Bazillian ornamental rock imports and exports: A study of the impact of Covid-19 in the market

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Abstract — The present study will present a brief historical context, methods and proceedings of the brazilian ornamental rock export market. The impacts and crysis generated by the global Covid-19 pandem was characterized, and expressive reduction was verified. The analyzed period was the first semester (January through June) 2020, epoch in wihc occurred the beginning of the pandemic. We presented numbers and details of the sector trough an comparative analysis to the same period of 2019 and 2018. We present a brief context of what can happen in the next moments in this sector, in an idication of extension of the crisis generated by the Covid-19 impacts. We present methods that adress the ornamental rock market in Brazil and its relationship with its most important export and import countries in the world with data from official sources, separated by rock types to better understand the impacts on the market. We present in this study what the market can go throught with the global pandem.

Keywords— Pandemic, COVID-19, Ornamental, Rock, Exports.

I. INTRODUCTION

Over mankind’s history, mierals had a fundamental role in the advancement of the industry and tecnology (KLEIN et al, 2012). Mierals are crystalline, solid substances formed throught natural processes (KLEIN et al, 2012). The ones with economic value are called ores, resources that we use in our every day life and impact directly in our economy (KLEIN et al, 2012).

Rocks are crystalline aggregates of many minerals in a solid structure, and rocks, as with minerals, may have economic value, also becoming ores. Ornamental rocks are defined as natural rock material, subjected to diferent types and degrees of manufacturing (brute, sliced, sculpted, or polished), that are used in an aesthetic way (ABNT). Ornamental rocks are classified according to the export market in two main groups: marbles and granites (COSTA, 2001). These names are consolidated in the market and used worldwide to designate these objects, that are extracted in blocks and sliced, in wich the production chain involves four main steps: deposit prospecting, extraction, manufacturing and commercialization.

Ornamental rocks are used as construction material since ancienct Egypt, with relevance as a ornamental material in Italy I B.C. Roman people used travertine marble, and even with the ever-growing scarcity of this material, it is still explored in the region of Carrara, Italy.

The ornamental rock market has a great global demand, in wich developed countries are the main importers, and the coutries in development, as Brazil, are the main exporters (SINDIROCHAS 2019).

The year of 2020 was marked by the emergence of a new global disease, and China was the first country to be affected by the Coronavirus COVID-19 (McKibbitn et al, 2020). the first case, in Wuhan, ocuured around december 2019 (Khan et al, 2020). Governments of affected countries took various measures to stop the spread of the disease, that included airport lockdown, port lockdown, rail and highway closure, and ever curfew and
cities lockdown, that caused great impact on global economy, that resulted in different number of confirmed cases (Graphic 1).

The present study aims to analyze the impacts of the pandemic in the ornamental rocks sector through an analysis of exterior commerce data from the Economy Ministry of Brazil, along with official pandemic data from John Hopkins Universisy, in Baltimore - EUA

II. METHODOLOGY

The methodology consisted in collecting data from the ComexStat platform (http://comexstat.mdic.gov.br), from the Ministry of Economy of Brazil. This platform reports monthly the official import and export data of Brazil, divided into many categories, by country and type of product, using the worldwide known SH system, notably the Class (SH4), Subposition (SH6) and the Mercosul Common Nomenclature (NCM). With data in hand, tables and graphics were made to better visualize the numbers.

The Covid-19 data used was obtained from the Data Repository by the Center for Systems Science and Engineering (CSSE), Johns Hopkins University, obtained through GitHub platform. GitHub is an online database host that allows multiple users to have access to databases of various open source projects throughout the world. To make the graphics we utilizes Microsoft PowerBI Desktop (https://powerbi.microsoft.com).

The analysed periods was the first semester (January to June) 2018, 2019 and 2020. These periods will be referred as 1S18, 1S19 ans 1S20, respectively. Values of medium price and its variations were also calculated for the periods investigated, ans separated by country, to identify the major contributors to the results.

To compose the ornamental rock database, we divided this sector in five categories: 1. Brute Carbonatic Rocks; 2. Brute Silicate Rocks; 3. Manufactured Carbonatic Rocks; 4. Manufactured Silicate Rocks; and 5. Slates and other rocks. To classify the export products in these categories, we used the same criteria as the SINDIROCHAS entity (www.sindirochas.com) in its monthly exports report, dividing the NCMs that are considered ornamental rocks in the 5 categories, as summarized in the table below.

| Groups                        | NCM Code    | NCM Description                                           |
|-------------------------------|-------------|-----------------------------------------------------------|
| Brute Carbonate Rocks         | 25151100    | Marbles and Travertine, brute                             |
|                               | 25151210    | Sliced Marbles, in rectangular boards or blocks.          |
|                               | 25151220    | Sliced Travertines in rectangular boards or blocks.       |
|                               | 25152000    | Granites and other cornerstone or calcareous construction stones, alabastres |
| Brute Silicate Rocks          | 25062000    | Quartzites, cut in saw or brute, or in rectangular boards or blocks |
|                               | 25161100    | Brute Granite                                             |
|                               | 25161200    | Sliced Granites, in rectangular boards or blocks.         |
|                               | 25169000    | Other construction Rocks                                  |
|                               | 25162000    | Sandstone, cut in blocks, boards, or rectangular blocks   |
| Manufactured Carbonatic Rocks | 68022100    | Marbles, travertine and alabaster, cut in saw with flat surface |
|                               | 68029100    | Marbles, travertine and alabaster, polished               |
|                               | 68029200    | Other Calcareous rocks, polished                          |
| Manufactured Silicate Rocks   | 68021000    | Tiles, cubes, tablets and similars, even in a shape other than rectangular, whose largest face can be inserted in a square with 7cm sides. Granules, fragments and powders, even if artificially coloured |
|                               | 68022300    | Granite, simply cut in saw, with flat and polished surface |
|                               | 68022900    | Other construction Rocks, cut in saw, with flat and polished surface |
The table above shows us the uses and classifications of rock groups, according to Brazilian and South American (Mercosul) standards agreed on NCM.

Before starting analyzing the numbers, however, extensive bibliographic research was realized. To do so, articles, books, dissertations and scientific magazines, and publications in general were scrutinized. The main goal of this step was to provide a background for the activities being developed.

In Brazil, the ornamental rock production chain is structured through the Local Productive Arrangements (APLs) (Suzigan 2006). These local arrangements are the union of small extractors that work nearby, and sharing common useful structures to minimize the operational costs, such as transport, equipment maintenance, machinery, etc. (Suzigan 2006). According to Slack et al (2002), the APL by process has as its main objectives, to minimize production costs that are associated with the extraction and transportation of the product, from the source to the consumer. There is research pointing to the advantages of business in agglomerations, that is growing in its concept and being driven toward better efficiency and competitiveness of business, regions and countries. (LASTRES; CASSIOLATO 2005)

In Brazil, the APLs grants competitiveness, in an environment that lacks adequate logistic infrastructure. An expressive sum of the extractors work this way.

In developed countries, ornamental rocks, brute or manufactured, are mainly transported through railways. In Brazil, the main transportation pathway is through highways, which elevates a lot the freight costs, reducing competitiveness (SUZIGAN 2006). Transportation was very affected by the pandemic, when countries implemented their lockdowns.

In relation to the COVID-19 pandemic, we had lockdowns in Brazil, that included highway blocks, blocked access to ports, and locked access to the shared APL infrastructure, which caused a lot of delays and impacts on the sector. Beside, port access was also blocked throughout the world, causing even more difficulties and delays, because is the main pathway by which Brazil imports and exports ornamental rocks. There was also an expressive fall in demand, caused by the COVID-19 pandemic.

III. RESULTS AND DISCUSSION

3.1 Imports

We begin analyzing the import market in its whole, by weight (tons), in the periods of study:

| PERIOD      | US$      | Tons (t) |
|-------------|----------|----------|
| 1S18 (jan-jun) | 15.280.947 | 26.046   |
| 1S19 (jan-jun) | 11.201.086 | 21.386   |
| 1S20 (jan-jun) | 8.737.007  | 17.125   |

We can note that imports had a negative variation, Brazil importing 20% less in 1S20 compared to 1S19 in weight.

To analyse which kind of rocks we exported the least, we classified by type as seen below:

| Code          | Description                                      |
|---------------|--------------------------------------------------|
| 68029990      | Other construction Rocks manufactured in other ways |
| 68029390      | Granites manufactured in other ways              |
| 25140000      | Slates, chopped or cut in saw, in blocks or boards in rectangular shape |
| 25261000      | Natural Soapstone, chopped or cut in saw, in blocks or boards in a rectangular shape |
| 68010000      | Paving stones, slabs for paving, of natural stones (except slates) |
| 68030000      | Natural Slates and its works and its aggregates  |

We begin analyzing the import market in its whole, by weight (tons), in the periods of study:
Table 2 - Ornamental Rock imports in 1S18, 1S19 and 1S20, in FOB value, by type. Source: comexstat.mdic.gov.br.

| Groups                  | 2018 - Value FOB (US$) | 2019 - Value FOB (US$) | 2020 - Value FOB (US$) | (%) Variation 1S18 - 1S19 | (%) Variation 1S19 - 1S20 |
|-------------------------|------------------------|------------------------|------------------------|---------------------------|---------------------------|
| Slates and other rocks  | 575.681                | 295.548                | 293.955                | -48.66%                   | -0.54%                    |
| Manufactured Silicate Rocks | 2.156.579            | 1.132.605              | 1.402.238              | -47.48%                   | 23.81%                    |
| Brute Carbonatic Rocks  | 3.900.913              | 2.856.230              | 2.624.350              | -26.78%                   | -8.12%                    |
| Manufactured Carbonatic Rocks | 8.109.643            | 6.634.604              | 4.244.029              | -18.19%                   | -36.03%                   |
| Brute Silicatic Rocks   | 538.131                | 282.099                | 172.435                | -47.58%                   | -38.87%                   |
| Total                   | 15.280.947             | 11.201.086             | 8.737.007              | -26.70%                   | -22.00%                   |

In this way it is possible to note that brute carbonatic rocks were along the most affected, along with manufactured carbonatic rocks, both having almost 40% less imports in 1S20 than in 1S19, but in contrast we noted an 23% increase in manufactured silicatic rocks, being this type the only one that has increased in the period, showing that the market is demanding more of this type of product. We will look at price variations to better understand this result, as seen below:

Table 3 - Average price of the main Brazilian ornamental rock imports. In blue: positive variations. In red: negative variations. Source: comexstat.mdic.gov.br.

| Groups                  | 2018 - Average Price | 2019 - Average Price | 2020 - Average Price | (%) Variation 1S18 - 1S19 | (%) Variation 1S19 - 1S20 |
|-------------------------|----------------------|----------------------|----------------------|---------------------------|---------------------------|
| Slates and other rocks  | 734,29               | 631,51               | 701,56               | -14,00%                   | 11,09%                    |
| Manufactured Silicate Rocks | 743,90             | 727,43               | 516,67               | -2,21%                    | -28,97%                   |
| Brute Carbonatic Rocks  | 501,15               | 419,29               | 426,93               | -16,33%                   | 1,82%                     |
| Manufactured Carbonatic Rocks | 606,78            | 566,48               | 570,28               | -6,64%                    | 0,67%                     |
| Brute Silicatic Rocks   | 442,91               | 337,04               | 426,82               | -23,90%                   | 26,64%                    |
| Total                   | 586,67               | 523,76               | 510,16               | -10,72%                   | -2,60%                    |

A slight variation was observed between 2019 and 2020, but we should note that in relation to 2018 we had a 13% negative variation, denoting an expressive reduction in the analysed period.

The main natural ornamental rock exporters to Brazil were Italy, Turkey, Indonesia and Spain, respectively, and the main artificial ornamental rock exporters to Brazil were China, Spain and Greece, respectively. China has growing in its artificial rock export (ABIROCHAS 2020).

3.2 Exports

The export market in bulk numbers also show a considerable reduction when 1S19 and 1S20 are analyzed, as shown in the table below:

Table 4 - Total Brazilian ornamental rock exports in 1S18, 1S19 and 1S20. Source: comexstat.mdic.gov.br.

| PERIOD            | Value US$ | Weight (tons) |
|-------------------|-----------|---------------|
| 1S18 (jan-jun)    | 457.148.853 | 999.851 |
| 1S19 (jan-jun)    | 489.579.456 | 989.887 |
| 1S20 (jan-jun)    | 398.046.003 | 928.034 |
| Variation 1S18-1S19 (%) | 7.09% | -1.00% |
| Variation 1S19-1S20 (%) | -18.70% | -6.25% |
It is possible to note in table 04 a reduction in demand in
the last 3 years, both in weight and price, and we can see
that in 2020 the reduction was a lot more significant.

In the table below we describe these total values in FOB
US$ specifying the rock type:

| Groups                      | 2018 - Value (US$) | 2019 - Value (US$) | 2020 - Value (US$) | 1S18 - 1S19 Variation (%) | 1S19 - 1S20 Variation (%) |
|-----------------------------|--------------------|--------------------|--------------------|--------------------------|--------------------------|
| Manufactured Silicate Rocks| 312,822.592        | 344,757.930        | 261,098.137        | 10.21%                   | -24.27%                  |
| Slates and other rocks      | 24,256.654         | 25,717.633         | 20,229.314         | 6.02%                    | -21.34%                  |
| Brute Carbonatic Rocks      | 4,368.166          | 5,809.048          | 7,037.697          | 32.99%                   | 21.15%                   |
| Manufactured Carbonatic     | 21,016.773         | 28,855.793         | 25,501.355         | 37.30%                   | -11.62%                  |
| Rocks                       |                    |                    |                    |                          |                          |
| Brute Silicate Rocks        | 94,684.668         | 84,439.052         | 84,179.500         | -10.82%                  | -0.31%                   |
| Total                       | 457,148.853        | 489,579.456        | 398,046.003        | 7.09%                    | -18.70%                  |

We can note in table 05 that manufactured silicate
rocks and slates had a smaller variation than the other rock
types that presented significant reduction.

It is evident from tables 04 and 05 the good
moment experienced by the sector in 2018 through 2019.
There was significant growth in export weight and value to
the main importers. This scenario changes dramatically
when we analyse the 2019-2020 period. In these period,
we can observe a significant reduction in almost all export
categories, in exception to the brute carbonatic rocks, that
increased 21%, against the trend. The totals were greatly
affected, with prices falling 18%, almost 3x the reduction
in weight (-6.25%) (Table 1)

In the table below we describe the average price
by rock type, to better appreciate the details of exports:

| Groups                      | 2018 - Average Price (US$/t) | 2019 - Average Price (US$/t) | 2020 - Average Price (US$/t) | 1S18 - 1S19 Variation (%) | 1S19 - 1S20 Variation (%) |
|-----------------------------|------------------------------|------------------------------|------------------------------|--------------------------|--------------------------|
| Manufactured Silicate Rocks | 709.36                       | 716.91                       | 674.63                       | 1.07%                    | -5.90%                   |
| Slates and other rocks      | 385.59                       | 368.28                       | 346.47                       | -4.49%                   | -5.92%                   |
| Brute Carbonatic Rocks      | 387.39                       | 350.81                       | 419.13                       | -9.44%                   | 19.48%                   |
| Manufactured Carbonatic     | 1007.53                      | 1006.48                      | 908.49                       | -0.10%                   | -9.74%                   |
| Rocks                       |                              |                              |                              |                          |                          |
| Brute Silicate Rocks        | 204.14                       | 214.35                       | 192.30                       | 5.00%                    | -10.29%                  |
| Total                       | 457.22                       | 494.58                       | 428.91                       | 8.17%                    | -13.28%                  |

We can note in table 6 that brute silicate rocks
had a smaller reduction than the other rock types. We
follow analyzing weight and rock type in the period of study:
Table 7 - Variations in weight of ornamental rock exports in the periods analysed, in percentage. Source: comexstat.mdic.gov.br.

| Groups                   | 2018 – weight(T) | 2019 – weight(T) | 2020 – weight(T) | (% Variation 1S18 - 1S19) | (% Variation 1S19 - 1S20) |
|--------------------------|------------------|------------------|------------------|--------------------------|--------------------------|
| Slates and other rocks   | 784              | 468              | 419              | -40.31%                  | -10.47%                  |
| Manufactured Silicate Rocks | 2.899          | 1.557            | 2.714            | -46.29%                  | 74.31%                   |
| Brute Carbonatic Rocks   | 7.784            | 6.812            | 6.147            | -12.49%                  | -9.76%                   |
| Manufactured Carbonatic Rocks | 13.365       | 11.712           | 7.442            | -12.37%                  | -36.46%                  |
| Brute Silicatic Rocks    | 1.215            | 837              | 404              | -31.11%                  | -51.73%                  |
| Total                    | 26.047           | 21.386           | 17.126           | -17.89%                  | -19.92%                  |

We can observe a very great reduction in weight exports, in tons, showing that we exported a gradually smaller amount in 2020 than in the previous years, but brute carbonate rocks were agains the trend, with an whopping 75% increase in 1S20 compared to 1S19.

In the table below we present weight variations in the periods analysed according to rock type:

Table 8 - Ornamental Rock Exports in 1S19 and 1S20, in weight (tons), by rock type. Source: comexstat.mdic.gov.br.

| Groups                              | 2018 - Peso (t) | 2019 - Peso (t) | 2020 - Peso (t) | (% Variação 1S18 - 1S19) | (% Variação 1S19 - 1S20) |
|-------------------------------------|-----------------|-----------------|-----------------|--------------------------|--------------------------|
| Manufactured Silicate Rocks         | 440.995         | 480.891         | 387.026         | 9.05%                    | -19.52%                  |
| Slates and other rocks              | 62.908          | 69.832          | 58.387          | 11.01%                   | -16.39%                  |
| Brute Carbonatic Rocks              | 11.276          | 16.559          | 16.791          | 46.86%                   | 1.40%                    |
| Manufactured Carbonatic Rocks       | 20.860          | 28.670          | 28.070          | 37.44%                   | -2.09%                   |
| Brute Silicatic Rocks               | 463.812         | 393.935         | 437.759         | -15.07%                  | 11.12%                   |
| Total                               | 999.851         | 989.887         | 928.033         | -1.00%                   | -6.25%                   |

Slates and manufactured silicate rocks were amongst the ones that had significant reduction in the period.

Looking to the marbles data we can note that even with a small weight in exports, it has registered positive variation in weight, value and average price. and granite and quartzite exports had a increase driven by quartzites but even though had a 1.7% reduction in FOB US$ value and 2.2% reduction in weight, with a 0.6% increase in average price.

The most affected rock types were the manufactured ones, with a significant 13.2% reduction in FOB US$ price, 8.8% reduction in weight and 4.8% reduction in average price, being the most important factor that contributed to the bad performance of the brazilian ornamental rock exports.

The artificial rocks exports also had a small weight, being United States our biggest importer, but this rock type had increased demand in the period analysed, summing US$14.6 millions and 25.2 Mt, varying positively by 11 and 24.3% respectively. The most important consumers were China, Spain and Greece with remarks to China’s demands.

In table 09 below we describe the main countries to wich Brazil exports:
Table 9 - Average price of the main brazilian ornamental rock importers. In blue: positive values. In red: negative values. 
Source: comexstat.mdic.gov.br.

| Country  | jun/18  | jun/19  | jun/20  | (%) Average Price Variation 1S18 - 1S19 | (%) Average Price Variation 1S19 - 1S20 |
|----------|---------|---------|---------|----------------------------------------|----------------------------------------|
|          | Average Price (US$/t) | Average Price (US$/t) | Average Price (US$/t) |                          |                                        |
| China    | 168,05  | 202,47  | 142,20  | 20,48%                                 | -29,76%                                |
| United States | 711,28  | 711,07  | 615,05  | -0,03%                                 | -13,50%                                |
| Italy    | 573,88  | 449,71  | 491,07  | -21,64%                                | 9,20%                                  |
| Taiwan   | 270,31  | 135,17  | 193,96  | -49,99%                                | 43,49%                                 |
| United Kingdom | 383,21  | 370,80  | 345,97  | -3,24%                                 | -6,69%                                 |
| México   | 671,22  | 541,71  | 475,38  | -19,29%                                | -12,25%                                |
| Hong Kong| 224,54  | 229,40  | 64,60   | 2,17%                                  | -71,84%                                |
| Germany  | 556,24  | 446,00  | 456,84  | -19,82%                                | 2,43%                                  |
| Spain    | 826,43  | 625,59  | 869,21  | -24,30%                                | 38,94%                                 |
| Paraguay | 247,81  | 217,34  | 214,96  | -12,30%                                | -1,10%                                 |
| Vietnam  | 476,91  | 1048,74 | 935,45  | 119,90%                                | -10,80%                                |
| Colombia | 469,29  | 415,69  | 358,54  | -11,42%                                | -13,75%                                |
| Poland   | 422,82  | 325,91  | 516,57  | -22,92%                                | 58,50%                                 |
| Canada   | 1018,54 | 1089,02 | 1345,73 | 6,92%                                  | 23,57%                                 |
| Costa Rica | 480,37  | 430,89  | 325,04  | -10,30%                                | -24,57%                                |

According to table 09 is possible to note that most countries had negative variations when 1S19 is compared ro 1S20.

The table below configures the mains destinys of brazilian ornamental rock exports, showing reduction in 2020.

Table 10 – Brazilian exports in weight (tons) to the main importer countries. In blue: positive values. In red: negative values. 
Source: comexstat.mdic.gov.br.

| Country  | 2018 - Weight (t) | 2019 -Weight (t) | 2020 - Weight (t) | (%) Variation 1S18 - 1S19 | (%) Variation 1S19 - 1S20 |
|----------|-------------------|------------------|-------------------|----------------------------|----------------------------|
| China    | 361.289           | 294.897          | 358.568           | -18,38%                    | 21,59%                     |
| United Stated | 388.224           | 424.279          | 346.515           | 9,29%                      | -18,33%                    |
| Italy    | 63.803            | 62.899           | 58.155            | -1,42%                     | -7,54%                     |
| United Kingdom | 20.353           | 25.036           | 27.699            | 23,01%                     | 10,64%                     |
| México   | 20.903            | 24.870           | 23.698            | 18,98%                     | -4,71%                     |
| Hong Kong| 9.448             | 5.824            | 5.206             | -38,35%                    | -10,62%                    |
| Germany  | 8.528             | 9.000            | 8.465             | 5,54%                      | -5,94%                     |
| Spain    | 5.999             | 8.023            | 6.556             | 33,74%                     | -18,28%                    |
| Paraguay | 1.356             | 2.834            | 2.877             | 108,98%                    | 1,51%                      |
Vietnam 1.815 3.338 4.421 83.98% 32.42%
Colombia 7.475 7.404 6.105 -0.94% -17.56%
Poland 2.598 5.256 3.207 102.32% -38.98%
Canada 7.886 8.136 5.265 3.18% -35.29%
Costa Rica 1.432 1.436 1.625 0.23% 13.22%

Table 11 - Brazilian ornamental rock exports in 1S28, 1S19 and 1S20, by country. In blue: positive values. In red: negative values. Source: comexstat.mdic.gov.br.

| Country  | 2018 - Value (US$) | 2019 - Value (US$) | 2020 - Value (US$) | 1S18 - 1S19 Variation (%) | 1S19 - 1S20 Variation (%) |
|----------|--------------------|--------------------|--------------------|---------------------------|---------------------------|
| China    | 64.184.039         | 52.321.666         | 52.918.726         | -18.48%                   | 1.14%                     |
| United States | 275.235.857     | 305.940.584        | 236.411.948        | 11.16%                    | -22.73%                   |
| Italy    | 31.509.271         | 30.988.203         | 31.101.286         | -1.65%                    | 0.36%                     |
| United Kingdom | 7.808.392       | 9.015.176          | 9.216.661          | 15.45%                    | 2.23%                     |
| Mexico   | 12.603.359         | 14.331.322         | 12.893.136         | 13.71%                    | -10.04%                   |
| Hong Kong | 2.420.682          | 1.464.188          | 1.025.001          | -39.51%                   | -30.00%                   |
| Germany  | 4.183.966          | 4.860.720          | 3.894.331          | 16.17%                    | -19.88%                   |
| Spain    | 4.515.748          | 5.438.958          | 4.685.362          | 20.44%                    | -13.86%                   |
| Paraguay | 367.528            | 440.188            | 615.139            | 19.77%                    | 39.74%                    |
| Vietnam  | 1.700.658          | 2.979.824          | 3.193.097          | 75.22%                    | 7.16%                     |
| Colombia | 3.424.409          | 3.341.949          | 2.475.109          | -2.41%                    | -25.94%                   |
| Poland   | 1.212.841          | 2.393.859          | 1.913.501          | 97.38%                    | -20.07%                   |
| Canada   | 7.635.474          | 8.503.516          | 5.655.426          | 11.37%                    | -33.49%                   |
| Costa Rica | 672.961           | 693.159            | 653.582            | 3.00%                     | -5.71%                    |

Following this global analysis, in the table below we see the variation in the average price of the main importer countries:

Table 12 - Average price of the main ornamental rock importers of Brazil. in blue: positive values. In red: negative values. Source: comexstat.mdic.gov.br.

| Country  | 2018 - Average Price FOB US$ per ton | 2019 - Average Price FOB US$ per ton | 2020 - Average Price FOB US$ per ton | (% Variation 1S18 - 1S19) | (% Variation 1S19 - 1S20) |
|----------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------|---------------------------|
| Turquia  | 433.56                                | 402.39                                | 395.17                                | -7.19%                    | -1.79%                    |
| Itália   | 710.58                                | 586.70                                | 626.46                                | -17.43%                   | 6.78%                     |
| Espanha  | 477.15                                | 435.29                                | 493.54                                | -8.77%                    | 13.38%                    |
| Indonésia| 600.34                                | 537.45                                | 548.31                                | -10.48%                   | 2.02%                     |
| China    | 766.48                                | 774.72                                | 556.74                                | 1.07%                     | -28.14%                   |
| México   | 514.58                                | 462.64                                | 439.02                                | -10.09%                   | -5.11%                    |
| Portugal | 487.42                                | 470.21                                | 468.46                                | -3.53%                    | -0.37%                    |
Grécia | 566,42 | 755,93 | 669,67 | **33,46%** | **-11,41%**
Egito | 330,45 | 283,99 | 291,71 | **-14,06%** | **2,72%**
Namíbia | 0,00 | 282,80 | 404,81 | **0,00%** | **43,15%**
Total | 582,46 | 523,92 | 509,20 | **-10,05%** | **-2,81%**

We can note that China, one of the main global importers had a significant reduction in average price in the period analysed. In the chart below we detail the main brazilian importers by country:

United States are still brazilian’s biggest ornamental rock importer, but we can note the ever-growing participation of China in this market.

We exported a total of US$ 118,3 million, composing a total of 59,1% of all brazilian exports. China and Italy come close and consolidate as our best ornamental rock trading parthners, as buyers, china having only 11,1% of the exports share.

In the internal market we can note that few has changed, being Espirito Santo, Minas Gerais and Ceará, the biggest ornamental rock producers, respectively.
Source: Associação Brasileira da Indústria de Rochas Ornamentais (2020)

The main export routes are through marine ports, with no big changes, being Vitória port, Santos port and Rio de Janeiro ports, the main pathways that Brazil exports its rocks.

Source: Associação Brasileira da Indústria de Rochas Ornamentais (2020)

We can note a larger concentration of exports in the southern states of Brazil. Its important to analyse the number of cases of COVID-19 in the world, to better understand the moments of most severity of the pandemic in each country, and its economic closures and reopenings, as illustrated in the chart below:
We can analyse by this perspective and see it more clearly in the chart below:

Through the chart 02 we can note that China was leading the number of new cases in the beginning of the pandemic, with European countries following in a second moment, with Brazil and United States following the leadership in a late moment.

Various factors must be observed to analyse these results. Firstly, it is obvious the coincidence between the most severe moments of the pandemic (January through June 2020), as expressed in Chart 1, and the bad performance of the ornamental rock exports of Brazil. We also need to observe that changes in supply and demand seem to show a tendency toward bigger exports of brute products and smaller exports of manufactured products during the pandemic. This can be explained by the adaptation of the consumers to the new moment, more financially restricted, with which the consumers shifted toward products with cheaper average price, buying brute to manufacture later.

We can also observe that a significant reduction in the average price of exported products (Table 12). With
excessio of brute carbonatic rocks, that had a 19.48% increase in IS20, all other rock types presented a reduction in value per ton. This confirms the impacts od the oandemic in the brazilian export market of ornamento rocks, and agrees with the interpretation that the demand shifted towards brute products relative to the manufactured ones in the period investigated.

With relation to the exported weight, we observe a little different tendency: in the IS18 - IS19 period, there was no significan changes in the total exported weight, but there was reduction in the total brute rocks exported in relation to the manufactured ones, that experienced pronounced increase. Since the brasilian export profile is composed of mainly silicatic brute rocks, its 15.07% reduction balanced the totals, denoting a moment of stability in the market, that agrees to the IS18 - IS19 increase in average prices. That picture changes if we look at the IS19-IS20 interval, that showed a reduction in both total value and weight. This depicts the impacts of the pandemic in the brazilian ornamental rock market.

IV. CONCLUSION

The impacts of the pandemic on the brazilian rock market in notorious. The sector was very affected, and is going through difficulties because of it. The generalized reduction in average prices per ton, and the reduction in exports in the market, can drive a lot or producer out of business.

It is important to mention that this data is reflecting only the initial period of the pandemic in Brazil, and there is more impacts that will appear in the forthcoming months, or even years.

There is also a shift in the market toward artificial products, mainly driven by China. The reduction in the imports of natural rock material supports this observation.

In relation to the natural materials, there was an increase in the exported volume of manufactured silicatic rocks, products as granites and polished slabs are the most demanded, with increase in average price.

The reductions in exports were expressive, but the brute carbonatic rocks showed a increase, against the general tendency.

The United States, Italy and China are still our most important commercial partners in the ornamental rock market.

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