Problem of Entrepreneurship, trade and exchange activity

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ANALYSIS OF THE FLUCTUATIONS OF COPPER PRICES ON AUSTRALIAN DOLLAR EXCHANGE RATE
АНАЛІЗ КОЛИВАНЬ ЦІН НА МІДЬ ВІД КУРСУ АВСТРАЛІЙСЬКОГО ДОЛАРУ

Summary. *The aim of this research is to dispel the doubts about this subject and look at the commodity-currency relationship from different perspectives. We have reviewed multiple economic concepts to understand the background of the commodity-currency relationship, which will provide a clear overview of factors that explain this behaviour. The first section of the article will introduce the commodity-currency relationship with its initial background. Moreover, it will introduce the relevant articles concerning the researched topic. Subsequent sections will study the theoretical framework of the commodity-currency*

relationship based on the mining industry description, various economic theories, and choice of exchange rate systems. The mining industry is worth describing, as the supply of commodities is determined by production volumes in the mining sector. Economic theories describing the commodity currency relationship support the position that commodities can impact currency value. The choice of exchange rate regime is an important issue in the commodity currency relationship, as liberalization of capital markets in Australia facilitated investments in mining companies, which created the demand for the Australian dollar. Arguments within the sections are accompanied by references to scientific articles and descriptions of graphical data.

The commodity-currency relationship (in our case it is copper and the Australian dollar) does exist in Australia, mainly driven by high resource availability and favorable monetary policies implemented by the country's central bank during economic shocks (e.g. booming demand for copper due to digitization since copper acts as a perfect electrical conductor). The concept is also supported by multiple scientific articles like Chen & Rogoff (2003) [5], Clements & Fry (2007) [7], and Chen et al. (2008) [6].

Key words: commodity currency, Australian dollar, currency exchange, exchange rate, fluctuations, terms of trade, sticky prices, copper mining, purchasing power parity, portfolio balance.

Анотація. Мета цього дослідження — розвіяти сумніви щодо даної теми та поглянути на товарно-валютні відносини з різних точок зору. Ми розглянули кілька економічних концепцій, щоб зрозуміти передумови взаємозв'язку між товаром і валютою, що дасть чіткий огляд факторів, що пояснюють таку поведінку. У першому розділі статті буде представлено товарно-валютні відносини з їх початковою основою. Крім того, він представить відповідні статті, що стосуються досліджуваної теми. У наступних розділах вивчатимуться теоретичні основи товарно-

валютних відносин на основі опису гірничодобувної галузі, різних економічних теорій та вибору систем обмінних курсів. Гірничодобувну промисловість варто описати, оскільки пропозиція товарів визначається обсягами виробництва в гірничодобувній галузі. Економічні теорії, які описують співвідношення валюти товару, підтримують позицію, що товари можуть впливати на вартість валюти. Вибір режиму обмінного курсу є важливим питанням у відносинах товарної валюти, оскільки лібералізація ринків капіталу в Австралії сприяла інвестиціям у гірничодобувні компанії, що створило попит на австралійський долар. Аргументи всередині розділів супроводжуються посиланнями на наукові статті та описом графічних даних.

Товарно-валютні відносини (у нашому випадку це мідь і австралійський долар) дійсно існують в Австралії, головним чином завдяки високій доступності ресурсів і сприятливій грошово-кредитній політиці, яку проводить центральний банк країни під час економічних потрясінь (наприклад, бурхливий попит на мідь через оцифровку оскільки мідь діє як ідеальний електричний провідник). Концепція також підтверджується кількома науковими статтями, такими як Chen & Rogoff (2003) [5], Clements & Fry (2007) [7] та Chen et al. (2008) [6].

Ключові слова: *товарна валюта, австралійський долар, валютний курс, валютний курс, коливання, умови торгівлі, постійні ціни, видобуток міді, паритет купівельної спроможності, портфельний баланс.*

Statement of the problem. The topic presented in the article is worth investigating, as knowledge of connections between economic fundamentals and exchange rates is crucial during periods of economic instability. It is beneficial to both policymakers and investors. Firstly, it helps to design reactive policies for real and monetary shocks. Secondly, it may be used in making investment

decisions. Moreover, copper is a valuable metal, which demand is rising because of fast-growing technological advancement caused by digitalization.

Analysis of recent and publications. The first relevant article was published by Chen and Rogoff in 2003. Authors have investigated the real exchange rate behavior in countries, where primary commodities have a considerable share of their exports. Sample countries were Australia, Canada, and New Zealand. To better understand the commodity-currency relationship, authors identified a perfect sample country, as an industrialized economy with relatively small governmental interventions in internal and external markets and where floating exchange rate regimes have been adopted for a long time. When a country with market power potentially influences the price of its export commodity, an endogeneity problem may arise. However, these sample countries may only have market power on a few key commodities, in general, they are considered price takers in the global market for most exported goods. Chen and Rogoff find that commodity prices measured in US dollars of corresponding countries have a strong and stable impact on the real exchange rate of Australia and New Zealand. Authors suggest that commodity price changes act as exogenous shocks for small open economies and can potentially explain their terms-of-trade fluctuations [17].

Another relevant contribution to the topic was prepared by Clements and Fry in 2008, where authors researched the influence of commodity prices on domestic currencies in countries with a high commodity-exporting sector, such as Australia, New Zealand, and Canada. Most of the research was devoted to the analysis of the pricing power of certain commodities over currencies using the Kalman filter. The authors tested the commodity-currency relationship in both directions between 1975 and 2005 time periods, mainly, the commodity-currency and currency-commodity relationship was estimated. Authors identified that Australia, New Zealand, and Canada are among the commodity-currency countries. The evidence in the paper supports the currency-commodity theory more than the commodity-currency: "The spillovers from commodities to

currencies in terms of currency returns turned out to be smaller than the spillovers from currencies to commodities (1% versus 2-5.2% for currency-commodity relationship)" [7].

The final core paper we rely on was prepared by Chen, Rogoff and Rossi in 2008, which aims at exploring the commodity-currency relationship in both directions in Australia, New Zealand, Canada, and South Africa using between 1973 and 2008 using quarterly data. This paper focuses on the link between commodity currency through income effect and terms-of-trade. The evidence in the paper suggests that currencies contain efficient forward-looking information, which can be used to forecast commodity prices. However, the author also assumes that commodities can also forecast currencies, but their relationship is less robust. It occurs because when market participants expect commodity price shocks, their expectations are "priced into the current exchange" due to potential income from exports with reference to currency value (Chen, 2010).

Formulation purposes of article. The term "commodity currency" became popular after the global transition to the floating exchange rate regime by major commodity-exporting countries, such as New Zealand, Australia, and Canada. The term indicates that countries that export primary commodities, which contribute the main share of their exports, will face a connection between the domestic currency and commodities produced. The papers analysed in the article suggest that the relationship is possible in two directions, however, the issue that currency can predict commodity prices is more robust. The objective of the paper was to describe the commodity currency relationship explaining the theoretical background of it.

The commodity currency relationship can be explained by various economic channels. In general, increasing commodity prices occurred due to the commodity boom caused by rising Asian economies. That leads to significant capital inflows in Australia, which put inflationary pressure on the Australian dollar exchange rate. As a result, Australia became dependent on mining cycles

and terms of trade indicators, which facilitated the forecasting of its currency exchange rate. Adopting a floating exchange rate regime was a meaningful decision for the Australian economy, as it helped absorb the consequences of real economic shocks, which could damage national income and employment. In addition, the floating exchange rate regime facilitated trade relations for Australia and strengthened the commodity currency relationship.

Policymakers and investors have been actively researching the relationship between economic fundamentals and exchange rates to be able to conduct efficient macro and microeconomic policies or forecast asset prices. The relationship between commodity prices and exchange rates became more relevant since the liberalization of global economies and the transition to a floating exchange rate regime by leading countries after the fall of the Bretton Woods System. When the value of the currency of a commodity-exporting country moves in the same direction as the price of its most traded commodity, such a relationship is called commodity currency [7]. The commodity currency relationship has been subject to multiple research: Chen & Rogoff (2003) [5], Clements & Fry (2007) [7], and Chen et al. (2008) [6]. The results show that the relationship is possible in two directions, mainly commodities can impact currency quotes and currency can be used to forecast commodity prices.

The main material. In economic forecasts, commodity prices can be used in determining future business cycles in certain economies. The price of the commodity is used to determine how the supply and demand within the corresponding industry will change. Moreover, this relationship is of high interest to policymakers, as commodity prices can act as indicators for exchange rate fluctuations [1]. Commodity price rises have been historically high since the Global Financial Crisis in 2008-2009, reaching abnormal growth levels comparable to the Industrial Revolution of the 1970s in real terms [13]. Commodity prices are cyclical in terms of global economic conditions, as they have a substantial impact on national income, trade balances, price levels, and

nominal exchange rates or, for those with pegged currencies, international reserves [15]. Hence, the macroeconomic impact of commodity prices is significant.

Most of the economic relations between countries have been always based on trade. From ancient times until now, natural resources have been key determinants of prosperity. For economic growth, the existence of natural resources in large volumes is essential. Consequently, a country with an abundance of natural resources would have significant market power and will be able to influence international trade relations.

Increased demand in growing industrialized economies, especially in the eastern part of the globe, has pushed commodity prices higher, at the same time, real interest rates were falling to almost negative figures, which encouraged commodity stockpiling and price hikes [15]. Consequently, the roles of commodity-exporting countries, such as New Zealand and Australia, have been gaining momentum. Being classified as industrialized economies, Australia and New Zealand are more reliant on commodity exports than other economies in the Eastern world, as gauged by the proportion of commodity exports in their total exports [13]. Both countries, to varying degrees, can plausibly be described as "commodity economies", due to the large share of their production and exports accounted for by primary commodity products [5]. For example, mineral products account for 54% of Australian total exports and the situation has been maintained for at least the past two decades in this country. In addition, Australia is specialized in agricultural and soft commodities like wheat and wool respectively. On the contrary, New Zealand has been exporting mostly soft commodities, which currently stand for 45% of the country's total exports. Despite the relatively small size of their economies, these countries are market leaders in exporting particular commodities [5]. Consequently, when the value of the currency of a commodity exporting country moves "in sympathy with world commodity prices, it is said that this country has a commodity currency" [7]. A decrease in the price of an

important export commodity should lead to a downward pressure on demand for a country's currency, which should result in a fall in its exchange rate [17].

Particularly, Australia is a trade-exposed economy, which means foreign demand for its goods and services has considerable implications for the domestic economy. For instance, when a major trade partner of Australia is experiencing an economic downturn, it will decrease the level of imports from Australia, which will be reflected in economic indicators and, in most cases, lead to the depreciation of the Australian dollar.

Australia has the second largest copper reserves in the world, which is 11% of total global reserves. However, currently, Australia is ranked as the 6th copper producer with a 4% share of total production (Australian Government, 2023 [18]). The value of Australia's exports of copper in 2018 totaled $9.3 billion, up 22% from $7.6 billion in 2017. In 2018, the London Metal Exchange cash price averaged US$6525/t, an increase from US$6164/t in 2017 [18]. By the end of December 2018, Economic Demonstrated Resources (EDR) of copper in Australia were 88.17 Mt. South Australia holds 66% of Australia's copper EDR, followed by New South Wales (15%), Queensland (12%), Western Australia (6%)

and Tasmania (1%). Figure 1 shows all copper reserves with production levels from 1985 to 2018 with corresponding resource life cycles for both EDR and ore.
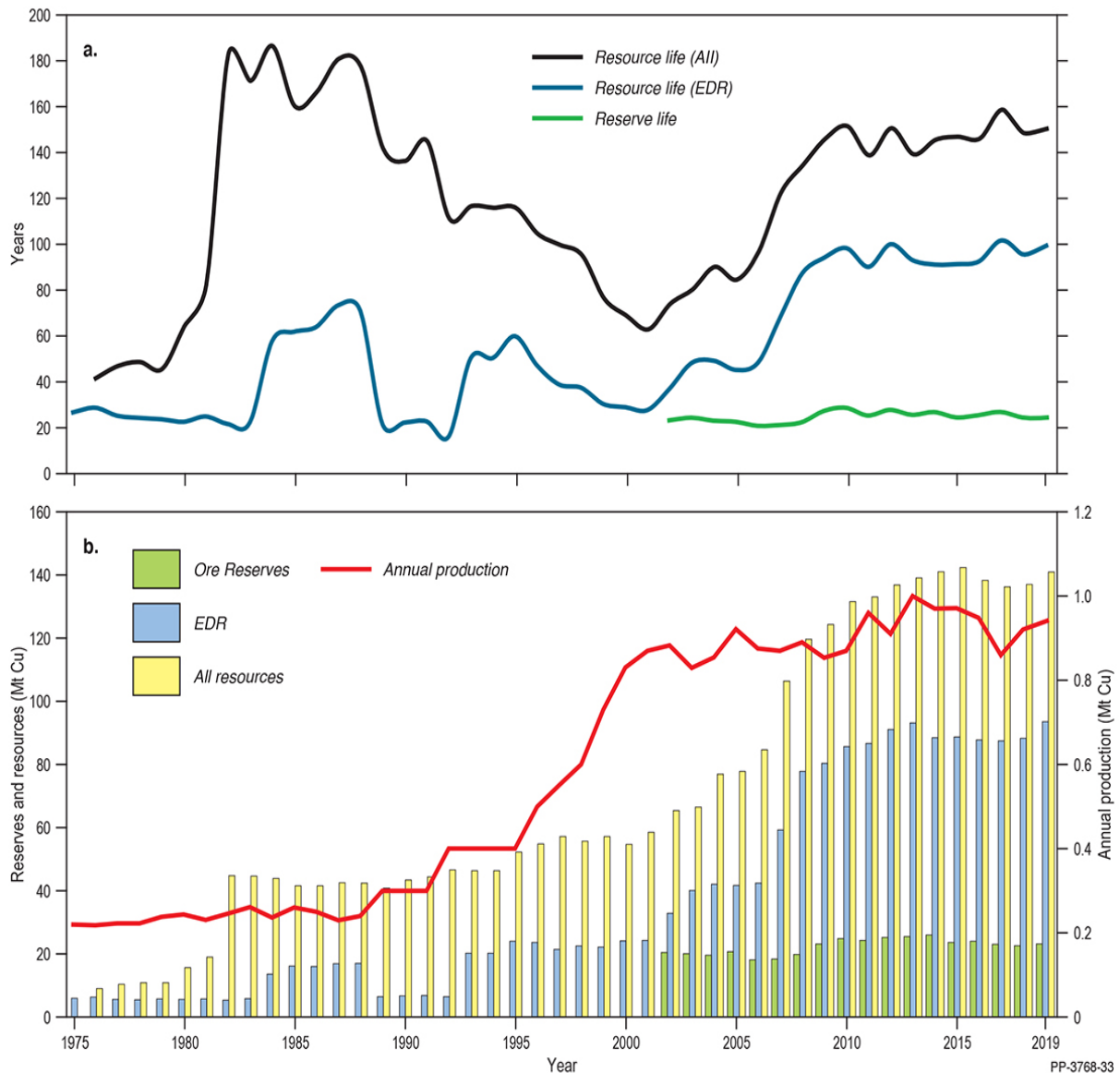

Fig. 1. Trends in copper reserve and resource life with production volumes in Australia

Source: Australian Government, Geoscience Australia, 2021 [18]

Reserve life measures the number of years required to extract all resources from the mine, in other words, it is the length of the full mine cycle. Resource life is derived from the ratio between resource number and its production number, as every mineral resource has its own production number depending on its characteristics. Australia has been developing new copper mines since 1981 to satisfy the growing international demand for raw materials, especially from Asian

economies. Moreover, significant capital inflows to the country helped to explore new copper deposits and increase the quantities produced. Spending on copper exploration in 2018 was $260 million, a 70% increase on 2017 ($155 million) with increases in copper exploration expenditure occurring over the last two years still not reaching the levels seen in 2012 ($414 million). new copper deposits and increase the quantities produced. Spending on copper exploration in 2018 was $260 million, a 70% increase on 2017 ($155 million) with increases in copper exploration expenditure occurring over the last two years still not reaching the levels seen in 2012 ($414 million). Copper reserve life is mostly constant with an average of 20 years; however, resource life has been increasing since 1990 to more than 100 years after 2010, which indicates that Australia has explored multiple copper resources and added them to inventories but did not match with annual production levels [18]. Since 2009, resource life has been mostly flat and ranged from 90 to 110 years, which shows a match between levels of production and levels of copper extraction and exploration.

What makes the Australian mining industry stand out, is its unique innovative environment, which is particularly suitable for the development of innovative patents. According to the report on patent data in the Australian mining industry conducted by Francis (2015) [10], 6539 mining inventions were filed between 1994 and 2011. Mining Equipment Technology Sector (METS) companies, those which provide miners with technology and operating services, have the biggest share in patent statistics, with 4934 patents between 1994 and 2011.

Price stickiness occurs when market prices for certain goods do not change immediately in response to demand and supply shifts or price fluctuations. Rudiger Dornbusch (1976) [8] was the first economist who provided an explanation of exchange rate volatility, because of sticky prices for goods and flexible prices for currencies. Dornbusch's theory combined short-run features of the Mundell-Fleming model and long-run characteristics of the flexible price

model with endogenous expectations. The international economy was in transition, mainly due to changes in interest rate regimes, thus, understanding their behaviour in response to market price fluctuations was crucial. Dornbusch's theory assumed a small open economy with a flexible exchange rate system and perfect capital mobility (mentioned cases with Canada, Australia, and New Zealand can be good examples). The theory is based on rational expectations, which state that individuals make decisions based on rationality, information, and experience.

Portfolio balance is another model which explains exchange rate fluctuations under a flexible regime. Under this model, the exchange rate is considered as an asset price influenced by changes in the demand and supply conditions for domestic currency, and domestic and foreign financial assets, mainly bonds. The development of financial markets in an exponential direction is visible in the role of equity portfolio flows in the determination of short-run supply and demand conditions for foreign exchange balances [11]. While transaction costs may not lead to price compensations, investors should be able to adapt their behavior with respect to future market movements [1]. In making decisions, the investor also makes a trade-off between risk and returns on the portfolio to achieve profit maximization [12]. The portfolio balance model can be also applied to a small open economy under flexible exchange rates, which performs money asset and commodity transactions. If an investor expects rising commodity prices, he will invest more in commodity-producing countries which export commodities, as interest rates tend to rise in these countries. Moreover, investment funds will flow into the country, as it produces more returns. The induced capital inflows lead to an appreciation of the exchange rate due to higher demand for domestic currency [1]. High inflows of foreign currency to the domestic economy may result in monetary interventions, thus, the changes in money stock will change exchange rates. On the contrary, local companies generate less revenue in domestic currency when exchange rates are increasing.

That means, investors are paid less dividends, as they depend on company earnings. The portfolio balance model also assumes "equity is reallocating away from the appreciating market" [11].

A country's terms of trade (ToT) is the ratio of its export prices to import prices [3]. It can be explained as the amount of export that can be bought for one unit of import. Improvements in a country's terms of trade usually lead to upward shifts in demand for its currency, which pushes exchange rates in the same direction [16].

In the tradition of small open economy models, the terms of trade are exogenous variables that play a key role in determining not only the exchange rate, but the whole distribution of resources and activity through the economy [5]. Australia falls into the definition of small open economy, as it has no market power in determining prices on internationally traded goods. Australia is a commodity exporting country, thus, changes in commodity prices affect a national value of exports and leads to ToT shocks [9]. Moreover, as commodity trading is conducted mostly in a few global exchange markets using US dollars, world commodity price fluctuations can better capture exogenous shocks to terms of trade of countries with commodity currency [5].

Another research conducted by Sanidas (2005) [20] was dedicated to the investigation of economic variables that impact long-term fluctuations of the Australian dollar using Fourier analysis and simple regression. In the beginning, the author tried to identify variables that cause price fluctuations of exported mineral commodities based on the commodity price indexes reported by the Reserve Bank of Australia. It was concluded that mineral commodity price cycles (coal, iron, copper, and nickel) are influenced by mining and production volumes of corresponding commodities and other commodities Australia exports (sugar and wool). The author was observing commodity price changes from 1982 to 2005, and during this period Australian mining industry was facing an economic boom due to high international demand, especially from new active international

trade participants – India and China. They launched the process of liberalization of the domestic economy to participate in international trade.

During this period Australia has managed to increase iron ore production to 20% (from 13%), nickel production from 8% to 17%, and copper mining from 4% to 7% [20]. The situation did not change in the consecutive years: "Between 2003 and 2012, Australia's iron ore production increased by 144%, or 307 Mt, to total 520 Mt in 2012. Australia's production of iron ore increased by 43 Mt in 2012 alone, an amount greater than the total annual iron ore production of many countries" [18]. Growth of the Australian mining sector is possible due to significant capital inflows, as, in the short-run, higher commodity prices cause increased money supply in the commodity production industry (Kohlscheen et al., 2016). Consequently, a rise in export revenues leads to domestic currency appreciation. In the long run, this effect is compounded by attractive investment opportunities in the mining industry, which boosts domestic foreign direct investments [14].

According to RBA, Australia has been significantly increasing capital expenditures in the mining sector caused by extraordinary commodity price rise. Higher commodity prices pushed producers to increase production volumes to satisfy international demand and get higher revenues. To be able to produce more, mining firms expanded existing mines and developed new mines as well, which led to the largest resource investment boom in the history of Australia (Figure 2).

a. Trend break added to 'Total non-mining capital expenditure' trend series for Dec 2018, Sep 2015, Sep 2008, Mar 2007 and Jun 2003.

Source: Australian Bureau of Statistics, Private New Capital Expenditure and Expected Expenditure, Australia March 2023

Fig. 2. Capital expenditures in mining and non-mining sectors in Australia from 2003 to 2023

Source: Reserve Bank of Australia, 2023 [18]

To compare, mining investments in Australia had averaged over 1.5% of the national GDP for the last 50 years led by a terms-of-trade boom [18]. Investments in the mining sector have grown from $4bn in 1990 to $88bn in 2015. It is positively correlated with globalization and international demand for mineral commodities.

Purchasing Power Parity assumes that similar baskets of goods should be priced the same in different countries in a common currency. PPP considers ratios of domestic – foreign prices and exchange rates. The theory is based on the law of one price (LOP), which states that the price of homogeneous goods should be equal when there are no transaction costs and trade barriers. Theories that invoke purchasing power parity assume that in some circumstances a fall in either currency's purchasing power (a rise in its price level) would lead to a proportional decrease in that currency's valuation on the foreign exchange market. Depending

on the theory, purchasing power parity is assumed to hold either in the long run or, more strongly, in the short run. The theory is usually composed of two forms: relative and absolute.

Conclusions. Financial markets and markets of goods and services react to price changes differently. Mainly, the price level affecting financial markets is more volatile than price indices from the goods and services market (Xia et al., 2003 [21]). That can be explained by the vulnerability of asset prices to global news in the short term due to speculations. On the contrary, goods and services are reluctant to intensive price fluctuations. It can be explained that assets, such as commodities are traded on flexible-price markets, while manufactured goods have fixed prices and can make substantive price movements in case of meaningful events [21]. Moreover, primary commodities act as raw materials for production purposes, which makes them vulnerable to demand and supply factors, thus, adding to their cyclicity and price volatility [2]. That means inflation in the financial markets is more volatile than official inflation.

Since the liberalization of international trade and globalization of leading Asian economies, the demand for mineral commodities has grown significantly, which began to draw vast attention from investors, researchers, policymakers, and speculators. Commodities contribute to the economic prosperity of the nation, which holds high commodity reserves. That has an inevitable reflection in the currency value of this country. Thus, investigating the relationship between commodities and currencies is worth attention.

According to the definition of "commodity currency" and recent research conducted by Chen & Rogoff (2003) [5], Clements & Fry (2007) [7] and Chen et al. (2008) [6] show that Australia can be an almost perfect scope for testing the significance of commodity-currency theory. Australia is a small open economy with a significant share of commodities in its exports, and, historically, the Australian dollar has been one of the most liquid currencies globally. This relationship can be explained by the existence of sticky prices, purchasing power

parity theory, high dependence on terms-of-trade, capital inflows from Asian economies (explained by the portfolio balance approach) during the commodity boom, and vulnerability to mining cycles. Moreover, the role of exchange rate regimes was considered in this paper. Both scenarios of the rise and fall of commodity prices were shown and explained graphically. The theory analyzed in this paper suggests that floating exchange rates regime acts as a booster for the commodity-currency relationship, as countries dominantly facing real shocks rather than monetary shocks use floating currency as a shock absorber [15; 4].

Limitations:

1. The article is aimed at the description of related articles coverage providing a summary of the commodity-currency relationship. Moreover, we observe multiple economic theories explaining this relationship. However, our research is lacking empirical evidence, therefore, future research will be devoted to empirical research on the topic.

2. Papers referenced in the following article are not older than 2019. Financial markets are developing rapidly, and new patterns may have appeared, therefore, some of the fluctuations may have been missed.

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