Related Industrial Diversification as an Economic Development Strategy

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Plan

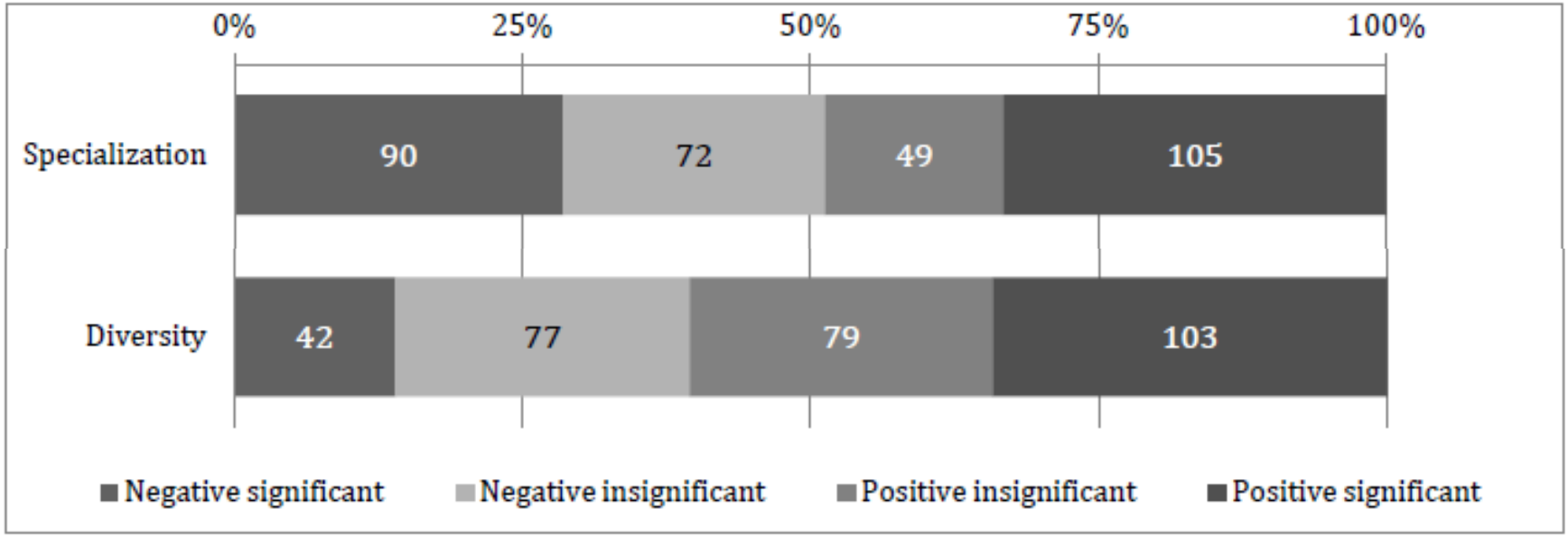
Theoretical concepts

- Related variety
- Related diversification
- Economic complexity

Policy considerations

- Not obvious
- A new framework

Variety, specialisation and growth



De Groot, H. L., Poot, J. and Smit, M. J. (2016), Which agglomeration externalities matter most and why? *Journal of Economic Surveys* 30: 756–782.

Related variety

Variety can be related or unrelated

Entropy decomposition theorem

Unrelated variety absorbs random shocks
Hypothesis: unrelated variety -> less unemployment

Related variety enhances inter-industry spillovers
Hypothesis: related variety -> more employment

Frenken K., Van Oort F. Verburg T. (2007) Related variety, unrelated variety and regional economic growth, *Regional Studies* 41, 685–697

Related variety (cont.)

Most studies find positive effect of related variety on employment growth

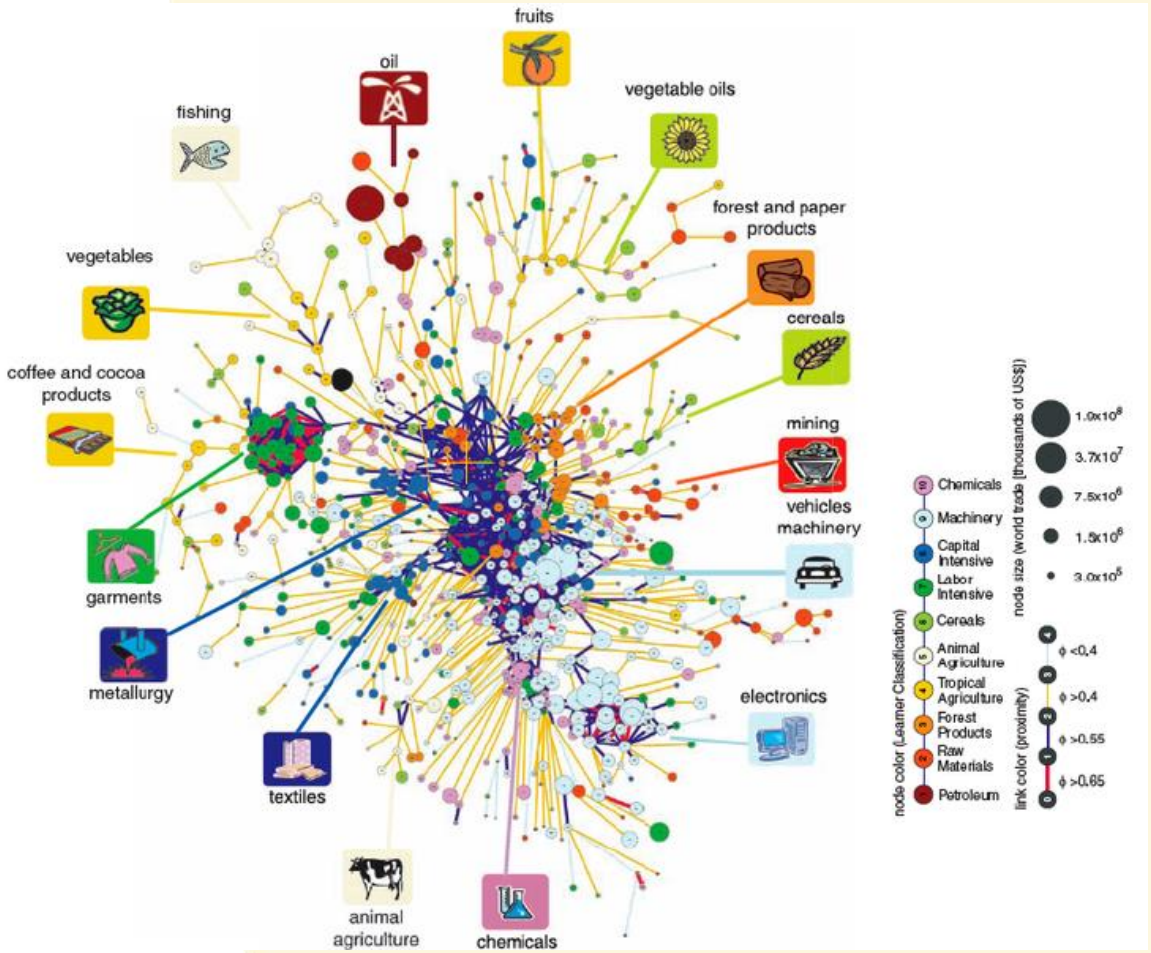
Some studies find negative effect of unrelated variety on unemployment growth

Related-variety effect may be specific to knowledge-intensive sectors only

Limitation of entropy measure

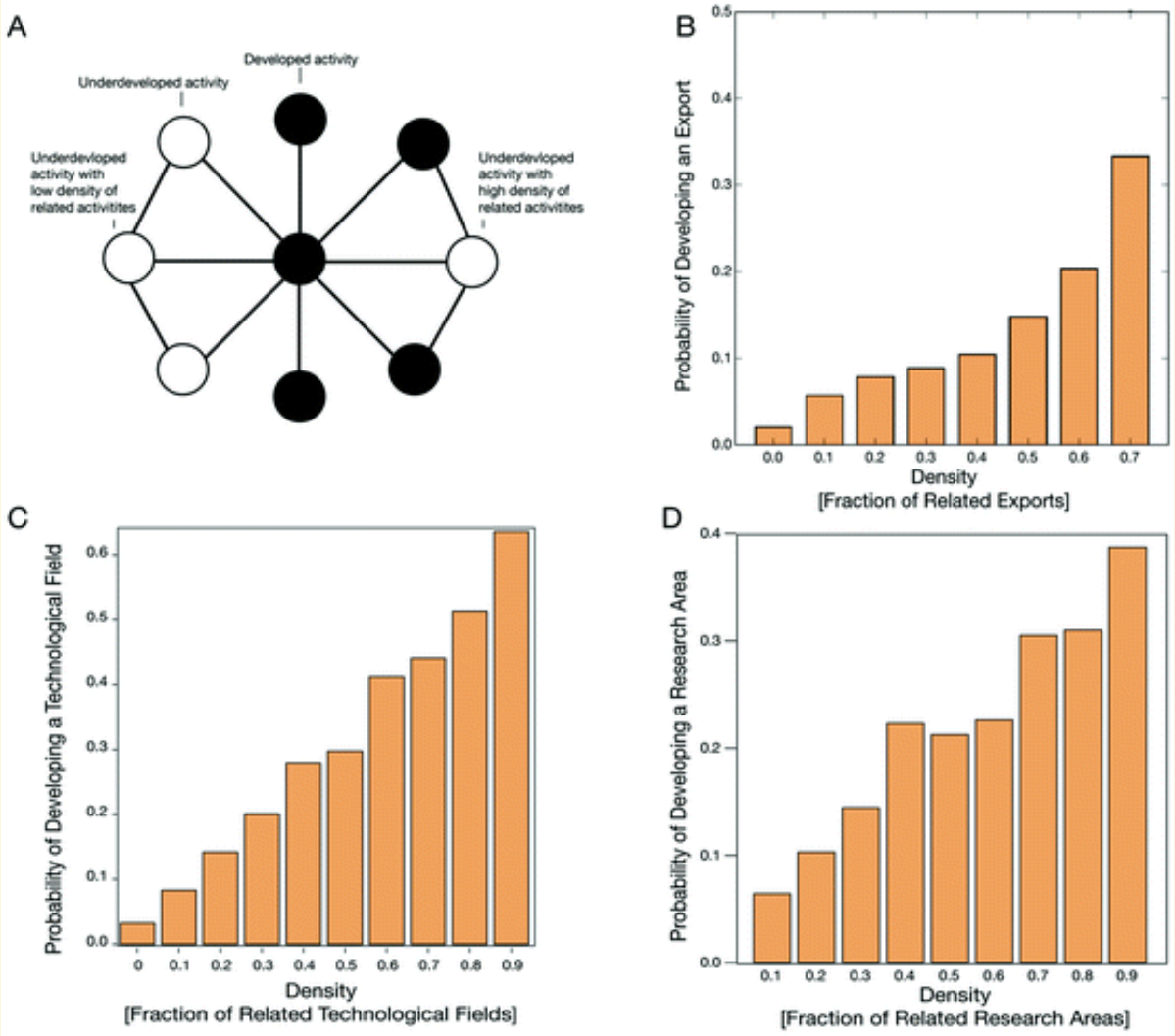
Alje van Dam (2019) Diversity and its decomposition into variety, balance and disparity. *Royal Society Open Science* 6(7), http://doi.org/10.1098/rsos.190452

Related diversification



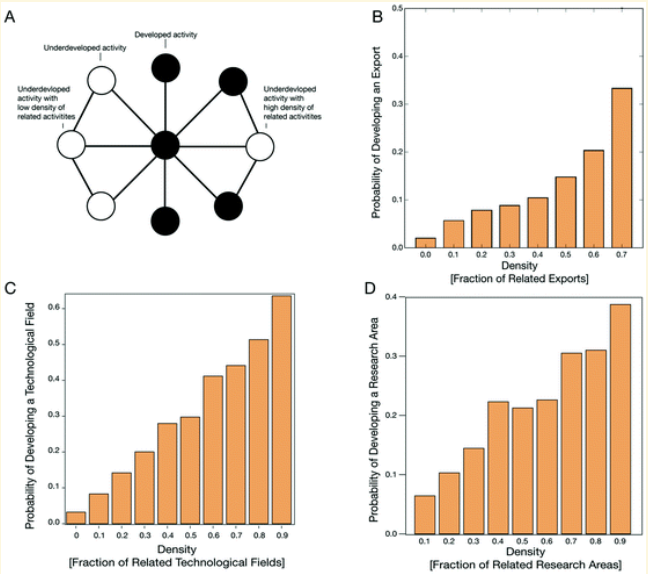
Hidalgo C.A., Klinger B., Barabási A.-L., Hausmann R. (2007) The product space conditions the development of nations. Science 317 (5837): 482-487.

Related diversification (cont.)



Hidalgo et al. (2018) The principle of relatedness, *Unifying Themes in Complex Systems* IX, pp. 451-457

Related diversification (cont.)



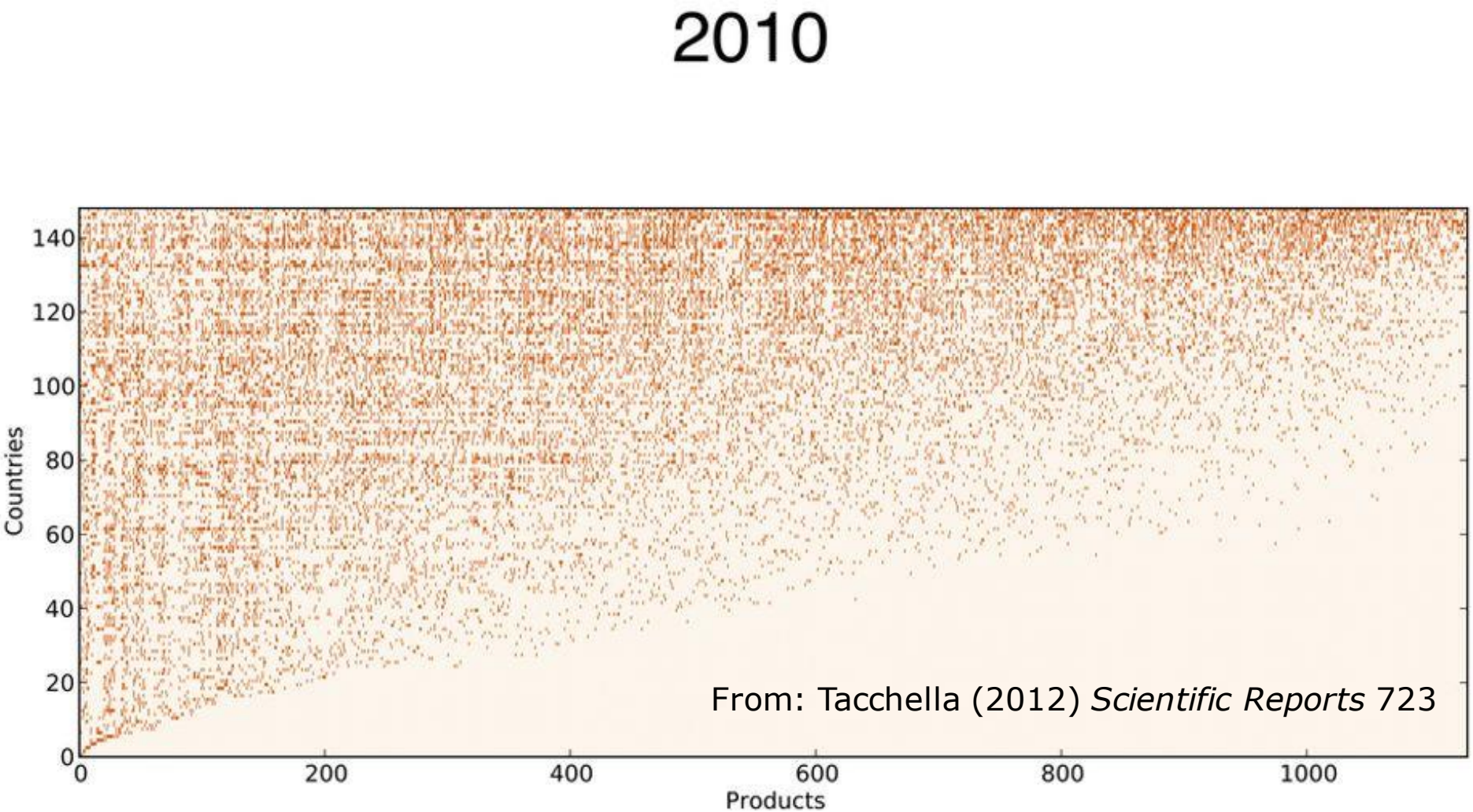
Most studies find strong positive effect of relatedness on the probability of diversification

GDP, liberal-market institutions, social capital as moderating factors

Migration and MNOs enhance unrelated diversification

Methodological challenges remain

Economic Complexity



From: Tacchella (2012) *Scientific Reports* 723

Economic Complexity (cont.)

If you accept that complex products are rare, then we observe that complex products are produced by economies with high variety

Some associate the variety of an economy with the complexity of an economy

However, variety and complexity should not conflated: variety refers to the number of products in an economy while complexity refers to the division-of-labour in production

'The Hump' can then be explained
by rich countries losing simple products

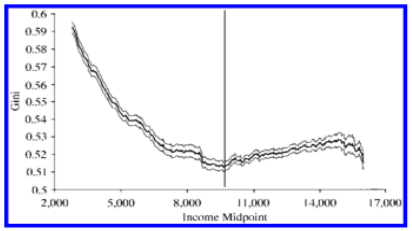


FIGURE 3. ESTIMATED CURVE (NONPARAMETRIC)—GINI INDEX—UNIDO 3-DIGIT VALUE-ADDED DATA

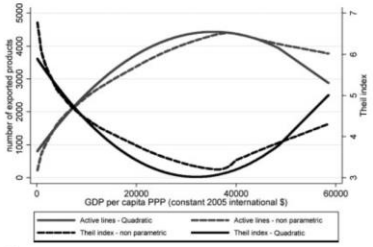


FIGURE 1.—PREDICTED THEIL'S CONCENTRATION INDEX & NUMBER OF ACTIVE EXPORT LINES

Note:
Quadratic corresponds to the OLS estimation of $Y_{it} = \alpha_0 + \alpha_1 GDPpc_{it} + \alpha_2 GDPpc_{it}^2 + \nu_{it}$, with Y_{it} being alternatively the Theil index and the number of active export lines. *Nonparametric* corresponds to smoother nonparametric regressions of Y_{it} on the *GDPpc*. Author calculations using COMTRADE.

Van Dam & Frenken, 2019, Variety, Complexity and Economic Development, arXiv:1903.07997

Policy

High complexity Low relatedness	**High complexity** **High relatedness**
Low complexity Low relatedness	Low complexity High relatedness

But:

Lack of competitiveness of related industries

Lack of additionality of related-industry policy

Strong assumption wrt ability to produce complex products

Policy (cont.)

A new framework with two policies (work in progress):

- **Specific policy**: leads to unrelated diversification increasing variety (industrial policy, technology policy)
- **Generic policy**: raises ability c* to produce complex products increasing complexity (science, innovation-system)

Assumption: Related diversification occurs without policy, but only into products with $c < c^*$

Key logic: return to generic policy increases with variety

Implication: early-stage policy should increase variety through specific policy, later-stage policy should raise complexity through generic policy

Innovation policy

Mission-oriented (Mazzucato)

- technology-base industrial policy
- works mainly for large countries/regions
- politically legitimate
- risky but potentially high additionality
- lobby-sensitive

Relatedness (Foray/Boschma)

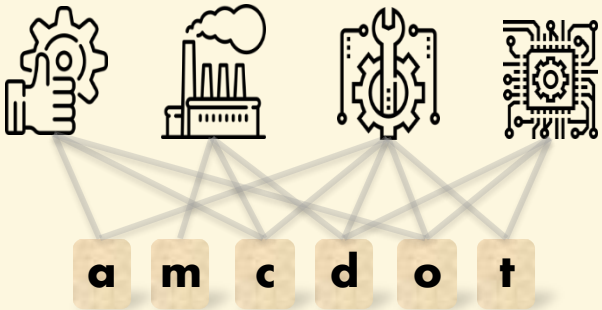
- supply-led exploitation of related variety
- applies to any region, esp. rural and 'lagging' ones
- economically legitimate (evolutionary)
- not risky but low additionality
- lobby-sensitive

Unrelatedness (Frenken)

- making the unrelated related
- applies to any region, esp. urban and 'advanced' ones
- potential breakthrough leading to unique niche
- market failure: support risky entrepreneurship (incubator example)
- societal challenge: temporary innovation system (vision zero example)
- regulatory: "Innovation principle" (sharing economy example)

The scrabble metaphor

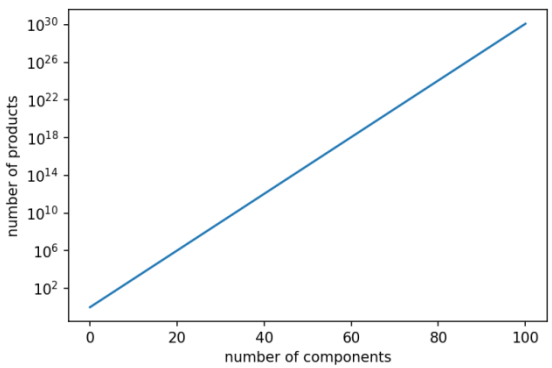
- Products are words
- Capabilities are letters
- Letters make up words

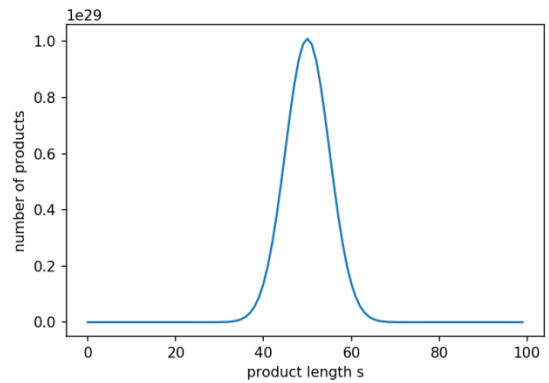


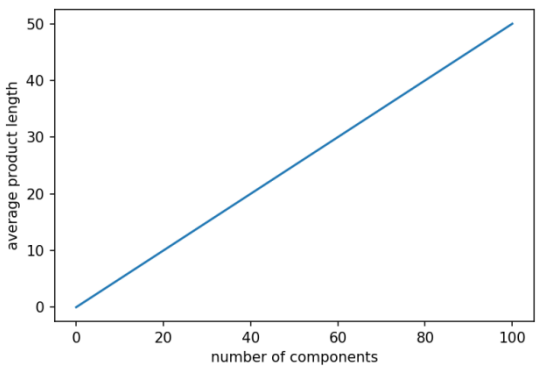
- The letters available in a country determine:
  - Which words a country can spell (**product variety**)
  - The average length of words (**product sophistication**)
- Countries develop by acquiring letters one by one allowing them, over time, to produce **more products** and **more sophisticated products**

The model (2)

- Given n capabilities (letters), there are 2^n possible products (words)
- The average product length is $\frac{n}{2}$







Assuming average product length is a proxy of $GDPpc$, we have:

$$\log d \propto GDPpc$$

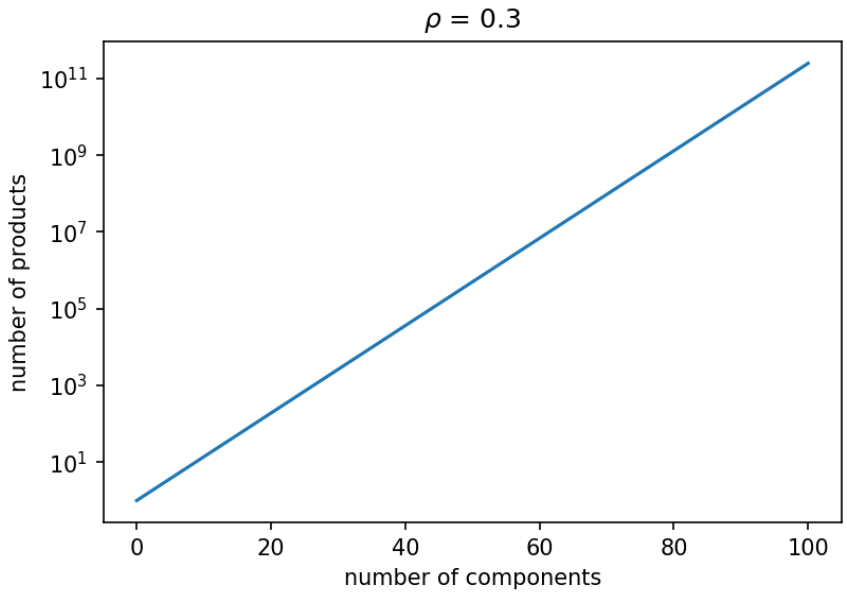
The model (3)

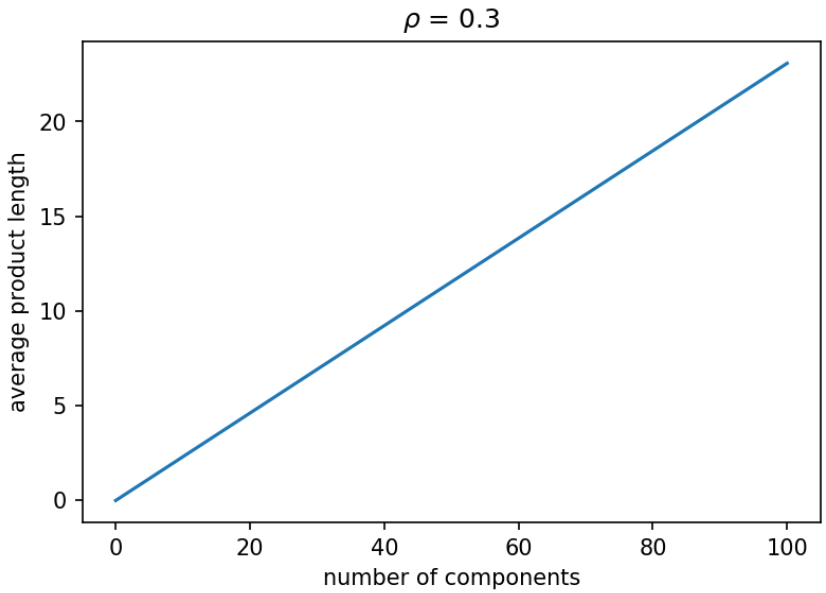
- The probability that a component is used in a product $\rho \in (0,1)$
- Then probability that s components make up a viable product ρ^s
- Number of possible sets of size *s* out of *n* components $\binom{n}{s} = \frac{n!}{s!(n-s)!}$
- The expected **product variety** made with *n* components $d(n) = \sum_{s=0}^{n} \binom{n}{s} \rho^s = (1+\rho)^n$
- Taking logs $\log(d) \propto n$
- **Average product sophistication** is total length over all products $\bar{s}(n) = \frac{\sum_{s=0}^{n} s\binom{n}{s}\rho^s}{(1+\rho)^n} = \frac{\rho}{1+\rho} n$

Diversification and average product length

Log diversification grows linearly in n

avg product length grows linearly in n





Assuming average product length is a proxy of $GDPpc$, we have:

$$\log d \propto GDPpc$$

Loss of variety

- Contrary to what Hausmann & Hidalgo (2011) assume, countries do not make **all** products they can. They tend to lose simple products (short words) as they develop and increase their GDP pc

- r defines the range of product lengths a country makes $0 \leq r \leq n$

- Total number of products given r $d(n|r) = \sum_{s=n-r}^{n} \binom{n}{s} \rho^s$

- Average product length given r $\bar{s}(n|r) = \frac{\sum_{s=n-r}^{n} s \binom{n}{s} \rho^s}{\sum_{s=n-r}^{n} \binom{n}{s} \rho^s}$