



# PEOPLE'S REPUBLIC OF CHINA—MACAO SPECIAL ADMINISTRATIVE REGION

## SELECTED ISSUES

May 2024

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# PEOPLE'S REPUBLIC OF CHINA—MACAO SPECIAL ADMINISTRATIVE REGION

## SELECTED ISSUES

April 24, 2024

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**Asia and Pacific  
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# TOWARDS ECONOMIC DIVERSIFICATION IN MACAO SAR

## A. Introduction

**1. The Macao SAR authorities have set an ambitious economic diversification plan.** The plan envisions the development of four nascent industries: i) traditional Chinese medicine (TCM) big health, ii) modern financial services, iii) high technology, and iv) convention, exhibition, trade, culture and sports. Furthermore, it will be complemented with the promotion of a robust and diversified integrated tourism and leisure sector. In addition, the government has launched support and incentive measures to boost the Guangdong-Macao In-Depth Cooperation Zone (GMICZ) in Hengqin, with the aim of easing Macao SAR's integration to the Greater Bay Area (GBA) and providing a broader platform for economic diversification. Also, the development of the GMICZ will address development challenges in Macao SAR due to its geographical and population sizes. Macao SAR is a densely populated area with 19,737 people per square kilometer (as of 2021). Being adjacent to Macao SAR and having a land area of 3.6 times the size of Macao SAR and a population of 53,000 people (as of 2020), the Hengqin island could offer a solution to these challenges.

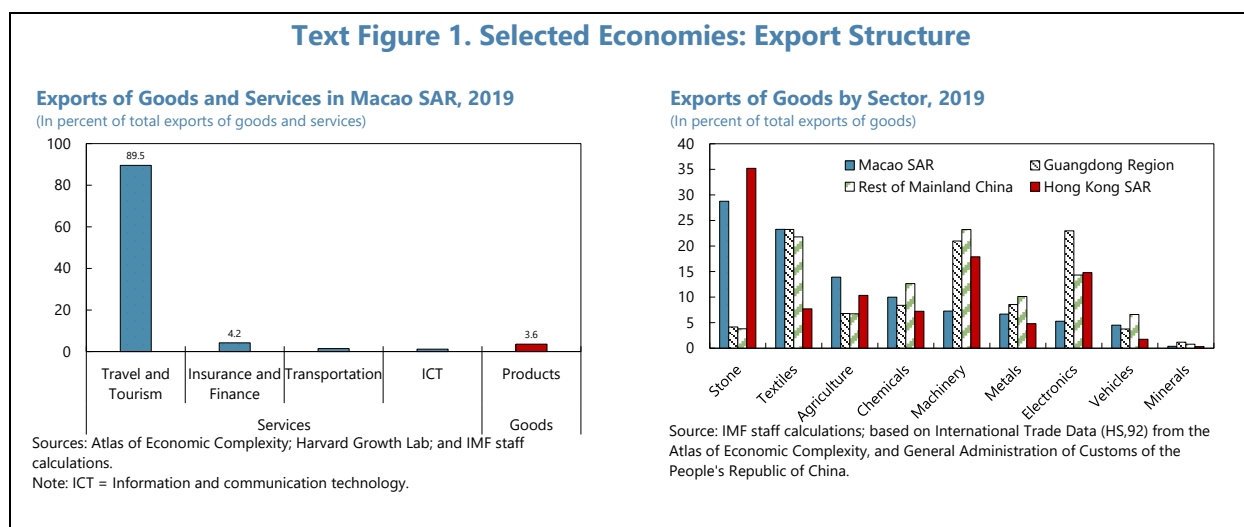
**2. This Selected Issues paper explores product level counterpart data on the exports of goods to identify the availability of know-how that Macao SAR can leverage to enhance its diversification gains.** Our analysis first attempts to identify distinctive characteristics of Macao SAR's export basket. Second, it unravels the availability of Macao SAR's productive knowledge and assesses how different it is from the productive knowledge needed for the government's targeted industries. Third, it explores Guangdong region's productive knowledge and identifies synergies between Macao SAR's targeted industries through the economic diversification plan. Finally, it draws some policy implications for Macao SAR to enhance the effectiveness of its diversification policies, including in the GMICZ.

## B. Export Basket Structure

**3. Macao SAR's export basket is dominated by export of services, while goods exports is concentrated in three sectors.** The share of exports of goods in percent of total exports of goods and services represented only 3.6 percent in 2019—strikingly below the 61.5 percent average for other advanced economies. Contrary, the share of exports of services in percent of total exports was 96.4 percent in 2019 making Macao SAR the economy with the highest share of export of services in total.<sup>1</sup> Hong Kong SAR and Guangdong region are Macao SAR's main export destinations, representing 75 and 4 percent of total exports respectively. Stone, textile, and agricultural sectors

<sup>1</sup> Computations based on a sample of 196 member economies from IMF World Economic Outlook October 2023. Calculations based on Our World in Data based of World Bank.

account for two thirds of the total exports of goods. In contrast, neighboring regions of Guangdong and Hong Kong SAR have less concentrated structure of exports of goods.<sup>2</sup>



**4. Macao SAR actively trades goods with neighboring regions.** Macao SAR's strategic geographical location and well-established infrastructure, coupled with its proximity to Guangdong region and Hong Kong SAR, provide clear indicators of the observed trade patterns in the exports of goods. Both Guangdong region and Hong Kong SAR emerge as major trading partners in Macao SAR's exports of goods.<sup>3</sup> The majority of Macao SAR's goods export is luxury goods. However, a considerable share of these products is re-export.

## C. Unraveling Productive Knowledge

**5. Our analysis is based on the theory of economic complexity** (Hausmann et al (2013)). Under this framework, economic complexity quantifies an economy's available know-how (productive knowledge) and its ability to recombine it to create a larger variety and quality of products.<sup>4</sup> This allows us to capture two distinct features: i) diversity and ii) ubiquity. The former captures the number of products that a country can export with its available resources. The latter measures the number of countries that can make a product. A highly complex product will require a large productive knowledge, hence limiting the number of countries that make this product. In addition, this framework uses network theory to create a map (product space) that captures the similarity of products in terms of their knowledge requirements. Leveraging on their work, we will trace each country's product capacity (i.e., country's exports of products with revealed comparative advantage) and other products that lie nearby.

<sup>2</sup> The median share of goods by sector across selected regions stood at 8 percent.

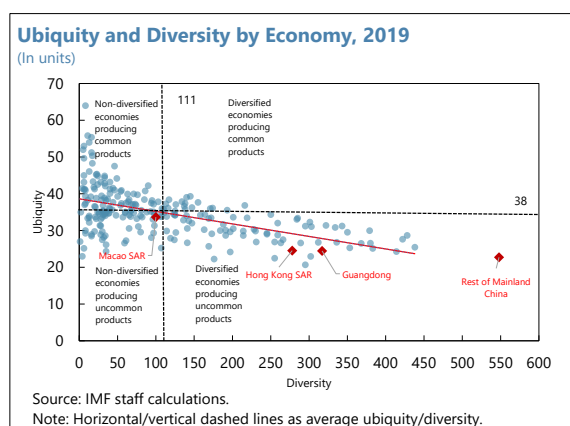
<sup>3</sup> Hong Kong SAR was the second economy with the largest trade openness index in 2019 standing at 353.8 percent of GDP (only behind Luxembourg). The index measures total trade (of goods and services) in percent of GDP.

<sup>4</sup> Under this theoretical framework, economic growth is explained by the reallocation of resources from low to higher productivity goods.

**6. Our analysis uses two databases to capture unilateral trade of goods between economies and products (identified under the Harmonized System, 1992).** First, International Trade Data (ITD) contains trade data between all countries and their trading partners at the 6-digit level.<sup>5</sup> Second, Guangdong Bilateral Trade – Customs (GBT) provides bilateral trade data between the Guangdong region and all counterpart trading regions at the 6-digit level.<sup>6</sup> We disaggregate goods trade data between Guangdong region and Rest of Mainland China, allowing us a granular exploration of goods trade between Macao SAR and the Guangdong region<sup>7</sup>.

**7. Macao SAR's economy is less diversified, has a small set of products with revealed comparative advantage (RCA), and produces ubiquitous goods (less complex) compared with regional peers.** Economies that produce more ubiquitous products tend to have less diversity.

Macao SAR lies close to the intersection between the average levels of ubiquity (38) and diversity (111). On the contrary, Macao SAR's main trading partners: Hong Kong SAR, Guangdong region, and rest of Mainland China, are much more diversified economies producing complex goods, hence lying in the bottom-right quadrant. Our analysis suggests that Macao SAR has a small number of exported goods with  $RCA > 1$ .<sup>8</sup> The actual share of exported goods with  $RCA \geq 1$  in 2019 stood at 11.6 percent—much lower compared with neighboring regions (see Text Figure 2).

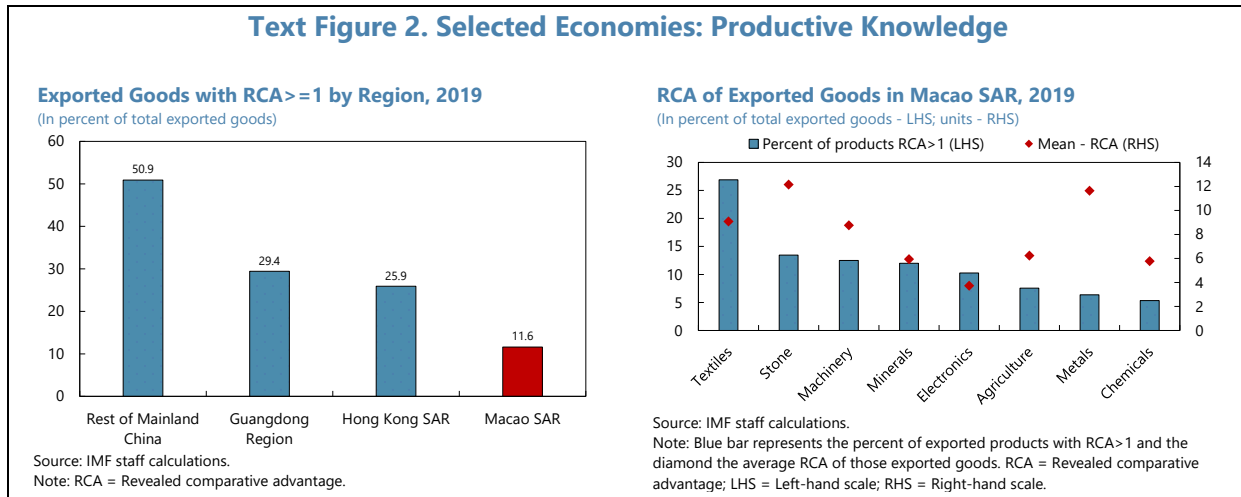


<sup>5</sup> Atlas of Economic Complexity compiled from United Nations Statistics Division (COMTRADE).

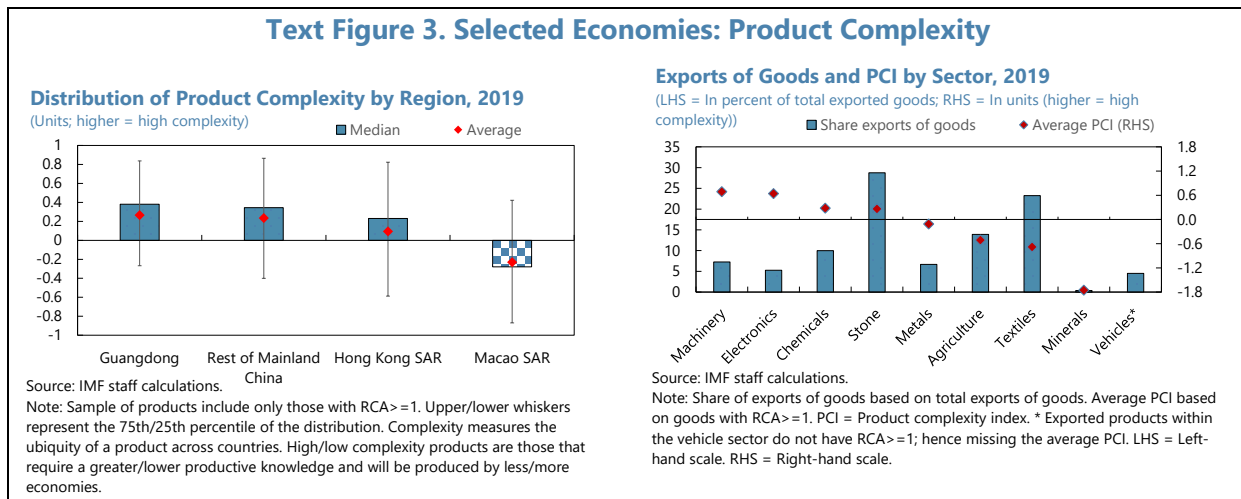
<sup>6</sup> General Administration of Customs of the People's Republic of China.

<sup>7</sup> The data for exports of goods analyzed includes re-exports which is considerable for Macao SAR and could bias the analysis.

<sup>8</sup> A country possesses RCA in a product  $i$  when its ratio of exports of product  $i$  to its total exports of all products exceeds the same ratio for the world as a whole.



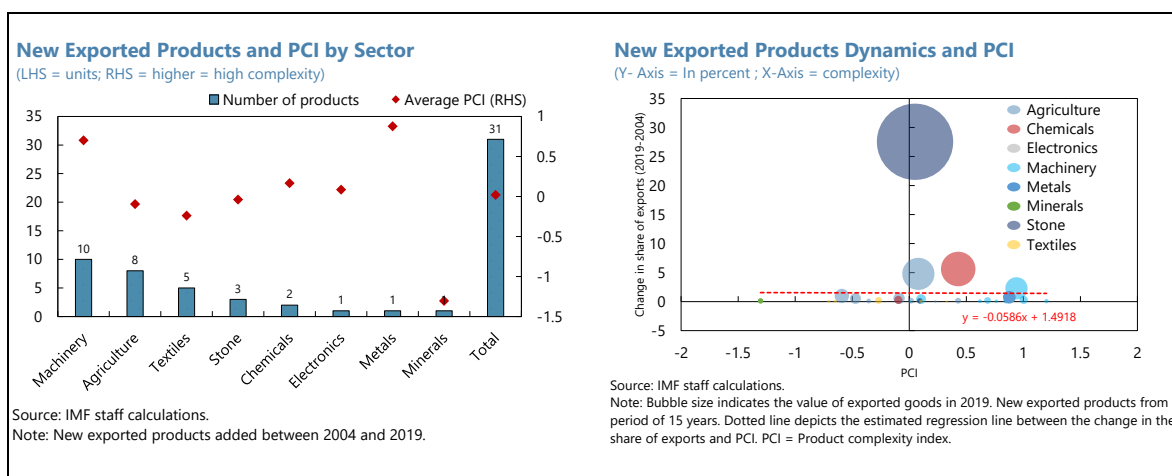
**8. Macao SAR’s export basket is characterized by low complexity products.** The Product complexity index (PCI) is a unit of measurement that allow us to quantify how many economies can make a certain product. Particularly, higher complexity products will tend to be produced by a smaller number of economies since its production entails an intensive effort and many resources. The distribution of products in which Macao SAR has RCA presents lower complexity (on average - 0.23) compared with regional peers (see Text Figure 3).



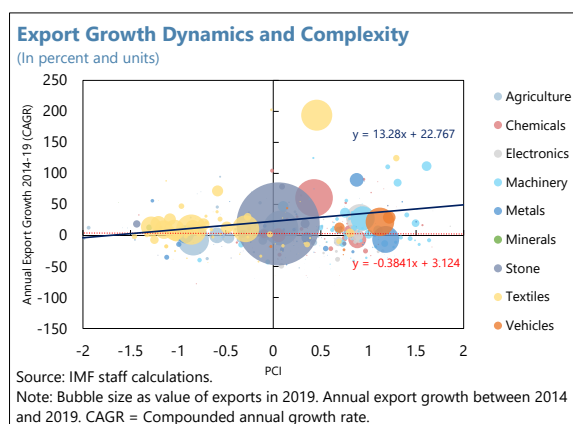
**9. Macao SAR has added low complexity products to its export basket overtime.** Under our methodological approach, a product is considered to be new if it was absent 15 years ago (RCA < 0.5) and present today (RCA >= 1 for at least 3 consecutive years from 2019) in its export basket<sup>9</sup>. During 2004-19, Macao SAR has added 31 new products to its export basket with an average level of complexity close to zero. The Machinery sector has been able to add the greatest number of products (10) with the highest level of complexity. However, there is no relationship between the change in the relevance of a product in the export basket and its complexity. Ideally, we would like

<sup>9</sup> This follows the same procedure as the one applied in the Atlas of Economic Complexity.

to see a positive relationship that could entail that the change in relevance of those goods is explained by its complexity since highly complex products tend to be associated with higher growth.



**10. Growth in exports has been driven by a mix of low and high complexity products.** We explore growth dynamics during 2014-19 to disentangle how exports' growth has evolved across the export basket of goods when compared with the level of complexity of each product.<sup>10</sup> Macao SAR has seen a moderate pattern of export growth, with the largest contribution to export growth coming from a mix of low and high complexity products. There is no linear relationship between export growth and product complexity without controlling for the value of exports. However, if we re-estimate the linear regression by the weighted (on exports value) sum of squared residuals instead of the sum of the squared residuals, the slope coefficient turns positive and significant (blue line).<sup>11</sup> This would entail that even for Macao SAR, which poses an export basket with a predominant amount of low complexity products, export growth has been balanced by a mix of low and high complexity products.



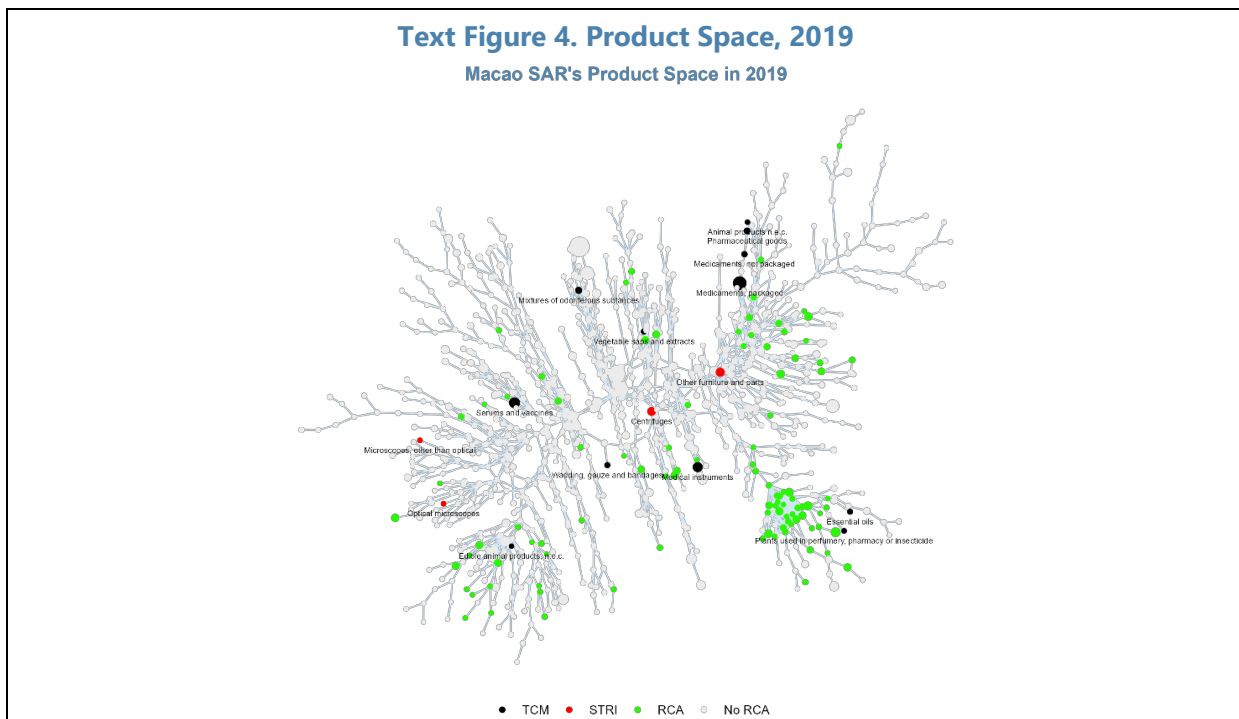
**11. The theory of economic complexity relies on three measures to explore the position of a country in the product space: distance, complexity outlook, and opportunity gain.**

<sup>10</sup> Growth is measured with the compounded annual growth rate formula to analyze growth between two periods (i.e. 2019 and 2014 in our case). This computation assumes that exports growth or decline at a steady rate over the period considered.

<sup>11</sup> Utilizing the weighted least squares (WLS) helps addressing the outliers and heteroscedasticity of the data, where errors in export data are larger for high-value categories.

- **Distance:** Captures how far a product is from an economy's productive knowledge, which is computed by the proximity between the products that it currently makes. Distance is bounded between 0 (closer) and 1 (distant).
- **Complexity outlook:** A higher complexity outlook implies being closer to more products (not currently produced) and/or of products that are more complex.
- **Opportunity gain:** Measures the potential gain to an economy if it were to move to a new product. This is derived by the change in complexity outlook.

**12. On Macao SAR's product space, textile sector has the closest nodes, which is far from sectors targeted by the government (Text Figure 4).** According to the theory of economic complexity, products requiring similar productive knowledge will be located close to each other on the product space. Economies will find easier to diversify into products located closer to those that the country is already producing. For instance, it should be easier for Macao SAR to diversify to new products that: are in the textile industry or located in neighboring industries. However, both Traditional Chinese Medicine (TCM) and Scientific and Technological Research Industry (STRI) sectors are quite far from the products where Macao possesses RCA.



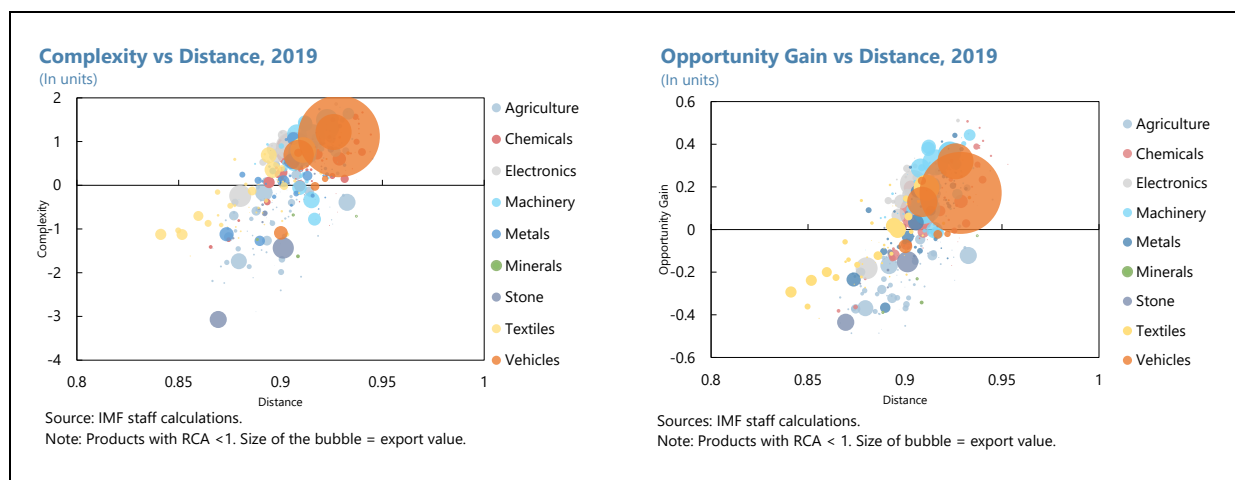


**Text Figure 4. Product Space, 2019 (Concluded)****Guangdong Region's Product Space in 2019**

Source: Atlas of Economic Complexity - International Trade Data (HS 92) ; Guangdong Bilateral Trade – Customs and, IMF staff calculations.

Note: Each node represents a product, the size of the bubble the value of global exports. According to the theory of economic complexity, products with similar capabilities will be located close to each other as it is measured by proximity (or the probability of exporting both products). Economies will find easier to diversify into products located closer to those that the country is already producing (know-how). TCM = Traditional Chinese Medicine; STRI = Scientific and Technological Research Industry; RCA = Revealed Comparative Advantage. Black and red nodes are those identified products from TCM and STRI regardless of RCA. Green nodes as products with  $RCA > 1$ . Non-colored nodes as products with  $RCA < 1$ .

**13. Macao SAR's current productive knowledge lies far away from high complexity products.** Figure 9 and 10 depict the set of products that Macao SAR is currently not possessing RCA. First, the horizontal axis represents the distance between Macao SAR's current export basket and each new product that could be exported. The distance is high and ranges between 0.84 and 0.95. The products closer to Macao SAR's current export basket belong to the Textile sector which presents a low level of complexity. The opportunity gain associated with the production of textile products is low. This is explained by two facts: i) the products require a low level of productive knowledge (that is not easily transferrable from low productivity activities into higher ones), and because ii) it offers lower possibilities to develop more products with a higher degree of complexity.



**14. Integration into the GBA offers an opportunity for Macao SAR to leverage Guangdong region’s extensive productive knowledge to advance its diversification agenda.** Our analysis shows that the Guangdong region has well developed network of products with high complexity, where it possesses RCA. In addition, Guangdong region’s productive knowledge is much closer to the ones required by the TCM and STRI sectors. Moreover, the rich product space in Guangdong region offers possibilities to diversify into products with high opportunity gains beyond the sectors identified by the government.

#### D. Policies to Foster Economic Diversification

**15. The authorities should implement economy-wide reforms that improve efficiency and resource allocation to capitalize on the knowledge base available in the GBA.**

- Public investment in skill upgrading and outcome-oriented occupational and on-the-job training could facilitate the acquisition of skills required for new occupational activities. Additionally, streamlining the administrative requirements for hiring of non-resident workers could increase Macao SAR’s competitiveness to attract foreign talent.
- Improving the design and targeting of Macao SAR’s R&D tax incentives, scaling up public spending on basic research, and improving small and medium enterprises’ access to finance and digital technologies would bolster productivity and support diversification efforts.
- The use of industrial policies (IP) must be well-justified, carefully designed, based on sound cost-benefit analysis, and efficiently implemented. IP should address a well-identified market failure that cannot be addressed through alternative ‘horizontal’ policies, use the best set of instruments to achieve the policy goals, supported by a governance framework to reduce risks of rent-seeking and corruption, with the benefits outweighing the costs, and compatible with fiscal sustainability as well as with external and domestic stability. Transparent mechanisms for project selection and regular reviews, as well as clearly defined sunset clauses to ensure that policies are phased out gradually would mitigate governance risks.

- An adequate development of infrastructure is crucial to maximize the spillovers from the GMICZ into the rest of the economy. Efficient transport and logistics infrastructure are key to facilitate the movement of goods and people. Guaranteeing a sound interconnectedness of the GMICZ could reinforce an adequate propagation of the positive spillovers from industrial policy.

## Annex I. Trade Data

We make use of different databases to compile an international trade database:

- **International Trade Data (HS, 92) (ITD):** It provides international trade data between all countries in the world and its counterpart trading partners on a yearly frequency and at the 6 digit code level for products (Harmonized System, 92). It contains trade data for 250 countries and territories, classified into 20 categories of goods and 5 of services. In total it contains 6,000 products at the global level. The source of data is the Atlas of Economic Complexity<sup>1</sup>.
- **Classifications data:** This database provides metadata classification systems of products for SITC Rev.2 and Harmonized System 92.
- **Guangdong Bilateral Trade – Customs (GBT):** This database provides bilateral trade data between the Guangdong Province and all counterpart trading regions. It provides product data at the 6 digit level for 2019 (HS, 92). The source of this data is General Administration of Customs of the People's Republic of China.

We make use of ITD and GBT databases to construct an aggregated trade database to disentangle trade linkages between Macao SAR and neighboring regions. While the first database (ITD) contains trade between Macao SAR and a wide range of countries, it does not contain trade between Macao SAR and the Guangdong Province. For this reason, we decompose Mainland China trade from ITD into two regions: Guangdong Province and Rest of Mainland China. The following equation displays the approach followed for both imports and exports:

$$\text{Mainland China}_{i,ITD} - \text{Guangdong}_{i,GBT} = \text{Rest of Mainland China}_i$$

$$i = \text{imports or exports}$$

$$GBT = \text{Guangdong Bilateral Trade and ITD} = \text{International Trade Data}$$

- **Data Cleaning**

Since both databases contain 6 digit codes at the HS 92, we make sure that the sample of products and HS product codes is identical in both databases before merging.

We merge both databases by "HS product code" and by counterpart country under the International Organization for Standardization of country codes at three letters (ISO3c) and compute for both exports and imports for rest of Mainland China as it is described in the equation above.

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<sup>1</sup> The authors compile raw data on trade in goods provided by the United Nations Statistics Division (COMTRADE) and clean it. For additional information visit the following hyperlink:

<https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/T4CHWJ>

We run several consistency checks to ensure that the total trade between Guangdong Province and rest of Mainland China adds up to Mainland China total trade. However, we find that Guangdong Province's trade is larger than Mainland China total trade for some products. These could be explained by several reasons:

- i) Mapping errors between both databases in the "HS product code"
- ii) Errors in the aggregation of categories from a smaller level (8 digit) to a higher level (6 digits)
- iii) Statistical errors and different approaches to register customs trade data in the databases.

We deal with these errors by redistributing the "trade-errors"<sup>2</sup> across different trade partners:

For each product that contains a 'trade-error' we extract a trade matrix of Mainland China and Guangdong Province vis a vis imports and exports with other economies. (ie example only exports)

Product	Country	Country - Partner	Exports to Mainland China	Exports to Guangdong Region	Exports to Rest of Mainland China	Dummy Trade Error
210310	Mainland China	Australia	2	1	1	0
210310	Mainland China	Hong Kong SAR	1	2	-1	1
210310	Mainland China	Macao SAR	1	0	0	0

Source: IMF staff calculations.

We distribute the 'trade-error' (in this case China-Hong Kong SAR) based on economy specific weights (exports/total exports for China) for those economies without an error.

Product	Country	Country - Partner	Exports to Mainland China	Exports to Guangdong Region	Exports to Rest of Mainland China	Dummy Trade Error	Weight
210310	Mainland China	Australia	2	1	1	0	0.66
210310	Mainland China	Hong Kong SAR	1	2	-1	1	0
210310	Mainland China	Macao SAR	1	0	0	0	0.33

Source: IMF staff calculations.

We compute the sum of total errors (the sum of exports of those products with errors and reallocate those based on the aforementioned country specific weights (ie Reallocation = Total errors \* Weight).

<sup>2</sup> Trade error is defined when imports or exports from Guangdong Province for a particular product are greater than the same for Mainland China.

**Annex I. Text Table 3. Redistributing Trade Errors - Reallocation**

Product	Country	Country - Partner	Exports to Mainland China	Exports to Guangdong Region	Exports to Rest of Mainland China	Dummy Trade Error	Weight	Total Errors	Reallocation
210310	Mainland China	Australia	2	1	1	0	0.66	1	1*0.66
210310	Mainland China	Hong Kong SAR	1	2	-1	1	0	1	1*0
210310	Mainland China	Macao SAR	1	0	0	0	0.33	1	1*0.33

Source: IMF staff calculations.

Finally we adjust the variable “Exports to Guangdong Province” and recompute the residual of Mainland China trade:

$$\text{If } \text{reallocate} == 0; \text{exports}_{cngd} = \text{exports}_{chn}$$

$$\text{else; } \text{exports}_{cngd} = \text{exports}_{cngd}$$

Then we recompute the exports from Guangdong Province adjusted

$$\text{exports}_{cngd_{new}} = \text{exports}_{cngd} + \text{reallocate}$$

The final database separates Mainland China into: i) Guangdong Province and rest of Mainland China.

As of now, our database presents trade between our decomposed version of Mainland China (into Guangdong Province and rest of Mainland China) and other countries of the world. However, we still need to compute the opposite: trade between country X and the decomposed version of Mainland China. We are lacking this because the ITD database only offers trade between country X and Mainland China. To compute this in our final database we do as follows:

**Annex I. Text Table 4. Counterpart Trade between “Country X” vis a vis Guangdong Province and Rest of Mainland China**

Country/Region	Country - Partner	Product	Indicator	Value
Country X	Mainland China	901819	Exports	1,391,490
Country X	Mainland China	901819	Imports	11,579,538
Guangdong Province	Country X	901819	Exports	3,368,203
Guangdong Province	Country X	901819	Imports	60,823
Rest of Mainland China	Country X	901819	Exports	8,211,335
Rest of Mainland China	Country X	901819	Imports	1,330,667

Source: IMF staff calculations.

Revert what Guangdong Province/rest of Mainland China exports and imports with a particular country. For instance: Guangdong Province/rest of Mainland China exports to country x will be the imports of country x with Guangdong Province/rest of Mainland China.

We check that the sum of exports/imports between country X and both regions adds up to the total trade between country X and Mainland China from the former database.

**Annex I. Text Table 5. Counterpart Trade between “Country X” vis a vis Guangdong Province and Rest of Mainland China (revert)**

Country/Region	Country - Partner	Product	Indicator	Value
Country X	Guangdong Province	901819	Imports	3,368,203
Country X	Guangdong Province	901819	Exports	60,823
Country X	Rest of Mainland China	901819	Imports	8,211,335
Country X	Rest of Mainland China	901819	Exports	1,330,667

Source: IMF staff calculations.

**Annex I. Text Table 6. Consistency Check, vis a vis Trade “Country X” with Mainland China**

Country/Region	Country - Partner	Product	Indicator	Value
Country X	Mainland China	901819	Imports	11,579,538
Country X	Mainland China	901819	Exports	1,391,490

Source: IMF staff calculations.  
Note: Values derived from Table A5 from the sum of exports and imports.

As another step to reduce the complexity in the number of products, we aggregate the 6 digit codes into 4 digit codes. Additionally, we merge this 4 digit database with the Classifications Data to identify the product description and the sector at the 2 digit level sector codes.

Finally, we conduct several robustness checks to ensure the consistency and balance of the new database that we have created with the decomposition of Mainland China into both regions. First, we verify that the sum of world exports and imports is equal. Second, we check the size of Guangdong Province’s exports in percent of Mainland total exports. This yields 21%, being close to the number reported by official statistics of 25% in 2019.

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