plastics (light purple); Transport Vehicles (dark purple); Machinery (blue); Electronics (turquoise); Other (dark blue).

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2. Applying Complexity to Fibrous Products

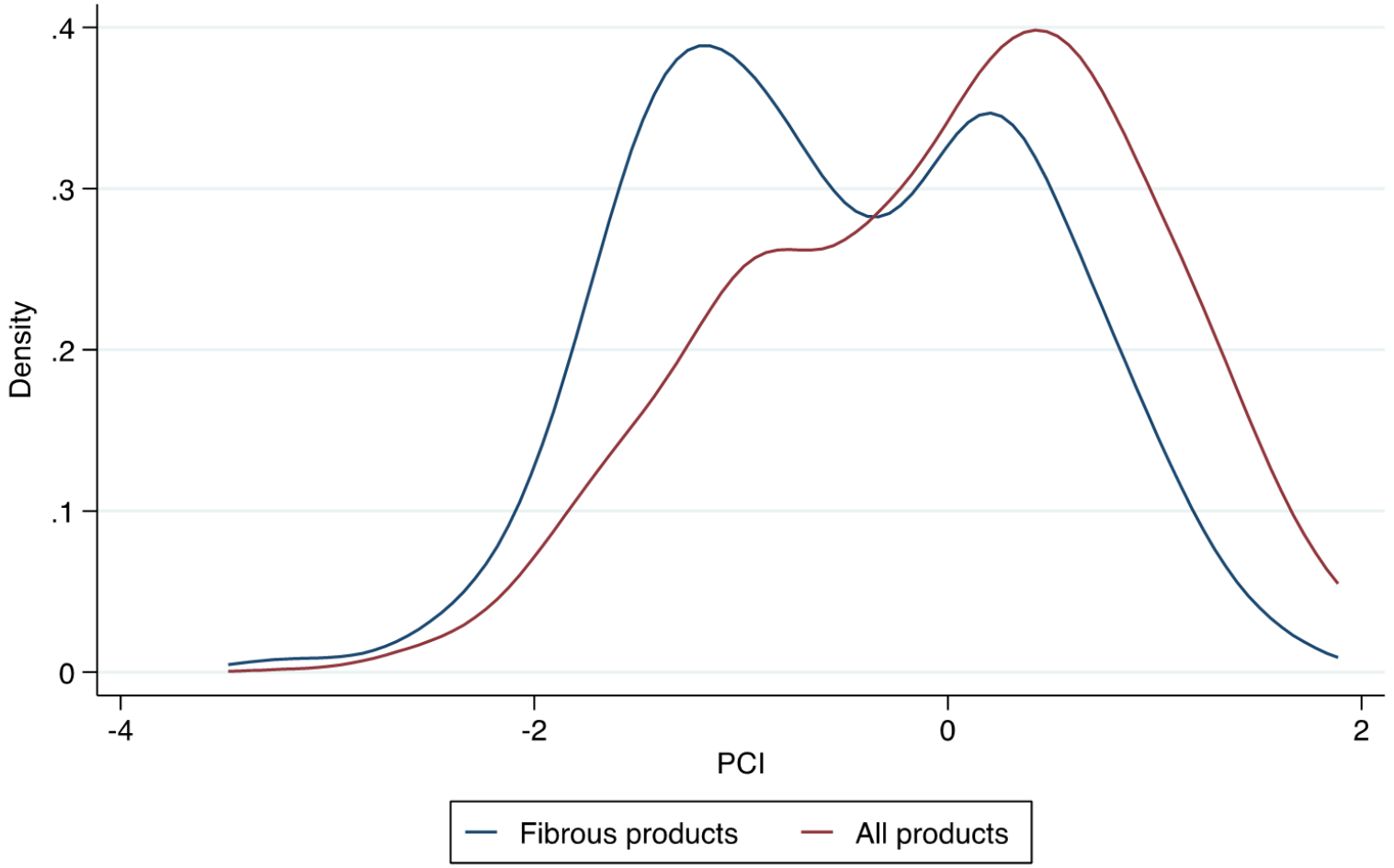
Identifying Fibrous Products

To identify whether a product was fibrous or not:

- Refer to list of products provided by Engineering team
- Map each of these products to the relevant HS04 code
- Manual mapping of products resulted in 175 fibrous products in total

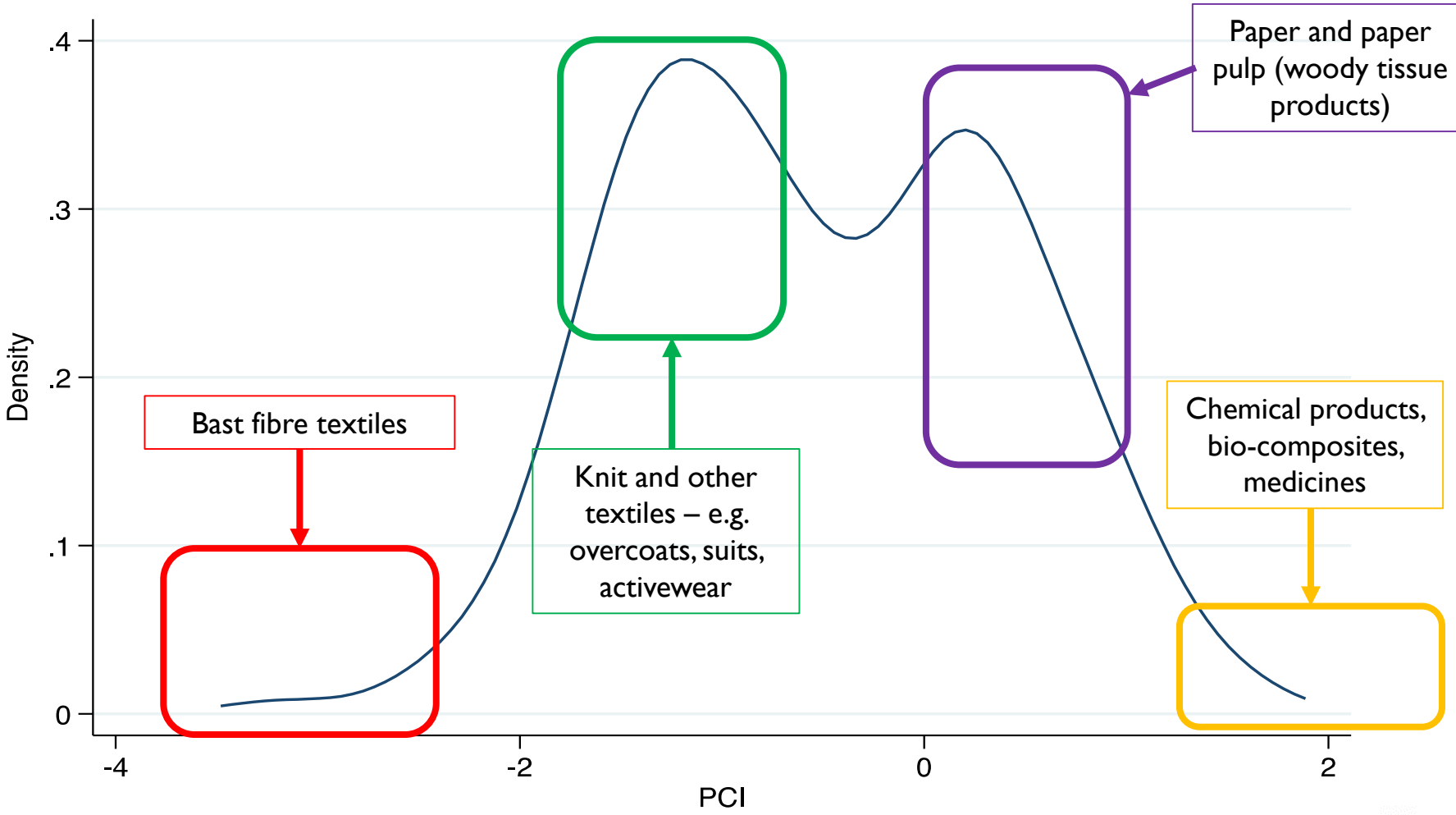
Caveat: Although products identified could be produced using these fibrous plants, there is no way of knowing the share of or viability of production – e.g. bicycles.

How Do Fibrous Products Compare?



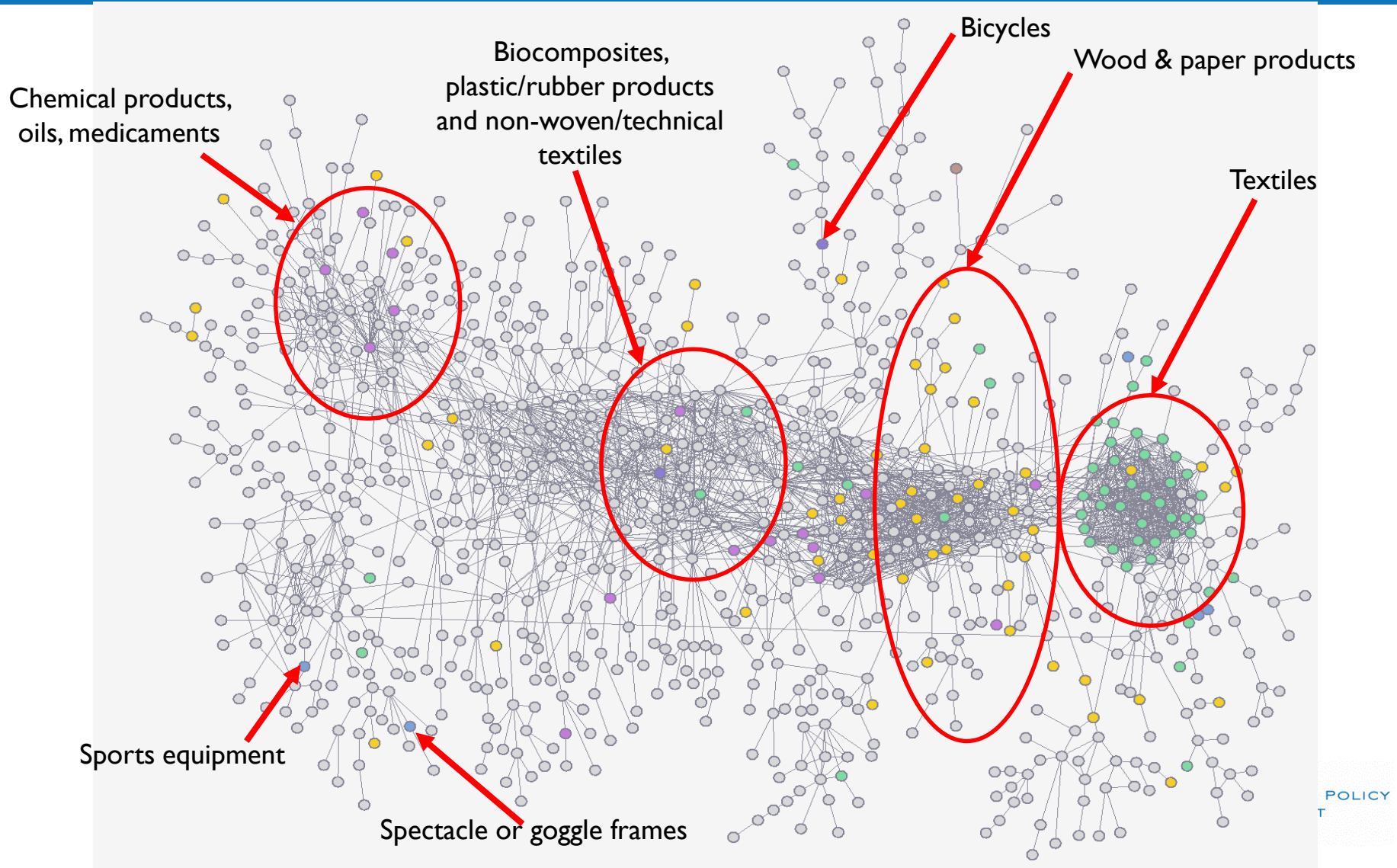
Source: Own calculations using Atlas of Economic Complexity data (2019)
Note: Kolmogorov-Smirnov p-value of 0.000

Complexity of Fibrous Products



Source: Own calculations using Atlas of Economic Complexity data (2019)
Note: Kolmogorov-Smirnov p-value of 0.000

Locating Fibrous Products in the Product Space



Building a Fibrous Product Space

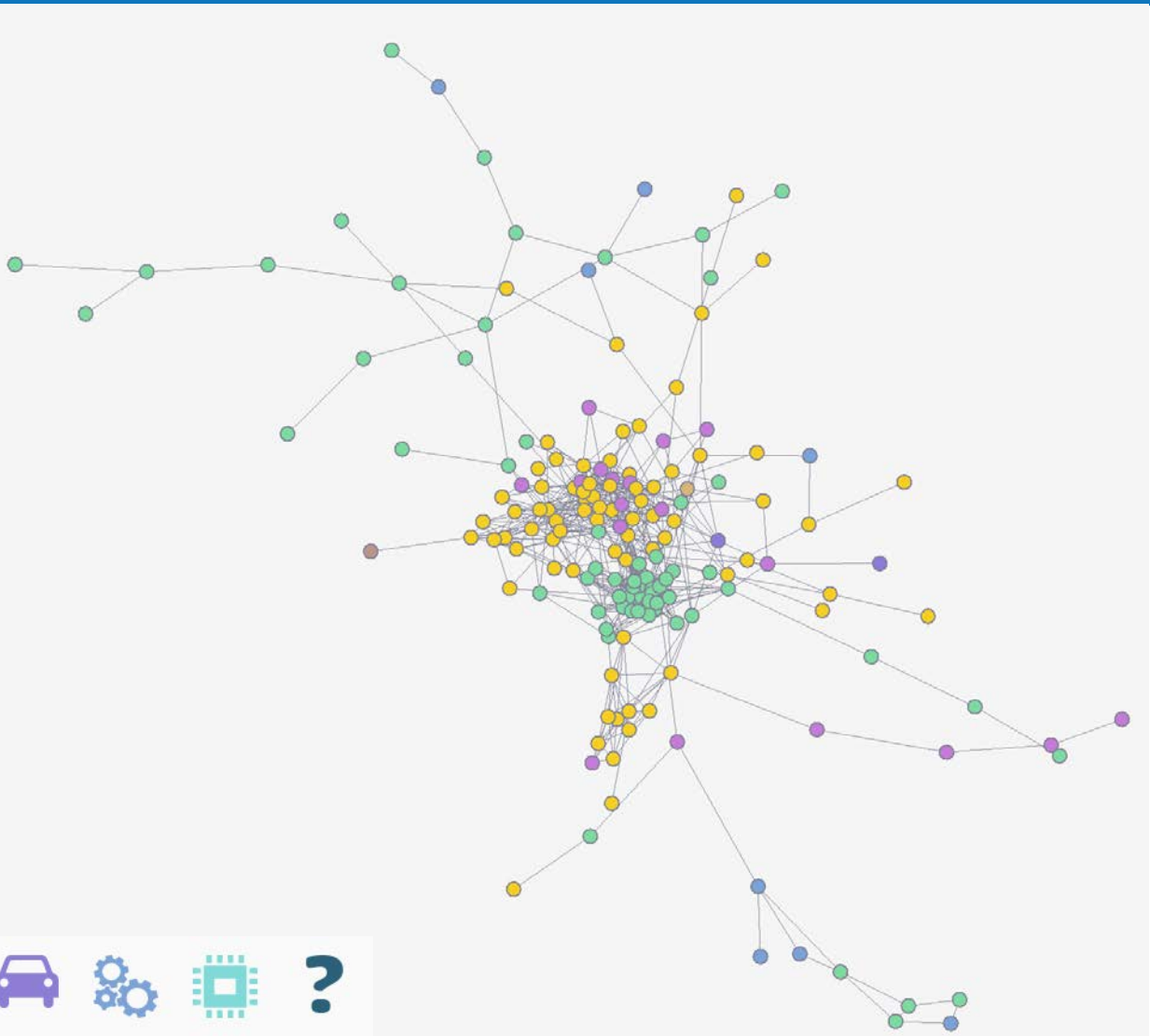
Perhaps we are interested in how a country like South Africa fits specifically into the fibrous world economy.

Just like you can visualise the product space for all products and highlight where $RCA \geq 1$, we could build a fibrous product space.

A fibrous plant product space can show us how much of the fibrous economy we as a country are engaged in.

The Fibrous Product Space

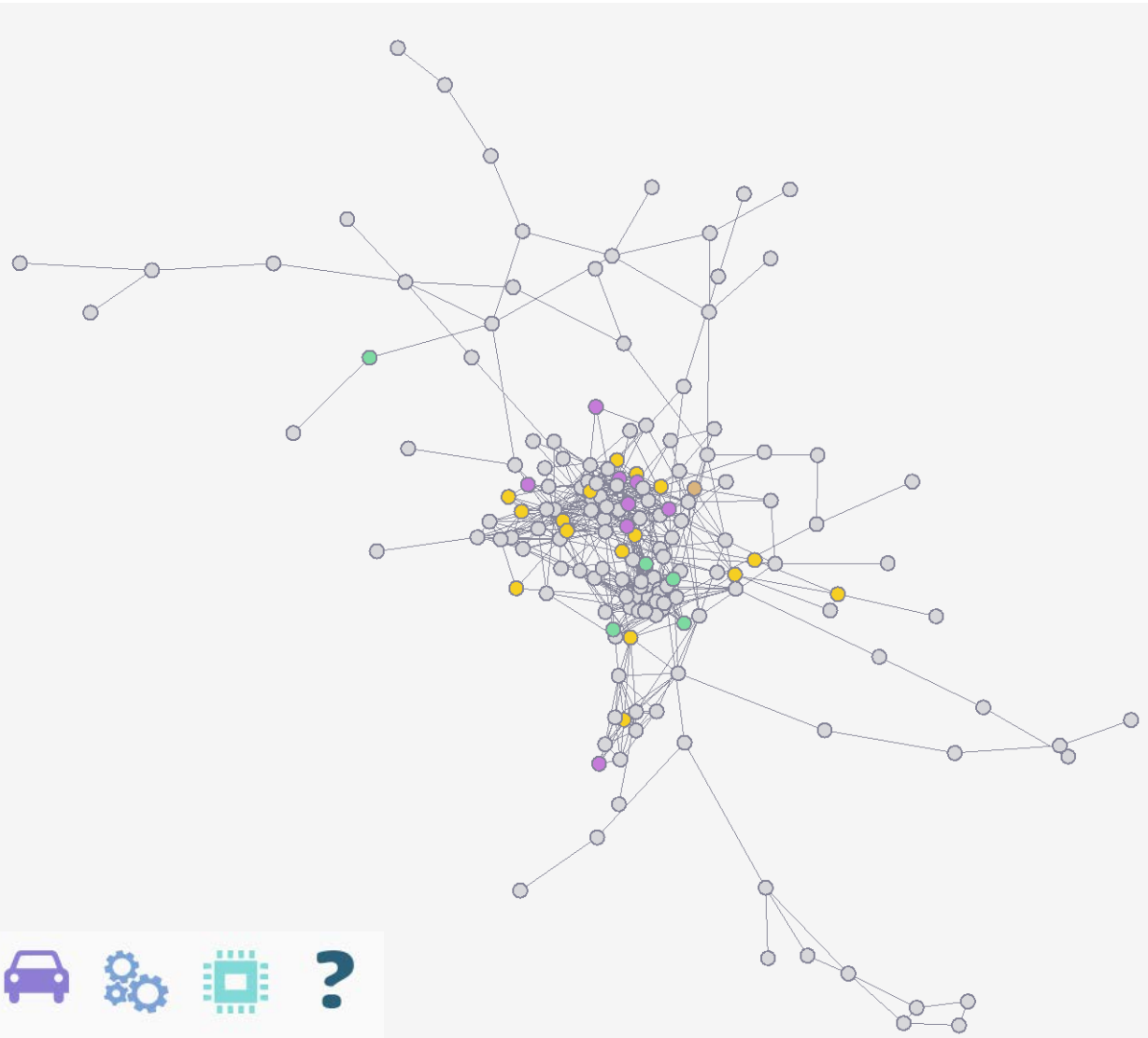
- Cluster of agricultural, chemical and textile products in the centre of the product space.
- Machinery and some simple textiles (e.g. bast fibres, yarns and woven fabrics) spread out away from the centre.



South Africa's Fibrous Product Space

SA currently occupies nodes in the Fibrous Product space for products such as:

- Seed oils and margarines (agricultural)
- Wood charcoal (agricultural)
- Polishes, soaps and creams (chemical)
- Paper and paper notebooks (agricultural)
- Footwear and hat shapes (textiles)



Creating a Fibrous Complexity Index (FCI)

To understand the fibrous market globally and a country's relative position in the global market, we create a Fibrous Complexity Index (FCI).

This captures the extent to which a country can competitively export a diverse range of technologically sophisticated fibrous products.

Calculated by following the approach adopted by Mealy & Teytelboym (2018):

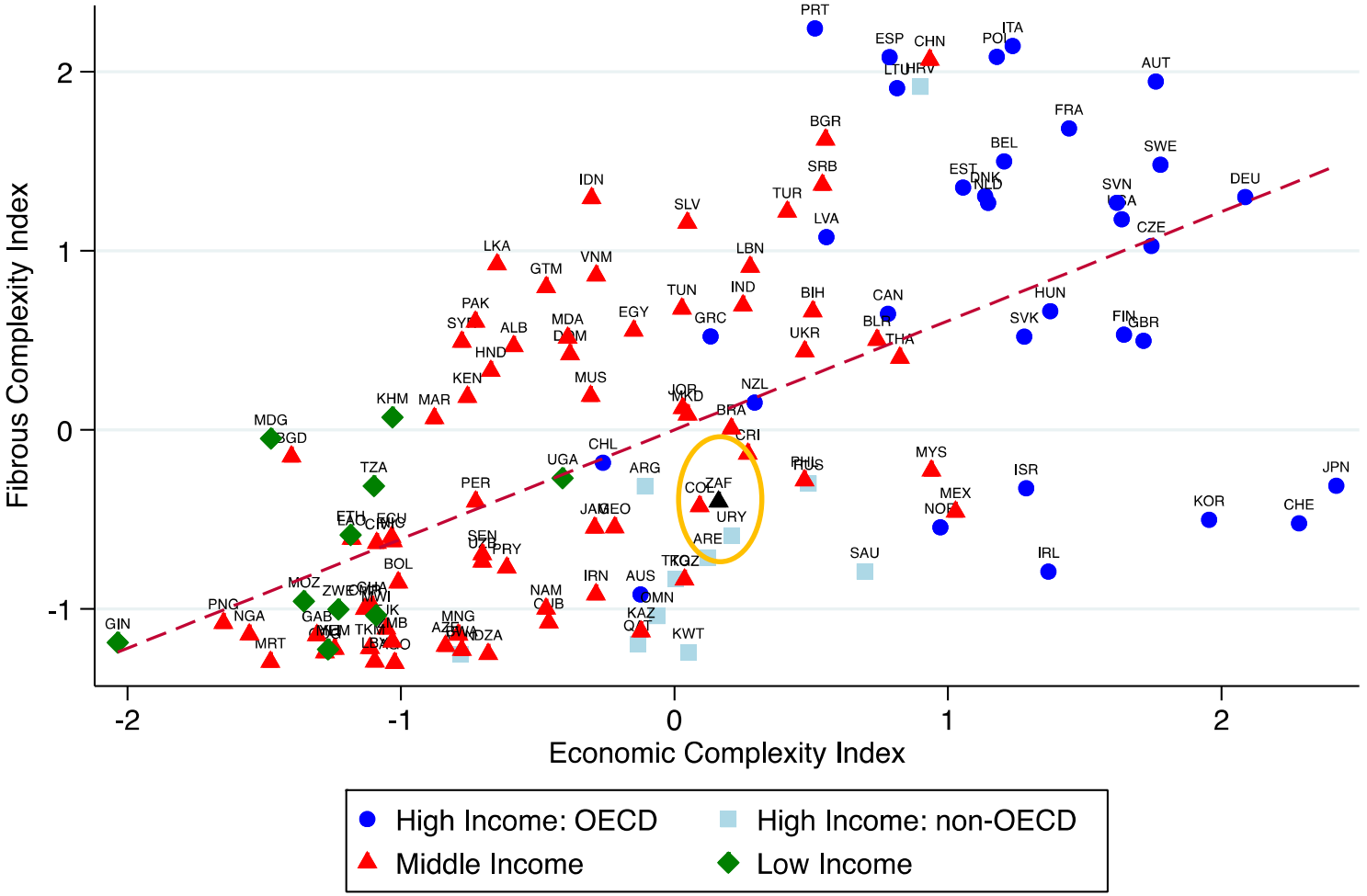
$$FCI_c = \sum_f \rho_f \widetilde{PCI_f}$$

where ρ_f is a binary vector, with a 1 if country c exports fibrous product f with $RCA \geq 1$, and $\widetilde{PCI_f}$ is the PCI for fibrous product f normalised so that values lie between 0 and 1.

FCI rankings (2016)

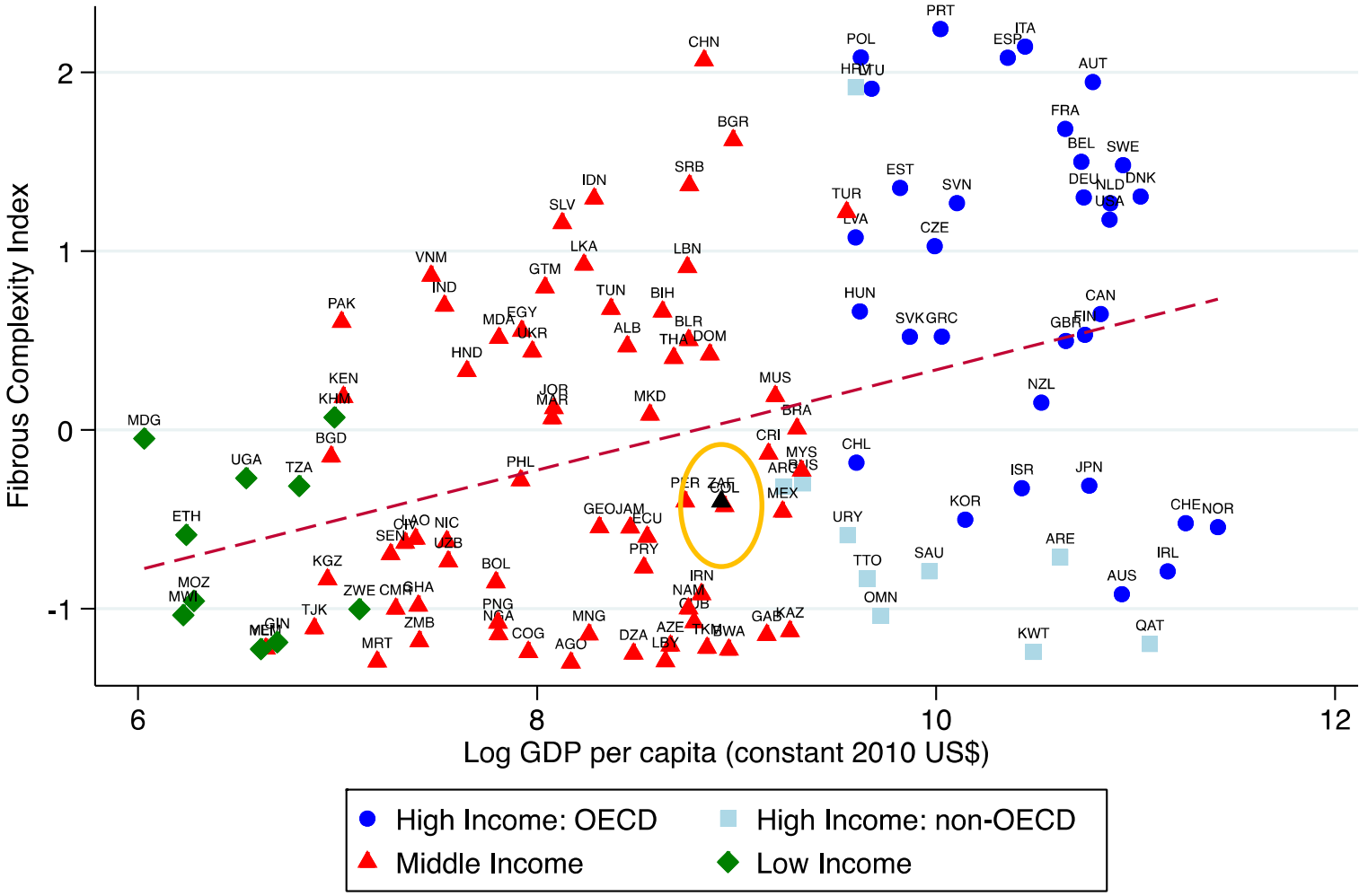
Rank	FCI	Country
1	2.242	Portugal
2	2.144	Italy
3	2.083	Poland
4	2.081	Spain
5	2.066	China
⋮		
70	-0.401	South Africa
⋮		
119	-1.230	Guinea
120	-1.233	Congo
121	-1.245	Yemen
122	-1.256	Mauritania
123	-1.272	Angola

Linking FCI and ECI



Source: Own calculations from Atlas of Economic Complexity (2019)
Note: Correlation=0.610, p-value=0.000. Red dashed line is line of best fit

Linking FCI and Development



Source: Own calculations from Atlas of Economic Complexity (2019)
Note: Correlation=0.378, p-value=0.000. Red dashed line is line of best fit.

Why grow FCI?

- The positive correlations shown indicate that growing the fibrous plant economy (FCI) could potentially grow the economy as a whole (ECI), and also lead to development (GDP per capita).
- South Africa is currently below the regression lines in both cases.
  - So, we have perhaps underinvested in the fibrous plant economy for our level of development, and our level of complexity.
  - Perhaps this means there are opportunities available in the fibrous plant industry that we have not explored.
- But now, how do we decide what products to focus on in order to build economic and/or fibrous complexity?

3. Fibrous Futures: Frontier Products

Identifying products to diversify into

Growing an economy = Growing complexity

BUT you also want to ensure that your proposed diversification path is feasible …

For example:

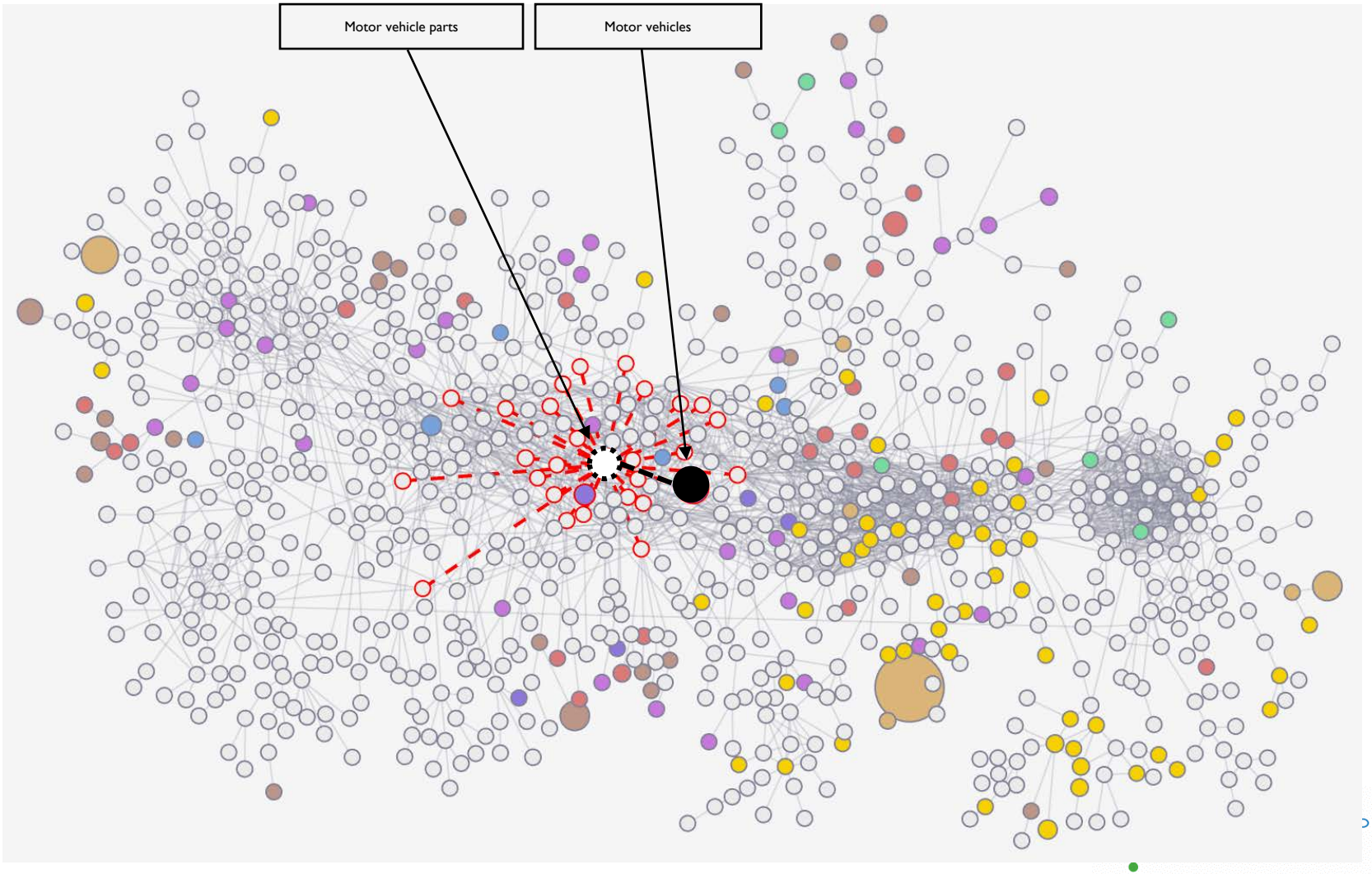
You produce T-shirts now.

Yes, Computer Microprocessors are more complex, but they require a lot of new skills and a large accumulation of capabilities.

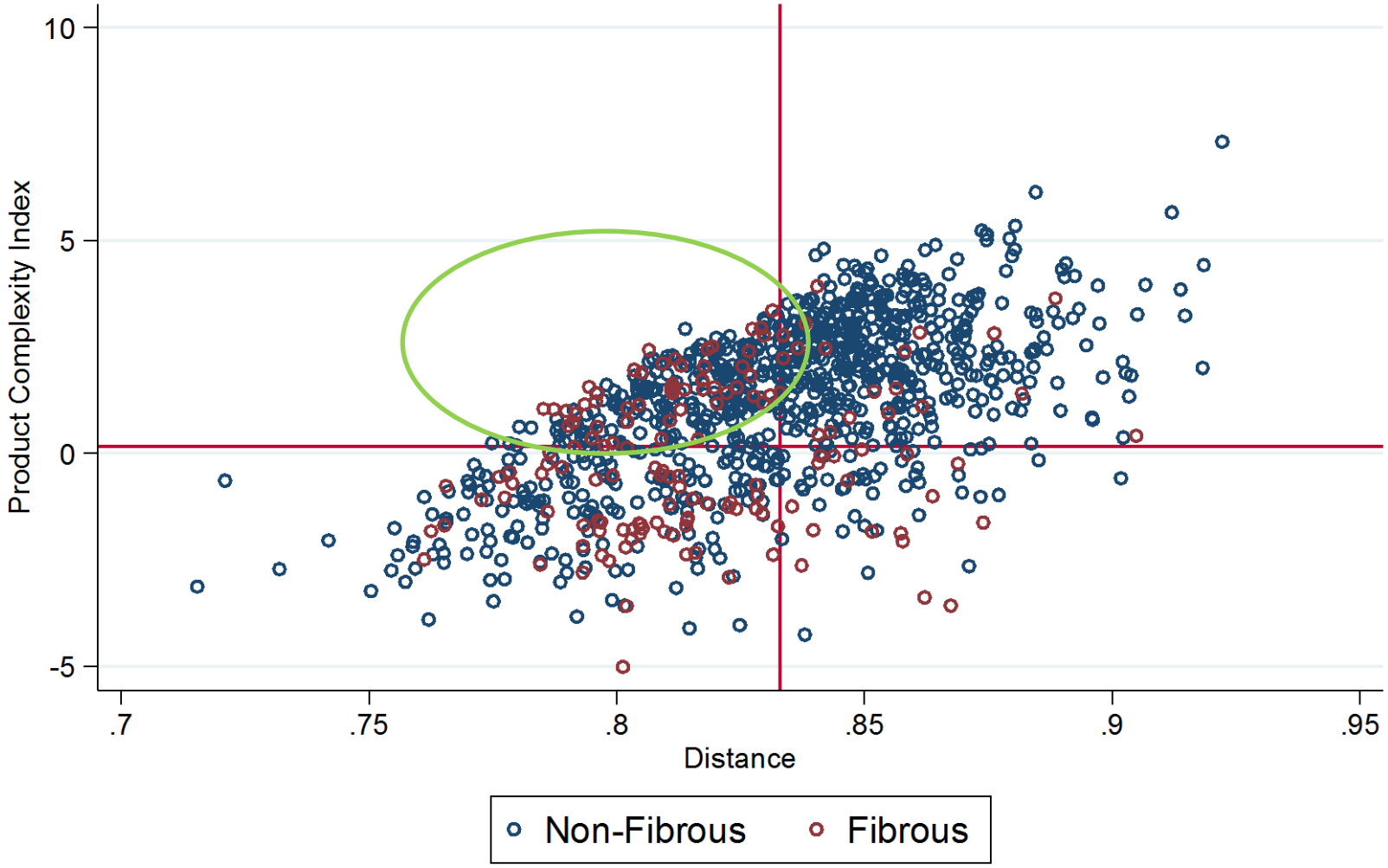
Maybe we should focus on low-hanging fruit: e.g. move from T-shirts to footwear.

These ideas inform the notion of a **frontier product**.

Identifying Frontier Products: An Example

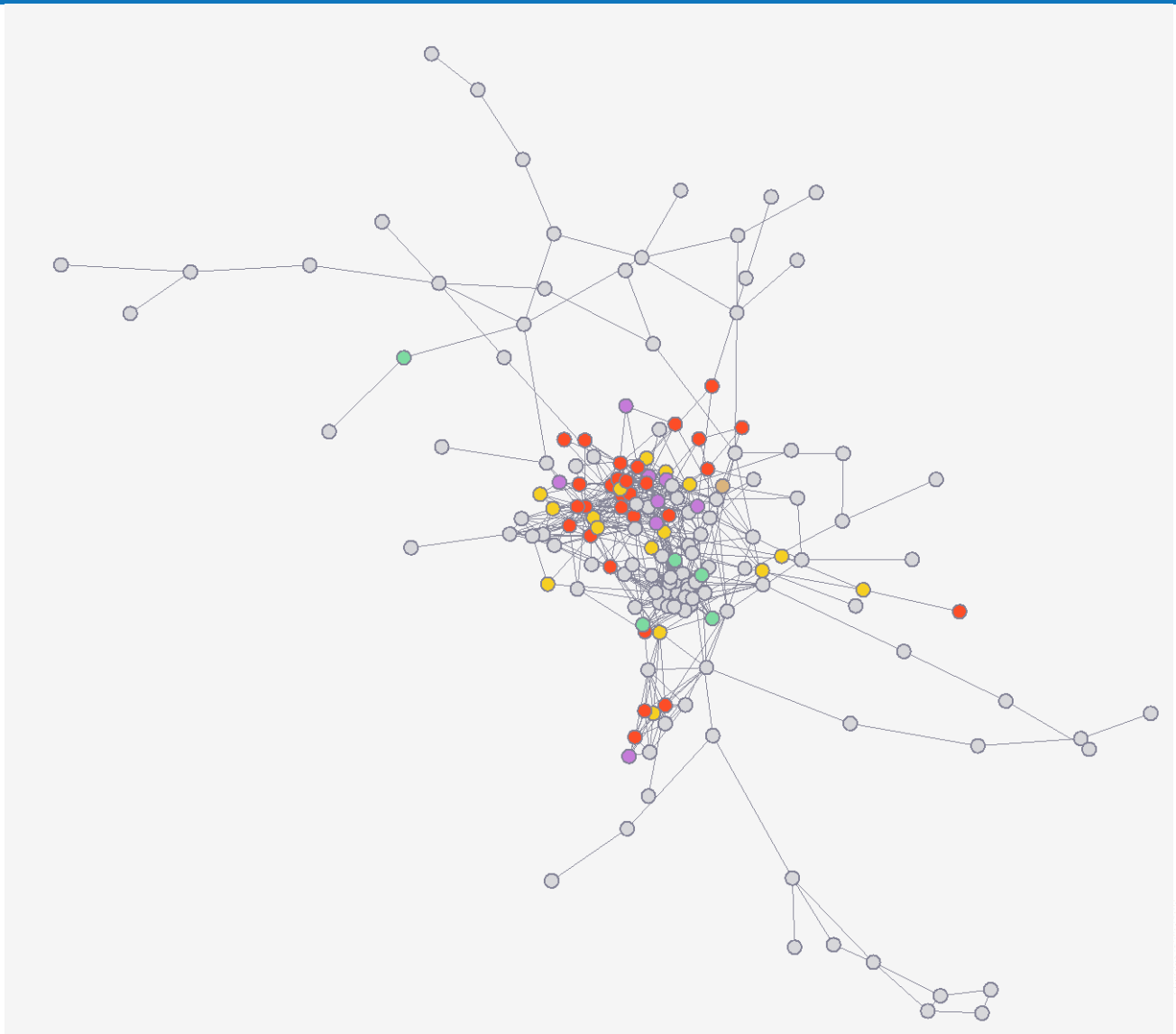


Identifying Frontier Products



Source: Own calculations from Atlas of Economic Complexity (2019)
Note: Distance defined as 1-density.

Fibrous Frontier Products?



The Fibrous Frontier Products

Community	Average PCI	Number of Products
Vegetable products	0.541	2
Foodstuffs	0.843	4
Miscellaneous	1.097	2
Wood & wood products	1.561	29
Chemicals & allied industries	1.731	8
Textiles/clothing	2.112	4
Transportation	2.925	1

- Transportation product is vehicle parts – i.e. fibrous panels for car doors, etc.
- Textile products are things like wadding, felt, non-woven textiles and technical use textiles (filters, machine clothing, conveyor belts, etc.)
- Miscellaneous products are seats (for cars, perhaps) and other furniture
- Wood & wood products include paper and wood pulp (generally the paper industry)

Where to from here?

- By using economic complexity we have identified frontier products – i.e. products that could encourage growth and L/R development.
- We have identified which of these are fibrous products.
  - We can identify to develop the South African economy, while also developing our fibrous economy
- Fine in theory – but are there any practical constraints (e.g. trade barriers, lack of capital/knowledge) that could make certain products more practical than others?
  - This is where we approach experts and industry leaders for their opinions – get a holistic picture of the practicalities involved.

Where to from here?

- Currently we are busy conducting the interview stage of our research. Some of the constraints that have been raised already:
  - Economies of scale
  - Legal constraints (permits)
  - Capital investments
  - Lack of expertise and/or skills
- This stage of the research aims to narrow the set of frontier products by focussing on what **real** players in the market feel they can engage with.
- This point feeds into much of what will be focussed on for the remainder of the day.

Thank You