Probabilistic Shift-Share Analysis of World Industrial Patterns, 1995-2019

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I thank Lionel Artige for inviting me to investigate this topic more deeply, sharing some of his preliminary results, suggesting additional bibliography, and offering valuable comments on earlier drafts. All remaining errors and shortcomings remain mine.

Abstract: This paper revisits Shift-Share and Constant Market Share Analysis by introducing a maximum entropy prior to replace ad hoc weighting schemes, assuming a uniform distribution of sectors. The resulting decomposition is additive and exact over discrete time periods, eliminating the need for a residual term. Both composition and competitiveness effects are derived from deviations relative to neutral expected growth.

Applying the method to global manufacturing data (1995–2019) for 76 countries at current and constant prices, the analysis distinguishes developed and developing countries trajectories. Adjustments for home bias and demand structure deepen the insight. Compared with traditional approaches, this probabilistic SSA confirms competitiveness as the main driver of industrial growth, with methodological implications for structural analysis and policy.

Key words: industrialisation, global manufacturing, structural decomposition, shift-share analysis, constant market share analysis.

JEL codes : C18, F14, L60, N60, O47.

1. Background and motivation

Traditional shift-share analysis (SSA) relies on ad hoc weighting and often includes a residual component that lacks theoretical grounding. This paper presents a decomposition grounded in information theory, using a uniform prior distribution to model neutral expectations across sector. It offers an exact and additive way to evaluate changes in manufacturing output across countries over discrete time periods without relying on arbitrary weighting or residual terms.

Using a maximum entropy prior based on a uniform sectoral distribution, the method disentangles composition and competitiveness effects in a way that satisfies long-standing theoretical criteria and avoid the ad-hoc nature of the traditional accounting approaches.

The method is applied to a sample of 76 countries and regions between 1995 and 2019 — a period marked by four major global episodes: hyper-globalisation (1995–2005), post-crisis adjustment (2005–2010), a “New Normal” (2010–2015), and resurgent protectionism (post-2015). The framework captures industrial transformations from both supply and demand perspectives, with refinements that address home-market bias and exchange rate distortions.

Beyond its methodological innovations, the paper offers new empirical insights into patterns of industrialisation and deindustrialisation across development levels — demonstrating, among other things, that competitiveness, more than industrial mix, has driven the evolution of manufacturing output worldwide.

This approach not only resolves long-standing conceptual challenges in SSA, but also offers practical, policy-relevant understanding of the structural sources of industrial transformation across the globe.

Besides this introduction, the paper is structured as follows. Section 2 reviews the theoretical foundations of Shift-Share Analysis and introduces the proposed probabilistic decomposition method. Section 3 outlines the dataset and is followed by a presentation of empirical findings, with regional and country-level analyses. discussion of results obtained. Section 5 presents some methodological refinements, including adjustments for price effects and home-market bias. Section 6 compares the new approach with traditional SSA methods. The paper concludes with reflections on the implications for structural analysis and industrial policy.

2. Revisiting Shift Share Analysis: Towards an unbiased and theoretically consistent SSA

The decomposition of aggregate changes into component effects has been studied for over a century. Bennet's fundamental idea as early as 1920 is that "in a short period the rate of increase of expenditure of a family can be divided into the increase due to change of prices and the increase due to increase of consumption. He was also already aware of the limitations of such a decomposition in discrete time. "Such division of expenditure into two parts is always possible if the step taken is small enough to be treated as infinitesimal. It is only when it is attempted to take a big step in one operation that difficulties arise." (p.458). Indeed, the longer the step, the bigger is the discrete time decomposition issue.

1) Positioning the problem: from continuous to discrete time decomposition

Assume we are looking at the behaviour of total industry (in value or in employment) from a home country perspective. Hence, let (V^i_w) be the total value of home country "i" production (or employment) and ($V^{\cdot}_w$) the total value of world production or employment. The share of the home country "i" in world total at time "t" is given by

$$S^i_t = V^i_{w,t} / V^{\cdot}_{w,t} \qquad [1]$$

The basic decomposition of changes in home country results can therefore be represented by:

$$\frac{dV^i_{w,t}}{dt} = S^i_t \left(\frac{dV^{\cdot}_{w,t}}{dt}\right) + V^{\cdot}_{w,t} \left(\frac{dS^i_t}{dt}\right) \qquad [2]$$

Given ($V^{\cdot}_{w,t}$), the (exogenous) situation observed for the entire world, the structure of a country's industries (S^i_t) affects its potential for growth. For example, if a country specializes in products that are in high demand.

When applying this analysis in discrete time, with a final year distant from the starting one, as it is the usual way of doing SSA, we face an issue that is often referred to as the "index number problem". In discrete time, when only data corresponding to the beginning and the end of a period are available, the equation is rewritten as:

$$\Delta V^i_{w,1} \equiv S^i_0 \Delta V^{\cdot}_{w,1} + V^{\cdot}_{w,1} \, \Delta S^i_1 \qquad [3]$$

Where 0 and 1 stand for the first and last year of the period. ΔV^1 and ΔS^1 indicate the changes between 0 and 1 in national or world export production and in sector share, respectively. $S_0^i \varDelta V_{w,1}^{\cdot}$ is often referred as the global scale effect, indicating the average growth in production if sectoral market shares remained constant. It is a "composition" effect measuring the average growth based on a Laspeyres type of indexing. $V_{w,1}^{\cdot}\ \Delta S_1^i$ is the ex-post effect due to changes in the product mix, weighted by world demand at final time 1. It is sometimes also referred as the "competitive" effect, and measure the average growth based on a Paasche indexing.

But we can also permutate the use of Laspeyres and Paasche. [3] becomes:

$$\varDelta V_{w,1}^i \equiv S_1^i \varDelta V_{w,1}^{\cdot} + V_{w,0}^{\cdot}\ \Delta S_1^i \qquad [4]$$

If mixing Laspeyres and Paasche weights was able to mimic equation [2], applying [3] or [4] gives different decomposition. In the absence of any explicit theoretical justification, there is no strong reason for choosing one decomposition or the other one. It was commonly accepted that the SSA method would gain in theoretical consistency and in empirical applicability if only initial years' weights (Laspeyres indices) were employed throughout the calculation. These efforts however create an additional problem, because a new residual term is produced as a side-effect of these decompositions.

$$\varDelta V_{w,1}^i \equiv S_i^0 \varDelta V_{w,1}^{\cdot} + V_{w,0}^0\ \Delta S_1^i + \ \varDelta V_{w,1}^{\cdot}\ \Delta S_1^i \qquad [5]$$

This residual term $\varDelta V_{w,1}^{\cdot}\ \Delta S_1^i$ is frequently interpreted as an interaction between global demand and national production structure. However, its theoretical justification remains shaky. Some view it as a meaningful indicator of adaptability to global demand shifts; others (including this paper) argue it's merely an artifact of imperfect decomposition in discrete time.

The problem with this approach is that nothing opposes further discrete-time decomposition of equation [5]. So, if a solution exists, it is not unique. Indeed, many researchers remain uncomfortable with the addition of several ad-hoc residual terms, which do not exist in the theoretical model. Artige and van Neuss (2014) offer a comprehensive review of this debate and the relevant literature. They also identify additional consistency flaws in their literature survey. In particular, they emphasise that it does not satisfy the Rosenfeld (1959) criterium of independence of the two effects. For a separation of the two effects to be unambiguous, the competitive effect should not be influenced by the economic structure.

Besides the traditional SSA decomposition, another method (stochastic regression) is also possible when high frequency observations are available. Such an alternative approach, first discussed in the late 1970's but implemented only years later, is the so-called "dynamic regression shift-share analysis". In this case, residuals still exist, but they are supposed to be randomly distributed (a meaningless error term). Fritz and Streicher (2005) provide an example of application to regional employment. In Section 6, we will build on this approach to reconcile our exact decomposition with the more traditional Esteban-Marquillas (1972) 3-components SSA results.

In the next sections, we present an innovative and theoretically consistent way of reinterpreting the SSA decomposition in discrete time that does not require a residual term. For simplicity, we will restrict the discussion to the value of industrial output X^i_k (country *i* and product *k*) but a similar formulation could be made using sectoral labour L^i_k.

2) Artige and van Neuss (2014)

In their pioneering paper, Artige and van Neuss (2014) present a "New Shift Share Method". The core of their approach is to substitute for the absence of sectoral/product ordering in the shift-share analysis. While it is possible to rank growth rates from high to low, there is no ordinal ordering of economic structure: there is no good and bad sectoral specialization, a priori. Only ex post facto—e.g., using a Paasche index—can one assess whether the composition was favourable. In order to disentangle the effect of specialization from the effect of sectoral growth rates, they associate a uniform distribution of sectors to the sectoral growth rates.

This new decomposition solves additional consistency flaws the authors had identified in the previous literature. In particular, previous decompositions used in the literature could lead to biased conclusions, indicating spurious composition and competitive effects in the results, while none was present by construction.

3) A probabilistic interpretation

Looking into a closely related issue in market share analysis (Constant Market Share trade analysis, or CMS), Escaith (2021) independently developed a probabilistic approach that converges in practice to a decomposition similar to Artige and van Neuss (2014), albeit from a different perspective. CMS is a tool commonly used in empirical investigation of international trade. It aims at identifying the strength and weaknesses of national exports relative to other exporters competing in a given import market.

Escaith (2012) may be considered an information theory-based model. It is closely related, at least in its broad objective as well as its probabilistic reinterpretation, to Revealed Comparative Advantages (RCA) indices, another tool widely used in applied trade analysis. As acknowledged by Dietzenbacher and Lahr (2016), in regional sciences "SSA is roughly predicated on the concept of regional comparative advantage".

In an approach very similar to SSA, CMS decomposition intends to separate the effects of export structure (the specialisation of a country according to its revealed comparative advantages) and the evolution of demand by importing countries. As in traditional SSA, discrete time decomposition faces an accounting problem in discrete time. A new "residual" or "interaction term" is required to achieve the required identity (Milana, 1988; Richardson, 1971), which does not exist when doing the decomposition in continuous time.

Escaith (2021) starting point is the probabilistic approach of RCAs suggested in the pioneering paper of Kunimoto (1977). RCAs, from an information theory perspective, signal comparative advantages by comparing the observed situation with a hypothetical state of maximum entropy. These advantages, which are not observable directly, are inferred from the deviation of actual production flows with their expected (maximum entropy) value. This "expected" pattern is based on an uninformed "prior" (the best rational assessment of the probability of an outcome before collecting new information). [1] While RCA is usually applied to international trade, it can be extended to total production, as long as the appropriate data are available. [2]

Disregarding time index for now, the expected value of output of product "k" by country "i" in the "neutral situation" when no specific information is available, is given by:

$$E\left(X_k^i\right) = \left(\frac{X^i}{X^w}\right) \cdot \ M_k^w \qquad [6]$$

[1] This maximum entropy situation differs radically from the hypothetic case mentioned by Tyszynki (1951), who referred to it as maintaining unchanged the previous market shares.

[2] Long time series of internationally harmonised trade statistics are available for most countries. Adding domestic demand to exports in order to have both domestic and foreign demand requires using sectoral statistics or input-output tables that may not be easily available.

Where:

X^i_k : production of product k by country i

X^i: Total production of country i and X^w total world production, all products considered.

M^w_k : total world demand of product k, assuming Supply = Demand: $\Sigma_i(X^i_k) = M^w_k$

If the observed (X_k^i) is higher than $E(X_k^i)$, which is what is expected in a neutral situation, then we conclude that country "*i*" has special characteristics, other than its sheer economic size, that bestow it with special advantages in producing the product "*k*".

In absence of any prior information on the actual World market share [3] of a producer, the uninformed prior is given by a uniform distribution of output amid the total number of products produced in the market used as reference for conducting the SSA analysis (the World, in our case). Under this uninformed prior, the expected share of commodity *k* produced domestically by country "*i"* at time "*t*" is:

$$E(S^i_{k,t}) = 1/K \quad [7]$$

Where S^i_k is the weight of product *k* in the domestic production of country *i*

$$S^i_k = \left(\frac{X^i_k}{X^i}\right) \quad [8]$$

With $k = 1, \ldots$, K the total number of products or sectors in the World economy. K can be larger than the number of commodities actually produced by "*i*".

It flows that the neutral demand structure for the World, being the average of neutral production from all countries (*i* = 1 to N) is given, for each commodity "*k*", by:

$$E(S^w_{k,t}) = \frac{1}{N}\sum_{i=1}^{N} E(S^i_{k,t}) = 1/K \quad [9]$$

The difference between the observed and the expected growth rates of national output is:

$$x^i_t - E(x^i_t) = \sum_{k=1}^{K} x^i_{k,t}\,(S^i_{k,t-1} - E(S^i_{k,t-1})) \quad [10]$$

With $x^i_t = (X^i_t - X^i_{t-1})/(X^i_{t-1})$, the total production growth rate of country "*i*" in year "t" expressed in arithmetic form, and $E(x^i_t)$ denoting its expected value. Similarly, the difference in total World demand growth rate (all products together) between the observed and the expected demand structure is:

$$m^w_t - E(m^w_t) = \sum_{k=1}^{K} m^w_{k,t}\,(S^w_{k,t-1} - E(S^w_{k,t-1})) \quad [11]$$

With $m^w_t = (M^w_t - M^w_{t-1})/ (M^w_{t-1})$

And $S^w_{k,t-1} = \left(\frac{M^w_{k,t-1}}{M^w_{t-1}}\right)$

These differences between the national growth rate of production and the reference market in the actual situation can be expressed as a combination of the differences between the actual and neutral situations. As long as the number of traded commodities does not change between

[3] Note that the World market share in this context for any given country includes both domestic and foreign demands for its products.

the first and the final period, and after rearranging the terms (see Escaith, 2021), we arrive at the following decomposition of growth rate of country "*i*" production:

$$x_t^i - m_t^w =$$

$$\left[\sum_{k=1}^{K} x_{k,t}^i \left(S_{k,t-1}^i - \frac{1}{K}\right) - \sum_{k=1}^{K} m_{k,t}^w \left(S_{k,t-1}^w - \frac{1}{K}\right)\right] + \frac{1}{K}\sum_{k=1}^{K}\left(x_{k,t}^i - m_{k,t}^w\right) \qquad [12]$$

The difference between the observed growth rate of gross output for country "i" compared to growth of the reference World market (a global demand effect potentially felt by all producers) can be decomposed into two effects: the first term between brackets is the composition effect and the second one is the individual product competitiveness.

Rearranging [12], we verify that country "i" growth rate ($x^i{}_t$) is the sum of three effects: a common global trend ($m^w{}_t$) and two country specific composition and competitiveness effects:

$$x_t^i = GLOBAL + [COMPOSITION] + COMPETITIVENESS \qquad [13]$$

The composition effect, compares the average growth rate of output weighted by the structure of national exports (relative to what would have resulted from a neutral composition of exports), with the actual growth rate (relative to a neutral distribution) of weighted demand. It measures, therefore, the impact of the producing country's initial specialisation in fast or slow growing market segments, relative to a neutral situation without competitive advantages.

The competitive effect, results from averaging the growth differential product by product between the producing country and the whole market. It is an indicator of the relative "speed" of the industries in the competition.

Besides being well rooted in information theory, an important property of this decomposition is that it solves also the index number issue: it is entirely expressed in terms of a Laspeyres index but does not produce a residual when calculated in discrete time. Artige and van Neuss (2014) show that it satisfies the Rosemberg criterium.

Note that in the present case, output is considered as the sum of all sectoral production in gross value. In this case, X^i is larger than the country's Gross Industrial Value-Added because the value of each sectoral output $X^i{}_k$ includes the value of the intermediate inputs required for producing *k*. Actually, the same decomposition could be done replacing sectoral output by Value-Added (and in this case, extending X^i to all sectors would be equal to the country's GDP) or by sectoral employment (the usual approach in regional science). Such approaches, valid in regional analysis withing a single country, present some issues from a Constant Market Share analysis perspective unless we measure trade in value-added.[4]

We now apply Probabilistic-SSA to a global sample of countries.

3. The data

The countries are those included in the 2023 release of the OECD Harmonized Input Output and Trade in Value Added tables. [5] The data cover 76 countries, plus a Rest of World region. The values are in current US dollar (more on this below). We focus on manufacturing industries, themselves divided into three sub categories based on their technological content (see annex). The analysis

[4] See the pioneering WTO and IDE-JETRO (2011) for a non-technical introduction.
[5] Available at https://www.oecd.org/en/data/datasets/input-output-tables.html. The present calculation are based on the April 2024 release.

is done by 5-year intervals, starting 1995. The last interval 2015-2020 has been truncated at 2019, keeping aside 2020 which was greatly affected by the COVID-19 pandemia.

Production is either sold on the domestic market or exported. The valuation of domestic production at current market exchange rate creates an issue when doing time series analysis-based international comparisons. Swings in the USD-denominated nominal production prices, be they due to bilateral exchange rate fluctuations or high domestic inflation over long period of time, may distort the analysis.

4. Shift Share Results

The average rate of growth of total annual production (our Global component) has averaged about 3% per year during the 1995-2019 period. The evolution is very similar between industries, classified according to their technological intensity. When correcting current prices in USD by the evolution of the domestic manufacture deflators to obtain estimates at constant price, the real average growth is higher. Besides inflation, this difference between current and constant prices is due to the evolution of bilateral exchange rates, as well as the deflation impact of trade with low-cost emerging countries.

Table 1 Average Annual Growth of Total Manufacture Output (1995-2019)

Industry	Current USD	Constant prices
High-Tech	3.2%	4.6%
Medium-Tech	2.9%	4.6%
Low-Tech	2.9%	4.0%

Note: Based on 76 countries plus Rest of World.
Sources: Author's calculations, based on OECD and UNIDO data.

The global average hides large differences between countries. The annual mean at current price varies from a minimum of -0.6% (Japan) to a maximum of 14.4% (Vietnam, which does even better than China at 14.0%). The Japan case is illustrative of the analytical difficulties to reconciliate current and constant prices. When looking a real (constant price) industrial output, Japanese industries registered a positive 1.5% annual growth rate. So, there are two ways of looking at our results. A World market share analysis, and in this case, values in current USD are the yardstick. Or a more country-oriented look at industrial production, and in this case the constant price is the most appropriate indicator. More on this in section 5.a below.

More generally, results obtained with the Artige and van Neuss -Escaith method (Probabilistic-SSA, thereafter) are analysed at two levels: first, a regional disaggregation, then by identifying homogeneous groups, or "clusters", based on their specific Probabilistic-SSA indicators. The first section uses the cluster analysis results to showcase selected typical profiles.

a. Selected typical countries

We conducted a first k-means cluster analysis, to identify possible outliers. It led to removing Brunei Darussalam, Iceland, Myanmar, Nigeria.

Then, we conducted a second clustering exercise on the remaining 73 countries. An interesting partition is obtained with 5 clusters. We obtain two large clusters. The largest, with 33 observations centred on the Netherlands, includes mainly developed economies. The second, centred on Peru, includes 22 countries and is mainly populated with developing countries. The third and fourth clusters include mainly Eastern European ex-transitions economies with a couple of exception: Turkey and Ireland in the third clusters. The last cluster is made of China, Kazakhstan, Laos and Vietnam.

Table 2 Clustering shift-share country results: Central objects

		Share effect (Composition)					Shift (Competitivity)				
Centroid	**Size**	**1995-2000**	**2000-2005**	**2005-2010**	**2010-2015**	**2015-2019**	**1995-2000**	**2000-2005**	**2005-2010**	**2010-2015**	**2015-2019**
Netherlands	33	-1.0%	2.4%	2.3%	1.8%	-1.8%	-13.3%	12.3%	-28.0%	-23.4%	4.3%
Peru	22	-1.2%	2.3%	-0.3%	-5.2%	-0.3%	-6.8%	6.3%	34.1%	-3.0%	-0.5%
Latvia	8	-4.0%	-22.4%	-18.3%	-4.1%	2.1%	31.1%	94.8%	7.7%	-14.4%	10.1%
Roumania	6	2.1%	-4.7%	-10.3%	1.1%	-0.8%	-28.4%	119.0%	26.0%	-13.7%	16.5%
China	4	1.1%	-1.6%	2.5%	0.1%	-0.4%	62.0%	57.4%	123.9%	66.8%	-2.0%

Note: Cluster results after removing outliers. Four outliers removed: Brunei Darussalam, Island, Myanmar and Nigeria (see text). Composition refers to the industrial mix between Low, Medium and High technology industries. The shift refers to the capacity to adapt the industrial mix to changes in World demand.
Source: Author, based on OECD data

How should we read Table 2? Let's remember that the Probabilistic-SSA results explain the sources (Composition and Competitiveness) of each country divergence in a Global context. This global effect is common to all countries (growth rate of world production of all manufactures) and was measured at 6.1% over the 1995-2000 period; 38.3% (2000-2005); 44.7% (2005-2010); 19.5% (2010-2015) and 10.6% (2015-2019).

During the 2000-2005 quinquennial, Netherlands total manufacture production (all sector included) grew 53.0%, thanks to a global trend of 38.3%, a small 2.4% bonus due to its sectoral composition and a gain of 12.3% attributed at its competitiveness. Some countries, like Latvia, were ill-prepared to compete on the world market, with a poor inter-industry composition that caused it losses. After 2010, it was able to correct this handicap thanks to past competitivity gains (probably gaining new market share after joining the EU). Romania shows a similar pattern, but with a more favourable initial composition structure.

The results show that China did not benefit nor was particularly hindered by its industrial structure, even in the first years. All its high growth is imputable to gains in competitiveness. This highlights how competitiveness — rather than industrial mix — was the dominant force behind growth, particularly in fast-globalizing economies.

b. Results by region

We now turn our attention at the results by geographical groupings. The regional disaggregation is based on World Bank criteria, with three major deviations. Europe (ECA) is further disaggregated between the initial EU15 members (including UK), the EU13 members that joined later, and the rest. China (PRC) is taken out of the Eastern Asia and Pacific region (EAP), considering its sheer size and its leading role in the GVC model of industrialization. EAP without China itself is further disaggregated into developed (EAP-DVD) and developing (EAP-DVG) countries.

Table 3 presents the regional results, after removing the four outliers. In the table, China is treated as a single region (PCR) but included in the Developed countries average (All DVG).

The composition effect is relatively low in the regional averages. This reflects the fact that there was very little change in the composition of World demand for manufacture. The relative structure of High, Medium and Low technology global output in 1995 was 42%, 19% and 39%, respectively. After 24 years, it had barely changed (43%, 21% and 37% in 2019).

The limited variation in industrial composition across regions underscores the central role of competitiveness in explaining divergent growth paths. The coefficient of variation observed for the competitiveness effect is much higher than for the composition one, for both developed and developing countries.

Table 3 Composition and Competition effects, by regions (mean values)

	Share effect (Composition)					Shift (Competitivity)					Shift and Share effects				
Regions	Share2000	Share2005	Share2010	Share2015	Share2019	Shift2000	Shift2005	Shift2010	Shift2015	Shift2019	1995-2000	2000-2005	2005-2010	2010-2015	2015-2019
EAP_DVD	1.4%	-0.4%	2.0%	0.2%	-1.5%	-13.0%	15.6%	-16.3%	-24.3%	3.5%	-11.6%	15.3%	-14.3%	-24.1%	2.0%
ECA	-1.4%	4.5%	0.6%	-1.2%	0.9%	-19.1%	93.5%	47.4%	-24.5%	6.7%	-20.6%	98.0%	47.9%	-25.7%	7.6%
EU13	-2.5%	-6.3%	-2.3%	-2.1%	-0.7%	6.6%	78.5%	-4.3%	-18.2%	16.4%	4.0%	72.2%	-6.6%	-20.4%	15.8%
EU15	-0.8%	0.6%	1.7%	0.7%	-0.4%	-8.0%	13.9%	-32.8%	-22.3%	3.0%	-8.8%	14.5%	-31.1%	-21.6%	2.6%
NAM	-1.1%	-0.3%	0.2%	-0.5%	0.5%	21.6%	-16.5%	-40.0%	-14.7%	-2.7%	20.5%	-16.9%	-39.9%	-15.2%	-2.2%
DVD Mean*	-1.2%	-1.3%	0.2%	-0.4%	-0.3%	-4.7%	43.8%	-16.4%	-22.1%	8.1%	-6.0%	42.5%	-16.2%	-22.6%	7.7%
- Median	-1.0%	0.5%	1.3%	-0.1%	0.0%	-10.3%	29.0%	-22.9%	-23.4%	6.4%	-11.3%	29.5%	-21.5%	-23.5%	6.4%
EAP_DVG	2.3%	0.0%	-4.9%	-4.7%	-4.6%	1.0%	20.3%	35.6%	19.8%	22.4%	3.4%	20.4%	30.7%	15.1%	17.8%
LAC	-1.4%	-0.2%	1.3%	0.0%	1.0%	13.2%	-0.2%	21.2%	-11.9%	-11.0%	11.8%	-0.4%	22.5%	-11.9%	-10.0%
MNA	-0.8%	2.8%	-4.2%	0.0%	0.0%	18.0%	-1.1%	29.4%	7.6%	2.9%	17.2%	1.7%	25.2%	7.6%	3.0%
PCR	1.1%	-1.6%	2.5%	0.1%	-0.4%	62.0%	57.4%	123.9%	66.8%	-2.0%	63.1%	55.8%	126.4%	66.9%	-2.5%
SAS	0.5%	1.6%	1.3%	-0.8%	-0.9%	16.3%	26.5%	37.0%	16.9%	19.1%	16.8%	28.0%	38.3%	16.1%	18.3%
SSA	-2.6%	1.5%	-0.3%	-0.6%	-2.5%	-8.7%	38.9%	-3.5%	-6.1%	7.0%	-11.3%	40.4%	-3.8%	-6.7%	4.5%
DVG Mean*	-0.1%	1.0%	-2.0%	-1.9%	-1.6%	10.1%	21.3%	35.1%	7.0%	7.0%	10.0%	22.3%	33.1%	5.2%	5.4%
- Median	-1.2%	2.0%	0.2%	-0.5%	0.0%	2.8%	20.2%	26.1%	-4.7%	9.3%	1.7%	22.2%	26.3%	-5.2%	9.3%

Notes: */ Simple average of all selected countries in the category, irrespective of regional grouping. ECA is classified here in the developed group, albeit it includes, according to the World Bank classification, some developing countries (Turkey, Kazakhstan) and transition economies (Belarus, Russia and Ukraine) together with high-income developed economies such as Norway or Switzerland.
Source: Author, based on OECD data.

For the sub-sample of developed economies, we observe a 4% coefficient for composition and 26% for competitiveness. The gap is even larger in the case of developing economies: 6% against 36%, respectively. It should not be surprising that countries of recent industrialisation are better placed to adapt their production-mix to changes in demand, as they do not have to support the transition costs of transforming or abandoning legacy industries. On the other hand, several developing regions registered significant loss in competitiveness at some point in time. It is, in particular, the case of Latin America and Sub-Saharan Africa.

On the developed economies side, and leaving aside the very heterogeneous EAC region, we note the low or even negative values observed for the shift effect, at least up to 2015, for EU15 and North America. On the other hand, being regions of legacy industries, they had to carry the weight of hysteresis. The EU13 countries, Eastern European countries classified now as developed economies, benefitted from their privileged access to the Western European countries and moved up the value chain in terms of market share. This said, the catching-up effect slowed-down and turned negative after 2005, perhaps – as we will see below—at a time where China was asserting itself as the "World Factory".

China (PRC) is an interesting case. The gains in competitiveness were particularly strong between 1995 and 2015. They became negative after 2015. This evolution is attuned to an opening of China to the world market after joining WTO in 2001, attracting foreign direct investment and transforming the country into the "Factory China", an expansion which was followed by a slow-down in GVC globalization after the 2008-2009 global crisis, and bilateral trade tensions with the USA in 2016. But this may be just a coincidence and China may simply be confronted to a classical "middle income trap", after years of fast convergence with high-income economies.

5. Disentangling exchange rate and geographic market specialisation effects

The previous results are based on supply and demand effects measured in current USD. The competitive effect, in particular, is therefore affected by nominal changes in the bilateral exchange rate with the USD.

Another source of differences between countries is their concentration on specific regional markets, usually at home or close to home. In a pure frictionless free-trade, distance and trade costs should not interfere with the outcome of world market supply-demand realisation. But we are not in the frictionless text-book hypothetical case of perfect competition.

Monetary and non-monetary trade costs, including the so-called "home bias" giving a preference for domestically produced goods, weight a lot on the capacity of suppliers to compete on foreign markets. It is expected that a country well established in a dynamic market will register a positive shift in its competitive indicator, even if there were no change in its industrial efficiency.

The objective of this section is to isolate these specific exchange rate and regional effects.

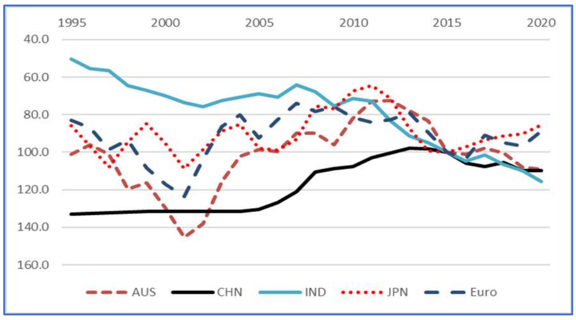
a. Isolating the price and exchange rate effects

1) Sources of nominal variations

Harmonized IO tables are expressed in US dollar (USD) at market exchange rate. The value of national currencies in USD has followed different trends over the 1995-2020 period. The Indian rupia has followed a rather smooth devaluation trend (Figure 1) while we observe more complex behaviour in other cases. For example, the currencies of several developed economies (Australian dollar, Euro, Yen) alternate up and downs. The Chinese Renminbi, after a long period of stability, started appreciating after 2005 before depreciating again after 2014.

These variations are expected to introduce a large amount of noise in our data, even if we consider that in open economy, the manufactured products tend to follow the "Law of One Price". This "Law" states that identical goods should trade at the same international (USD) price in different markets, after accounting for exchange rates and transportation costs. Accordingly, in the long term, nominal variations due to exchange rates and domestic inflation should mainly affect non-traded products, essentially services. At least in theory, but who knows?

Figure 1 Bilateral exchange rate with the USD, 1995-2020 (selected countries)



Note: 2015 =100, inverted scale.
Source: Author, based on BIS data.

Notwithstanding the hypothetical Law of One Price, we look at controlling for the possible effects of nominal variations on tradeable manufacture prices. We investigated three different ways of controlling for this possible bias. The first one, adopted in the present essay, is to measure production at constant price through the whole period, using sectoral deflators. The second approach is to use purchasing power parities that are expected to smooth the effect of inflation and exchange rate in the long term. Finally, looking at the employment implications rather than at the value of output is quite frequent in regional applications of SSA.

None of these approaches is free of bias. Measuring production at constant price provides a hypothetical picture, "as if" prices had not changed since the base year. This is perhaps the closest approximation to measuring production in "physical" terms. It faces obvious limitations when analysis changes (shifts) in international market shares where transactions are done in current price.

Using current exchange rates at purchasing power parities seems a good compromise. But probably not for manufacture production in open economies because PPP$ measuring the purchasing power of 1 USD on the domestic market is mainly influenced by the cost of services. In the case of manufacture, the law of one price states that the price of a tradeable good will have the same (international) price globally, after controlling for trade costs. In other words, the domestic price of traded commodities will tend to converge towards their international price, as measured at the market exchange rate.

Using employment equivalence is another way of approximating some "physical" measure, independent from nominal fluctuations in prices and exchange rates. Yet, over a long period, large differences in labour productivity between countries will blur the picture.

2) Results at constant prices

We present here the results based on constant price using sectoral deflators. To do so, we recalculate the main indicators at constant dollar. In the process, we use deflator data from UNIDO which provides comparable Manufacturing Value Added at current and constant 2015 USD for a large sample of countries. Rest of World was imputed as the median of developing countries deflators.

Because deflators do not distinguish between High/Med/Low technology manufacture, the weight within each country won't change. On the contrary, because deflators differ between countries, the respective market share will differ from country to country, and both the structure and growth of World demand (which is the sum of countries production) will be affected.

In practice, $x^i{}_t$ and $m^w{}_t$ in equation [12], which measure growth rates will be modified. It has to be expected that S_k^i, the weight of product k in the domestic production of country "i", will not change much.

Table 4 Composition and Competition effects at constant 2015 prices, by regions (mean values)

	Share effect (Composition)					Shift (Competitivity)					Shift and Share effects				
Regions	Share2000	Share2005	Share2010	Share2015	Share2019	Shift2000	Shift2005	Shift2010	Shift2015	Shift2019	1995-2000	2000-2005	2005-2010	2010-2015	2015-2019
EAP_DVD	2.5%	-0.1%	1.6%	0.5%	-1.5%	-6.4%	-7.1%	-7.2%	-24.6%	2.0%	-3.9%	-7.1%	-5.6%	-24.1%	0.5%
ECA	-1.2%	3.2%	0.1%	-1.1%	1.1%	9.9%	21.1%	12.2%	-14.2%	2.8%	8.7%	24.3%	12.3%	-15.3%	3.9%
EU13	-2.9%	-4.0%	-1.7%	-2.1%	-0.5%	-1.3%	16.9%	-5.8%	-8.2%	9.1%	-4.2%	12.9%	-7.4%	-10.3%	8.6%
EU15	-0.6%	0.5%	1.2%	0.9%	-0.3%	3.0%	-12.2%	-22.1%	-19.0%	1.0%	2.4%	-11.7%	-20.9%	-18.0%	0.7%
NAM	-1.0%	-0.5%	-0.1%	-0.4%	0.5%	6.5%	-13.8%	-32.3%	-18.5%	-6.9%	5.5%	-14.4%	-32.4%	-18.9%	-6.3%
DVD Mean*	-1.1%	-0.7%	0.1%	-0.3%	-0.2%	1.8%	0.8%	-12.9%	-16.4%	3.1%	0.7%	0.1%	-12.9%	-16.7%	2.9%
- Median	-0.9%	0.3%	0.8%	0.1%	0.1%	-2.8%	-6.1%	-14.9%	-18.0%	1.9%	-3.7%	-5.9%	-14.1%	-17.8%	1.9%
EAP_DVG	2.7%	-0.4%	-3.2%	-4.1%	-4.3%	-6.4%	23.4%	17.2%	11.5%	16.8%	-3.7%	23.0%	14.0%	7.4%	12.5%
LAC	-1.5%	-0.6%	0.7%	0.0%	1.2%	-10.6%	1.8%	-11.2%	-17.9%	-6.8%	-12.2%	1.1%	-10.5%	-17.9%	-5.6%
MNA	-0.7%	2.3%	-3.4%	0.1%	0.1%	1.8%	-0.7%	4.2%	-8.3%	-1.8%	1.1%	1.6%	0.8%	-8.2%	-1.7%
PCR	1.2%	-1.6%	1.5%	0.2%	-0.4%	38.2%	44.1%	61.0%	49.1%	2.2%	39.4%	42.5%	62.5%	49.3%	1.8%
SAS	0.8%	1.3%	0.7%	-0.9%	-0.7%	9.3%	17.1%	12.4%	4.8%	23.4%	10.0%	18.4%	13.1%	3.9%	22.7%
SSA	-2.9%	1.2%	-0.7%	-0.5%	-2.5%	-1.2%	11.0%	-1.9%	-0.8%	18.8%	-4.2%	12.2%	-2.6%	-1.3%	16.3%
DVG Mean*	-0.1%	0.6%	-1.6%	-1.7%	-1.4%	0.0%	14.1%	9.0%	0.4%	7.9%	0.0%	14.6%	7.4%	-1.3%	6.5%
- Median	-1.0%	1.5%	-0.1%	-0.4%	0.0%	-0.3%	6.4%	1.1%	-7.3%	6.7%	-1.3%	7.9%	1.0%	-7.7%	6.7%

Notes: */ see Table 3. National values at current price deflated by the deflator of manufacture value-added base 2015=100
Source: Author, based on OECD and UNIDO data

We present the results for illustration only. Applying Probabilistic -SSA method at constant prices is not actually relevant when considering structural changes in the world market. The basic assumption of the identity between global supply (the sum of national production) and demand (the sum of domestic demand of intermediate and final goods) is not granted anymore. Indeed, and except some very specific cases of long-term future contracts negotiated at fixed prices, markets balance supply and demand at current prices, not at constant ones. On the other hand, as we shall see below, constant process may better represent trends at national level.

The main changes with current price results are observed in the “Global” effect, which measures the overall growth at world level. While one would have expected higher growth rates at current prices -as is usual a country level, this wasn’t always the case. The reason is that the USD values at current prices are not only subject to domestic inflation, but also to exchange rate fluctuations. An additional effect was the deflationary effect on the international price of manufacture resulting from the increased competition of large low-cost exporters, in particular China.

The main discrepancy in the Global effect is in the 1995-2000 period, marked by severe devaluation in several developing countries. At current USD, the growth rate was only 6%, compared to 30% at constant price. Between 2015 and 2019, on the contrary, the growth rate at current price is much higher than in real terms (a positive 11% against a negative -3%).

Differentiating countries by development status indicates that, in general, calculating the indicators in real terms have heterogeneous effects: unfavourable for developing countries in 1995-2000, while favourable for developed economies. The latter were, on the contrary, greatly affected by nominal variations during 2000-2015 with a difference of 43 percentage points in the competitivity indicator (0.8% in real terms, against a large 44% at current prices).

3) Results in absolute variations

The results obtained so far show large variations in the competitiveness effect, sometimes with a change of sign from one period to another. This may be due to our choice of decomposing the rate of growth rather than analysing the absolute variations of the composition and competitiveness effects.[6] In order to avoid a size effect, we normalised all countries at 100 in 1995 and recalculated the respective Composition and Competitiveness indices based on the variations calculated at national level.

Table 5 Current and Constant prices: Accumulated Composition and Competitiveness effects in 2019 (1995=100)

	[1] Current prices		[2] Constant prices		([1]-[2]) / [2]	
Region	COMPO Mean	COMPET Mean	COMPO Mean	COMPET Mean	COMPO Mean	COMPET Mean
Developed countries						
EAP_DVD	101.7	69.6	102.9	67.9	-1.2%	2.4%
ECA	103.4	224.9	102.1	131.0	1.3%	71.7%
EU13	87.5	192.5	89.8	112.5	-2.6%	71.1%
EU15	101.7	59.3	101.6	59.3	0.1%	-0.1%
NAM	98.8	50.1	98.6	46.6	0.2%	7.4%
All DVD:						
- Mean	*97.4*	*110.7*	*98.1*	*81.8*	*-0.7%*	*35.4%*
- Median	*100.5*	*61.2*	*101.0*	*55.4*	*-0.4%*	*10.4%*
Developing countries						
EAP_DVG	88.6	347.9	90.8	206.9	-2.4%	68.2%
LAC	100.6	97.3	99.7	61.0	0.9%	59.5%
MNA	97.6	166.8	98.3	89.6	-0.7%	86.2%
PCR	101.6	933.0	100.9	488.6	0.7%	91.0%
SAS	101.7	279.3	101.2	193.8	0.5%	44.1%
SSA	95.4	127.1	94.6	125.5	0.9%	1.3%
All DVG:						
- Mean	*95.5*	*254.5*	*95.8*	*152.8*	*-0.4%*	*66.6%*
- Median	*99.6*	*145.9*	*99.7*	*110.7*	*-0.2%*	*31.7%*

[6] I thank L. Artige for suggesting this approach.

Notes: */ see Table 3. Based on national values at constant price, 1995=100. Averages are based on all countries in each sub-sample.
Source: Author, based on OECD and UNIDO data

The end-results in 2019 (see Table 5) are illustrative of the differences resulting from accumulated year to year variations at both current and constant prices. The composition effect is not much affected by the change of prices, as the same country deflator was applied to all three types of industries. The small differences, close to rounding errors, are attributable to differences in total country and export and global growth rates.

At the contrary, the competitive components are sometimes greatly affected. With one exception (EU15), the competitive effect is stronger when measured at current prices. It is also stronger for developing countries than for developed ones. The competitiveness effect measuring the capacity to gain new market shares, especially in dynamic markets, this result is consistent with our previous deduction that the shift-share results on growth rates indicated a convergence between developed and developing countries. This said, the differences between the mean and median values indicate a large heterogeneity between countries.

Among developed economies, EU13 and ECA are the sole sub-regions that registered a net improvement in competitiveness, comparing current and constant prices. ECA (Non-EU European and Central Asia countries) is a very heterogeneous group and a closer country-by-country analysis would be required. EU13 countries share a common economic history since the mid-20th century. The improvement observed reflects probably their incorporation into the Western European market and the flows of foreign direct investments that improved their industrial basis.

Latin America stands out within the group of developing economies. Its poor performance in terms of competitiveness reflects its difficulties in adapting its industrial basis to a more competitive global market. The better performance of Middle-East and North African countries at current prices than at constant ones is interesting. Perhaps it is due to the fact that many of them benefited from improved market access to the European markets (EUROMED initiative) in a context of a strong Euro. Most of the gap between constant and current indicators was observed between 2000 and 2010.

b. Isolating the regional market effect

If the variant in real term was mainly for illustrative purpose, the next one is much more relevant from a theoretical perspective. Trade economists identify as a “home bias” the consumers’ preference for domestically produced goods at the expense of competitive imports. This “home bias”, also known as "missing trade” or "the border puzzle", has often been observed in the empirical literature. Today, it is assumed in most theoretical models. Trefler (1995) provides an early assessment of the home bias effect and how it interferes with Heckscher-Ohlin’s approach to comparative advantages.

The artifice we use here to control for the “home bias” is to consider that the manufacture products consumed “at Home” belong to a specific variety. The intuition is that industries initially specializing in a given market (in this variety of product) will naturally benefit if demand in this market is highly dynamic, even if they did not improve on their intrinsic industrial competitiveness. In other words, we hope to transfer to the Composition effect part of what was attributed to the Competitiveness effect in Table 3.

Instead of having 3 types of industrial products based on their technological content, we now have 36 different varieties: 3 products x 12 regions (including Rest of World exports). In Table 6, China (PRC) is in the Top-5 for all three industries (High, Medium and Low technologies). Southern Asia (SAS) was also a buoyant market for Medium and High technology products. Developed Eastern Asia and Pacific is in the Bottom-5, also for these 3 industries. This reflects, among other things, the declining importance of the Japanese economy. EU15 was also a low growth market, in average of the 1995-2019 period.

Table 6 Top-5 and Bottom-5 regional markets for products in terms of 1995-2029 average annual rate of growth

Industry & Region	1995	2019	Annual Growth Rate
	Top 5		
Man_Med&PCR	205 807	3 597 457	12.7%
Man_High&PCR	379 320	6 435 253	12.5%
Man_Low&PCR	309 450	5 222 403	12.5%
Man_Med&SAS	60 801	458 620	8.8%
Man_High&SAS	93 671	681 305	8.6%
	Bottom 5		
Man_Med&EU15	914 990	1 334 443	1.6%
Man_Low&EU15	1 912 175	2 673 370	1.4%
Man_High&EAP_DVD	1 681 284	2 084 293	0.9%
Man_Low&EAP_DVD	1 271 577	1 465 024	0.6%
Man_Med&EAP_DVD	848 107	966 587	0.5%

Note: Sales on regional markets include demand for both domestic and foreign products.
Source: Author, based on OECD data

Considering the traditional strength of the "Home Bias" in international trade, this result indicates strong initial advantages for China and disadvantages for EU15 based on the dynamism of their respective domestic markets. Obviously, the latter could partially compensate this disadvantage by increasing its exports to more dynamic regions, including exports to China and Southern Asia (SAS).

The rise of Southern Asia reflects, among other things, the emergence of India as a global player, both in terms of exports (especially IT and business services, not covered in this study) but also as a market of final destination. On the contrary of the SSA region, East Asia and the Pacific (excluding China, which is compatibilized separately) is stagnating. This reflects, among other things, the deflationary trend that affected Japan, its largest economy.

Differentiating manufacture products by their region of final destination changes the way the composition effect is calculated: instead of three products, we now have 33 ones. In practice, K in equation [7] is 33 instead of 3.

Despite this difference, we can verify that the net effect of the shift and share effects in Table 7 remains equal to what was obtained in Table 3. As expected, the end-result of the new methodology is invariant to the level of product disaggregation. Indeed, this flows from the fact that the methodology decomposes each country variations between the global effect, common to all countries and composition and competitivity effects that are proper to each country. As long as the global effect is unaffected by a change in the granularity of the disaggregation, any change in the composition effect should be balanced by an equal variation in competitiveness, but in the opposite direction.

Table 7 Composition and Competition effects after differentiating products by regional destination (mean values)

	Share effect (Composition)					Shift (Competitivity)					Shift and Share effects				
Regions	Share2000	Share2005	Share2010	Share2015	Share2019	Shift2000	Shift2005	Shift2010	Shift2015	Shift2019	1995-2000	2000-2005	2005-2010	2010-2015	2015-2019
EAP_DVD	-31.2%	-11.1%	-19.0%	-9.0%	-13.5%	19.6%	26.3%	4.7%	-15.1%	15.5%	-11.6%	15.3%	-14.3%	-24.1%	2.0%
ECA	-76.5%	-25.0%	-172.3%	-26.8%	-24.3%	56.0%	123.0%	220.3%	1.2%	31.9%	-20.6%	98.0%	47.9%	-25.7%	7.6%
EU13	-83.0%	-188.2%	-91.7%	-83.2%	-49.1%	87.0%	260.4%	85.0%	62.9%	64.8%	4.0%	72.2%	-6.6%	-20.4%	15.8%
EU15	-22.9%	-5.0%	-18.4%	-32.4%	-13.3%	14.1%	19.4%	-12.7%	10.8%	15.9%	-8.8%	14.5%	-31.1%	-21.6%	2.6%
NAM	1.0%	8.7%	-28.4%	-16.4%	-23.0%	19.5%	-25.6%	-11.5%	1.2%	20.7%	20.5%	-16.9%	-39.9%	-15.2%	-2.2%
DVD Mean*	-51.2%	-63.0%	-49.3%	-46.3%	-25.8%	45.3%	105.5%	33.1%	23.7%	33.6%	-6.0%	42.5%	-16.2%	-22.6%	7.7%
- Median	-18.5%	-13.2%	-31.2%	-29.8%	-10.9%	12.9%	37.9%	10.3%	12.3%	22.9%	-5.6%	24.7%	-20.9%	-17.5%	11.9%
EAP_DVG	-137.6%	-251.4%	-108.7%	-69.2%	-72.2%	141.0%	271.8%	139.4%	84.3%	90.0%	3.4%	20.4%	30.7%	15.1%	17.8%
LAC	-72.8%	-198.7%	-14.8%	-49.0%	-54.2%	84.6%	198.3%	37.2%	37.1%	44.2%	11.8%	-0.4%	22.5%	-11.9%	-10.0%
MNA	-70.6%	-129.8%	-70.1%	-9.9%	-55.2%	87.8%	131.5%	95.3%	17.5%	58.2%	17.2%	1.7%	25.2%	7.6%	3.0%
PCR	-52.2%	-199.5%	19.4%	11.2%	-5.1%	115.3%	255.3%	107.0%	55.6%	2.6%	63.1%	55.8%	126.4%	66.9%	-2.5%
SAS	2.9%	-29.9%	-23.1%	-11.7%	-8.4%	43.9%	64.0%	28.8%	1.6%	-2.6%	46.7%	34.1%	5.7%	-10.1%	-11.0%
SSA	-27.5%	-117.6%	-54.7%	-19.2%	-3.6%	44.3%	145.6%	92.9%	35.3%	21.9%	16.8%	28.0%	38.3%	16.1%	18.3%
DVG Mean*	-79.6%	-188.1%	-107.6%	-53.9%	-72.9%	89.6%	210.4%	140.8%	59.0%	78.4%	10.0%	22.3%	33.1%	5.2%	5.4%
- Median	-52.1%	-96.3%	-31.7%	-25.4%	-38.8%	46.9%	114.5%	65.3%	14.6%	33.6%	-5.2%	18.2%	33.6%	-10.8%	-5.1%

Notes: */ see Table 3.
Source: Author, based on OECD data

The composition effect assigned to developed economies drops: their traditional focus on serving their "home" market was definitely a handicap. It is particularly negative for the developed countries in the Asian and Pacific region (EAP-DEV), which ranked in the bottom-5 market dynamism for all industrial products in Table 6. This negative effect is compensated by the shift (Competitivity) effect when these countries of old industrialisation were able to penetrate into new export markets. These markets need not be amongst the most dynamic: the good score of EU13 of the shift effect is probably due to their increased sales to EU15 countries, a region also in the bottom-5.

Interestingly, most developing regions share with developed countries a similar Shift-Share pattern. Sub-Saharan Africa fares badly on the composition criterium. This is unexpected, as it was in the top-5 of rapidly expanding markets for high and medium technological products. Even China, at least over the 1995-2005 period, is penalised in its composition effect. It is only after 2005 that the composition effect of taking into consideration the "home market bias" becomes positive, as one would have expected from Table 6. Explaining these differences would require additional data.

Yet, the results showcase the potential information gains the new methodology would bring when analysing changes in world industrial production and demand. For example, when taking a regional integration perspective, our method could be applied considering that the "home" market is the regional one, especially for deep regional integration schemes such as the European Union and the North American Trade Agreement.

6. Comparing our approach with traditional SSA

The readers may have been intrigued by the variations from one period to another one in the results obtained. It is particularly evident for the Shift contribution in Table 2. The competitivity contribution for EU15 is particularly unstable, jumping from a high of 14% for the 2000-2005 period to a low of -33% for the next 2005-2010 period. Do we find similar instability using traditional approach that allow for additional components in their Shift-Share decomposition?

We use REAT (Wieland, 2019) to compute a three-component SSA as in Esteban-Marquillas (1972). The three components are Industry-mix (Composition), Industry-dynamism (Competitiveness) and a new Allocation effect. This allocation effect has several possible interpretations, according to Esteban-Marquillas (1972): adequate specialisation on comparative advantages; net-shift independently of the industry-mix and the sectoral competitiveness. Because this net-shift cannot be, by construction, independent from the two other structural effects (their sum must equal total growth), we may also understand it as the effect of covariance between composition and competitiveness during the period.

Table 8 Comparing Traditional and New SSA results

	Mean values				
Period	**E-M_COMPO**	**EM_COMPET**	**E-M_ALLOC**	**pSSA_COMPO**	**pSSA_COMPET**
1995-2000	-0.015	0.017	0.013	-0.010	0.023
2000-2005	0.015	0.336	-0.025	0.001	0.324
2005-2010	0.001	0.122	-0.027	-0.012	0.108
2010-2015	-0.009	-0.064	-0.008	-0.016	-0.065
2015-2019	0.004	0.075	-0.015	-0.012	0.076

Note: E-M prefix stands for Esteban-Marquillas method; pSSA: probabilistic Shift-Share Analysis based on a uniform prior (maximum entropy).
The calculations are made on the full sample of 77 economies, including the outliers and Rest of World cases that were excluded from previous calculations.
Source: Author based on OECD data

Table 6 presents the mean values obtained for the effects obtained applying Esteban-Marquillas type of SSA (E-M_SSA) as in equation [5] and our approach (Probabilistic-SSA) as in equation [12] on the full sample of 77 countries and regions. We see that the sum of the three E-M_SSA components are equal to the sum of the two Probabilistic-SSA. At first glance, we note that there is a closer relationship between the two Competitivity effects than between the two Composition ones. The next table looks at the correlation coefficients.

Table 9 Correlation between Traditional and New SSA results

Periods\Effects	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1995-2000	0.29	1.00	0.57	-0.03	0.75	0.18	-0.01	0.99
2000-2005	-0.07	1.00	0.83	-0.29	0.85	-0.12	-0.20	0.99
2005-2010	0.03	1.00	0.93	-0.43	0.93	-0.33	-0.41	0.99
2010-2015	0.33	1.00	0.94	-0.55	0.95	-0.41	-0.58	0.99
2015-2019	-0.10	0.98	0.91	-0.36	0.92	0.00	-0.36	0.91

Note: Correlations between: (1): the M-E and pSSA compo(sition) effects;
(2) same for the two compet(itiveness) effects;
(3) M-E allocation and pSSA compo; (4) M-E allocation and pSSA compet;
(5) M-E Alloc+compo and pSSA compo; (6) M-E Alloc+compet and pSSA compo;
(7) M-E Alloc+compo and pSSA compet; (8) M-E Alloc+compet and pSSA compet.
Where pSSA: probabilistic Shift-Share Analysis based on a uniform prior (maximum entropy).

Table 9 confirms the strong correlation between the two competitiveness effects (column 2). But the low correlation between the composition effects is perplexing. If correlation with one type of effect was high, we would have expected a high correlation for the other one, as the sum of the two shift-share effects are expected to be equal to the growth rate, unless the allocation effect in the traditional approach is large enough. The answer is probably found looking at the high correlation between the M-E allocation effect and the Probabilistic-SSA composition, especially after year 2000 (column 3). On the contrary, the correlation between the allocation effect and the Probabilistic-SSA competitiveness component is moderately negative.

To quantify the relative weight of each structural component, we reframe the traditional accounting-based M-E SSA through a stochastic lens. Specifically, we estimate a fixed-effects panel model using a short panel dataset (large N, small T), observing countries across five time periods.

In the model, each country industrial production growth is regressed with M-E Composition and Competitiveness effects as predictors, plus a residual that is expected to capture ex-ante the allocation effect (By construction, for each country at each time period, Allocation = Growth – COMPO – COMPET).

Obviously, this identity does not hold ex-post regression as the Ordinary Least Squares (OLS) optimization will try to minimise this "residual" and distribute the influence of the Allocation effect between the two exogenous predictors.

We consider two sets of fixed effects (two-way interaction): country specific and time specific. The resulting model takes the form:

$$\delta Qit = \alpha i + \gamma t + \beta COMPOit + \sigma COMPETit + \varepsilon it \quad [14]$$

With δQit : Growth of industrial output, summing all technological levels, for country "t" during period "t".

[14] is estimated using OLS on a balanced panel of 77 countries and regions over 5-time periods. In our data, the ex-ante influence of Allocation on Growth is usually negative, see Table 8. After this ex-post treatment, regression residuals (εit) still exist in the decomposition, but they are supposed to be centred to 0 and randomly distributed. A similar approach is suggested in Fritz and Streicher (2005).

The results in Table 10 confirm the prevalence of the competitive effect in explaining the growth of industrial production over the period 1995-2019.

Table 10 Regression results (formula = Growth ~ COMPET + COMPO)

Coefficient	Estimate	Std. Error	t-value	Pr(>|t|)	
M-E COMPET	0.94	0.01	100.96	0.00	***
M-E COMPO	0.56	0.25	2.24	0.03	*
R-Squared:	0.97				

Note: Two-ways interaction OLS on a balanced panel of 77 observations over a 5-time period (N= 385).
Signif. codes: '***' p≤0.001, '*' p≤ 0.05

The time-period fixed effects indicate that the growth of manufactured production, compared to 1995-2000 base period, increased rapidly up to 2010, to slow-down significantly afterward. This pattern is consistent with the hypothesis of a "New Normal" materialising in the World Trade economy after the 2008-2009 global crisis.

Table 11 Fixed effects

Period	Fixed_Effect
1995-2000	0.071
2000-2005	0.388
2005-2010	0.431
2010-2015	0.184
2015-2019	0.101

The country fixed effects in Table 12 indicate what is the additional gain that an economy will register on its manufacture production, in addition to the contribution of its composition and competitive effects. As expected, we find in the top-tier developing or "transition" countries and in the bottom-tier developed economies or small-service oriented countries. The faster growth could have been explained by supply-side factors (normally captured by the COMPO and COMPET effects) and by country-specific demand-driven effects, as evidenced by the weight of the Home-Bias in fast-growing domestic markets (see again Table 7 above).

Table 12 Country Fixed-Effects, Top and Bottom 20 countries

Top-20						Bottom-20					
Country	F_Effect	Rank	Country	F_Effect	Rank	Country	F_Effect	Rank	Country	F_Effect	Rank
CHN	11.1%	1	IND	8.7%	11	FRA	6.3%	57	ROU	4.8%	67
KHM	11.0%	2	EGY	8.6%	12	JPN	6.1%	58	MLT	4.4%	68
BGD	10.9%	3	COL	8.5%	13	PRT	5.9%	59	VNM	4.2%	69
KAZ	10.0%	4	PHL	8.4%	14	PER	5.9%	60	ISL	4.0%	70
BLR	9.9%	5	SAU	8.4%	15	MAR	5.8%	61	CYP	2.1%	71
IRL	9.3%	6	CRI	8.3%	16	SGP	5.8%	62	HKG	1.8%	72
CHE	9.3%	7	KOR	8.3%	17	MMR	5.8%	63	NGA	0.8%	73
RUS	9.0%	8	MEX	8.1%	18	FIN	5.7%	64	LVA	-0.1%	74
UKR	8.8%	9	CIV	8.1%	19	TUN	5.5%	65	EST	-0.5%	75
LUX	8.7%	10	CZE	8.1%	20	LTU	5.5%	66	LAO	-4.3%	76

Note: Rest of World (ROW, initial rank 57) excluded.

We should not read too much into these country fixed effects. The rank-correlation between the average growth of manufacture over the period and the strength of the country fixed effect is only 0.34. Table 13 compare actual growth of manufacturing output by region and their rank with the Fixed Effect ranking.

There are several apparent inconsistencies when looking at the regional results. For example, while developed East Asia and Pacific suffered a net deindustrialisation (-4.4% over the 1995-2019 period), its ranking in terms of fixed effect is much better than the developing Eastern Asia countries (China not included). Same thing occurred with the European Union, where the founding EU15 countries rank better in terms of Fixed effects than the more recent EU13 ex-transition countries, despite a huge gap in terms of growth rates.

Table 13Comparing Growth and Country Fixed Effects

Region	Growth 1995-2019	Rank Growth	Rank Fixed Effect
EAP_DVD	-4.4%	52	33
EAP_DVG	21.1%	27	42
ECA	18.6%	31	23
EU13	13.0%	31	53
EU15	-8.9%	62	45
LAC	2.4%	43	31
MNA	10.9%	32	35
NAM	-10.7%	64	43
CHN	61.9%	3	1
SAS	23.5%	17	16
SSA	8.4%	35	42
Developed	1.1%	47	43
Developing	16.6%	30	34

The discrepancy between observed growth and countries' fixed effects means that the actual results in terms of manufacture growth is mainly due to the composition and the competitiveness effects, especially after controlling for the Home-Market bias. Indeed, supply-side is not enough for explaining industrialisation, and it is advisable to include differentiated demand driving effects in shift-share analysis.

7. Conclusions

This paper introduces a novel Shift-Share Analysis (SSA) method rooted in information theory, replacing arbitrary weighting and residual-dependent models with a theoretically consistent, additive decomposition. By leveraging a maximum entropy prior, the approach ensures clear separation of composition and competitiveness effects even in discrete time. Our approach is similar in its results to Artige and van Neuss (2014) and satisfies long-standing consistency criteria, such as Rosenfeld's independence condition.

As a proof of concept, the method was applied to the evolution of global manufacturing from 1995 to 2019. Its flexibility allows for correction of exchange rate distortions and home-market bias, thus strengthening comparative insight. The results illuminate the changing industrial landscape across 76 countries and regions during distinct global epochs: hyper-globalization, post-crisis adjustment, the "New Normal," and rising protectionism.

The analysis decomposes the growth of national industrial production into three terms:

- *Composition Effect*: Sectoral specialization relative to neutral expectation
- *Competitiveness Effect*: Deviation of actual growth from expected in each product
- *Global Effect*: Overall market growth assumed to be uniform across countries

Beyond the methodological contribution, the results offer substantive findings. Contrary to conventional assumptions, initial sectoral composition, reflecting historical comparative advantages, played a limited role in shaping manufacturing outcomes. Instead, competitiveness was the primary driver, especially among countries that integrated dynamically into global value chains. China's rapid ascent and the EU13's convergence are illustrative examples, while more mature economies faced structural inertia. The limited contribution of sectoral composition is likely due, at least in part, to the high level of aggregation used for industrial sectors, which were grouped into three clusters based on their technological content. A more detailed disaggregation might have revealed greater differentiation.

Comparing the proposed method with the traditional Esteban-Marquillas decomposition — including regression-based reinterpretation — underlines the explanatory power and interpretability of the new framework. Further, we show that when accounting for domestic market dynamism and regional specialization, much of what standard or probabilistic SSA attribute to competitiveness may in part reflect demand-side positioning on the home market.

In sum, this approach enriches both the theoretical and empirical toolkit of structural analysis. It offers a more coherent lens through which to assess industrial evolution and should be a valuable asset for scholars and policymakers seeking to understand and shape the trajectory of global manufacturing.

Annex: List of sectors by technological level

The C codes refer to the coding system used in OECD Inter-country Input-Output tables.

- High and Medium-High Technology (sector code and label)
  C20 Chemical and chemical products
  C21 Pharmaceuticals, medicinal chemical and botanical products
  C26 Computer, electronic and optical equipment
  C27 Electrical equipment
  C28 Machinery and equipment, not elsewhere classified (nec)
  C29 Motor vehicles, trailers and semi-trailers
  C30 Other transport equipment

- Medium technology (sector code and label)
  C22 Rubber and plastics products
  C23 Other non-metallic mineral products
  C24 Basic metals

C31T33 Manufacturing nec; repair and installation of machinery and equipment

- Low and Medium-Low technology (sector code and label)
  C10T12 Food products, beverages and tobacco
  C13T15 Textiles, textile products, leather and footwear
  C16 Wood and products of wood and cork
  C17_18 Paper products and printing
  C19 Coke and refined petroleum products
  C25 Fabricated metal products

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