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Spillover effects between commodities and the Australian dollar

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Abstract

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The paper investigates the volatility spillover effects between commodities exported by Australia and the Australian dollar. These findings give better information about the transmissions of shocks between commodities and the Australian currency. We find that the spillover effects on the Australian dollar are more connected to herd behaviour than to export commodities. The research is carried out using a time-varying approach as per the methodology used by Diebold and Yilmaz (2009). We identify the commodities that transmit volatility to the currency but also the currencies that obtain volatility from Australian dollar. Further, we bring evidence that the AUD reacts more quickly to shocks than the commodities but over the longer term it obtains volatility from these commodities during periods of economic turbulence. The study provides specific investment recommendations for investors whose assets are held in AUD.

Key words

Spillovers, connectedness, commodities, exchange rates

JEL: C18, C58, F31, G15, Q02

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Introduction

The importance of the effects of the transmission of volatility were highlighted by the great financial crisis as the risk was spread over many countries. These effects rapidly increase during crises (Baruník et al., 2017; Grobys, 2015). The greater the global economic-policy shock, the more the markets are interconnected, and thus more asset classes are affected (Uluceviz and Yilmaz, 2018). However, shocks can also be connected to purely local factors or with some specific assets. There are several studies about the negative effect of oil price drops on the currencies of countries that export oil (Belasen and Demirer, 2019; Yin et al., 2022). The currencies of emerging economies are more affected by policy-shocks due to the vulnerable political situation of these regions.

In order to better view the effects of transmission, knowing the origins of these shocks, Diebold and Yilmaz (2009) created a methodology (DYCI). They started to measure the dynamic transmission of volatility from one asset to another using a time-varying approach. The method is based on forecast error decomposition using vector autoregressions. It is able to identify the origins of the volatility transmitted into the market and how it varied over time.

Amongst others, this connectedness over time has been identified within the forex markets (Antonakakis, 2012; Rajhans and Jain, 2015). The risk spills over into currencies as investors rebalance their portfolios (Camanho, 2020). Investors tend to rebalance their portfolios, held in domestic currencies, mainly as a response to an economic-policy shock in order to avoid a currency risk (Tran, 2019). Several studies have also identified connectedness between commodities (Nazlioglu, 2013; Xiarchos and Burnett, 2018; Yang et al., 2021). When oil price volatility increases, this volatility tends to be transmitted into gas prices (Krehlik and Baruník, 2017). Gold price volatility also tends to be transmitted to silver prices (Yang et al., 2021). Some papers have also studied the relationship between increased volatility on the commodity markets and their effect on currency volatility. They have found that these commodity volatility shocks play an important role in the management of currency risks (Ghosh, 2012). These volatility transmissions have mainly been identified in relation to "commodity currencies"[1] .

[1] These currencies export selected commodities and therefore they are narrowly connected with commodity cycles (Belasen and Demirer, 2019; Bork et al., 2022).

Australia is one of the countries whose commodities export make a significant contribution to their total level of exports. Therefore, the Australian dollar (AUD) is a currency that is affected by commodity cycles, along with other factors. But to the best of our knowledge, there have not been any studies that deal with the issue of volatility spillover between commodities and the AUD. A closer identification of which commodities transmitted volatility to the AUD and when it took place will improve our knowledge of the impact of commodity shocks on the volatility of the AUD. A better understanding of this issue helps investors who hold assets in AUD to manage their currency risk. Currency spillover not only affects diversification strategies (Kanas, 2000) but also option strategies (James et al., 2012).

In this paper, we make several contributions. First, we identify volatility transmission between the AUD and the commodities that are exported in the highest volumes by Australia. Secondly, we cover the COVID-19 period that included the biggest ever drop in the price of oil. Thirdly, and most importantly, we offer specific recommendations for investors and portfolio managers who hold their investments in AUD.

The structure of this paper is as follows. Section 2: a review of studies connected with the issue of volatility spillover. Section 3: a description of the methodology and data. Section 4: results, and Section 5: conclusions.

1 Literature review

The currencies of countries that export commodities are affected by changes in the prices of those commodities. When the commodity price of an exported commodity rises it also causes a rise in the export price. As exporters want to change the profits they make from the exports into domestic currency there is pressure on the currency to appreciate (RBA, 2022). However, this causal link can also operate in reverse. Commodity currencies are more liquid and are traded throughout the day, five days per week. An effect of this is that commodity currencies react to news more quickly and as the commodities are priced in these currencies, they also tend to react to changes in the exchange rates (Bork et al., 2022).

Among other currencies, the Australian dollar is also affected by commodity prices (Belasen and Demirer, 2019; Yin et al., 2022). The Australian economy exports many different commodities and thus there is an increased demand for Australian dollars when exporters want to exchange the currency of their profits (RBA, 2022). However, the traditional exchange channels could be affected during a period of increased uncertainty (Uluceviz and Yilmaz, 2018). When there are economic-policy shocks the traditional variables play a less important role in the valuation of currencies. Volatility increases as a consequence of an increase in risk aversion throughout the economy (Tran, 2019). This feeds into the models used to predict movements in the economy but as they are based on traditional economic variables their accuracy decreases (King, 1994) due to a change in the behaviour of investors (Pastor and Veronesi, 2012). Investors tend to sell the assets they consider to be exposed to the highest level of risk (Tran, 2019), plus the assets that they hold in currencies other than their primary currency (Camanho, 2020). During a time of economic turbulence there is also a decrease in the level of economic activity and that has negative impact on oil prices. However, at the same time gold is considered to be a safe haven during economic-policy shocks (Yin et al., 2022).

Economic turbulence and the rebalancing of portfolios increases the volatility of assets (Wu, 2001) that spills over into other countries (Adrian and Brunnermeier, 2009). This leads to an increase in the degree of connectedness between assets and countries. This was confirmed by Chang et al. (2021), they identified an increase in volatility spillover in nine major currencies, from 2008 to 2015, mainly in connection with economic policy shocks. Negative shocks generate higher spillover effects (Segal et al. 2015). This was also confirmed by Barunik et al. (2017) in their study. They found that the volatility spillover between six major currencies, from 2007 to 2015, was greater for negative shocks. As they stated, negative spillover is mainly tied to fiscal factors and positive spillover is more often impacted by monetary factors. Bartsch (2019) states that this asymmetrical volatility phenomenon is mainly driven by fear. The study used GARCH models that included the monthly economic policy uncertainty indices of the UK and US and studied their impact on exchange rate volatility.

Connectedness between assets has been the subject of several studies (Diebold and Yilmaz, 2009; Ghosh, 2012; Rajhans and Jain, 2015). Uluceviz and Yilmaz (2020) studied real financial connectedness between variables in the Swiss economy including the exchange rate, the real activity index and the KOF-barometer, but also stocks and bonds. They found that the EUR-CHF exchange rate played an important role, particularly during the great financial crisis, but also in 2015. Diebold and Yilmaz (2009) found significant volatility transmission between bonds, stocks and currencies relating to nineteen countries in the period of 1992 to 2007. Rajhans and Jain (2015) also provided some important evidence regarding the AUD. They found that the AUD-USD exchange rate becomes more volatile when there are global shocks.

Several studies have been carried out into connectedness between volatility and commodity markets. According to Nazlioglu (2013) oil volatility impacts the volatility of agronomical commodities, mostly during the period after the crisis. Xiarchos and Burnett (2018) have studied the relationship between the price volatility of Crude oil, Corn and Ethanol from 1997 until 2014. They found that crude oil price volatility impacted the futures prices of Corn, but that it was also connected to seasonality. Krehlik and Barunik (2017) identified important volatility spillover between oil and gasoline with a response time of less than a week.

The have been less studies into the relationship between the volatility of commodities and the volatility of currencies. Ghosh (2012) found that oil price volatility led to volatility in the Indian currency for the period from 2003 to 2012. A closer study of these effects is very important for investors as currency volatility increases the risk to portfolios that are held in that currency. Through this mechanism hedging strategies are affected (James et al., 2012) along with the diversification of portfolios (Kanas, 2000).

2 Data and methods

The dataset is built on the assumption that the AUD-USD exchange rate, as a "commodity currency" (Bork et al., 2022) is impacted by the volatility and shocks on the commodity markets. The data was downloaded from November 2010 to the end of November 2021. The period begins at the end of the great financial crisis and continues up to the current date. It is daily data and has been transformed by logarithmic difference. The data has been downloaded for the commodities: iron (IRON), natural gas (NMX), gold (XAUUSD), crude oil (WTI), wheat (ZW), copper (CMX), and silver (XAGUSD). The exchange rate and commodity prices were downloaded from Bloomberg.

To calculate the volatility that one variable contributes to the others we will create some indices. These indices will separately define both causalities – spillover FROM and TO a currency. The volatility spillover will be identified through the use of the DYCI method created by Diebold and Yilmaz (2009). It is a method for variance decomposition that demonstrates, for the quantity of information, that each variable adds to each other in regression and demonstrates how much of the forecast error variance of each variable can be explained by exogenous shocks from the other variables.

This method is based on the connection of the variance decomposition matrix to the vector autoregression of N-variables. The index value is calculated using a share of the forecast errors of the diagonal components of the variance-covariance matrix from the sum of all the components of the matrix. The authors (Diebold and Yilmaz, 2014) use variance decompositions that can be divided into forecast error parts, and these can be allocated to systemic shocks.

The study of the spread of shocks through the study of increased volatility needs to identify causality. This could be done by employing and modifying the generalized VAR approach defined by Pesaran and Shin (1998) where the variance decompositions are independent of the order of variables. Thus, the shocks are not orthogonalized and the sum of the contributions to forecasting error is not necessarily equal to one. This approach allows the user to define their own share of the variance as parts of the *H*-step forecast errors x_i against shocks xi and the shares of the variances between the variables is defined as the degree of connectedness. That connectedness is understood as parts of the H-stepped forecast errors in the forecasts x_i against the shocks of the xj variable (*i*,*j*=1,2,...,*N*, while *i* ≠ *j*). When the error component ε_t has a normal distribution, the generalized impulse response function is defined as follows:

$$\gamma_j^g(h) = \frac{1}{\sqrt{\sigma_{jj}}} A_h \sum e_j, \qquad h = 0, 1, 2, \ldots \tag{1}$$

where ∑ is the forecast error variance matrix of the vector *ε*, σ_{jj} is the standard deviation of the error part of the variable j and e_i is a vector with a value of 1 for i-th component and zero as all the other values. The contribution of the *j* component against the forecast error of the *i* component, *j* is defined as follows:

$$\boldsymbol{\theta_{ij}^g(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} \left(e_i' A_h \Sigma e_j\right)^2}{\sum_{h=0}^{H-1} \left(e_i' A_h \Sigma A_h' e_i\right)}}. \tag{2}$$

while the sum of the components of the decomposed variances of each row is not necessarily equal to 1, $\sum_{j=1}^{N} \theta_{ij}^g(H) \neq 1$. To normalize the information in the formula, Diebold and Yilmaz (2012) normalize each entry by the sum of the rows:

$$C_{i\leftarrow j}^{H} = \frac{\theta_{i,j}^{g}(H)}{\sum_{j=1}^{N}\theta_{i,j}^{g}(H)}. \qquad \textbf{(3)}$$

The formula is further explained: $\sum_{j=1}^{N} C_{i\leftarrow j}^{H} = 1$ a $\sum_{i,j=1}^{N} C_{i\leftarrow j}^{H} = N$. By using normalized entries of the generalized decompositions of variances Diebold and Yilmaz (2009) created the Total spillover index:

$$\boldsymbol{C}^{\boldsymbol{H}} = \frac{\sum_{\substack{j=1 \\ j\neq i}}^{N} \boldsymbol{C}_{i\leftarrow j}^{\boldsymbol{H}}}{\sum_{i,j=1}^{N} \boldsymbol{C}_{i\leftarrow j}^{\boldsymbol{H}}} = \frac{\sum_{\substack{i,j=1 \\ i\neq j}}^{N} \boldsymbol{C}_{i\leftarrow j}^{\boldsymbol{H}}}{\boldsymbol{N}}. \qquad \textbf{(4)}$$

3 Results

Australia is a global exporter of several commodities. This leads us to consider its currency to be a "commodity currency" (Bork et al., 2022). Most of their commodity exports go to China (39,1 %) but Japan (14,6 %), South Korea (6,66 %), India (5,38%), UK (3,74 %), and USA (3,62 %) are also important commodity export partners (The Observatory of Economic Complexity, 2022). Table 1 shows Australian commodity exports as a percentage of global supply.

Table 1: Australian Commodity Exports

Commodity	**Ticker**	**Value: $ million**	**% Share**
Iron ores & concentrates	IRON	102.86	21.6
Natural gas	NMX	47.53	10.0
Gold	XAU	24.39	5.1
Crude petroleum	WTI	8.57	1.8
Wheat	ZW	3.85	0.8
Copper	CMX	3.43	0.7
Silver	XAG	0.05	0.0

Note: The table provides information about the commodities exported by Australia in 2019; the "$ million" column shows the notional value of the commodities exported; the "% Share" column is the percentage share of the global supply of that commodity.

Source: Australian Government, 2020

A calculation of the volatility contributed by specific commodities is provided in Table 2. The table calculates the explanatory power of a shock to one commodity and its corresponding effect on another. The resultant degree of volatility is shown in the "From Others" column and the volatility transmitted to others is provided in the "To Others" row. The results in Table 2 show several interesting findings. Precious metals, including gold, silver and copper obtain less volatility from themselves than from other variables. We could interpret this as a result of the high degree of connectedness between them. Gold transmits 41,49 % of its volatility to other commodities, mainly to silver, copper and the AUD-USD exchange rate. Gold is one of Australia's most highly exported commodities but it is also used as the safe haven during times of economic turbulence (Baur et al., 2016). Copper is also in the top 25 most highly exported Australian commodities. This commodity is more connected with the AUD-USD exchange rate as copper is more commonly used in industrial production as it is significantly cheaper. The price of this commodity is therefore tied to economic cycles in the same way as other industrial commodities (Bork et al., 2022).

The AUD-USD currency exchange rate also correlates with economic cycles. However, copper shares its volatility with the precious metal silver (8,28 %) and gold (3,8 %) but also with iron (3,6 %) and wheat (1,77 %) as other representatives of commodities that are tied to economic cycles. Silver is used as safe haven but is also an input commodity for industrial production. That could explain its connectedness with gold (32,92 %) as an anticyclical commodity but then with copper (10,78 %) and wheat (1,14 %) as cyclical commodities. It is interesting that even though silver is not exported in large quantities by Australia (see Table 1) it still shares 6-8 % of its volatility with gold and copper. The results obtained for iron, wheat, gas, and oil are also interesting. Looking at a static sample these commodities are net obtainers of volatility and share very little volatility with other commodities. A closer look at the dynamic sample provides more detailed information about their relationships.

Table 2: Volatility spillover

	Iron	Wheat	Gas	Gold	Oil	Copper	Silver	AUD-USD	FROM Others
Iron	93.96	0.18	0.24	0.33	0.05	3.60	0.52	1.12	6.4

Wheat	0.17	92.80	0.32	0.58	0.32	1.77	1.14	2.91	7.20
Gas	0.12	0.32	98.60	0.20	-0.16	0.22	0.48	0.22	1.40
Gold	0.05	0.38	0.01	57.99	0.01	3.80	32.92	4.84	42.01
Oil	0.04	0.09	-0.30	-0.03	98.25	0.94	0.23	0.79	1.75
Copper	1.48	1.38	0.23	4.68	0.61	68.70	10.78	12.14	31.30
Silver	0.14	0.76	0.12	30.32	0.17	8.28	53.27	6.94	46.73
AUD-USD	0.39	1.95	0.26	5.42	0.43	12.3	8.71	70.82	29.18
TO Others	2.39	5.6	0.89	41.49	1.42	30.64	54.77	28.94	20.70
Net spillover	-3.65	-2.14	-0.51	-0.52	-0.33	-0.66	8.04	-0.24	

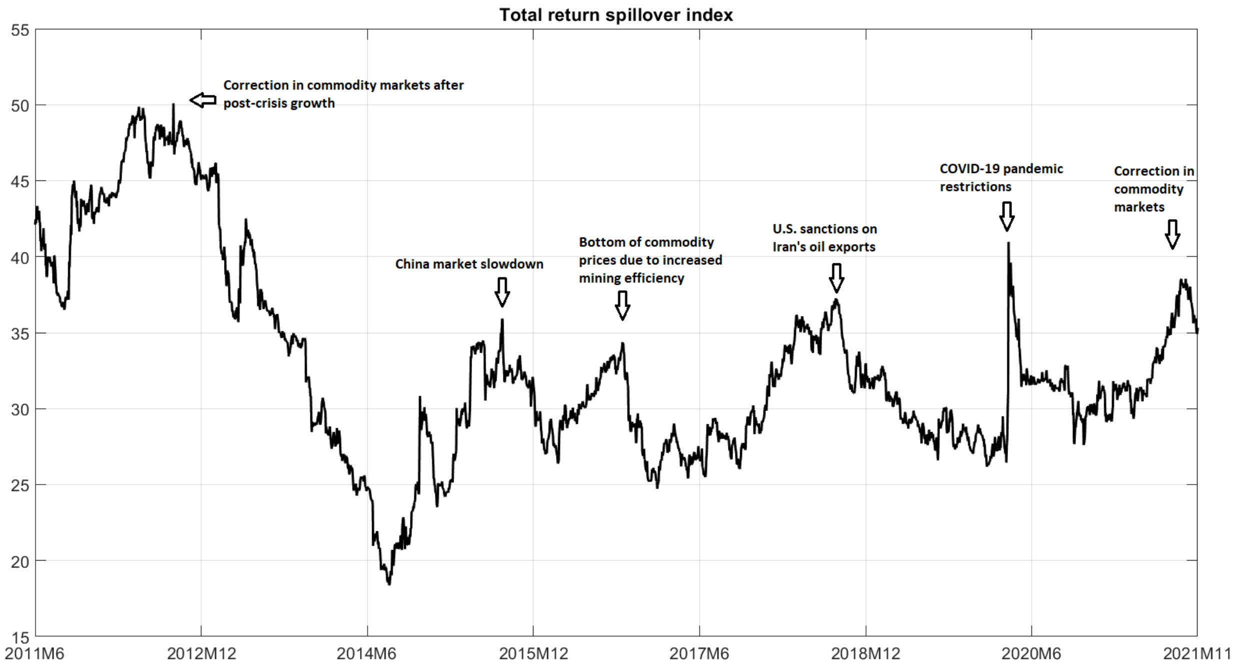
Note: The table presents the percentage volatility shared between commodities. The commodities shown in the rows are the first in against the second in the columns. "From others" column represents volatility obtained by chosen variable from all other variables. Row "To others" represents volatility transmitted from one variable to others and row "net spillover" compares volatility obtained and transmitted.
Source: own estimations.

Table 2 shows that the volatility of the AUD-USD exchange rate is connected to several commodities. The currency shares more than 1 % of its volatility with iron (1,12 %), wheat (2,91 %), gold (4,84 %), copper (12,14 %), and silver (6,94 %). These results are very important. Australia is one of the largest global exporters of iron and natural gas, but the volatility obtained, or contributed, by this pair to the other commodities is very low. This might mean that the volatility transmitted between commodities and the currency is not particularly tied to their share of global exports or to the volume of exports by country. That finding is further supported by the fact that the silver is the second most connected commodity with the AUD-USD exchange rate, even though the level of exports of silver are very low (Table 1). A dynamic sample would provide more information about these spillover effects.

3.1. An analysis of the effects of volatility spillover based on dynamic samples

The Total spillover index (Figure 1) shows the absolute volatility shared between seven commodities and the Australian dollar. As we can see the highest degree of connectedness is mainly tied to period of shocks to commodity prices. The selected commodities and the AUD-USD exchange rate share 20-50 % of volatility over time. This time-varying approach provides evidence that it is connected to economic shocks. This is in agreement with several other studies (Baruník et al., 2017; Grobys, 2015) although this study is the first to identify this relationship between the AUD-USD exchange rate and commodity prices. The highest degree of volatility transmitted between commodities was at the beginning of the period of study. This was after the great financial crisis as the economy started to grow after a big market correction. In 2011 commodities reached all-time highs and the AUD-USD exchange rate also peaked (United Nations, 2011). However, the spillover was at its highest at the end of 2012 when a correction began to the prices of the booming commodities.

Figure 1: Total spillover index



Note: The y-axis provides information about the percentage of shared volatility between all the selected commodities using dynamic samples. The direction of spillovers are not shown.

Source: own estimations

There were several factors behind these corrections. Price of natural gas was affected by warm weather and robust supply (EIA, 2012), WTI was impacted by the discovery of new deposits in Mexico (Zhang et al., 2019) and the price of iron started to correct as demand from China decreased (United Nations, 2016). The spillover effects again peaked at the end of 2014 and during 2015. This was caused by shocks in the oil market. WTI lost more than 60 % of its value as the efficiency of oil extraction improved. Wheat prices also dropped by more than 60 % as the input costs, including the price of oil and the cost of chemical fertilizers, dropped rapidly (The World Bank, 2015).

In 2018 the volatility spillover once again increased and rose from 25 % of shared volatility to almost 40 %. The main shock to the commodity markets was the imposition of sanctions, by the USA, on Iranian oil exports. This impacted oil prices but also the input costs for commodities such as wheat (The World Bank, 2015). A big spike can also be seen in 2020. This was due to the panic caused by the COVID-19 pandemic restrictions. The travelling restrictions plus the failed OPEC deal in April caused oil prices to drop to historic lows (The World Bank, 2020). Due to restrictions in exports and a general industrial slowdown the price of commodities such as silver, copper, and wheat also dropped (The World Bank, 2020). There was another spike in shared volatility in September 2021 which signalled the end of the restrictions. As countries better adapted to the pandemic restrictions and the number of cases of COVID declined, economies opened back up and this generated rapid growth in the price of commodities. September 2021 represented a correction of these uptrend inflation-based movements (The World Bank, 2022).

A more detailed analysis of this dynamic sample could be done by separately considering the observed and transmitted volatility. These results are provided in Figures 4 and 5. Figure 4 shows the results of volatility transmitted to the Australian dollar by commodities. When we compare it with the Figure 5, we can see that the spillover from commodity shocks lasts longer than those transmitted by the AUD-USD exchange rate shocks. In 2012 the AUD transmitted more than 70 % of its volatility to commodities (Figure 5) but it only lasted for around two months whereas when the commodities transmitted their volatility to the AUD (Figure 4) it lasted for almost a year (60 % of volatility). A comparison of these two plots shows that the obtained volatility is generally higher during shocks connected to drops in the price of oil.

Even though the AUD transmitted almost 90 % of its volatility to commodity prices during the COVID-19 pandemic, it was a spike that only lasted for a month while the volatility transmitted by the commodities to the AUD lasted for almost a year.

3.1. An analysis of net volatility

A closer look at Figure 2 suggest the interpretation that the Australian dollar is a net volatility obtainer (Table 2). Figure 2 confirms the findings that economic-policy shocks tend to cause spikes in the AUD-USD exchange rate but the longer term-economic impact is driven by commodity prices. When a shock occurs, the AUD reacts very quickly, this can be seen in the rapid increases shown in Figure 2, but then commodities transmit volatility to the currency.

At the beginning of 2012 the AUD transmitted volatility to commodities but as it was followed by a higher correction in the price of oil, natural gas and also iron, the AUD continued to obtain additional volatility for almost three years until 2014. In 2014, for almost a month, the AUD transmitted nearly 10 % of volatility to commodities, but again it was only very short term. It may be that the AUD reacts to shocks in the oil price and transmits these shocks to other commodities exported by Australia. The COVID-19 pandemic showed, on a dynamic sample, a very close degree of connectedness between commodity prices. At the beginning of the pandemic, over a few days, the AUD transmitted almost 50 % of its volatility to commodities, but then obtained up to 25 % of the volatility from commodities for almost a year.

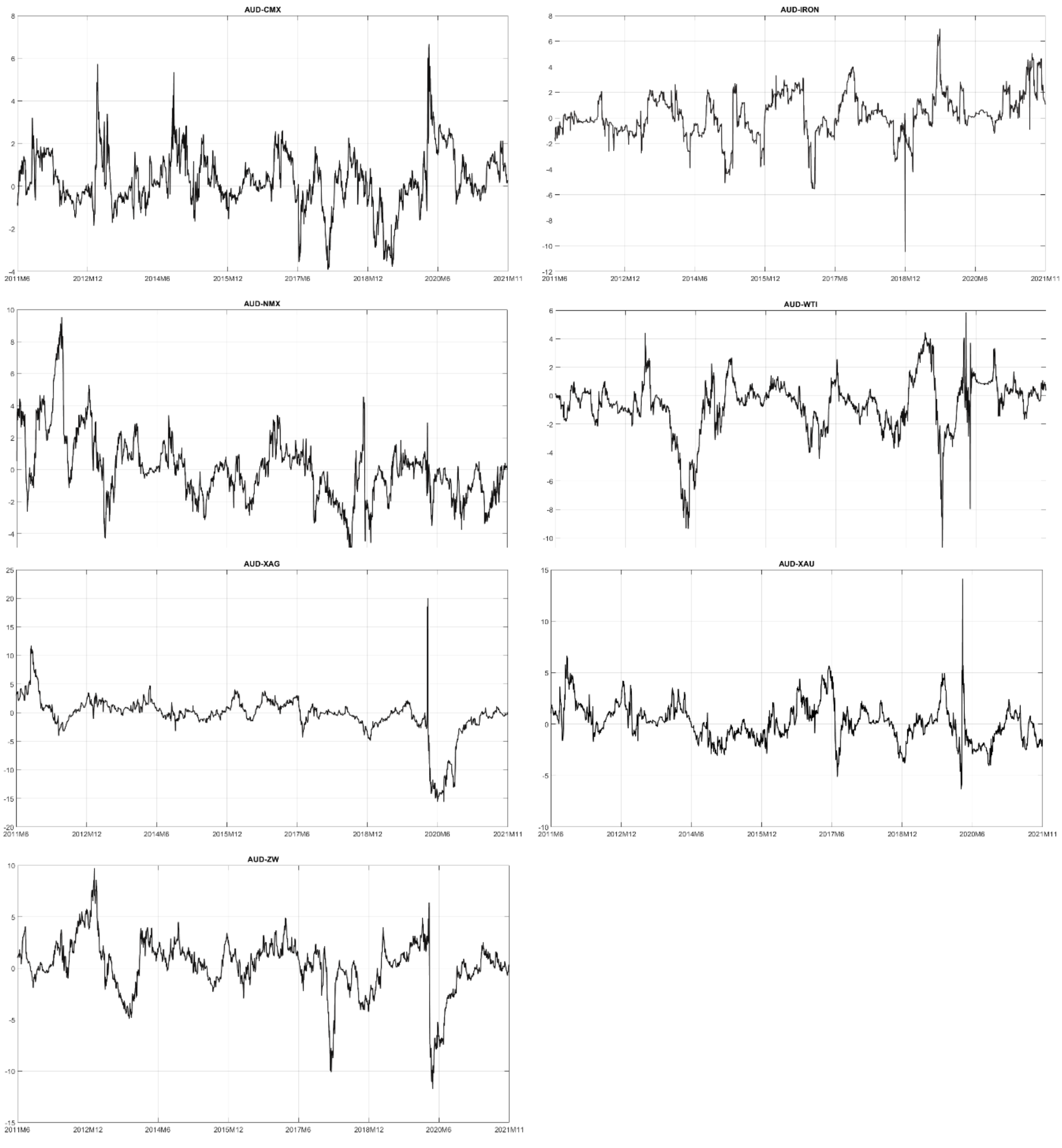
Figure 2: Net volatility spillovers

Note: Using a dynamic sample the graph provides information on the percentage (y-axis) of volatility shared by the Australian dollar and commodities in a net comparison. This figure compares the obtained and transmitted volatility using a time-varying approach.
Source: own estimation.

Looking at these results we can say that Australian dollar reacts more quickly to shocks than commodities, but if we look at a horizon longer than a month it obtains risk from commodities. This also agrees with the static sample (Table 2). These results are also in agreement with Ghosh (2012) who identified similar volatility causality between oil and the Indian currency. An analysis using specific separate commodities will give greater robustness to the more detailed information.

A closer look at net directional spillover between the Australian dollar and specific commodities provides more detailed information. This directional spillover is shown in Figure 3. Volatility that is shared between the Australian dollar and copper is mostly transmitted by the AUD. The AUD even transmitted volatility at the beginning of 2013 when one of Australia's biggest miners cancelled the opening of planned copper mines (RBA, 2021). However, this volatility spike was very short-term and then over the longer term copper transmitted its volatility to the AUD as the commodity lost over 50 % of its value over the following months. A similar volatility spike took place in 2014 as oil prices fell and this had an effect on the AUD. A decrease in the value of the AUD was welcomed by the Australian central bank and in this way it was transmitted to copper (RBA, 2021). In 2017 the downtrend in the price of copper reversed, this impacted the AUD and in turn that caused AUD to obtain volatility obtainer for almost two years.

Figure 3: Net volatility spillover between Australian dollar and seven commodities



Note: Using dynamic data the graph provides information on the percentage (y-axis) of volatility that the Australian dollar shared with specific commodities. This figure compares the obtained and transmitted volatility using a time-varying approach.

Source: own estimations.

Looking at Figure 3 we can conclude that the volatility transmission of the AUD spiked against all the observed commodities for less than a month and then for more than a year it obtained volatility. From the results it seems that the currency reacts more quickly to economic-policy shocks but over the longer term, more than a month, it is affected by the volatility of commodities. This result was identified for all variables.

The connectedness between the AUD-USD exchange rate and iron seems to be dependent on Chinese iron demand. Shared volatility from 2013 until 2016 appears to be a reaction to turn arounds in the price of iron due to uncertainty over China demand. However, from 2013 to 2015 worldwide steel production slowed due to slowing demand (The World Bank, 2016). The AUD obtained more than 10 % volatility in December 2018 as iron lost more than 15 % of its value as Chinese demand eased (RBA, 2021). The finding that the AUD reacts more quickly to shocks but then goes on to obtain volatility is also confirmed by the net directional spillover analysis for natural gas. In 2011 as all the commodities peaked, the AUD transmitted up to 10 % of its volatility to natural gas. However, the gas producers increased their production levels, and the combination of mild weather caused the natural gas price to fall, as did other commodities (EIA, 2012). The commodity then transmitted more volatility to the AUD until the end of the period, but only to a minor extent (a maximum of 4 %).

The relationship between the AUD and WTI is much more changeable (Figure 3). Even though Australia only exports 1.8 % of the worldwide total of exported oil (Table 1) and far less of it is exported than iron, gas, or gold, it still has the biggest impact on the AUD. It confirms the second finding of this study that spillover between commodities and the Australian dollar are not tied to the value of exports in these currencies, but are much more connected to the herd-like mentality of all the “commodity currencies” (Bork et al., 2022). The AUD mainly obtained volatility during 2014 (10 %) when there was a reduction in the volume of oil exported by the oil-exporting countries and a peak in shale oil production in the United States (The World Bank, 2018). During 2018 the AUD once more obtained volatility from WTI (4 %) because the U.S. introduced sanctions on exports of Iranian oil. At the end of the observed period, we identified significantly greater spillover effects. This was mainly connected to the COVID-19 pandemic restrictions when there was the biggest drop in oil prices ever recorded (The World Bank, 2020).

Another directional analysis that contributes to our study is between the AUD and silver. In addition to the peaks in the prices of commodities in 2011 the relationship was quite neutral but during the COVID-19 crisis a decrease in the value of the AUD transmitted 20 % of its volatility to silver over the space of a few days, then for six months silver transmitted its price volatility back to the AUD. This was the biggest connectedness between the AUD and a commodity found during the pandemic. This finding is very important as Australia exports very little silver, it confirms that these spillover effects are tied to the herd instinct related to the "commodity currencies" and not to the exports of these countries. The pandemic also confirmed the result that the AUD reacts more quickly to shocks than commodities but in return is then affected by commodity risk for a much longer period of time. The connectedness between currency and gold was neutral. However, every time a shock occurs, first the AUD transmits its volatility and as time goes on it then obtains volatility during the turbulent period. The connectedness between the AUD and wheat showed a similar connectedness. However, wheat shocks are tied to oil price development. From 2012 to 2015 the commodity lost almost 66 % of its value because of the decreasing costs of oil and chemical fertilizers (The World Bank, 2015). Wheat transmitted volatility (10 %) as the trend turned in 2017 in a similar way to copper.

Discussion and Conclusions

The study identified the connectedness between the Australian dollar and seven commodities. To the best of our knowledge, these volatility spillovers have not previously been identified. Considering the results, we would like to present several important contributions. The Australian dollar is a net volatility transmitter to copper and iron (0-8 % of transmitted volatility) and a net obtainer, mainly from oil (up to 10 % of obtained volatility). Its relationship with other commodities is more neutral and variable over time. Our main finding is that the connectedness between the AUD and commodities is neither based on the volume of the commodity exported by Australia nor its share of worldwide production.

We find that the Australian dollar is mainly affected by commodities for which they only export lower volumes. The AUD, as a "commodity currency", is traded in connection with other commodities and similar currencies and that produces a herd mentality. Another important finding is that the currency is very quick to react to economic-policy shocks and when a shock occurs the currency transmits volatility to commodity prices for a short period of time. This is a consequence of the high level of liquidity within the forex market. As the shock has an impact on economic cycles and commodity prices, the AUD begins to obtain volatility from commodities. This finding gives investors the guidance that when a shock occurs, they have time to hedge their portfolios before commodity prices begin to affect the long-term volatility of the currency.

The research has shown that the connectedness between the AUD and wheat price changed in relation to the developments in the oil price. Future research could identify the extent to which the Australian dollar acts as a “mediator” between the volatility spillovers of commodities.

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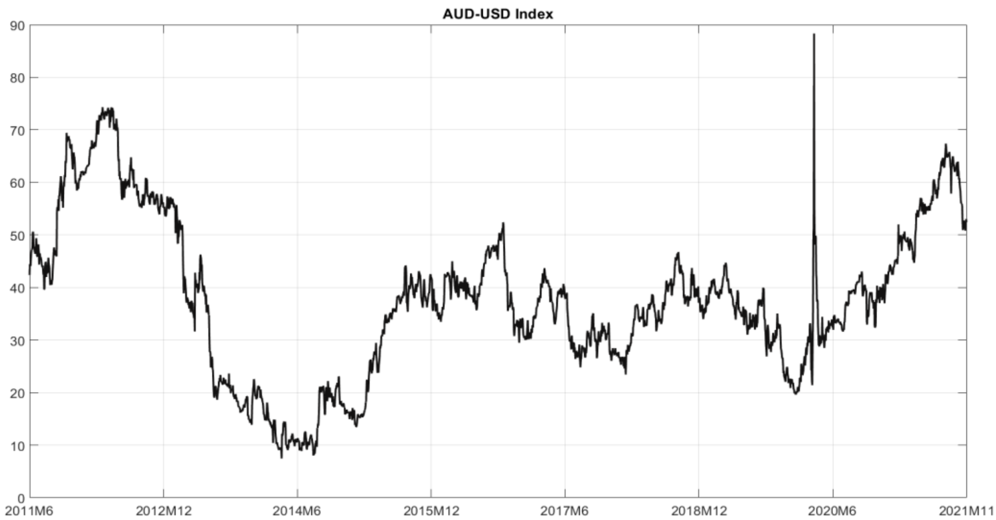
Appendix

Figure 4: Directional volatility spillovers, FROM the seven commodities TO the AUD-USD exchange rate

Note: Using a dynamic sample the graph provides information on the percentage (y-axis) volatility the AUD-USD exchange rate obtained from the seven commodities.

Source: own estimation

Figure 5: Directional volatility spillovers, TO the seven commodities FROM the AUD-USD exchange rate



Note: Using a dynamic sample the graph provides information on the percentage (y-axis) volatility the AUD-USD exchange rate transmitted to the seven commodities.

Source: own estimation

Appendix

Table A1: Descriptive Statistics

Variables	Obs.	Mean	St. Dev.	Min	Mdn	Max	Skewness	Kurtosis	ADF Test
Iron	2782	104.53	42.06	38.54	93.85	219.77	0.55	-0.61	-1.45
Wheat	2782	579.32	125.31	361.00	541.25	943.88	0.63	-0.42	-2.03
Natural gas	2782	3.14	0.84	1.48	2.95	6.31	0.58	0.04	-2.66*
Gold	2782	1476.90	211.93	1108.10	1395.20	2115.20	0.67	-0.63	-1.73
Crude oil	2782	68.62	22.97	10.01	63.07	113.52	0.17	-1.21	-1.57
Copper	2782	3.15	0.63	1.99	3.09	4.76	0.46	-0.45	-1.54
Silver	2782	22.13	6.51	11.98	19.35	47.52	1.11	0.45	-2.00
Audusd	2782	0.83	0.13	0.57	0.77	1.10	0.59	-1.12	-1.28
Iron log diff	2781	0,00	0.02	-0.22	0.00	0.15	-2.72	37.08	-27.83***
Wheat log diff	2781	0,00	0.02	-0.12	0.00	0.10	0.17	1.88	-38.46***
Gas log diff	2781	0.00	0.03	-0.18	0.00	0.20	0.23	3.76	-39.27***
Gold log diff	2781	0.00	0.01	-0.10	0.00	0.11	-0.15	14.78	-55.49***
Crude oil log diff	2781	0.00	0.03	-0.60	0.00	0.32	-3.04	85.42	-34.98***
Copper log diff	2781	0.00	0.01	-0.08	0.00	0.07	-0.15	2.49	-54.96***
Silver log diff	2781	0.00	0.02	-0.20	0.00	0.08	-0.95	8.25	-55.02***
Audusd log diff	2781	0.00	0.01	-0.04	0.00	0.03	-0.24	2.05	-35.98***

Source: own estimation