Exploring Price Volatility in the Brazil Nut Market in Madre de Dios

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Abstract

In southern Peru, the drivers of deforestation in the Amazon include illegal gold mining, illegal logging and agricultural practices. Amidst these challenges, Brazil nuts remain an important non-timber forest product that simultaneously has the potential to promote forest conservation and support local communities. This paper seeks to analyze price volatility and its effects on local producers and sustainable practices in the Brazil nut industry in the Madre de Dios Department of Peru. Incorporating both government data and interviews with local producers, this study shows that price volatility persists in the Brazil nut market and poses considerable socioeconomic challenges. Interview responses show that price volatility causes financial insecurity and operational challenges. The goal of this study is to contribute a perspective on the market dynamics of Brazil nuts and emphasizes the necessity of addressing price volatility to ensure the success and sustainability of the Brazil nut industry in Peru.

Keywords: Brazil nuts, Price volatility, Madre de Dios, Sustainable forest management, Amazon rainforest

Introduction

The Amazon rainforest is the largest tropical rainforest on the planet and plays an important role in regulating the global climate and maintaining weather patterns (Bryce, 2024) . The Amazon Basin also houses a wealth of natural resources, causing the region to become a target for deforestation and exploitation. The drivers of deforestation are often nuanced and involve several factors such as agricultural expansion, timber extraction, mining, climate change, and socioeconomic factors (Cruz, et al., 2023). Indeed, in southern Peru, the two most profitable industries are illegal gold mining and illegal logging. Both these activities involve heavily decimating the Amazon rainforest and lack sufficient government regulation. Similarly, agricultural practices and livestock farming are also major contributors to deforestation in Peru (Cruz, et al., 2023). Farmers resort to burning land to clear space for cultivation or raising ruminants.

Luckily, Brazil nuts (Bertholletia excelsa) have become one of the most important non-timber forest products (NTFP) for Peru and the Amazon Basin (Ramirez & Belcher, 2020). It is a significant economic driver for local communities and is equally beneficial for the region's diverse ecosystem. In terms of economic importance, the Brazil nut industry is one of the most lucrative legal industries in the Department of Madre de Dios, where most Brazil nut harvesting takes place in Peru. At the local level, the Brazil nut industry supports the annual income of one-third of residents in the department (Ramirez & Belcher, 2020) . With regards to sustainability, Brazil nuts are part of a minority of globally traded commodities that have the potential to

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protect at-risk forests. The nuts must be harvested directly from natural forests in the Amazon instead of being produced as crops. As such, this NTFP is an important incentive for forest preservation (Guariguata et al., 2017). However, one main challenge in the Brazil nut industry is volatile market prices. Frequent changes in prices over a short period can expose producers to risk and uncertainty, making long-term planning more challenging. This hinders the efficient and sustainable use of the resource and risks decreasing production.

Understanding the effects of price volatility on local producers is vital for conceiving strategies to stabilize the market and promote sustainable growth. Indeed, price volatility of an NTFP can hurt producer income, and create issues in planning future production. The goal of this study is to fill a gap in the existing literature on the topic of Brazil nut markets in Peru and intends to contribute a focused, but essential, perspective of market dynamics and sustainable practices in the Brazil nut industry.

Theoretical Frameworks and Definitions

Price Volatility

Price volatility refers to the degree of fluctuations in the price of an asset, a commodity, or a market. For many essential food or agricultural commodities, price fluctuations are expected since demand for food products is often inelastic. This means that price changes do not significantly alter consumers' demand for the commodity. Price volatility is also often necessary since it prevents marketsfrom stagnating (Tothova, 2011) . From a macroeconomic perspective, higher prices are desired by net exporting countries since they benefit from a better balance of payments. On the other hand, countries that import more are disadvantaged by higher prices (Tothova, 2011). More price volatility also tends to concern producers and processors who incur more risk and uncertainty if they lack the proper tools to handle the unpredictability of frequent price changes (Tothova, 2011).

Producers will often be more worried about lower prices since they threaten living standards and the ability to provide for the family business (FAO et al., 2011). Specifically, it is harder to cover the costs of operational demands of the business such as transportation, paying employees, and other administrative tasks. Increased uncertainty can also lead to sub-optimal production and investment choices (FAO et al., 2011).

Causes of Volatility in the Brazil Nut Market

In terms of the Brazil nut industry, price volatility is caused by a few combined factors. First, climate change, weather events, and tree productivity can cause fluctuations in export levels. Drastic weather changes can impact transportation by river or cause floods that ruin certain roads. As a result, producers will experience difficulties in accessing or exiting the forest. Second, shipment delays also affect how many Brazil nuts can be stored at once making it more challenging for suppliers and buyers to meet demand at any given time. Third, when prices are low, producers may be less willing to harvest nuts in the following year. As a result, fewer nuts will be harvested, and prices will increase again. Fourth, heavy speculation is common in the Brazil nut market because future prices are not predetermined (Guariguata et al., 2017).

Brazil Nut Concession System

The Peruvian concession system provides private individuals, companies,

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communities or organizations with a long-term contract allowing them to access public forest land to harvest Brazil nuts. This system started in the Madre de Dios Department in 2000 but is used internationally to promote sustainable forest management. The concessions in Peru are either located within protected areas such as the Tambopata National Reserve or outside protected areas. (Willem et al., 2019) For this study, only individuals who own concessions outside of protected areas have been considered.

Methods

To better understand market prices in recent years, I consulted the Reporte Estadistico de Castana (2021). This statistical report on the Brazil nut market was published in December of 2021 and is the most recent government report issued on this topic. With this report, I was able to access data on monthly prices over three years : 2019, 2020, and 2021. The data from this report was useful in assessing the presence of price volatility in the Brazil nut industry in Peru.

Price volatility is often measured in two ways : historical (realized) price volatility or implicit volatility. The former consists of observing movements of a price over a historical period. It follows fluctuations that have already occurred and reflects the resolution of the forces of supply and demand. The latter attempts to estimate how volatile an asset might be in the future. This reflects the market's expectation of how prices are likely to change. For this study and given the available data, I use historical volatility as a measure since it can also be a good predictor of future trends in price changes. The Reporte Estadistico de Castana uses Free on Board (FOB) prices. FOB prices are useful since they do not take into account transport prices which can be very variable in and of themselves.

The historical price volatility was calculated as follows:

I first used the Reporte Estadistico de Castana to collect past prices of Brazil nuts.

- I calculated the expected price (mean) for the period between 2019-2021.
- I then calculated the difference between each price and the average price.
- Then I squared the difference and took the sum of the squared differences (SSD).
- I found the variance by dividing the SSD by the sample size.
- Finally, I calculated the standard deviation.

The standard deviation indicates how much the market price of Brazil nuts usually deviates from the average market price.

Short interviews were also conducted. The interviews lasted about five to ten minutes and had a total of 17 questions. These interviews were intended to supplement the data collected from the statistical report by providing a qualitative perspective on frequent price variations. These interviews also allowed me to explore how prices differ among local producers and how they are affected by fluctuations. The interviews took place in Monterrey and Allegria, two towns located in the district of Las Piedras, in the province of Tambopata in the Madre de Dios region of Peru. Six individuals were interviewed. The participants consisted of adults who owned or managed Brazil nut concessions. The youngest participant was 25 years of age and the oldest was 72. Of the six interviewed, two were women. Most of the participants owned or worked on their concession with other family members. Participants were sought out through various recruitment methods. One technique

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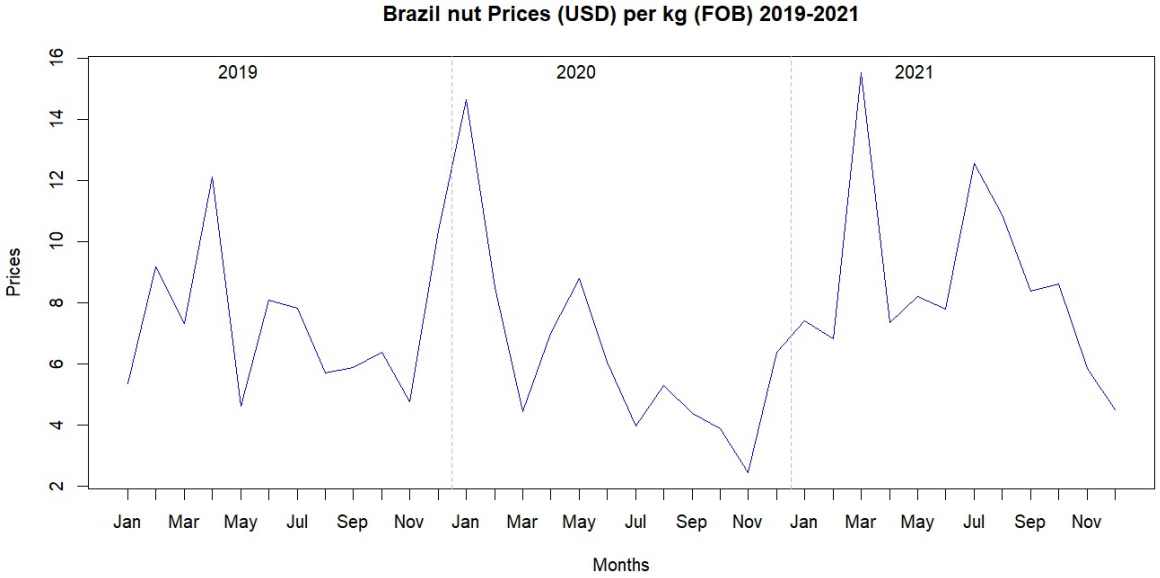

Figure 1: Fluctuations in Price 2019-2021

was using personal networks by asking existing contacts for referrals. This technique was beneficial because it was quick and cost-effective. Another technique I used was cold recruiting, namely door-to-door recruitment in the towns where the interviews took place. This method was used simultaneously with snowball sampling where I asked participants if they could refer other concessionaires who might be nearby and interested in an interview. This method helped me locate new participants quickly and more efficiently.

Results

Government Dataset

The dataset consists of monthly prices in USD per kilogram of Brazil nuts from January 2019 to December of 2021. The average prices of Brazil nuts in 2019, 2020, and 2021 were $7.21, $6.08, and $8.71 respectively. Overall, the prices range from $2.44 to $15.54, with the lowest price being in November 2020 and the highest price in March 2021. Prices in 2021 had the

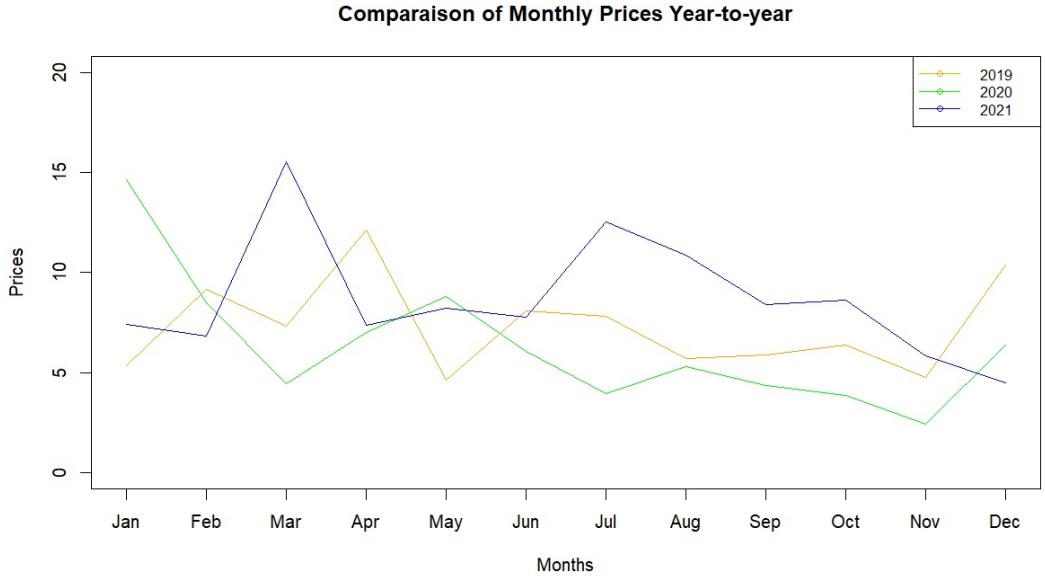

Figure 2: Comparison of price changes by year

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largest range of among the three years, the difference being $11.03. The historical price volatility of Brazil nuts in this period was calculated by finding the standard deviation of the prices. Indeed, the standard deviation of Brazil nut prices between 2019 and 2021 is $4.29, while the average price was $7.33. That means that on average the market price for Brazil nuts deviates from the average price by $4.29 or by 58.5%.

Figure 1 demonstrates how frequently prices change over the three year period. Prices have been the lowest during 2020 and highest in 2021. Figure 2 presents the same information but visually compares price trends between the three years. By observing figure 2, it is evident that there is no specific period within the year that consistently has higher or lower prices.

Interview Results

The six people who were interviewed were asked to report the highest price they have ever received for a barrel of Brazil nuts as well as the lowest price they have ever been offered. All six respondents remembered the highest and lowest prices they sold their nuts at. However, of the six only four could remember both the year

Figure 3: Unadjusted maximum and minimum prices

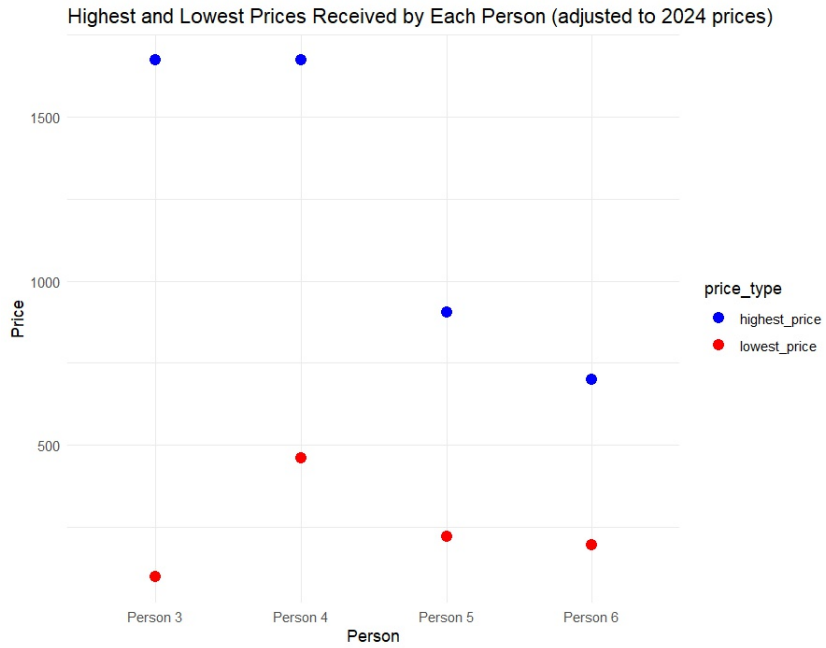

Figure 4: Adjusted maximum and minimum prices

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they received their highest price and the year they received their lowest price. Without considering any adjustments for inflation, the six concessioners all had similar responses for their lowest prices, whereas the highest prices were more varied. The lowest prices range from 50 soles per barrel to 190 soles within 24 years. On the other hand, the highest reported prices were less consistent and ranged from 1000 soles a barrel to 400 all between the years 2010 and 2021. When adjusting prices to 2024 soles, only four responses could be accounted for since only four respondents remembered the years of both their highest and lowest prices. Even after adjusting these prices for inflation, the range between the highest price ever received and the lowest price ever received remains large and is not consistent across the respondents. When asked about how fluctuations in price affect their business, almost all six concessioners shared similar views. Many respondents felt that price decreases affected them more harshly than when prices increased. Most respondents felt that it is harder to operate the concession if prices are too low since no money is coming in. Indeed, one respondent explains that it is financially difficult for his business since it is more difficult to turn a profit and often, he experiences a loss in income. As a result, it is harder to reinvest the money into his business. Two respondents shared that with low prices, it is hard to purchase other staples and food for themselves. While prices for Brazil nuts go up and down, basic staples needed for daily life keep on rising. One of the respondents also mentions that if prices are too low then they must resort to collecting timber from other trees to support themselves. Additionally, another concession manager explains that when prices are low it is harder for them to pay for transportation of their Brazil nuts. Furthermore, after paying employee wages and government taxes, they cannot make a profit if prices remain low. This participant also mentions that they sometimes experience difficulties paying government taxes since the taxes always remain the same, but prices fluctuate.

The concessioners were also asked to report how they decide which price to sell their harvested nuts at. Two respondents mentioned that they look for whoever is willing to pay the most for their harvest. Similarly, another respondent seeks information about which companies are willing to pay the most and also tries to discover what price other concessioners are selling their Brazil nuts at. Two respondents also mentioned that they try to wait for prices to increase before selling their stock. One of these respondents added that he asks other individuals if they think prices will be high or low before waiting to sell his harvest.

Discussion

The results of this study demonstrate the significant impact of volatile prices on the Brazil nut industry and producers in the Madre de Dios region of Peru. Both quantitative data and qualitative insights illustrate that the Brazil nut market experiences fluctuations. From 2019 to 2021, monthly FOB prices deviated on average by 58.5 percent from the mean price. Interviews with concessioners also revealed that volatile prices are also present upstream in the supply chain at the producer price. Of course, it is to define high or excessive volatility since it is often subjective and depends on the commodity, the period, and the environment. However, after analysing prices reported by the Peruvian government and conducting interviews with local producers, it is evident that prices of Brazil nuts seldom remain

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constant and pose several challenges. While fluctuations in price are expected in such a market and are sometimes desired to avoid a stagnant market, prices that fluctuate too often also have negative repercussions. Indeed, frequent fluctuations in price affect producers' ability to plan, invest, and sustain their operations effectively.

Impact on Producers

As the theory predicts, price fluctuations introduce uncertainty and risk that not all family-run concessions are equipped to handle. In fact, when asked how price changes affect them, many local producers chose to discuss more about how they were negatively affected by significant drops in price rather than how they were benefited by high prices. Interestingly, this reveals that losses seem to be more impactful than gains for concessioners. In other words, a loss feels much worse than a gain.

The interviews also demonstrated several socioeconmic challenges imposed by price fluctuations. In line with the theoretical frameworks, producers reported being more concerned about low prices since it threatens their livelihoods and the ability to manage their business. For example, when prices drop, it is hard to turn a profit after covering basic operational expenses such as transportation, employee wages, and other administrative costs. As the theory suggests, this financial strain can push producers to alter their decision-making process and lead to sub-optimal production and investment decisions. For example, with a decrease in revenue, concessioners are less likely to reinvest money into their business which can create long-lasting difficulties. Another consequence of price volatility is that it may lead to risk-averse behaviour. For instance, producers may be less willing to remain in the Brazil nut industry if they incur too much unpredictability and may look for alternative labour. Without the necessary tools to handle uncertainty caused by price volatility, the Brazil nut industry might seem less favorable to producers than other local industries that may not have the same sustainable potential that Brazil nut harvesting has. Interestingly, one of the respondents commented that when prices are too low, the workers on his concession resort to timber extraction.

During the interviews, two concessioners revealed that they commonly wait for prices to rise before selling their harvest. One respondent also mentioned that they rely on advice from other concessioners regarding future price estimations. These responses underscore the role of speculation in the Brazil nut market, where producers try to predict price movements to optimize their income. This approach can introduce additional risks if predictions are inaccurate.

Sustainable Forest Management

The Brazil nut industry plays a crucial role in promoting sustainable forest management in the Amazon Basin. Brazil nuts must be harvested from natural forests, so the industry provides a strong economic incentive to preserve these ecosystems. However, the volatility in market prices undermines this potential. When prices are low or too volatile, producers may be less motivated to maintain their concessions or potential producers may be less incentivized to enter the industry. Consequently, producers are more likely to partake in unsustainable practices such as illegal logging or gold mining, which are also large industries in the area and offer more immediate financial returns.

The lack of price stability may also

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complicate efforts to implement sustainable management practices. Without a reliable stream of income, it is more challenging to invest in sustainable techniques and comply with environmental regulations imposed on concessioners. By introducing a high degree of uncertainty, frequent price fluctuations can discourage this type of investment and possibly cause over-exploitation and degradation of forest resources.

Price volatility in the Brazil nut markets threatens the sustainability of the industry. With increased uncertainty, it is harder for producers to efficiently plan for the future. New Brazil nut trees take decades to mature and yield fruits. If prices frequently move up and down with no ability to foresee future trends, planting more trees or maintaining existing ones may seem like too risky of an investment.

The interviews also revealed that with prices for essential goods rising constantly, Brazil nut prices exacerbate the financial insecurity of Brazil nut concessioners. This can start a cycle where producers are unable to reinvest in their business, hindering long-term planning and productivity.

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