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Transmission of World Commodity Price Shocks in Benin
Case of the Cashew Nuts Sector

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TRANSMISSION OF WORLD COMMODITY PRICE SHOCKS IN BENIN: CASE OF THE CASHEW NUTS SECTOR

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Abstract

This study investigated the transmission of world price shocks in the cashew nut sector in Benin using a co-movement analysis on the cyclical components of prices and SVAR models. The results showed a negative correlation between the Benin cashew price and the world cashew supply. This finding suggests that supply shocks mainly drive fluctuations in cashew price in Benin. Demand shocks are evident, but their impact is less significant. The co-movement analysis between Vietnam's WW320 cashew price and Benin's cashew price revealed a positive correlation, indicating that fluctuations in the Vietnamese price are transmitted to the Beninese price. The Beninese price is more volatile, which supports the effect of shocks being more pronounced on the Beninese price. Applying a short-term sign restriction of 2 months, the SVAR model confirms the results of the co-movement analysis. In fact, using the impulse response function, we have seen that the price of cashew nuts in Benin is more volatile than the price of cashew nuts in Vietnam after any shock (demand or supply). The study contributed to a comprehensive understanding of the cashew industry's fluctuations and the response of Benin to shocks on the world price. This research has deepened our knowledge and laid the foundation for future research and policy considerations in commodity markets and their impact on national economies.

Keywords: Benin, Vietnam, cashew nuts, commodity, shocks, co-movement analysis

1 Context

Benin, as many developing countries, is classified as a commodity-dependent country according to the UNCTAD (2021b). The United Nations Conference on Trade and Development (UNCTAD) classifies commodity-dependent countries into three main categories, including dependence on agricultural product exports, dependence on fuel exports, and dependence on minerals, ore and metals exports. A country is classified as having a dependency on commodity exports when the proportion of its total merchandise exports made up of commodities exceeds 60% (UNCTAD, 2021b). A commodity can be defined as a primary product or good that is sold in its original state as found in nature (Glossary, n.d.). Commodities include raw materials like coal, crude oil, copper, iron ore, rough diamonds, and agricultural products such as wheat, cotton, and coffee beans. These goods are often traded on commodity exchanges, where their prices are influenced by global supply and demand forces. The Standard International Trade Classification (SITC) system categorizes commodities into five main groups[1], including food and live animals (SITC 0); beverages and tobacco (SITC 1); crude materials, excluding fuels (SITC 2); mineral fuels (SITC 3); and animal and vegetable oils, fats, and waxes (SITC 4). Commodities hold a crucial position in the economic decision-making of households, firms, and governments in both advanced and developing countries. They serve as primary inputs to produce consumer and industrial goods. Commodities not only serve as primary inputs to produce consumer and industrial goods, but they also serve as a source of income for several countries from the supply side (Houssa et al., 2022).

Benin is known for its agricultural sector, which plays a crucial role in its economy. Among the various agricultural products grown in Benin, cashew nuts are one of the most important and profitable crops. The cashew nut sector in Benin is a crucial component of the country's agricultural development plan. The National Program Document for the Development of the Cashew Nut Sector (PNDF-Anacarde) is an integral part of the Government Action Program (PAG) for 2016-2021 (Aoudji et al., 2021). The production of cashew nuts has been rapidly increasing in recent years, with the country being one of the largest producers of cashew nuts in Africa. In fact, according to the FAO statistics, Benin has produced nearly 8% of the total production of the continent in 2021 with 150.414 metric tons. This growth has significant implications for the country's economy, as well as for the farmers who rely on cashew production for their livelihoods. Cashew nuts are the second most important agricultural export

[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Commodity

of Benin, after cotton, generated over USD 48 million in revenue in 2021 (with approximately over 58.000 metric tons)[2]. It provides 3% of the Gross National Product (GNP) and 25% of agricultural export revenue (Fonds Africain de Dévelopement, 2019). However, like many other major cashew-producing countries in Africa, almost all cashews are exported as raw cashew nuts (RCN) to India or Vietnam for processing before being further distributed to end consumers (Venter, 2022). In fact, in-shell cashew nut represents nearly 98.6% of the Benin's total cashew nuts exports.[3] Considering Benin's in-shell cashew nut export partners, India (73.2%), Vietnam (14.8%) and United Arab Emirates (07.8%) account for 95.8% of Benin's in-shell cashew nut exports (Figure 1).

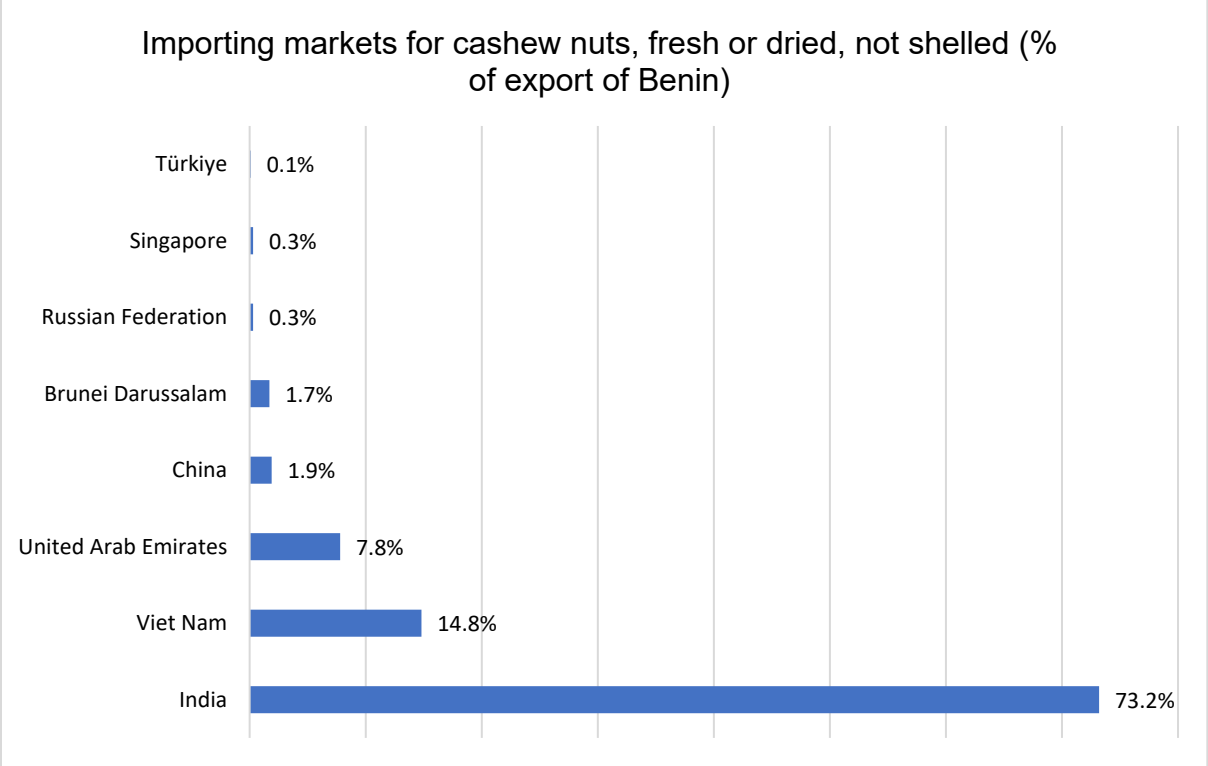

Figure 1: Importing markets for cashew nuts, fresh or dried, not shelled (% of export of Benin) in 2021
Source: Based on data from ITC TRADEMAP

Considering the shelled cashew nuts, which represents less than 2% of the total exports of the cashew nuts exports, Viet Nam (60.6%), Türkiye (12.6%), United States of America (11.8%), South Africa (05.3%) and Kazakhstan (04.0%) purchase 94.3% of the shelled cashew nuts exported by Benin in 2021 (Figure 2).

[2] Including both cashew nuts, fresh or dried, whether or not shelled or peeled
[3] Statistiques du commerce pour le développement international des entreprises (https://www.trademap.org)

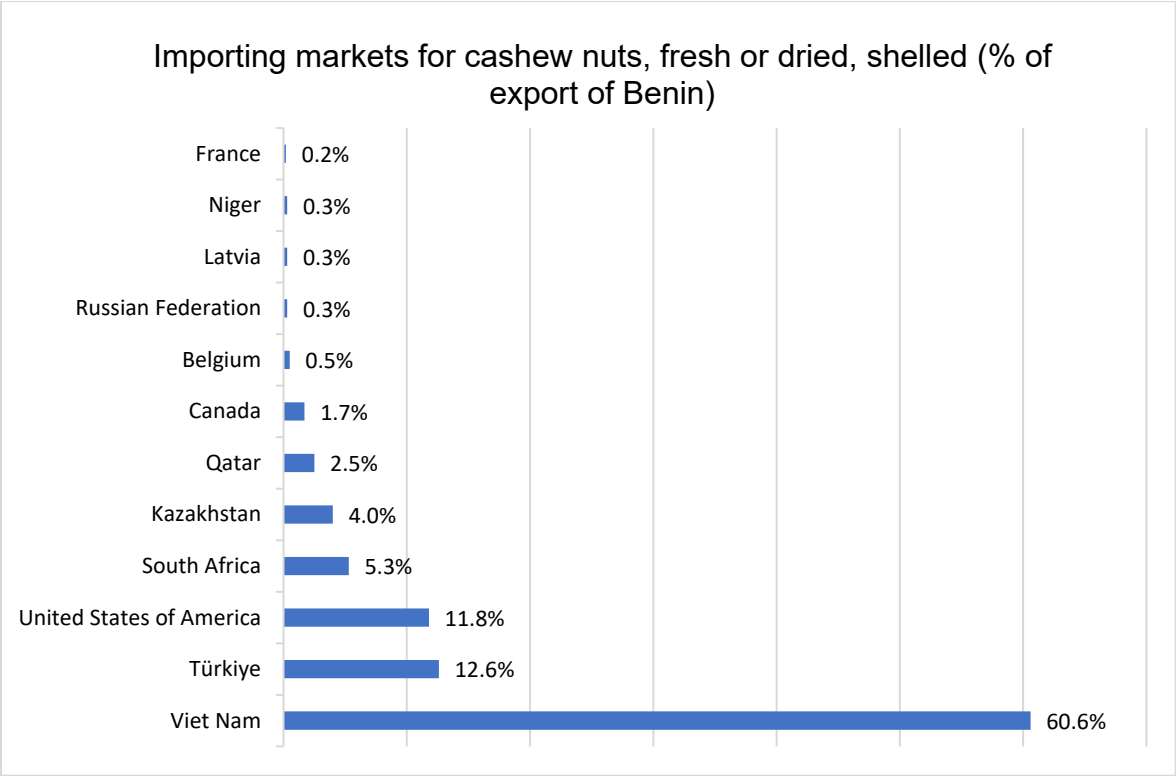

Figure 2: Importing markets for cashew nuts, fresh or dried, shelled (% of export of Benin) in 2021
Source: Based on data from ITC TRADEMAP

One of the main threats facing producers in developing countries is a sudden drop in international prices of basic agricultural products (Subervie, 2007). In fact, a significant portion of the income of small-scale producers of export-oriented agricultural products is dependent on world market prices (Subervie, 2007). Also, small-scale producers often lack effective insurance mechanisms and means to cope with significant drops in income, which increases their vulnerability (Subervie, 2007). Furthermore, if these prices cannot be predicted, decisions related to production cannot be made efficiently (Hazell et al., 1990; Subervie, 2007). As previously shown, Benin export 98% of its cashew production as raw cashew nuts. Any significant price shocks in the price of cashew nuts can have significant impacts on Benin's cashew industry, especially on producers.

This study aims to investigate the transmission of world price of cashew nuts shocks in Benin's cashew sector. Our objective is to analyze the effect of changes in cashew world price in Benin price and the mechanisms at play. We employ a co-movement analysis and Structural Vector Auto-Regressive (SVAR) model to identify the shocks and their impact on Benin.

2 Background

The cashew tree, *Anacardium occidentale L.*, is an evergreen plant that is originated from Brazil and belongs to the *Anacardiaceae* family. Initially, it was planted to prevent soil erosion in coastal areas due to its fast growth, tolerance to salt, and ability to thrive in sandy soils (UNCTAD, 2021a). Nowadays, the main purpose of cashew trees is to produce cashew nuts, which is done in countries across Africa, Asia, Latin America, and the Caribbean. These trees usually start bearing fruit three years after planting and reach peak yields after seven or eight years, with a lifespan of 20 to 25 years before yield declines (UNCTAD, 2021a). The cashew nut, which is the tree's true fruit, grows at the bottom of a swollen stalk called a cashew apple. The kernel, commonly known as the cashew nut, is protected by a thin skin and a thicker outer shell that contains an acidic oil called cashew nutshell liquid (CNSL), which is an important by-product with various applications.

The production of cashew nuts in Benin has a long history dating back to the 1960s, when cashew trees were first introduced to the country. However, it wasn't until the 1990s that cashew production began to significantly increase, driven by the government's efforts to diversify the country's economy and promote cashew cultivation as a means of poverty reduction.

Based on the products and their markets, four different value chains of cashew products in Benin can be identified. These are the value chain of: "raw cashew nuts for export", "raw cashew kernels for export", "roasted cashew kernels for the local market" and "cashew apple juice for the local market" (Gbaguidi, 2020).

The cashew value chain in Benin is made up of various direct and indirect actors. The direct actors include input (including agricultural equipment) suppliers, nursery operators, producers, individual collectors, semi-wholesalers and wholesalers, processors, and exporters.

- Input and agricultural equipment suppliers are individuals or formal/informal companies selling phytosanitary products, jute bags, packaging, weighing scales, and agricultural equipment.
- Nursery operators are limited in number and can be either formal (selected and trained by the state through PROCAD) or informal.
- Producers are the largest group of actors in the value chain. They are small farmers who use traditional methods of cashew cultivation due to limited resources. The national umbrella organization for cashew producers is FENAPAB, with village cooperatives organized into UCPA, and regional unions into URPA.

- Individual collectors directly purchase raw cashew nuts from producers and are active in primary marketing by purchasing small quantities of nuts and aggregating them for direct buyers with whom they have established relationships.
- Semi-wholesale and wholesale buyers act as intermediaries between individual collectors and Beninese exporters. They often operate informally and may also buy other tropical agricultural products for Indian and Pakistani expatriate traders and other tropical agricultural product exporters.
- Processors are individuals, associations, cooperatives, or companies engaged in cashew processing, including raw nut processors producing high-quality roasted and white nuts for export, roasted nuts for the local market, and processors of cashew apple into juice, alcohol, vinegar, and other derivative products.
- Exporters are Beninese and foreign companies (mostly Indian and Lebanese) that work on behalf of international traders (Indian and Vietnamese). Beninese exporters often deliver cashews to Indian and Vietnamese importers at the port of Cotonou, who handle customs formalities and international transportation. The national umbrella organization for Beninese exporters is the National Cashew Exporters Council (CONEC).

Concerning the indirect actors, their include the government and its institutions, institutions such as Chambre de Commerce et d'Industrie du Bénin (CCIB), local authorities, technical and financial partners (TFP), non-governmental organizations (NGOs) and other civil society organizations (CSOs), the private sector (employers' organizations), and agricultural professional organizations (Gbaguidi, 2020). The official cashew commercialization campaign typically in Benin spans from 15th March to 30th May or June.

According to the Programme National de Développement de la Filière Anacarde 2017-2021 (République du Bénin, 2017), the cashew tree thrives in regions with an annual rainfall ranging from 800 to 1,800 mm, occurring during a single rainy season lasting 5 to 7 months. It is sensitive to colder temperatures and prefers altitudes below 600 meters. Adequate sunlight and an average temperature between 12°C and 32°C are crucial for its optimal growth. Thanks to its fast-growing taproots, the cashew tree can adapt to various soil types, including nutrient-poor ones. It particularly favors loose, deep, sandy, or well-drained soils. As a result, cashew production in Benin is concentrated in the central regions and parts of the northern regions, where the climate and soil conditions are favorable for cashew cultivation. In Benin, cashew production is classified into four zones according to the climatic conditions and the presence of

cashew trees: highly favorable, favorable, less favorable, and marginal (as depicted in Figure 3). In 2016-2017, the 'highly favorable area' accounts for around 87% of the national orchard.

Since 2016, the government has adopted a new approach to agricultural development by creating seven Agricultural Development Poles (ADP) in different regions of the country, each dedicated to specific sectors based on agro-climatic characteristics and agricultural production traditions. The ADPs aim to better valorize local potential and to achieve the vision of a large-scale agriculture. Although cashew production takes place in several ADP, ADP 4 (that brings together the municipalities of the departments of Borgou, Collines, Donga, and the municipality of Djidja in the Zou department) is specifically dedicated to the cashew sector. All interventions in the cashew sector are coordinated by the ATDA of ADP 4, based in Parakou (Aoudji et al., 2021).

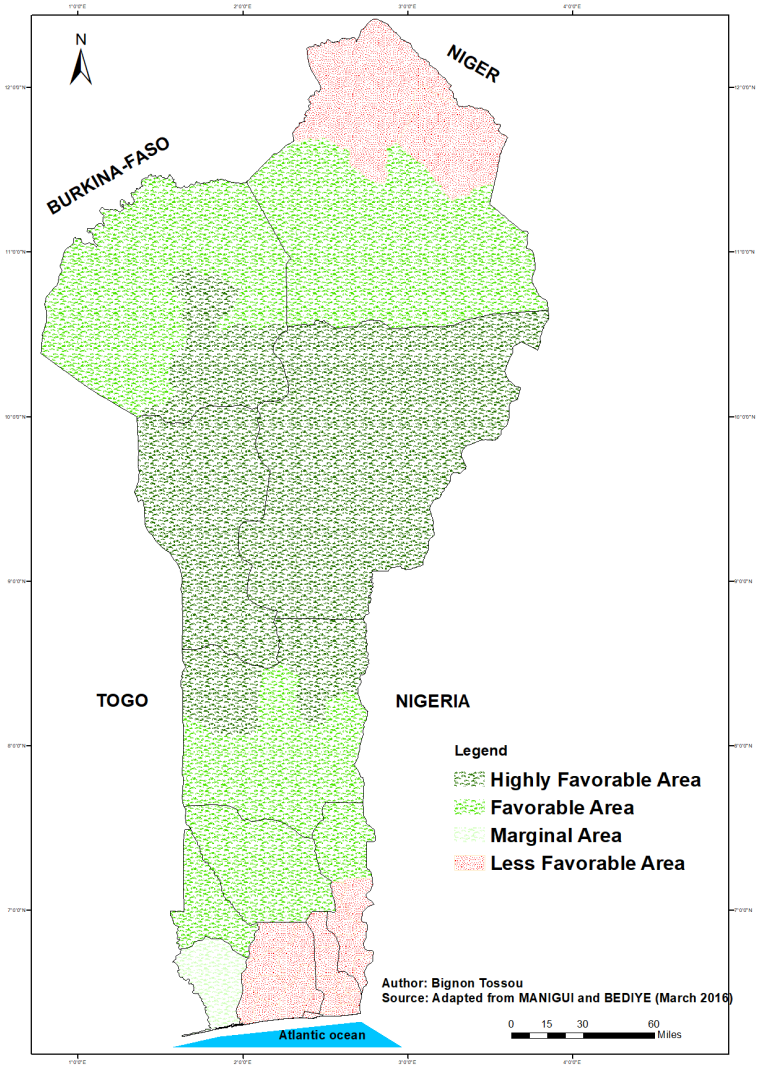

Figure 3: Benin's map with the cashew nuts production areas[4]

[4] Adapted from Programme National de Développement de la Filière Anacarde 2017-2021

The production of cashew nuts in Benin is dominated by smallholder farmers, who typically own less than five hectares of land and cultivate cashew trees as a cash crop alongside other subsistence crops. Cashew production has become an important source of income for many rural households in Benin, particularly in the northern regions of the country where poverty rates are highest (Fonds Africain de Développement, 2019). Cashew production in Benin has grown significantly (Figure 5), with a 276% increase between 2000 and 2021 and an annual growth rate of 6%. However, this growth is mainly due to an expansion of the area harvested rather than an improvement in yield. In fact, while the area harvested increased by 170% over the same period, from 185,000 ha in 2000 to 406,893 ha in 2021, the yield increased by 71% with an annual growth rate of 2%. It is worth noting that since 2012, the growth rate of yield has remained stable, indicating a strong correlation and dependence of production on the area harvested (see figure 4).

Figure 4: Growth rate of production, area harvested and yield (2000-2021)
Source: Based on data from FAOSTAT

Also, there are frequent fluctuations in the growth rate of production with notable declines observed in years 2010, 2012, 2016 and 2018. According to Adjovi and Yessouf (2020), the decline observed in 2016 is largely driven by the price of raw cashew nuts, which fell by 45.2% from 2015.

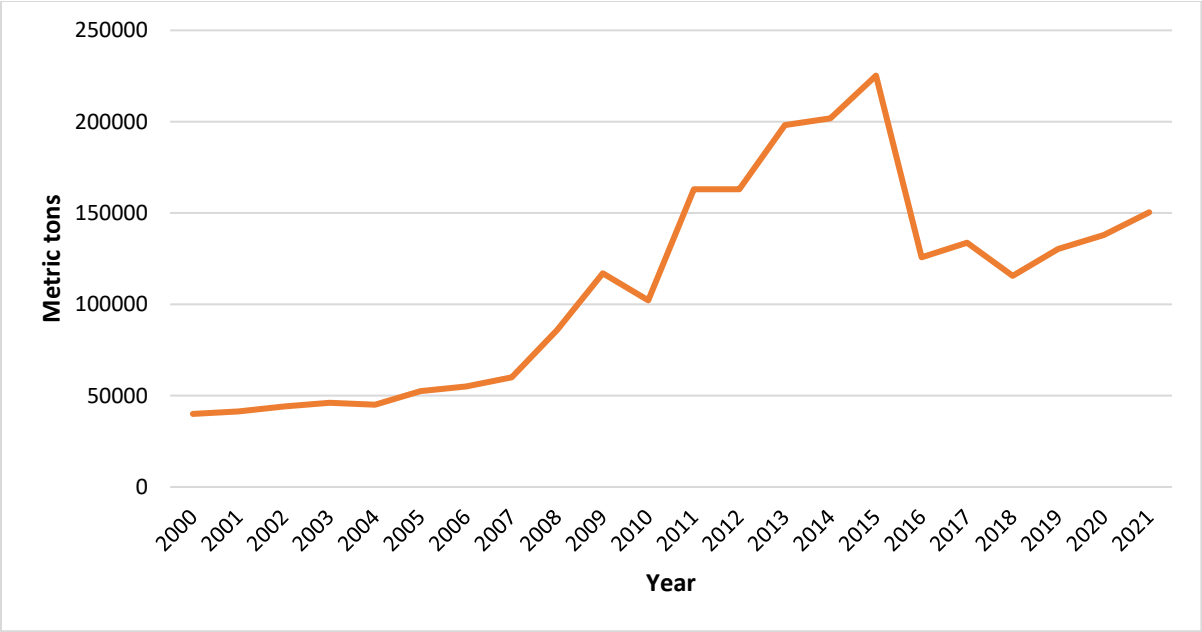

Figure 5: Evolution of production of cashew nuts in Benin (2000-2021)
Source: Based on data from FAOSTAT

Despite the significant growth in cashew production in Benin, the sector still faces several challenges. These include limited access to credit and technical assistance for smallholder farmers, inadequate infrastructure, and processing facilities (that can affect the quality of the cashew nuts), price volatility in international markets, and old trees that don't produce many cashews and are at risk of getting sick. The government of Benin and its partners (Enabel, GIZ, World Bank, USDA, Catholic Relief Service, African Development Bank, …) has implemented several policies and programs aimed at addressing these challenges, including the establishment of a cashew development fund, the promotion of private sector investment in processing facilities, and the provision of technical assistance and training to farmers. The government has a plan to address these challenges and make sure the cashew industry can continue to thrive. Along with government-led initiatives, multiple programs and projects have been established to improve yields and quality (Aoudji et al., 2021).

Looking to the future, the production of cashew nuts in Benin has significant potential for further growth and development. The country's favorable climate and soil conditions, combined with the increasing global demand for cashew nuts, provide opportunities for smallholder farmers to expand their production and income. However, achieving this growth will require continued investment in infrastructure, processing facilities, and technical assistance for farmers, as well as efforts to address challenges such as price volatility and climate change.

3 Theoretical framework

A small open economy (SOE) dynamic stochastic general equilibrium (DSGE) model is developed in the paper by Houssa et al. (2022) and describes three endogenous channels that capture spillovers from the global economy to a commodity exporter: a global commodity price channel, a domestic commodity supply channel, and a financial channel. Using Bayesian approaches, the model is calculated for two SOEs that export commodities, notably Canada and South Africa. The three channels in the model are important for understanding how external shocks can affect a commodity-exporting SOE. The world commodity price channel and the domestic commodity supply channel capture the impact of changes in commodity prices on the domestic economy. A favorable foreign aggregate demand shock can lead to an increase in the world commodity price, which can then affect the domestic economy through these channels. The financial channel captures the effects of changes in external financing conditions on the domestic economy. A favorable shock to foreign aggregate demand can lead to changes in external financing conditions, which can then affect the domestic economy through this channel. By opening up the three channels of foreign shocks, the authors are able to show how these channels can amplify the impact of foreign shocks and lead to stronger business cycle synchronization.

In our study, the primary emphasis is placed on investigating the world commodity channel transmission. This is achieved by examining the correlation between the global price, as exemplified by the cashew price in Vietnam, and the local price, represented by the cashew price in Benin. The methodology involves the utilization of both the Aggregate Demand-Aggregate Supply model framework and a Structural Vector Autoregression (SVAR) model.

3.1. Aggregate Demand- Aggregate Supply (AS-AD) model

The AD-AS model, which represents the aggregate demand-aggregate supply relationship, explains the interplay between price levels and output in macroeconomics. By analyzing the movements of these two curves, we can forecast the effects of external events on global supply (production) and price levels. According to the AD-AS model, when the fluctuation is primarily demand-related, both price levels and output will move in the same direction. On the other hand, if the dominant shock is supply-related, price levels and output will move in opposite directions. Positive supply shocks lead to increased output and lower prices, while negative supply shocks result in decreased output and higher prices.

3.2. Structural Vector Auto-Regressive Model (SVAR)

Sims (1980) introduced the structural vector autoregressive (VAR) technique as an alternative to the complex macro econometric models of the 1970s (Kotzé, n.d). This approach has become widely used in practical time series research due to its ability to include variables that occur simultaneously and to analyze the effects of individual shocks (Kotzé, n.d).

To establish the structural VAR model, specific limitations must be imposed on the model's parameters. Two common identification methods are short-run and long-run restrictions. The short-run restrictions were initially proposed by Sims (1986), while Blanchard and Quah (1989) introduced a technique for applying long-run restrictions (Kotzé, n.d).

Utilizing the Cholesky decomposition guarantees that the identified shocks from the VAR model will be both uncorrelated and distinctive (Kotzé, n.d). However, the particular method chosen for imposing these restrictions can influence the model's outcomes (Kotzé, n.d). Notable alternative restriction methods have been explored in Sims (1986) and Bernanke (1986).

The effects of a shock on the VAR model can be explored through an impulse response function. This function illustrates how a given structural shock influences a variable over time (Kotzé, n.d). Additionally, the forecast error variance decomposition allocates the forecast error variance to specific structural shocks at various time horizons (Kotzé, n.d).

4 Co-movement analysis

4.1. World (global) supply

Here, we analyze the global cashew nuts supply from 2000 to 2021, using monthly data that has been seasonally adjusted.

It is crucial to note that Africa plays a significant role in the global cashew industry, being the primary producer of Raw Cashew Nuts (RCNs). In fact, over the years, Africa has consistently been the backbone of the cashew industry, supplying a substantial portion of the world's RCNs (African Cashew Alliance, 2021). According to the statistics from FAOSTAT, Africa's production of RCNs grew by approximately 122%, increasing from 885,000 tons in 2000 to 1,970,000 tons in 2021, accounting for 53% of the world's production (Figure 6).

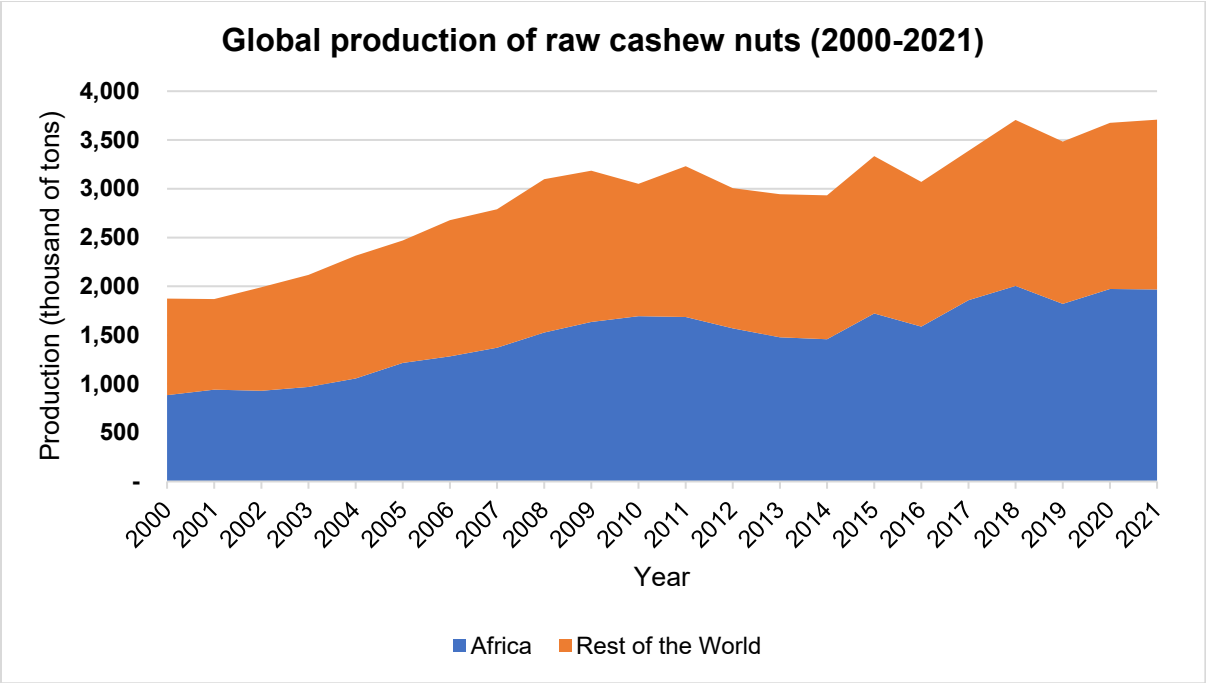

Figure 6: World production of raw cashew nuts from 2000 to 2021
Source: Based on data from FAOSTAT, 2022

Within Africa, West Africa stands out as the largest RCN producer by producing roughly 4/5 of the continent's overall production as shown in the Figure 7 (FAOSTAT, 2021). Countries such as Ivory Coast, Benin, Nigeria, Ghana, among others, contribute significantly to this production (FAOSTAT, 2021; African Cashew Alliance, 2021).

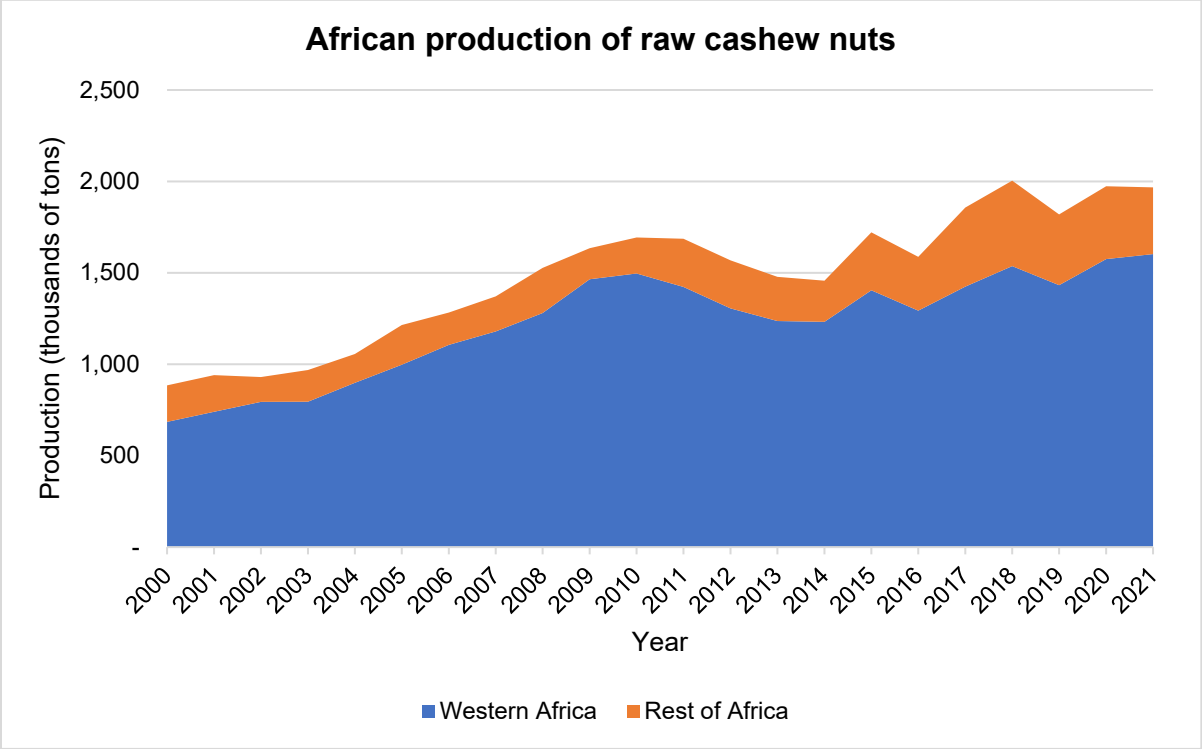

Figure 7: Africa's cashew production from 2000 to 2021
Source: Based on data from FAOSTAT, 2022

While Africa is a major producer, Asia takes on the role of a major processor, and Europe and the United States are the primary consumers of cashew products (African Cashew Alliance, 2021).

The rapid growth of cashew production (98% over the period 2000-2021) is fueled by the increasing consumption of cashew nuts worldwide (Boafo and Lyons, 2021). The rising demand for cashew nuts can be attributed to several factors, particularly in developed and emerging economies. Firstly, there is a growing awareness of the health and nutritional benefits associated with cashew nuts, leading to their increased popularity among health-conscious consumers. Additionally, the surge in plant-based diets has contributed to the growing preference for cashew nuts as a versatile and nutritious alternative to traditional snacks (Boafo and Lyons, 2021).

Moreover, cashew nuts are considered a suitable substitute for dairy products, catering to the needs of lactose-intolerant individuals or those seeking dairy-free options. Furthermore, they have become a popular savory snack choice, appealing to a wide range of consumers. Additionally, cashew nuts have emerged as a viable alternative to the ever-popular peanut butter, widening their usage in various culinary applications (Boafo and Lyons, 2021).

To analyze the data, the Hodrick-Prescott (HP) Filter function in Matlab has been employed to identify the cyclical components from the trend. This method helps in separating the cyclical fluctuations from the overall trend in the global cashew nuts supply data, providing us with valuable insights. After the seasonal adjustment, the data are converted in real terms using the consumer price index (CPI)

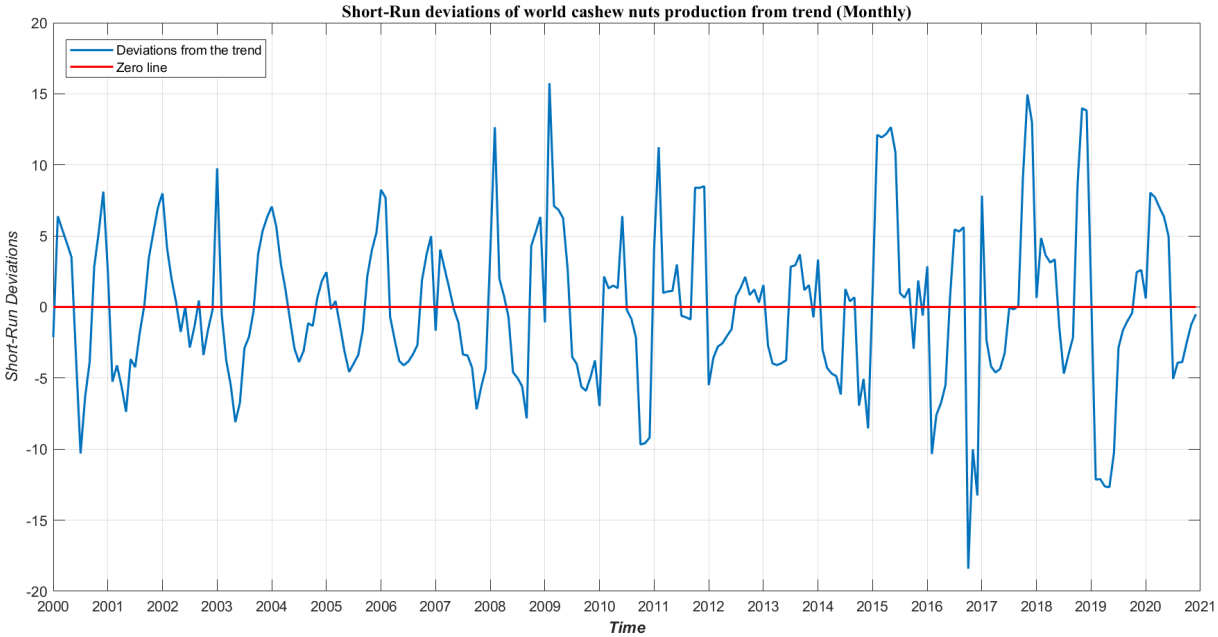

Figure 8: Short-run deviations of world cashew nuts supply from the trend (monthly data)

The deviations from the trend in the global cashew nuts supply from 2000 to 2021 demonstrate significant fluctuations with notable peaks and troughs (Figure 8). These peaks and troughs indicate periods of significant deviation from the overall trend.

The important peaks in the global cashew nuts supply, where the supply significantly exceeds the trend, are observed at the following time points: January 2003, February 2008, February 2009, February 2011, Half of 2015 (from February to June), End of 2017 (November & December), and the End of 2018 (November & December). On the other hand, there are important negative deviations, where the supply significantly falls below the trend, observed at the following time points: July 2000, End of 2010 (from October to December), End of 2016 (from October to December), and Half of 2019 (from February to June).

Despite the absence of a clear pattern, it seems there are times when the deviation values tend to increase or decrease over several consecutive months, suggesting some short-term momentum or autocorrelation. In general, positive deviations occur during months where most countries are harvesting cashews (Figure 9). However, in 2019, this pattern was disrupted and it has to do with pandemic situation the world went through. According to the African Cashew Alliance (2021), the Covid-19 pandemic amplified existing challenges in the global cashew industry, due largely to its dependence on single-origin supply chains and unreliable market information systems. The Covid-19 pandemic has affected the cashew industry on both the demand and supply sides. On the one hand, demand for raw cashew nuts declined since it was predicted a global decline in cashew consumption based on the impacts of the pandemic on the Indian and Chinese markets. On the other hand, movement restrictions and border closures made cashew exports from Africa difficult (African Cashew Alliance, 2021).

Also, the negative deviations observed at the end of 2016 in the global cashew nuts supply can be attributed to adverse weather conditions that affected cashew-producing countries during the 2016-2017 harvest season. According to reports from cashew nuts producing countries, there was a poor harvest season for raw cashew nuts during that period (Kodgav, 2021).

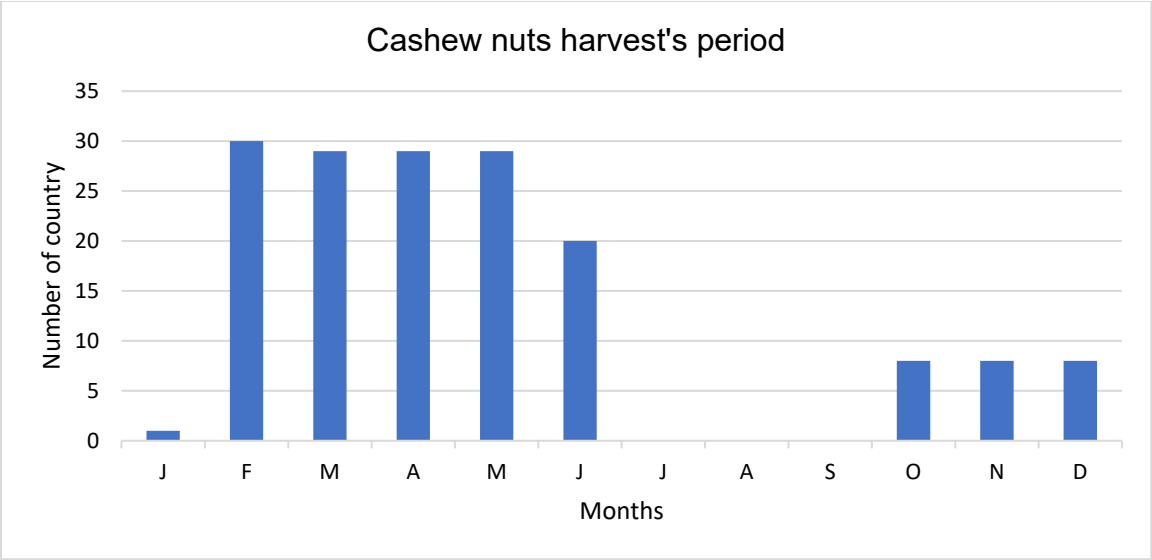

Figure 9: Cashew nut harvesting season in the main producing countries

The global cashew trade is closely tied to the annual cashew production cycle. Any disruptions such as low yields or adverse weather conditions can significantly impact the trade dynamics, leading to fluctuations in prices (Red River Foods, 2011). The sequence of cashew production starts with Vietnam, followed by India. Around the same time, West African countries also harvest their cashew crops. Later in August/September, Brazil and East African countries begin their harvests, bridging the trade gap until the new crops from Vietnam, India, and West Africa are ready for harvest early in the following year (Red River Foods, 2011). The share of these regions in the world supply is depicted on the Figure 10.

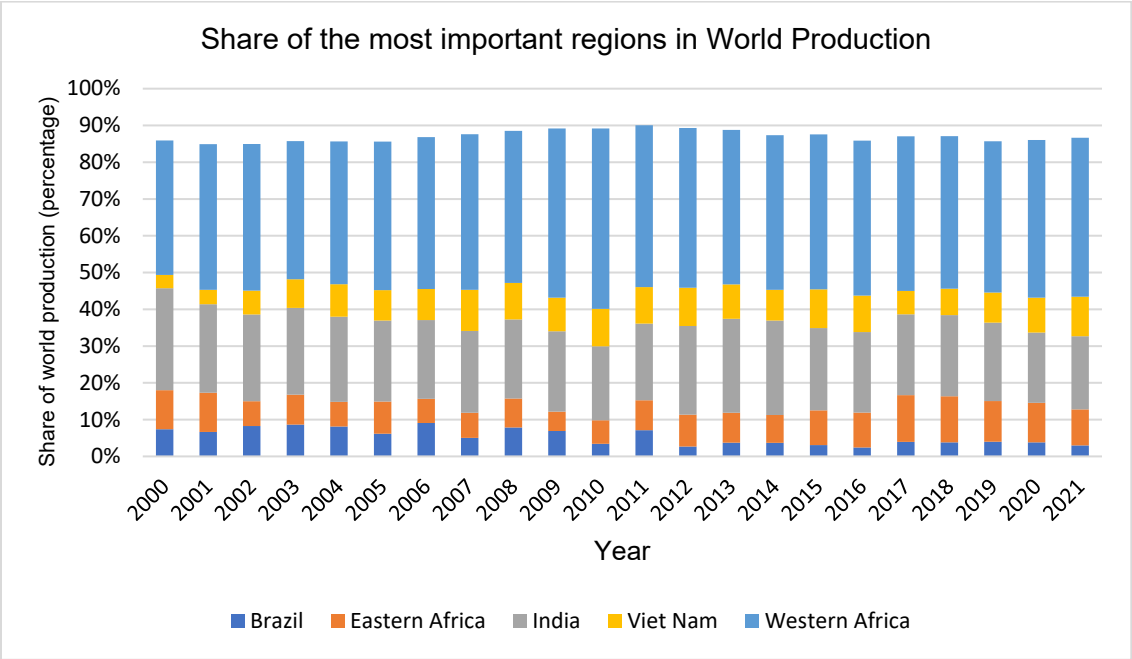

Figure 10: Share of the most important regions of cashew production
Source: Based on data from FAOSTAT, 2022

4.2. Monthly Prices series

As for the cashew supply series, we conducted an analysis on cashew prices. Our focus is on Vietnam prices (since Vietnam is one of the main exporters of processed cashew nuts and also the main importers of cashew nuts shelled from Benin) and Benin cashew kernel prices.

For the Vietnamese prices, we specifically examined the WW320 grade of cashew nuts. The dataset covers monthly data from January 2016 to August 2022 and has undergone seasonal adjustment to remove any seasonal patterns.

For Benin cashew kernel price, the dataset covers monthly data from August 2013 to June 2023 and has also undergone seasonal adjustment.

After the seasonal adjustment, we convert both prices into real terms by using the United States Consumer Price Index (CPI).

The primary objective of our analysis was to identify the cyclical components from the overall trend in the data. To achieve this, we utilized the Hodrick-Prescott (HP) Filter function in Matlab.

4.2.1. Vietnam price of WW320 cashew grade and global supply

Cashew nut w320 grade, also referred to as White Whole Cashew 320, is a high-quality and popular whole cashew. It is known internationally as Standard Large Nuts and is characterized by its regular size, non-damaged, and non-split appearance. On average, it produces between 300 to 320 pieces per pound (about 660 to 706 pieces per kg). These cashews have a delightful nutty flavor and a rich taste, making them ideal for use in various recipes such as salted cashew nuts, honey cashews, salt-roasted cashews, chili garlic cashews, and wasabi cashews. Additionally, they can be processed in various ways, including salting, sugaring, flavoring, roasting, oil frying, or used in industrial processing to make cashew cheese or cashew butter (Kimmy Farm, 2020).

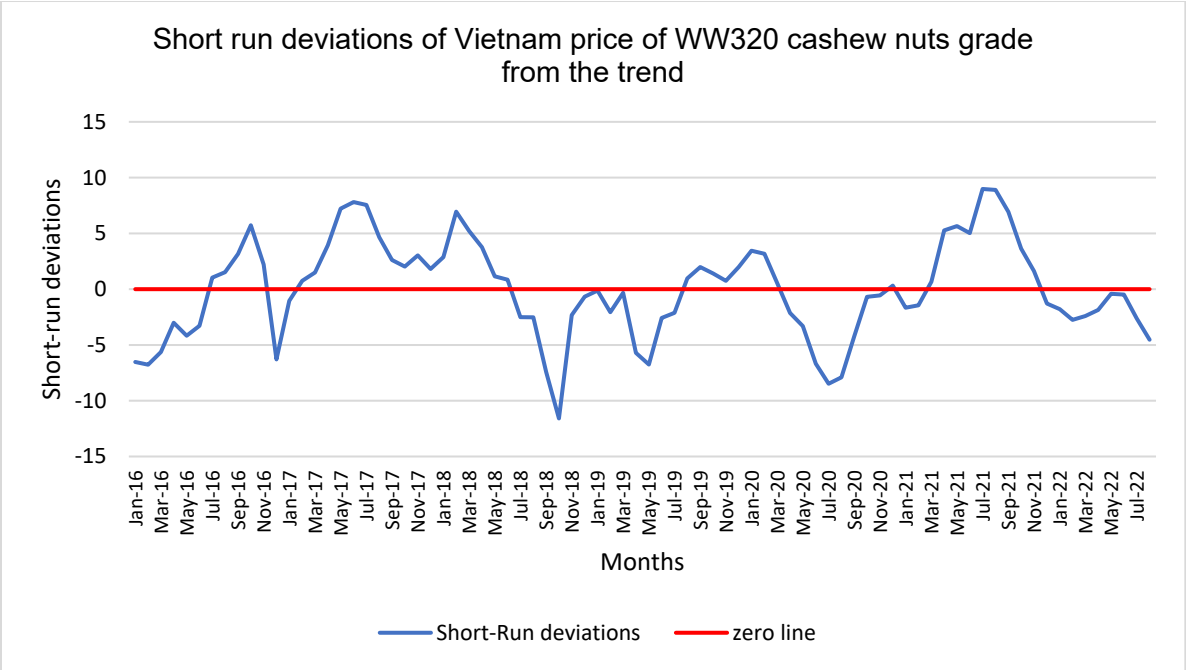

Figure 11: Short-run deviations of Vietnam price of WW320 cashew nuts grade from the trend (monthly data)

The price of cashew nuts has displayed significant fluctuations, as depicted in Figure 11. During the period of 2016-2017 (except for February and December 2016), the price exhibited a positive trend with mostly positive deviations. This can be attributed to several factors, including a poor harvest season for raw cashews nuts in producing countries and a 6.1% increase in demand mostly from Europe and the United States compared to the previous year (Kodgav, 2021). As a result, there was a surge in demand and a decrease in supply, leading to spikes in prices.

In contrast, 2018 witnessed an exceptional milestone in the world's cashew production, thanks to favorable harvests in Tanzania, India, and Ivory Coast (African Cashew Alliance, 2018). The abundant supply (approximately 4 million tons, 10% up in comparison to the previous year) on the market caused a drop in prices, with the lowest point of deviations observed in October, reaching -11.59. The prices then returned to the trend level for around three months in early 2019 before experiencing a sharp decline in mid-2019 due to oversupply in international markets (UNCTAD, 2021a). In fact, uncertainty and fear led to a sharp drop in cashew prices (African Cashew Alliance, 2021). As we explained earlier, demand for raw cashew nuts declined since it was expected a decline in cashew consumption based on the impacts of the pandemic on the Indian and Chinese markets (African Cashew Alliance, 2021). The price increased after a while in 2019 when border closures and shipment difficulties from Africa reduced supply.

However, the situation changed in 2020, and prices dropped due to oversupply resulting from the remaining 2019 production (due to difficulties of shipment and tightening demand) and the production of 2020.

A notable shift occurred from mid-2021, with mainly positive deviations observed. The growing demand for cashew kernels, especially in Europe and America, can explain this trend (African Cashew Alliance, 2021). However, by the end of 2021, the deviations returned to relatively low and negative values, indicating a stabilization period, with prices moving closer to the long-term trend.

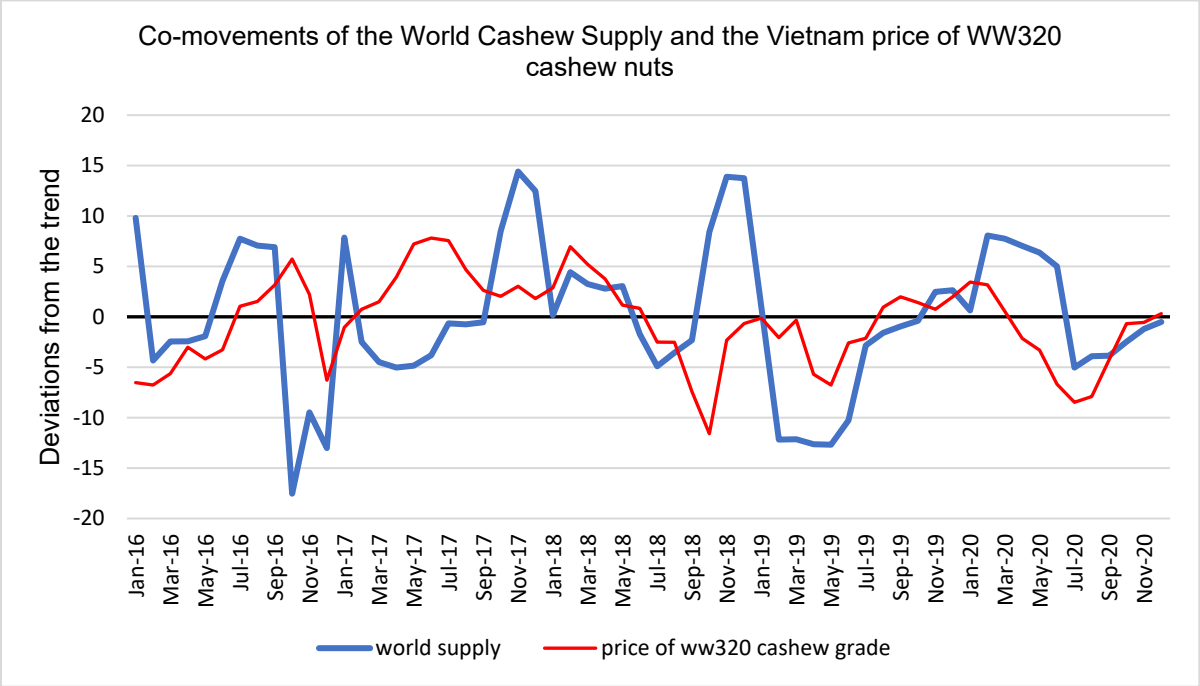

Figure 12: Co-movements of the World Cashew Supply and the Vietnam price of WW320 cashew nuts

Figure 12 represents the co-movement of the cyclical components of the global cashew nuts supply and the Vietnam price of WW320 cashew nuts grade. With some exceptions (2017, End of 2018 -from September to December-, and 2020) we observe that deviation from the trend in the global cashew supply and the Vietnam WW320 cashew prices move towards the same direction i.e., both having positive or negative deviation at the same period. We can say that most of the time, the variables have a positive co-movement.

In terms of Volatility, we observe amplitudes with higher lengths on average in the deviations of global cashew supply than deviations in the prices, suggesting that the global cashew supply is more volatile than the Vietnam WW320 cashew price.

Finally, with few exceptions, we observe that in most cases the turning points of the global cashew nuts supply come first and are followed by the turning points of prices. From this, we

conclude that the global cashew nuts supply is a leading variable and can be used to predict Vietnam cashew WW320 prices.

To Support our graphical analysis, we carried out a numerical analysis of data using the cross-correlation coefficient and the p-values (table 1). Let's denote the variable global supply Xt and the Vietnam WW320 cashew price Yt. Although most cross-correlation coefficients are statistically non-significant, they are positive (except for the WW320 price delayed by 4 and the global supply). This confirms the graphically depicted observation and suggests that the variables are positively correlated with some exceptions. An analysis of the relationship between global cashew nuts supply and the Vietnam cashew WW320 prices, both contemporaneous and lagging-leading, suggests that global cashew nuts supply is leading. In fact, the cross-correlation is significant only for the correlation coefficient between contemporaneous Vietnam cashew WW320 price and lagged global cashew nuts supply. This result is consistent with the intuition of the graphical analysis.

Table 1: Correlation coefficients between global supply and WW320 price

Variables	**Lag (k)**				
	0	**1**	**2**	**3**	**4**
Global supply (Xt; Yt-k)	0.103 (0.432)	0.166 (0.209)	0.178 (0.181)	0.039 (0.771)	-0.151 (0.266)
WW320 price (Yt; Xt-k)	0.103 (0.432)	0.004 (0.975)	-0.002 (0.987)	0.099 (0.464)	0.242* (0.072)

( ): p-value
*** significance at 1% threshold; ** significance at 5% threshold; * significance at 10% threshold.

Through co-movement analysis, one can examine and discuss the dominant shocks responsible for driving economic cycles. According to the AS-AD model, the co-movement analysis between global cashew nuts supply and Vietnam cashew WW320 prices, have led to the conclusion that demand-related shocks play a crucial role in the world cashew market.

However, as we noticed, supply-related shocks have had a significant impact on the cashew nut prices during some periods. For example, in 2016-2017, the supply was limited due to a poor harvest season (Kodgav, 2021). This negative supply shock caused the price to increase because there weren't enough cashews available, and as a result, the quantity supplied decreased.
Similarly, towards the end of 2018, there was an abundance of cashews on the market due to favorable harvests in Tanzania, India, and Ivory Coast (African Cashew Alliance, 2018). This surplus in supply caused the price to drop as there were more cashews nuts available for the demand.

4.2.2. Benin price of cashew kernel and global supply

Analyzing the prices of cashew kernels in major African producing countries, we noticed that their prices tend to change together. This is shown in Figure 13, where the prices follow a similar pattern and are quite close to each other. When we took into account the seasonal changes, we found that the price movements were also quite similar. This suggests that the insights we gained from analyzing the price patterns in Benin can be applied to all these countries.

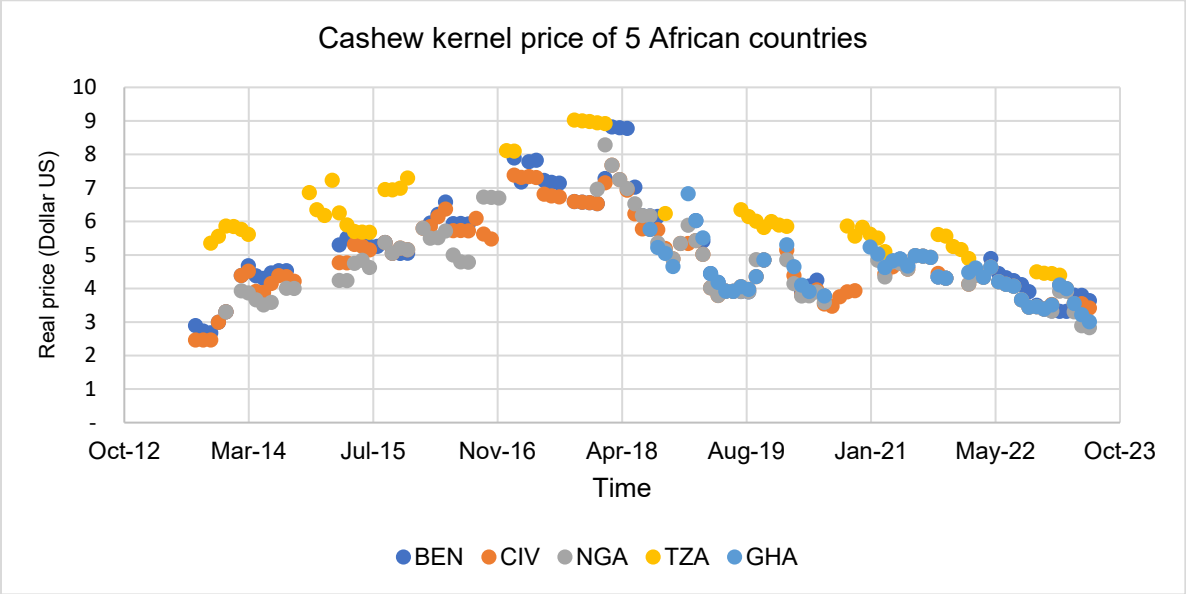

Figure 13: Cashew kernel real price of Benin, Ivory Coast, Nigeria, Tanzania and Ghana

Figure 14 below illustrates the fluctuations in cashew kernel prices in Benin over time. While the prices mostly move close to the trend, there are notable months where they experienced significant peaks and troughs.

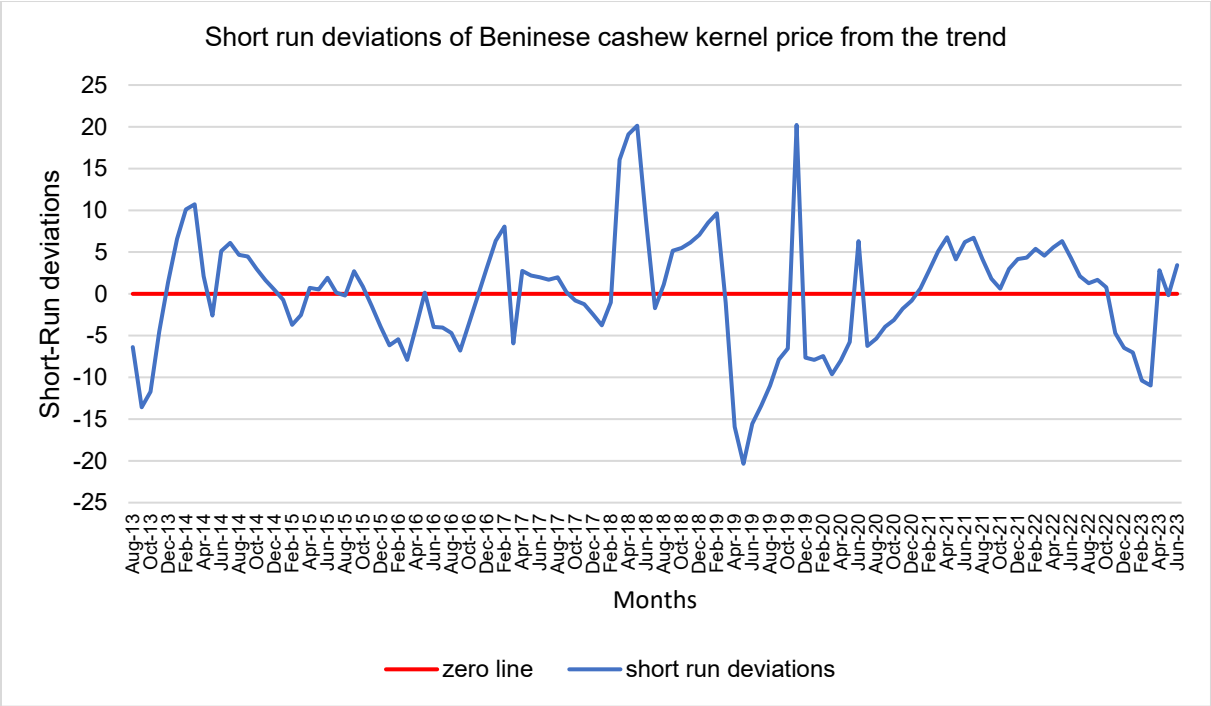

Figure 14: Short-run deviations of Benin cashew kernel price from the trend (monthly data)

The times when prices went significantly higher than expected were in February and March of 2014, during March to May of 2018, and in February and November of 2019. On the other hand, there were times when prices dropped notably below the expected trend. This occurred at the end of 2013 (specifically in September and October), most of the times in 2019 (except February and November), in March 2020, and at the beginning of 2023 (in February and March).

In the early years of 2014 and 2015, there was a noticeable trend characterized by minimal price differences between raw cashew materials and processed cashew kernels, as documented by the African Cashew Alliance and N'kalô (2016). This period was marked by intense competition between exporters and local processing plants in Africa, along with rivalries between India and Vietnam in securing raw cashew nuts from African suppliers (Krishnakumar, 2015). These factors could be some explanations of the higher prices observed in those periods.

Another explanation could be the rebound in global demand following a downturn in 2012-13 (Krishnakumar, 2015). The decrease in prices towards the end of 2013 can be attributed to that decrease in global demand as well.

In 2018, despite worldwide cashew production reaching record levels, Benin faced a significant drop of 14% in its cashew nut production compared to the previous year, as indicated by FAOSTAT statistics. This scarcity in supply could effectively explain the elevated prices of cashew kernels from Benin during that year.

Similarly, as seen in the case of Vietnamese prices, the outbreak of the Covid-19 pandemic, coupled with uncertain demand, led to a decrease in cashew kernel prices. Additionally, there was a notable decline in the prices of cashew kernels from Benin at the beginning of 2023. This could be attributed to the closure of the market for both Vietnamese and foreign traders, driven by a government policy that promotes localized processing of raw cashew nuts. Although this policy holds long-term benefits for the industry, it temporarily restricted competition and speculative activities that were previously observed.

The co-movement analysis with the global supply of cashew nuts, as shown in Figure 15 and detailed in Table 2, reveals a consistent pattern: the price evolution of cashew nuts in Benin and the global supply tend to be negatively correlated, with the former often acting as a leading indicator. When these findings are compared with the predictions of the AS-AD (Aggregate Supply-Aggregate Demand) model, a remarkable conclusion emerges: the dominant driving force behind the fluctuations is mainly due to supply shocks. Moreover, the data consistently show that price fluctuations are more pronounced and characterized by higher amplitudes.

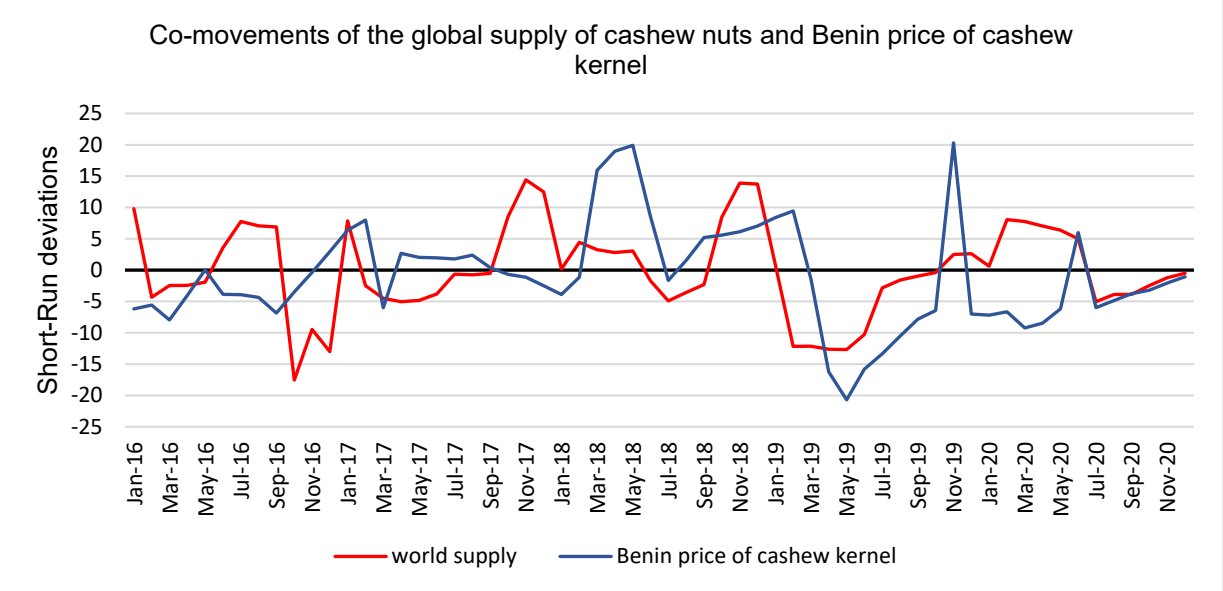

Figure 15: Co-movements of the global supply of cashew nuts and Benin price of cashew kernel

Table 2: Correlation coefficients between global supply and Benin price of cashew kernel

Variables	**Lag (k)**				
	0	**1**	**2**	**3**	**4**
Global supply (Xt; Yt-k)	-0.021 (0.873)	-0.284** (0.029)	-0.329** (0.012)	-0.265** (0.046)	-0.120 (0.379)
Benin price of cashew kernel (Yt; Xt-k)	-0.021 (0.873)	0.129 (0.329)	0.064 (0.632)	-0.136 (0.312)	-0.264** (0.049)

( ): p-value

*** significance at 1% threshold; ** significance at 5% threshold; * significance at 10% threshold.

4.2.3. Vietnam price of WW320 cashew grade and Benin price of cashew kernel

The objective of our analysis is to see how any shocks are transmitted to domestic markets. The co-movement analysis between the world price (represented by Vietnam price) and the domestic price (Benin kernel price) will give us better understanding. As we analyze graphically their movement (Figure 16) and with the numerical test (Table 3), we can conclude that the Vietnamese price is leading and both prices are moving in same direction (although there are some instances where the prices are negatively correlated, it seems not to be statistically significant according the numerical analysis). Benin price is more volatile, showing the higher deviations from the trend. From this analysis, we can see that variations in the world price are transmitted to Benin price and is sometimes harder on the Beninese price. Given that Benin accounts for a relatively modest share - around 4% - of total global cashew nut production, it assumes the role of a 'small country' within the market landscape. As a result, Benin acts as a price taker that is heavily influenced by prevailing market conditions, rather than having the ability to dictate prices on its own.

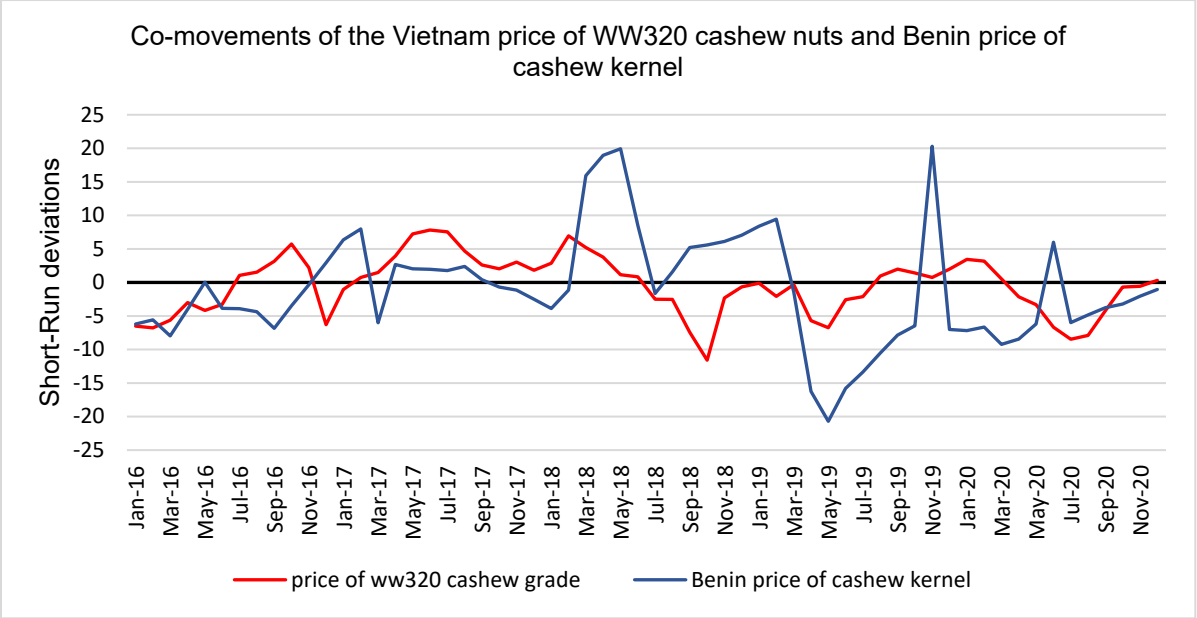

Figure 16: Co-movements of the Vietnam price of WW320 cashew nuts and Benin price of cashew kernel

Table 3: Correlation coefficients between WW320 price and Benin price of cashew kernel

Variables	Lag (k)				
	0	1	2	3	4
WW320 price (Xt; Yt-k)	0.076 (0.566)	-0.061 (0.645)	-0.223* (0.093)	-0.190 (0.157)	-0.106 (0.437)
Benin price of cashew kernel (Yt; Xt-k)	0.076 (0.566)	0.377*** (0.003)	0.610*** (0.000)	0.565*** (0.000)	0.354*** (0.007)

( ): p-value

*** significance at 1% threshold; ** significance at 5% threshold; * significance at 10% threshold.

5 SVAR model considering short-run sign restriction

To enhance the understanding of the applied AD-AS model through the co-movement analysis, we employ a Structural Vector Autoregression (SVAR) model. We fitted a 4-lag SVAR model, incorporating a constant and a time trend in our estimation. Our model follows a short-run sign restriction. For the restrictions, we set a maximum of 500 accepted draws. We set the restrictions on two months.

By doing the structural VAR with the short-run sign restrictions, we are trying to confirm the results of the co-movement analysis. With the results presented on the Figure 17, we can observe that supply shocks are more likely the one dominating in causing fluctuations. However, as shown already by the co-movement analysis, demand shocks had happened during some periods.

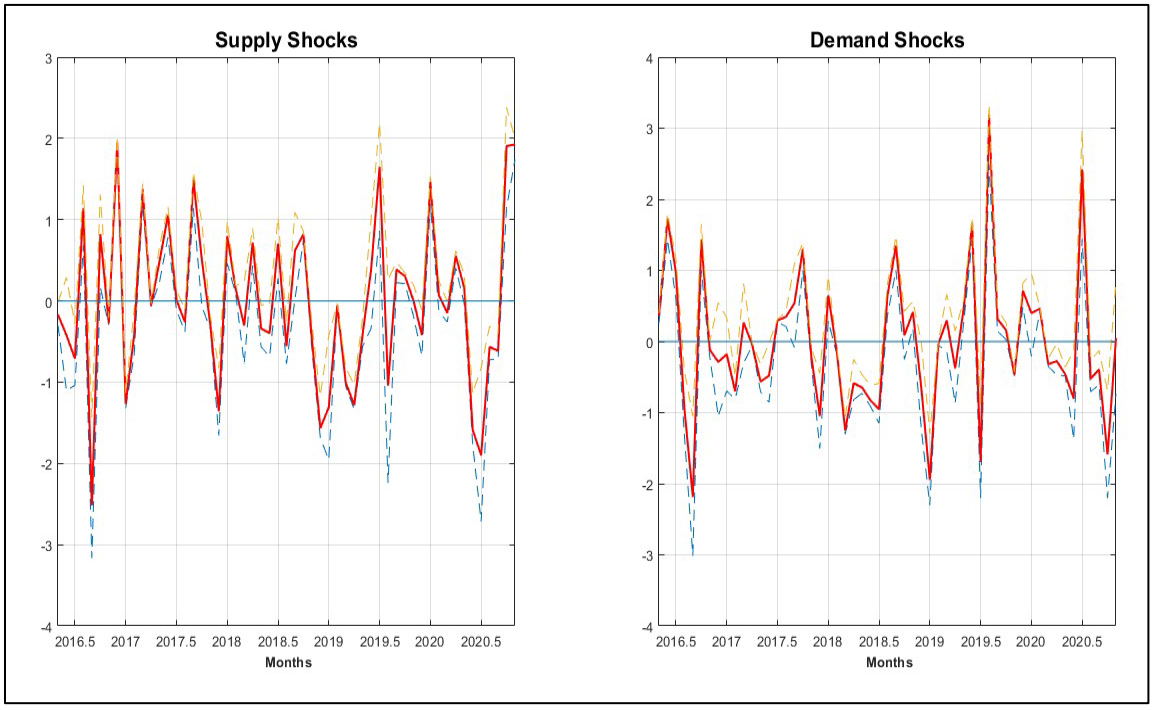

Figure 17: Estimated shocks for Benin (Short-Run restrictions)

Similarly, the SVAR model confirms what has been shown by the co-movement analysis. For Vietnam price, over the period studied, both shocks played a prominent role in causing fluctuations (Figure 18). For the co-movement analysis, only one coefficient was significant (even if it leads us to conclude that demand shocks, somewhat, dominated).

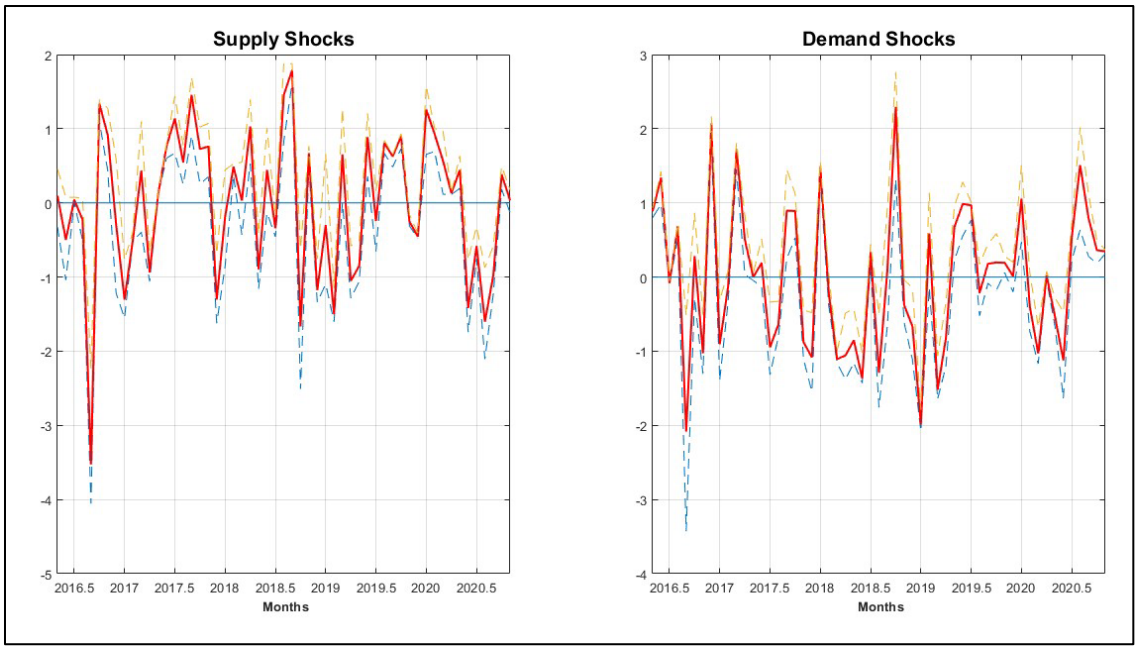

Figure 18: Estimated shocks for Vietnam (Short-run restrictions)

As depicted by the co-movement analysis, we observe here that any shocks (supply or demand) cause more fluctuations on the price of Benin than the Vietnamese one.

Figures 19 and 20 show the impulse response functions derived from the SVAR model. Sign restrictions have been imposed for a duration of two months. In both cases, Benin and Vietnam, it's clear that supply and demand shocks have the expected effects on the relevant variables: prices and cashew production (or supply). After the two-month period of imposed restrictions, prices and cashew nut supply diverge in response to a supply shock confirming the theory. Consistent with co-movement analysis, we observe that any type of shock, whether supply or demand, induces more pronounced fluctuations in cashew nut prices in Benin than in Vietnam.

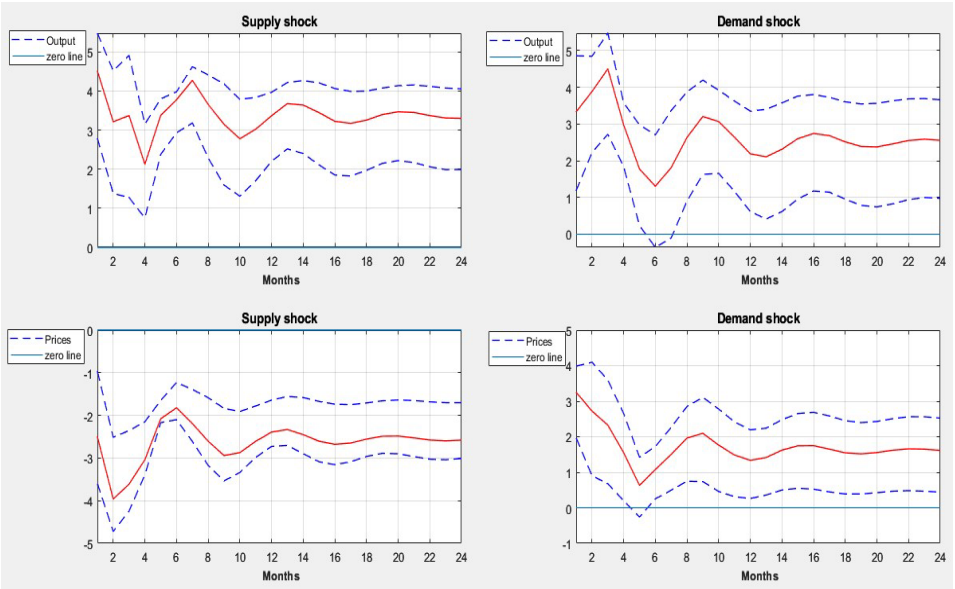

Figure 19: Response of output (cashew supply) and price (cashew kernel in Benin) to AD and AS shocks (short run sign restriction)

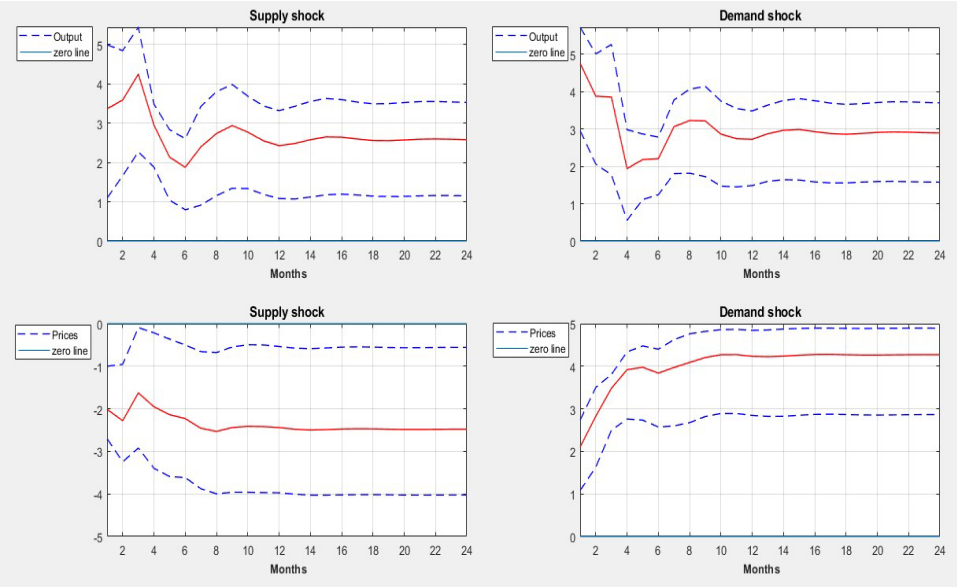

Figure 20: Response of output (cashew supply) and price (Vietnam price of WW320 cashew nuts grade) to AD and AS shocks (short run sign restriction)

6 Conclusion

This study examined the transmission of global commodity price shocks in the context of the cashew nut sector in Benin. Using analytical methods, including joint movement analysis and SVAR model analysis, we explored the dynamics between various crucial factors. Our investigation revealed that the behaviour of the almond price in Benin is closely linked to the global supply of cashew nuts. The negative correlation observed between the Benin price and the world cashew supply suggests that supply shocks mainly drive fluctuations in this sector. Although demand shocks are evident, their impact seems less significant by comparison. In addition, the co-movement analysis between the two prices - Vietnam's WW320 cashew price and Benin's grain price - highlighted their positive correlation and the leading variable nature of the Vietnamese price. This result highlights the fact that fluctuations in the Vietnamese price are transmitted to the Beninese price. The increased volatility of the Beninese price, which is in line with expected trends, proves that the effect of shocks is more pronounced when it comes to the Beninese price. To strengthen the validity of our results, we carried out an SVAR model analysis, applying short-term sign restrictions. To strengthen the validity of our results, we conducted a SVAR model analysis, applying short-run sign restrictions. This additional level of analysis validated the insights from the co-movement analysis, reinforcing the conclusions regarding the transmission of shocks from the world price to Benin price. In essence, this study has contributed to a comprehensive understanding of what has caused fluctuations in the cashew industry and how Benin price is reacting to shock on world price. The combination of analytical methods and empirical evidence has not only deepened our knowledge, but also laid the

foundation for future research and policy considerations in the area of commodity markets and their impact on national economies.

However, it is important to note that the conclusions of our study, although consistent with theory, are only valid for the period covered by the data used. Thus, an analysis with longer data could lead to different results (in particular with respect to the identification of shocks) or help to confirm the present results in a more robust way. Also, an analysis using a Vector Error Correction Model (VECM) could be an alternative to deepen the analyses to explore the elasticities and support the present results.

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