



COMMODITY PRICES DURING PANDEMICS: UNDERSTANDING THE EFFECT OF REGIONAL VARIABLES

PREÇOS DE COMMODITIES DURANTE PERÍODOS DE PANDEMIA: ENTENDENDO O EFEITO DE VARIÁVEIS REGIONAIS

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Abstract

Local decisions to contain pandemic can promote changes in markets over long distances, that is, commodity market consequences tend to be heterogeneous due to regional implications. It is trade-off between COVID-19 restrictions and regional economic activity level. Faced with supply chain disruptions, an exporting agricultural hub like Uberlandia region, Brazil, becomes more vulnerable to impacts caused by COVID-19. Thus, study objective was to analyze regional variables effect on price behavior of agricultural commodities resulting from global pandemic. Data include daily soybean and corn prices during the period between 2010 and 2020. The results indicate that coronavirus has impacted commodity prices variability, soybean and corn, through confirmed cases number. These results have important implications for commodities market, which suffers higher demand consequences with disruptions in supply, leading to higher returns on the part of investors.

Keywords: Commodities. Regionality. Pandemic. Coronavirus. COVID-19.

Resumo

As decisões locais para contenção da pandemia podem promover mudanças nos mercados em longas distâncias, ou seja, as consequências no mercado de commodities possuem tendência de heterogeneidade por implicações regionais. É o trade-off entre as restrições do COVID-19 e o nível de atividade econômica regional. Diante de rupturas na cadeia de abastecimento, um polo agrícola exportador como a região de Uberlândia se torna mais vulnerável frente aos impactos provocados pelo COVID-19. Assim, o objetivo do estudo foi analisar o efeito de variáveis regionais no comportamento do preço das commodities agrícolas resultante da pandemia global. Foram utilizadas cotações diárias de soja e milho no período entre 2010 e 2020. Os resultados indicam que o coronavírus tem impactado a variabilidade dos preços das commodities, soja e milho, por meio do número de casos confirmados. Esses resultados apresentam implicações importantes para mercado de commodities, que sofre as consequências de maior demanda com rupturas no abastecimento, levando a maiores retornos por parte dos investidores.

Palavras-chave: Commodities. Regionalidade. Pandemia. Coronavírus. COVID-19.

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Introduction

Interconnection between commodity market and major global shocks has been in contemporary research subject. In early 2020, the coronavirus outbreak (COVID-19) in China and its worldwide impact generated an abrupt drop in supply and demand for most economic activities. Being backbone of the economy (WORKIE et al., 2020), there were consequences to agricultural production, since negative returns and greater volatility were observed in commodity market compared to previous period (ALI; ALAM; RIZVI, 2020; BARICHELLO, 2020). In adverse economic conditions and market uncertainty, COVID-19 Pandemic drove commodity prices to freefall in different countries (SALISU; VO, 2020) and significant increases in other countries. Effects were diverse due containment adoption measures at different times (COLUCCIA et al., 2021), indicating how difficulties in human health interact in finance.

Coronavirus pandemic has become largely responsible for risks in commodity market (ADEKOYA; OLIYIDE, 2020), causing fluctuations in prices with the logistics chain interruption. While agricultural supply chains respond to demand, changing people's habits have created surpluses in some products and shortages in others. Consequently, commodity prices dynamics surpassed the levels presented in recent years, establishing a volatility above the global financial crisis in 2008/2009 (TRÖSTER; KÜBLBÖCK, 2020).

Higher market demand for consumption affects the prices of agricultural products negatively (ERTEN; OCAMPO, 2021), impacting the financial market. As a result, in the conditions imposed by coronavirus, people were driven to food storage as a precaution against possible interruptions in supply (HOBBS, 2020), a condition observed both at the global and regional levels. To contain the pandemic, there was an immediate reaction in the flow of inputs and agricultural production, including losses in the agrifood chain (SOENDERGAARD et al., 2020) and increased marketing costs.

Border blocks forced to close the production chain, showing the influence those involved activities in supply chain on commodity prices dynamics (CHENG; XIONG, 2014; TRÖSTER; KÜBLBÖCK, 2020). With heated demand, commodity prices tend to increase in the low flow of products (KUMAR et al., 2020; TISDELL, 2020) into strategic regions such as, for example, Uberlandia city, Minas Gerais state, Brazil. Its geographic position, with the agricultural disposal structure, favors the installation

of warehouses for distribution to all country regions (OLIVEIRA, 2016). This articulation consolidates a region importance as an agricultural export hub. However, its attractiveness brought about higher impact by COVID-19. According to State Department of Health of Minas Gerais data, in December 2020, Uberlandia was at the cases coronavirus top, below only the capital state, causing prolonged disruptions in the distribution of goods.

Supply challenges, due to interruptions in logistics networks, affected exports. In a continental dimension country, exports are geographically concentrated for strategic reasons, which explains vulnerability into cities whereby Uberlandia, through ruptures in supply chain, mainly farms and distribution centers (COLUCCIA et al., 2021). Faced with a disruption in agricultural production and increased demand, regions affected by COVID suffered positive oscillations in prices (FARIAS; ARAÚJO, 2020). In this sense, local decisions to contain pandemic can promote changes into markets over long distances, that is, consequences in commodities market have tendency to heterogeneity by regional implications. It is trade-off between COVID-19 constraints and regional economic activity level. Thus, this study analyzed the effect of regional variables on the behavior of agricultural commodity prices resulting from global pandemic.

In commodities market, pricing is dependent on informational efficiency, which, in turn, is impaired by different market variables (BOHL; PÜTZ; SULEWSKI, 2020). This is even more evident in large shocks, which cause structural changes in markets and generate asymmetric effects on market efficiency. The COVID-19 spatial irregularity suggests that its effects reached some places with higher impact and, in turn, prominent economies in commodity trading scenario. Given this situation, commodity prices variability is also irregularly impacted (KAMDEM; ESSOMBA; BERINYUY, 2020).

In Brazil, the financial market still has informational asymmetry degree (BELO; BRASIL, 2006; FORTI; PEIXOTO; SANTIAGO, 2009; MIARI; MESQUITA; PARDINI, 2015). Therefore, we investigated the impact of this health crisis on commodity markets to understand the response of market efficiency. Given the lower economic growth, emerging markets have relatively limited resources to deal with pandemic impacts, suggesting a worst-case scenario (TOPCU; GULAL, 2020). Additionally, the concentration of food production in few supplier countries, such as Brazil, implies more risks into financial market ruptures.

Brazilian agricultural market is the most important contributors to international trade (ARAUJO et al., 2020; CARRARA; BARBOSA, 2019), being a group with growth weight in economy. Some agricultural products exports, especially grains, remained strong and even increased during pandemic (LIN; ZHANG, 2020). According to Ministry of Industry, Foreign Trade and Services data, in 2020, Brazil exports stood out in two agricultural commodities: soybeans and corn. In Minas Gerais state, corn and soybean production represents 80% of all grains produced and 50% of production in Southeast region, according to Systematic Survey of Agricultural Production data (IBGE, 2020). Therefore, such cereals are used in this study, due to their economic and financial relevance.

While soybean is considered the world's leading agricultural crop (CAMPEÃO; SANCHES; MACIEL, 2020; HOLTZ et al., 2019), due to its extended protein content (MEDEIROS; NÄÄS, 2016) and raw material in industry, corn is the most produced cereal world, whose versatile utility contributes to its socioeconomic importance, both in human and animal food (CHAVES et al., 2020; RODRIGUES; TAVARES; MEIRELES, 2020). Productive methodology and technological inclusions have expanded the relationship between these commodities, which have a tall correlation in Brazilian context (TONIN et al., 2020). In this sense, agricultural commodities, such as soybeans and corn, are not immune to local dynamics, even if their pricing depends on a standardized and global market (WESZ JUNIOR, 2019).

Agricultural commodities, specifically corn and soybeans, quickly incorporate shocks and news, as suggested in the efficient market hypothesis (HAMADI; BASSIL; NEHME, 2017). Furthermore, grain cultivation, as it is highly mechanized (BREWIN, 2020; CUNHA; ZANDBERGEN, 2005), has been little affected (MALLORY, 2020; SOENDERGAARD et al., 2020) by pandemic. So far, global food prices have remained relatively stable, with exceptions on upside (rice) and downside (maize), implying lower export earnings (TRÖSTER; KÜBLBÖCK, 2020).

Existing literature considers impact of global health crises like the current ones, as the pandemic scale has not been witnessed for over a century. Currently, there is relevant literature on COVID-19 and its economic and financial relationship (CAGGIANO; CASTELNUOVO; KIMA, 2020; COSTOLA; IACOPINI; SANTAGIUSTINA, 2020; FORONI; MARCELLINO; STEVANOVIC, 2020), with an accelerating increased trend. Therefore, there is gap to new empirical research, mainly focused on influencing direct society. Still, regional analyzes are scarce.

In this paper, the main contribution is to provide financial researchers a local reality resulting from pandemic evolution in financial scenario through commodities pricing. This study also contributes to portfolio adjustments and financial assets pricing, including agents interested in production planning and promotion cereals. In addition to commodity assets into portfolios to protect high risks (BROOKS; PROKOPCZUK, 2013; KARSTANJE; VAN DER WEL; VAN DIJK, 2015; SALISU; AKANNI; RAHEEM, 2020), pandemic confirmed that agribusiness continues increasing its relevance (ARAUJO et al., 2020), both food and financial security. Finally, the price fluctuations study in commodity market can serve as a parameter in tackling the next pandemic wave or solving other global crises (COLUCCIA et al., 2021).

The present paper is organized as follows: after this introduction, research hypotheses are indicated in section 2. Then, the methodological procedures are presented in section 3. Subsequently, results analysis and respective discussions appear in section 4. Finally, section 5 concludes the paper and presents the final considerations.

Study Hypothesis

The simplicity of market efficiency is restricted to theory since its application still does not yield accurate results. An explanation is negligence of financial market agents to events and anomalies (TITAN, 2015), which can also explain the pandemic scenario designed. The COVID-19 crisis is informing financial agents, policy makers and public, that natural disasters can cause economic damage on unprecedented scale (GOODELL, 2020), as it has shifted risk tolerance downwards to most decision makers (HEO; RABBANI; GRABLE, 2020).

The resulting COVID-19 risk is perceived differently in short and long term (CHEVALLIER, 2020). It is possible to observe that while COVID-19 cases and deaths raise, volatility increases in emerging countries, at least until April 2020 (HARJOTO et al., 2020). Another study identified that stock market in the United States was not always efficient during the COVID-19 pandemic, showing low rationality by underestimating risk (EVANGELOS, 2020). However, there is evidence of rising commodity returns as growing fears related to COVID-19 impact (SALISU; AKANNI; RAHEEM, 2020).

Coronavirus impacted commodity prices variability as emerge confirmed cases and deaths numbers (KAMDEM; ESSOMBA; BERINYUY, 2020), relating to higher volatility, peculiar in emerging markets (HARJOTO et al., 2020). At the same time, public health crisis demonstrated an unbalanced

interdependence between markets (AMAR et al., 2020). On the one hand, there was a drop in international commodity prices (BARICHELLO, 2020). On the other hand, macroeconomic surprises had a greater impact on corn volatility and a lesser impact on soybean volatility, despite showing overreaction (HAMADI; BASSIL; NEHME, 2017).

In this sense, negative external events are not only associated with market volatility, but also describe financial agents' interest in taking risks. These decisions may be linked to respective local reality, affecting full financial market. As this imbalance propagated by economic rupture affects regions in a specific way, the expected impact in Uberlandia tends to high prices fluctuations, due to the relevance in production flow and the wide manifestation of COVID-19. Thus, the study initial hypothesis is:

H₁: COVID-19 confirmed cases number at regional level has positive effect in the soybean and corn commodities return.

Brazil's dependence on commodity exports has increased the prices relevance these products in economic and financial control (STOCKL; MOREIRA; GIUBERTI, 2017). Based on that, commodity prices dynamics was impacted by the uncertainties arising from COVID-19, evidencing that raise insertion in world market boost closer relationship between domestic and international prices (MATTOS; FRANCO DA SILVEIRA, 2018). This relationship is even more evident in regions such as Uberlandia, responsible for international market supplying with main grains towards human consumption. Furthermore, the implications include drop risk in export earnings and change in production pattern to long term (TRÖSTER; KÜBLBÖCK, 2020).

Investors can improve with commodity prices rising by investing in countries whose economy is largely dependent on commodity exports, as seen in Uberlandia region. Greater uncertainty about pandemic is moved to these financial agents as lower commodities demand and, consequently, reduced volatility in commodity markets (BAKAS; TRIANTAFYLLOU, 2020). However, this association may not represent unanimity, given the reflected information level in regional context.

Commodity exporters face negative impacts on demand, seeing an opportunity to increase regionalization efforts (TRÖSTER; KÜBLBÖCK, 2020). The main commodities exported in Brazil, such as soybean and corn are harvested once a year, so that 2019-2020 crop performed before

pandemic hit the country had no production interruptions (MALLORY, 2020). Although exports during pandemic are not restricted (KERR, 2020; SOEERGARD et al., 2020), there was a break in the distribution chain between suppliers and customers (Kumar et al., 2020), introducing regional imbalance (SOEVERGARD et al., 2020).

It is essential that commodity exporting countries are aware of pandemic effects, mainly related to local market decisions, including new production policies and changes in consumption pattern, which can promote changes in global systems (SILVA et al., 2017). This is because commodity export restrictions tend to reduce product prices inside country, while also reducing availability in world markets and pushing the international price raisings (SMITH; GLAUBER, 2020), that may explain a possible regions vulnerability such as Uberlandia. Thus, there is second supposition of the present study:

H_2 : the export level has a positive effect on the soybean and corn commodities return.

Data and methods

This study uses open data of Ministry of Industry, Foreign Trade and Services (MDIC) with exports information and Uberlandia Health Department regarding the pandemic evolution by confirmed cases number. The focus is on Uberlandia region, Minas Gerais state, given agricultural spatial concentration (RODRIGUES; TAVARES; MEIRELES, 2020), as well as infrastructure and cerrado vegetation under favorable conditions for grain production (OLIVEIRA, 2016), especially, soy and corn.

A data set was developed to analyze the two main traded commodities, resulting in data collection on three assets: soybean (Paraná and Paranagua regions) and corn. The period used covers January 2010 to November 2020, based daily data for commodity prices. The data source relating to commodity prices is Center for Advanced Studies in Applied Economics / Department of Economics, Administration and Sociology in College of Agriculture “Luiz de Queiroz” / University of São Paulo (CEPEA/ESALQ/USP).

First, commodity prices in dollars and Brazilian Real were collected. Quotes in dollars were used to robustness analysis purposes. Then, simple return these commodities, over analysis period, was calculated, as well as log-return. The latter was also used in robustness checks.

About control variables, models include characteristics as seasonality, represented by corn and soybean planting periods. The one-day price lag by each commodity was also considered a control variable. Prior to carrying out quantitative analyses, commodity returns were submitted to winsorize procedure, considering 2% level (1% at each side).

Results

Hypothesis Test

Table 1 displays descriptive statistics of study variables. In order to avoid eventual biases related to extreme outliers, it is worth pointing out that variables of commodities return were winsorized at the 2% level (1% at each side).

Table 1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min.	Max.
Soybean - Paranaguá (Simple Return)	2,726	0.073	0.895	-2.224	2.441
Soybean - Paraná (Simple Return)	2,726	0.051	0.816	-1.855	1.975
Corn (Simple Return)	2,718	0.050	0.870	-1.903	2.272
Soybean - Paranaguá (Log-Return)	2,726	0.069	0.894	-2.250	2.412
Soybean - Paraná (Log-Return)	2,726	0.048	0.816	-1.872	1.956
Corn (Log-Return)	2,718	0.046	0.869	-1.922	2.246
Confirm. Cases	2,726	0.300	1.217	0.000	7.041
Plant. Season.	2,727	0.323	0.468	0.000	1.000
Exports	2,724	23.631	0.152	23.143	23.987

Notes: commodities return: calculated in simple return and log-return, as specified in each case (variables relating to commodity returns were subjected to winsorize procedure at 2% - 1% level in each side); Confirm. Cases = natural logarithm of confirmed COVID-19 cases number in Uberlandia/MG city; Plant. Season. = *dummy* variable which receives 1 for corn and soybean planting periods; Exports = natural logarithm of exports value within Uberlandia/MG city; Analysis period: from January/2010 to November/2020.

Table 2 presents the results about the number effect of COVID-19 confirmed cases on soybean and corn commodities daily return. In this case, main explanatory variable is number of confirmed cases of COVID-19. For this table, commodity return was calculated based on simple return. Table 3 summarizes results about effect of period affected by COVID-19 on commodities return under study. In this Table, the main explanatory variable is a dummy, that represents the period affected by COVID-19 (March/2020 to final date). The two tables' results, together, point to positive effect of confirmed cases number on commodities return, as well as positive effect of this period on analyzed assets return. Namely, in period affected by COVID-19, average return of analyzed commodities was higher than the average return outside this period, in line with H_1 and previous studies (HARJOTO

et al., 2020; SALISU; AKANNI; RAHEEM, 2020). This suggests that during these periods there was an increase in commodity prices.

All analyses, whose results are available in Tables 2 and 3, a positive effect was also observed between one-day lagged return with assets return under analysis. The soybean planting periods showed, on average, lower returns than the other periods. Regarding H_2 , exports volume from Uberlandia city had a positive effect on soybeans commodities return, while the effect on corn commodity return was negative.

Table 2: COVID-19 confirmed cases number effect on commodities return

Variables	Soybean - Paranagua (R\$)				Soybean - Parana (R\$)				Corn (R\$)			
	Coef.	Std. Rob. Err.	t	P>t	Coef.	Std. Rob. Err.	t	P>t	Coef.	Std. Rob. Err.	t	P>t
L1.	0.057	0.022	2.62	0.009	0.207	0.020	10.37	0.000	0.264	0.021	12.57	0.000
Confirm. Cases	0.048	0.018	2.59	0.010	0.041	0.013	3.03	0.002	0.031	0.014	2.29	0.022
Plant. Season.	-0.088	0.035	-2.53	0.012	-0.058	0.032	-1.81	0.070	0.107	0.036	3.00	0.003
Exports	0.222	0.115	1.93	0.054	0.285	0.101	2.81	0.005	-0.175	0.100	-1.76	0.079
Constant	-5.167	2.719	-1.90	0.058	-6.695	2.397	-2.79	0.005	4.124	2.350	1.75	0.079
R2	1.10%				5.36%				8.06%			
n	2,723				2,723				2,711			

Notes: commodities return: calculated in simple return; L1 = indicates the commodity return under analysis with one-day lag; Confirm. Cases = natural logarithm of confirmed COVID-19 cases number in Uberlandia/MG city; Plant. Season. = *dummy* variable which receives 1 for corn and soybean planting periods; Exports = natural logarithm of exports value within Uberlandia/MG city; Analysis period: from January/2010 to November/2020.

Table 3: COVID-19 period effect on commodity returns

Variables	Soybean - Paranagua (R\$)				Soybean - Parana (R\$)				Corn (R\$)			
	Coef.	Std. Rob. Err.	t	P>t	Coef.	Std. Rob. Err.	t	P>t	Coef.	Std. Rob. Err.	t	P>t
L1.	0.056	0.022	2.58	0.010	0.206	0.020	10.32	0.000	0.265	0.021	12.59	0.000
Covid-Dummy	0.252	0.085	2.97	0.003	0.231	0.065	3.56	0.000	0.126	0.066	1.90	0.057
Plant. Season.	-0.082	0.035	-2.35	0.019	-0.053	0.032	-1.67	0.095	0.111	0.036	3.11	0.002
Exports	0.223	0.115	1.94	0.052	0.287	0.101	2.83	0.005	-0.176	0.100	-1.77	0.076
Constant	-5.198	2.719	-1.91	0.056	-6.750	2.396	-2.82	0.005	4.162	2.350	1.77	0.077
R2	1.20%				5.51%				8.01%			
n	2,723				2,723				2,711			

Notes: commodities return: calculated in simple return; L1 = indicates commodity return under analysis with one-day lag; COVID-Dummy = *dummy* variable, which receives 1 for the days within the period affected by COVID-19 (after March/2020); Plant. Season. = *dummy* variable which receives 1 for corn and soybean planting periods; Exports = natural logarithm of exports value within Uberlandia/MG city; Analysis period: from January/2010 to November/2020.

Robustness Test

Some rounds of additional tests were carried out to analyze the robustness of results obtained. Initially, simple return was replaced by log-return and models tested in Table 2 were estimated again. Results obtained were similar, suggesting that COVID-19 cases number had a positive effect on of studied commodities return (all cases, effect was positive at 0.05 significance level).

In the second round of analyses, commodity prices were collected in dollars, instead of Brazilian Real prices. Models were estimated again, using simple returns, and positive effect of COVID-19 cases number on commodity returns remained positive and statistically significant. Observed difference was present in lagged variable effect, which started to have a negative effect about soybean commodity return (instead of positive, as shown in Table 2); lagged return effect on current corn return remained positive. By replacing simple return with log-return in new tests based on dollar quotes, the results for effect of COVID-19 variable on commodity returns remained positive and statistically significant at 0.05 level.

In the third round of robustness tests, analysis period was restricted to years 2019 to 2020 and models were tested again. For two models related to soybean commodity, positive effect of COVID-19 cases number on these assets return remained positive and was statistically significant at 0.01 level. On the other hand, for corn commodity, positive effect became non-significant in analysis new round (period restricted between 2019 and 2020).

Finally, using an autoregressive moving-average model (ARMA 1,1), the results for hypotheses testing (H_1 and H_2) were also equivalent to those obtained in Tables 2 and 3 for the returns of soybean commodities (Paranaguá and Paraná).

Conclusion

The effects of COVID-19 containment measures were immediate in inputs flow, agricultural production, agro-industrial processing and logistical problems, generating uncertainty in agri-food chains. A fear that food markets will be affected by supply restrictions puts pressure on agricultural products prices. Large share of commodities, such as soy and corn, in Uberlandia city highlights its vulnerability to global shocks (pandemic).

When considering behavior in last decade, results suggest that coronavirus has impacted the recent variability in commodities prices, soybean and corn, through confirmed cases number. This confirms that collapse of economic activity and local trade, as result about coronavirus pandemic, contributes to strong pressure on commodity prices (ERTEN; OCAMPO, 2021), with trade restrictions generating higher food prices (SMITH; GLAUBER, 2020). Higher prices will probably encourage the production of these commodities in region, articulating financial market volatility.

In spite, there is a seasonality pattern in corn and soybean crops, whose planting period showed a lower return, on average. This condition is in line with still uncertain harvest expectation to be priced by market. Agricultural commodities exports stand out in Uberlandia city, Minas Gerais state, with geographic positioning as a competitive advantage. Its export dynamics suggest that access to international markets contributes to higher returns for commodities, especially soybeans. However, a lower return was observed for corn exports, indicating lower price volatility during pandemic crisis. This regionally identified distinction reflects asymmetric effects on market efficiency and need to expand analyzes of financial market at regional level.

These results have important implications for commodities market, which suffers consequences of higher demand with disruptions in supply, leading to higher returns on investors part. As result, a global health crisis can provide good financial returns for investments in commodities, at same time that society embitters prices on shelves, given the close relationship between domestic and international prices (MATTOS; FRANCO DA SILVEIRA, 2018). In this sense, the commodities market must be considered a pillar of support in resources distribution.

During the pandemic, agricultural commodities showed good sensitivity to regionally perceived macroeconomic uncertainties. This research supports local interventions to be implemented to face effects of shock caused by the pandemic, to improving forecasts in commodities market.

As more data becomes available and as pandemic evolves, the estimates made in this research can be updated, but for now, they represent a momentary assessment on commodities market impact. However, it will be necessary to capture long-term effects and analysis, both in period of virus persistence and in a future period of market recovery.

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