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10-year Simulation of Commodity-Based Convertibility of the Pakistan Rupee: a Model for Developing a D-8 Currency Bloc

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Keywords:

Grondona System, Real currency convertibility, Pakistan Rupee, Commodity prices, D-8, Simulation, Currency bloc, Fiat money

ABSTRACT

The fiat currencies being used worldwide suffer from inflation, instability of exchange-rates and manipulation by larger countries. The traditional means of stabilising the value of a currency is through guaranteeing its convertibility into real goods, such as with a gold standard. Re-introducing a gold standard today faces major difficulties, and since the 19th century, the idea of making currency convertible into a range of other commodities than gold and silver has been recognised as economically beneficial. This paper considers the little-known system of *conditional* currency convertibility based on primary commodities devised by the Australian economist Grondona as a means for individual countries to introduce an element of real convertibility into their monetary system, more flexible than the rigid convertibility of the classical gold standard. Conveniently, since the system is activated by market prices it is possible to simulate it realistically, and the paper uses the "C" language to simulate the operation of the "Grondona System" implemented in Pakistan through the decade 2009-2018. The results show how the system's market-driven, counter-cyclical stock-holding would have expanded the Rupee money supply as commodity prices fell, and reduced it proportionately as commodity prices rose again, driven by market prices. This would have helped to stabilise the real value of the Rupee, as well as the value of commodity imports over the trade cycle, thereby reducing fluctuations in Pakistan's trade balance and exchange-rate. Since the Grondona System is *Shariah*-compliant, this shows how the D-8 countries could stabilise currencies and partially stabilise their mutual exchange-rates.

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INTRODUCTION

Desirability and Difficulty of Implementing Currency Convertibility

The Bretton Woods conference in 1944 gave the US Dollar reserve currency status, in exchange for the US government agreeing to the discipline of preserving the real value of the Dollar by keeping it convertible into gold at $35 per ounce. However, as has happened repeatedly in history, political pressures to over-issue Dollars led to progressive loss of the US government's gold reserves, and after only 27 years the US government canceled its promise to redeem its Dollars with gold in 1971. Since then the US Dollar has been a purely "fiat" currency, and has lost more than 98% of its value, measured in terms of gold, of which the price in mid-2020 is some $1,900 per ounce. Other major currencies have likewise become merely fiat currencies, subject to inflation, instability and geo-political manipulation.

Thanks to the development of the Internet's revolutionary power of disseminating information worldwide at minimal cost, the fraud underlying the "western" monetary system, in which most new money is created not by governments for the benefit of the general public, but as debts to the privately-controlled banking system, has become more widely known than ever before. Perhaps the most authoritative discussion of this problem is that by retired Pakistan supreme court judge Taqi Usmani (2008), who explained how the west's debt-based "fiat" money has long been recognised as "*Riba*" in Islamic economics: that is, inherently dishonest, extracting enormous wealth fraudulently from the general public. In addition to being based on interest-bearing debts, it is additionally unjust since no private group in society should receive the benefit of "seigniorage", which arises with the creation of new money, as the banking system does today.

Experienced American economic policy maker and commentator Paul Craig Roberts has described the enormous economic damage caused by this situation in the USA (Roberts, 2019). As an early phase of this deception, the "Bank of England" was privately owned from when it was established in 1694 until it was "nationalised" in 1946. Likewise, the US "Federal Reserve System", established in 1913, is also privately owned by a small number of major banks (Martens & Martens, 2019).

In recent years the problem of debt-based fiat money has become the focus of a growing number of organisations outside the economic "mainstream", as represented by university economics departments – most of which do not teach their students about this central economic problem. Notable among these organisations are the American Monetary Institute (AMI), the Public Banking Institute (PBI) and Positive Money (PM). In recent years there has been increasing use of gold as monetary reserves by central banks, and the B.I.S. upgraded gold to be a "Tier 1" bank asset in March 2019.

In May 2019, at the "Future of Asia" conference in Tokyo, Prime Minister Mahathir of Malaysia called for the development of an international gold-backed currency for settling trade imbalances within Asia, receiving support: "As a wise elder statesman, Mahathir clearly understands the advantages of gold. Although his proposal is thus far no more than an informal suggestion, the younger leaders of Asia ought to heed his call and work towards making Mahathir's proposal a reality" (Garrie, 2019). However, reintroducing classic gold convertibility would be difficult even for a major country: the present paper describes a different approach to currency convertibility.

Primary commodity-based convertibility

As an alternative to a gold standard, the concept of convertibility based on a range of primary commodities has been advocated by a substantial number of eminent economists in the "western"

tradition, including Stanley Jevons in the 19th century (Jevons, 1877), and perhaps most strikingly both John Keynes (Keynes, 1938) and Friedrich Hayek (Hayek, 1943) in the 20th century. Although Keynes and Hayek famously led opposing schools of economics, as discussed in (Wapshott, 2012), they both wrote in favour of currency convertibility based on primary commodities, for identical reasons.

> At present a falling off in effective demand in the industrial consuming countries causes a price collapse … But if…. "Commodity Controls" are in a position to take up at stable prices the slack caused by the initial falling off in consuming demand. the vicious cycle may be inhibited at the start; and, again, by releasing stocks when consumption recovers, prevent the inflation of raw material prices (Keynes, 1938).

> With this system in operation an increase in the demand for liquid assets would lead to the accumulation of stocks of raw materials of the most general usefulness…. And as the hoarded currency was again returned to circulation and demand for commodities increased, these stocks would be released to satisfy the new demand (Hayek, 1943).

However, both Keynes and Hayek, like other economists before and since, failed to work out a practical means of implementing it. The key difficulty facing such a system is that commodity market prices are notoriously volatile over the trade cycle, frequently falling by 50% and rising by 100% or more. Due to this, a system of commodity-based convertibility must permit a much wider range of variation of the prices of the commodities involved than a gold standard, since commodity market prices must be able to adjust sufficiently according to changing conditions of supply and demand.
The system of *conditional* currency convertibility based on primary commodities which Australian economist Leo St. Clare Grondona designed was widely supported in Britain during the 1950s; it was described as "a modern equivalent of the gold standard"; and it was praised by such eminent British economists as Roy Harrod and Nikolas Kaldor.

Research to Date

The research literature on the subject of currency convertibility is complicated by the fact that it overlaps another topic typically treated separately, namely commodity price stabilisation. This is because stabilising the value of a currency in terms of a given commodity is *ipso facto* to stabilise the price of that commodity in terms of the currency. Hence the Grondona System of *conditional* currency convertibility is also a system of *partial* stabilisation of primary commodity prices.
There is an immense research literature both on alternatives to the current fiat money system and on commodity price stabilisation. However, despite vigorous support in the press and among politicians and economists, primarily during the 1950s, the Grondona System has received little analysis or discussion by academic researchers. Nevertheless, a theoretical analysis using a mathematical model was published by Nguyen in 1980 (Nguyen, 1980). Nguyen described related research to date: "The typical approach by writers in this field is to compare the instability of earnings under freely fluctuating prices with what it would be if prices were stabilized at some appropriate level" [Nguyen, 1980].
He continued by explaining the inadequacy of this approach:

> "Underlying this approach is the assumption of a buffer stock scheme which can operate successfully to maintain a perfectly stable price (i.e., "complete" price stabilisation) by being able to buy or sell any required amount at the chosen price" (Nguyen, 1980).

Nguyen then explained that incomplete information and associated costs make it impossible in reality to achieve complete stabilisation – for which the long history of failure of proposals for international commodity agreements provides much evidence. Nguyen then introduced his model which is designed to assess the effect of a system with "… the objective . . . to reduce, rather than to eliminate entirely, the fluctuations of prices" (Nguyen, 1980).
This is achieved by making the prices at which the system buys and sells commodities adjust continuously in inverse proportion to the quantity of reserves held. As explained below, this model is not precisely the same as Grondona's system, but is a mathematical idealization, using a continuous

function instead of a step function as used in Grondona's system (described below). (Nguyen states that he received the idea from the Australian Wool Board (AWB): Grondona had discussed his system with AWB staff at length.) Nguyen's resulting conclusion was very positive: "… in contrast to what is now widely believed, both objectives of price stability and earning stability can be achieved for almost all commodities…" (Nguyen, 1980).

In view of this demonstration of an apparently promising new approach to the problem of commodity market stabilisation, it is surprising that Nguyen did not himself pursue this research further. However, following Nguyen's positive result, a logical next step is to simulate a practical implementation of his theoretical rule. In particular, a system that bought and sold commodities at continuously changing prices, even if rule-based, would not be stabilising since traders would not be able to rely on continuously varying buying and selling prices. Grondona's practical realisation of this approach stipulated that his system's buying and selling prices would adjust according to the level of reserves in discrete, pre-announced steps, as described in detail below.

The authors consider that the most appropriate model for realistically assessing the operation of such a non-continuous system is not another mathematical model, but a simulation of a real commodity market, using actual past market data. For the present paper, the authors have simulated the operation of the Grondona system over a longer period than has been done before. Grondona designed his system specifically to make its operation as predictable as possible, driven by market prices, without discretion by the management of the system. This minimises any uncertainty among market participants about how the system would operate under different conditions, while also making it possible to simulate its operation reliably.

The computer language "C" is convenient for facilitating repeated simulations under different assumptions, which has enabled simulations of the Grondona System as implemented in a range of countries to date. The present paper discusses such a simulation of the Grondona System as it might have been implemented over the decade 2009 - 2018 in Pakistan, operating in Rupees (PKR). In recent years Pakistan has made considerable efforts to reduce the role of *Riba* in the economy, encouraging Islamic financial services, introducing *Zakat*, and other policies. The present study aims to clarify the potential benefits of implementing conditional currency convertibility of the Rupee based on primary commodities, as a step away from being a purely fiat currency.

Simulating the Grondona System

The flexibility needed to accommodate even large movements in prices of primary commodities is achieved in the Grondona System by making the *range* within which the system keeps a commodity's price in terms of its national currency, itself adjust in proportion to the quantity of reserves held. That is, the price-ranges ensured by the system for each commodity follow a published "price-schedule", falling as reserves accumulate and rising as they fall, as shown in Figure 1.

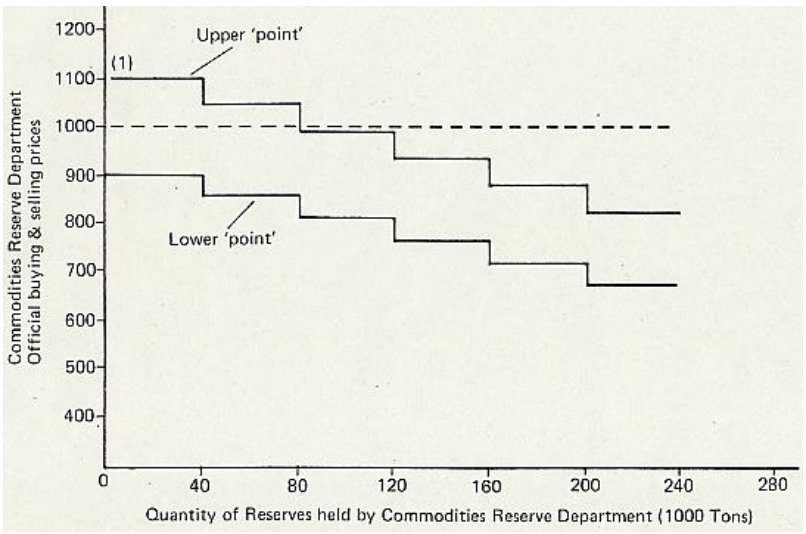


Figure 1: Price-schedule showing adjustment of price-range with quantity of reserves

Hence, at a time of falling market prices the current price-range of each commodity involved continues to fall proportionately as the quantity of reserves increases. In this way the maximum scale of reserves

that might accumulate under any market conditions is limited in advance to a scale which the implementing government considers prudent. That is, because of the automatic adjustment of the price-range for any commodity (or grade thereof), at some low price-level sellers will stop selling to the "Commodities Reserve Department" (CRD, the agency established by the government to implement the Grondona System). Hence, before implementing the system, government staff will estimate the optimal scale of operation in relation to each commodity (or grade thereof). In addition, the CRD does not guarantee the maximum price of any commodity unconditionally, but only as long as it holds reserves, as seen at point (1) in Figure 1.

As a consequence of these conditions, no international agreement is needed in order to raise large-scale funds, as would be needed for a system of fixed convertibility. This avoids the immense problems of complex international negotiations that would be needed for an international system. In addition, the implementing country thereby also obtains the further enormous benefit of being able to pay for the purchase of commodity reserves by issuing its own currency, as was done under the classical gold standard. The system also directly stabilises the real value of the national currency in terms of each commodity involved, on a scale decided in advance, which would not happen under an international system of fixed convertibility.

It is important also to recognise that, contrary to the ordinary expansion of the money supply of countries using fiat money, the money issued in exchange for reserves of commodities under the strict conditions imposed by the CRD, is clearly *not* "*Riba*". That is, the CRD issues currency only in return for physical delivery of real reserves of durable, essential, basic, imported commodities, at prices significantly below recent average market prices. Moreover, the currency is automatically withdrawn from circulation when market prices rise above previous average prices, and so reserves are repurchased from the CRD by market participants.

The important insight that this operation is essentially the same as the food storage policy implemented by Prophet Yusuf (AS) was discussed in (Ahmed, Collins and Meera, 2018a), concluding that the Grondona System is indeed *Shariah*-compliant. This makes it a potentially attractive policy for the D-8 leading OIC countries.

In order to simulate the system's operation, there are five parameters (which Grondona called the "gearing" of the system), which determine the scale of its transactions, and so the extent of its monetary and economic influence, as well as the maximum size of the government's financial commitment involved in implementing it. These parameters are as follows:

i) Range of commodities (&/or grades thereof): Only imported commodities are to be included, which are also durable, essential and basic. Domestically produced commodities and fuel minerals are therefore not part of the system, at least initially.

ii) Initial price levels: Other things being equal, the system's initial buying price for a commodity should be somewhat below the recent long-term average price (adjusted for inflation &/or other factors, as appropriate), which Grondona called the initial "Index" price.

iii) Size of "Blocks": Grondona named the maximum quantity that a CRD would purchase at any one price as a "Block", and he suggested the figure of 10% of annual imports as a guideline (though different values may well be more appropriate for different commodities).

iv) Width of price-bands: Grondona suggested that the system's initial buying and selling prices might be 10% below and 10% above the initial Index price, but that different values may be more appropriate for different commodities, depending on their past price volatility.

v) Price-steps between successive price-bands: Grondona suggested that the CRD's buying and selling prices might both fall by 5% of their initial level when each successive Block of a commodity accumulated.

These and many other details of the system are discussed in more detail in Grondona's books, such as (Grondona, 1975) and (Grondona, 1972) as well as in (Collins, 1985). An earlier simulation of a

Turkish CRD using Lira was published in (Ahmed, Collins and Meera, 2018b). However, that simulation covered only a few years, due to data limitations: the present simulation over a full decade provides a more complete view of the counter-cyclical timing of a CRD's operation. For this, the use of a computer program in "C", and the published trade statistics of the country implementing the system, are sufficient to demonstrate clearly how the system would exert a counter-cyclical stabilizing influence on a range of economic parameters.

Simulation of Pakistan CRD

In the following simulation of the Grondona System's implementation in Pakistan it is assumed that a CRD would be established as part of the State Bank of Pakistan, which is responsible for maintaining monetary and economic stability through the regulation of the national monetary and credit systems, as well as encouraging economic growth. It is important to note that the institutional innovation involved would be relatively easy for the State Bank, since the CRD would have no discretion in its operation. This is because it would operate "automatically", according to the fixed rules described above, when approached by either sellers or buyers of the commodities which it handled – essentially like the office in a central bank operating a gold standard responsible for the physical exchange of gold for currency.

In the following simulation, for simplicity, it is assumed that the CRD would have no substantial stabilising influence on world commodity market prices. Hence the simulation somewhat overestimates the scale of the CRD's likely turnover, and so its direct effect on the Rupee money supply. In reality, the CRD would have a significant stabilising influence on some commodity prices at some times, in which case the scale of the CRD's expansion and contraction of the money supply would be reduced proportionately.

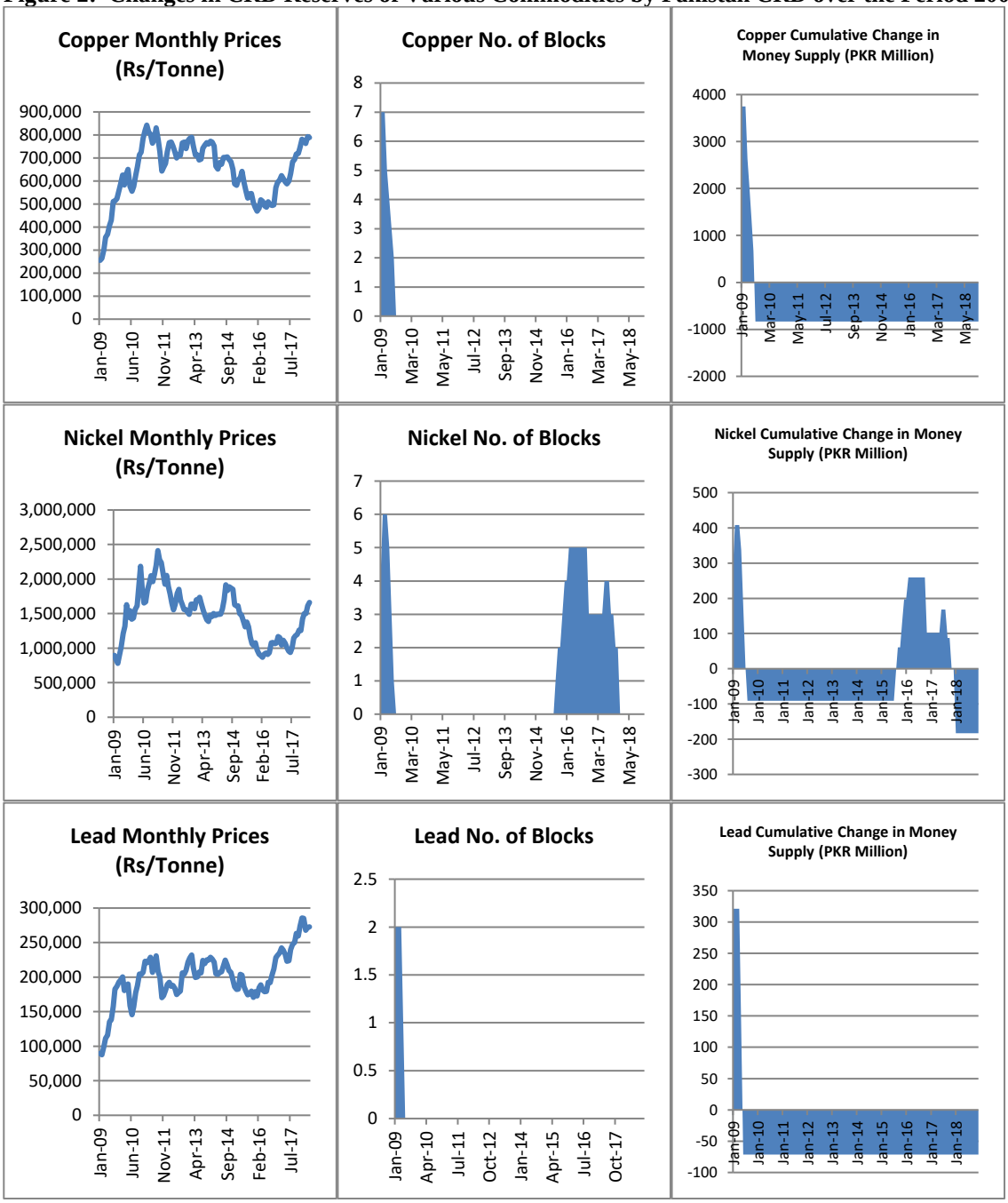
The simulation is for the period 2009-2018, and the operating conditions of the CRD are based on Pakistan trade data and macro-economic data from the preceding period of 2006-2008. In this the simulation follows the simple rule-of-thumb proposed by Grondona for illustrative purposes. A CRD established in Pakistan today would likely have considerably different terms of operation from that simulated here, operating on a substantially large scale, due to Pakistan's economic growth over the past decade.

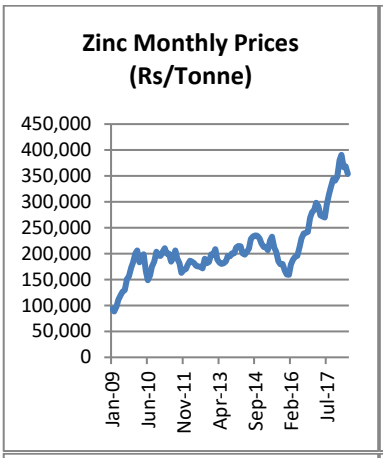
Since the CRD handles only Rupees, it is activated by changes in the Rupee prices of the primary commodities it handles, which are determined by world market prices in US Dollars and by the Rupee-Dollar exchange rate. In the following simulation, the Pakistan CRD is assumed to handle the following commodities: Copper, Nickel, Lead, Zinc (>99%), Zinc (<99%), Aluminium, Wheat, Barley and Maize. Once the system's "gearing" and initial conditions are decided for each of these commodities, the simulation proceeds by looking up the historical commodity market price and Rupee-Dollar exchange-rate to calculate the Rupee market price for each month, and then calculating whether the CRD would have bought or sold reserves, by comparing the Rupee market price and the CRD's current buying and selling prices.

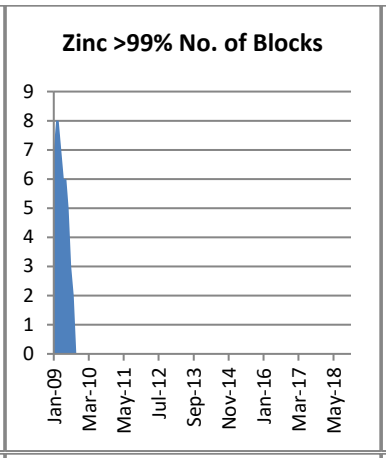
The results shown in Figure 2 are thus based on actual market price-movements over the decade of the simulation. On inspection, it can be seen that as commodity market prices rose in the first two years of the simulation, most of the CRD's initial reserves were purchased from it. Although even when holding no reserves, a CRD continues to have some stabilising effect on falling commodity prices, its influence against domestic inflation is clearly reduced. However, most commodity prices fell again from about 2014, whereupon reserves of most of the commodities accumulated once again.

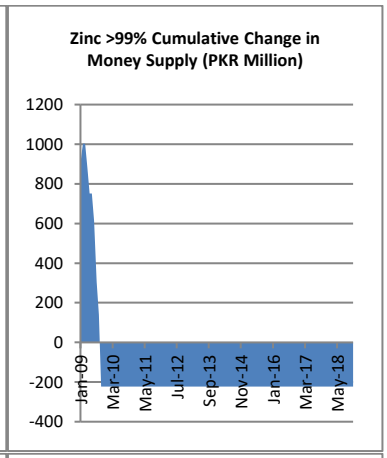
The graphs in Figure 2 below show clearly how the CRD would have responded to varying market conditions over a decade, accumulating reserves at times when Rupee prices were falling, and selling them when prices rose. Specifically, based on the initial conditions whereby the CRD accumulated reserves of all 9 commodities, all these fell to zero as commodity prices rose 100% or more over the following 4 years. Subsequently reserves accumulated again of the three grains, Nickel and Aluminium, the two metals falling to zero again in 2018, while grain reserves continued.

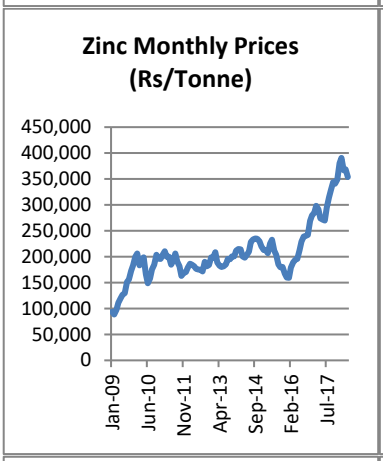
Figure 2: Changes in CRD Reserves of Various Commodities by Pakistan CRD over the Period 2009-2018.

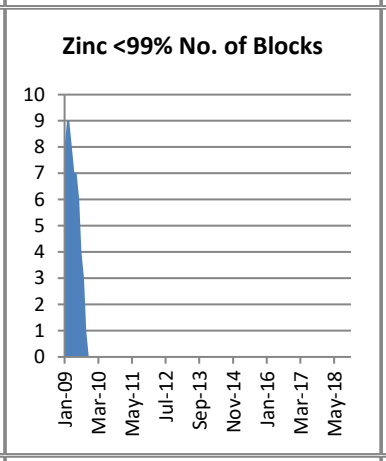


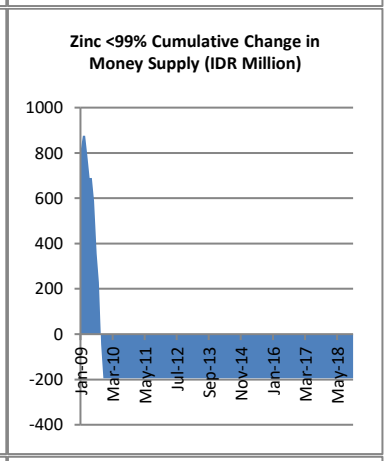


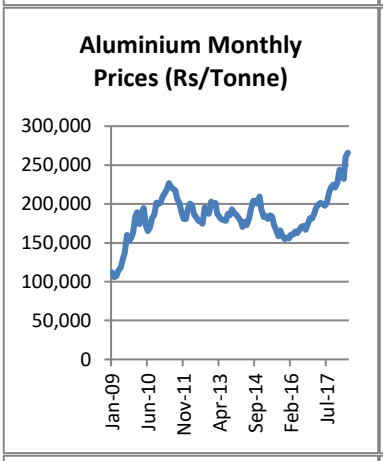


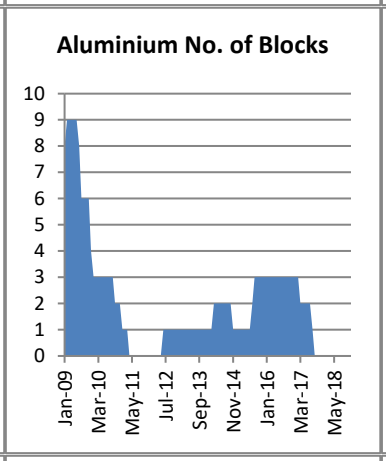


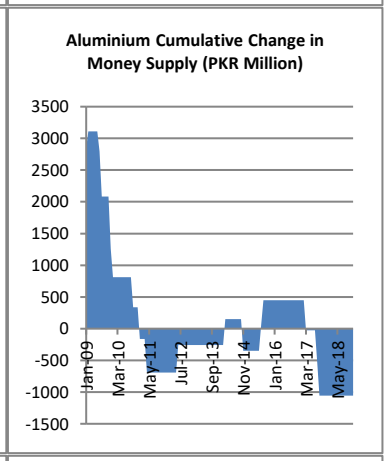


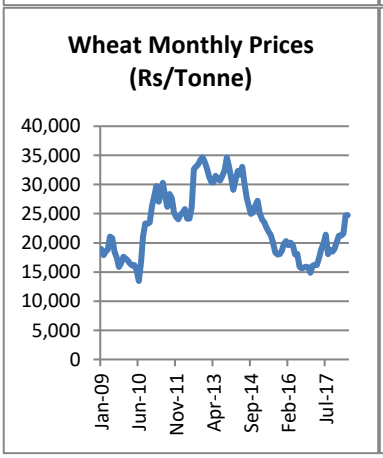


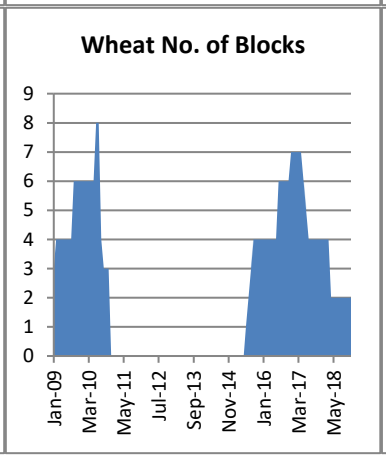


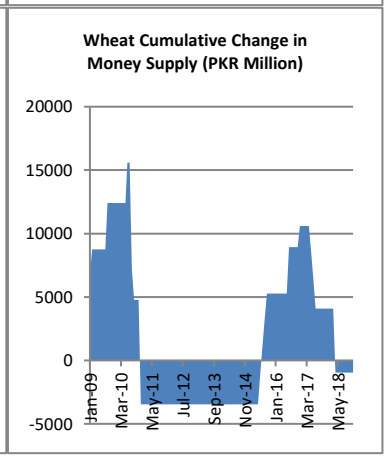


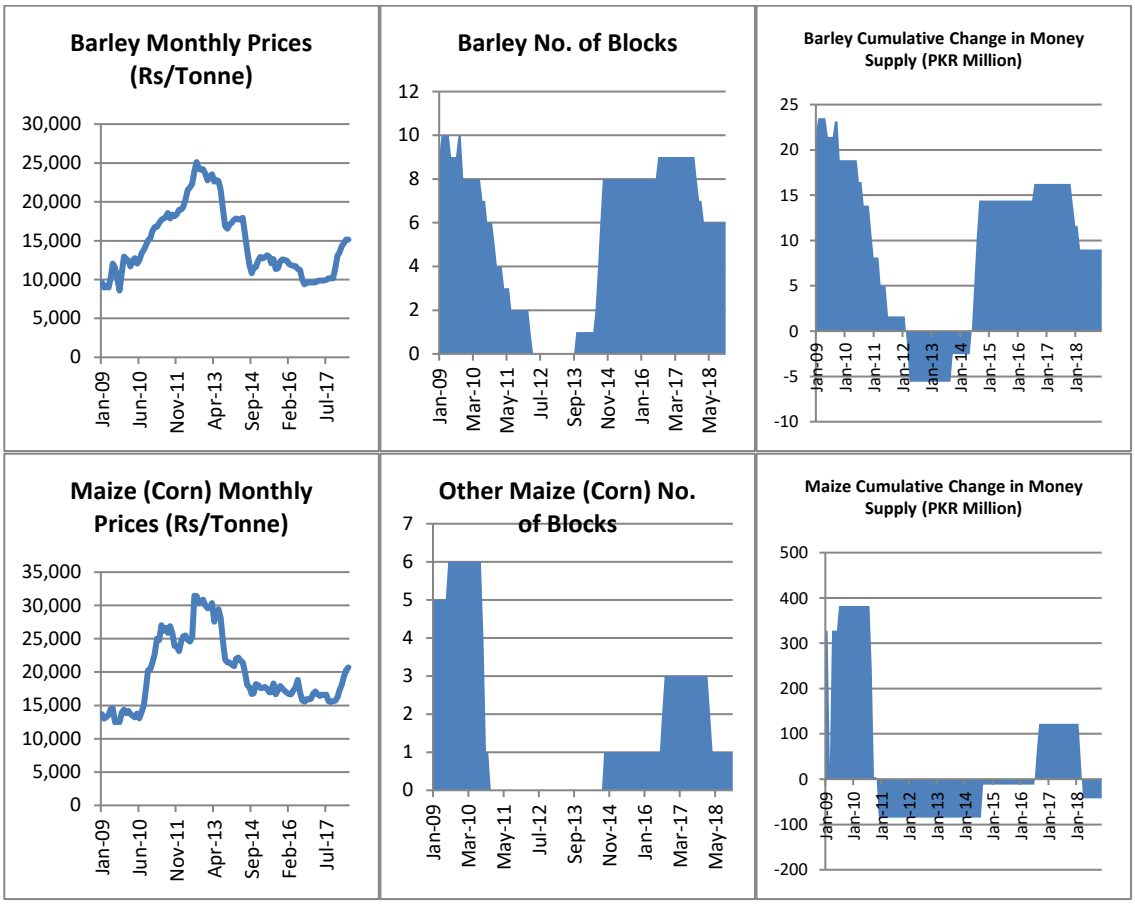












The above graphs also show that the overall changes in Rupee prices of each commodity varied widely: all rose overall, but maize by only about 100% whereas zinc rose by more than 200%. Fluctuations of +100% or more and nearly -50% occurred in the prices of all the commodities during the period of the simulation: any reduction in such extreme instability is desirable. In addition, purchases and sales of commodities by the CRD represent stabilising increases and reductions in imports over the commodity price cycle: this contribution to reducing the instability of Pakistan's commodity trade is desirable for both producers and users of the commodities.

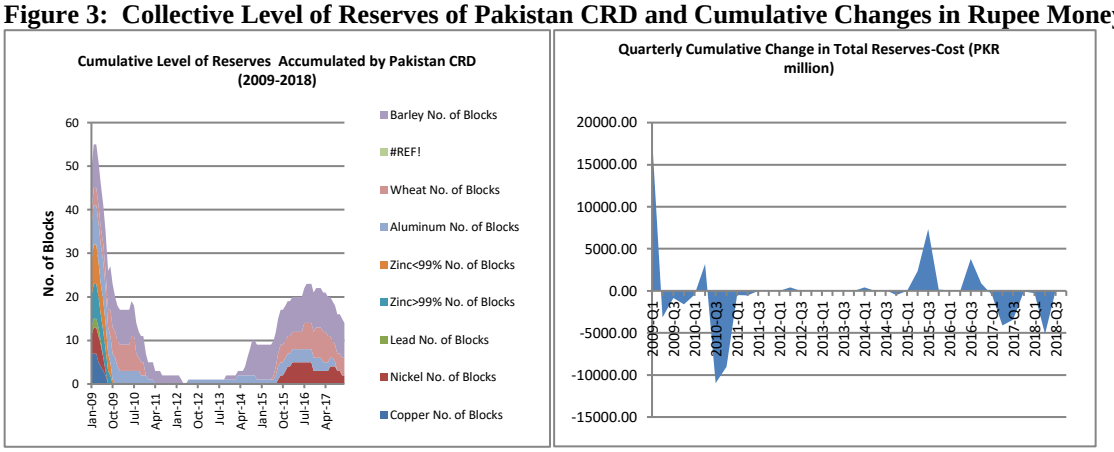
During the period of the simulation, the Rupee-Dollar exchange-rate depreciated from approximately 82 Rupees per Dollar in 2009 to approximately 105 Rupees per Dollar in 2017, before sliding to 138 at the end of 2018 (and 166 in mid-2020) – that is, by about 3% per year over the first 9 years of the simulation, followed by much faster depreciation of approximately 16% per year since then. The effect of a falling exchange-rate is to raise Rupee commodity prices, which reduces the average level of reserves held by the CRD, other things being equal. However, the CRD was nevertheless required to purchase reserves of most commodities during the second fall in commodity prices in 2014 – 2016 (i.e., without changing its initial prices from several years earlier). Hence exchange-rate depreciation of 3% per year is not sufficiently fast to prevent the CRD operating as intended, since commodity market price fluctuations are typically much larger. By contrast, the rapid depreciation of the Rupee-Dollar exchange-rate since 2018 would seriously impact the CRD's operation through loss of reserves. However, the present situation is not typical of recent decades, and will presumably not continue. Moreover, a CRD's operation would help to ameliorate it by stabilising primary commodity import quantities and prices.

The third graph in each line of Figure 2 shows the effect on the Rupee money supply of the CRD's operations in respect of each commodity, expanding it when prices were falling, and reducing it when prices were rising. In the present simulation the CRD's selling prices are some 20% above its buying

prices, and so whenever reserves of a commodity fall to zero the result is a net reduction in the Rupee money supply.

Figure 3 shows the collective effect on the money supply of the CRD's operations in respect of all commodities combined. It demonstrates the CRD expanding the Rupee money supply as commodity prices fell prior to 2009, and then reducing it as commodity prices rise from 2009 through 2012. The money supply increases again as commodity prices fall again from 2014 through 2016, and then falls again as prices rise again through 2018. That is, the combined effect of the CRD's counter-cyclical stock-holding of the nine different commodities shown in these graphs clearly shows the counter-cyclical timing of the system's influence on the Rupee money supply. The timing of the expansion and subsequent reduction of the CRD's reserves is precisely counter-cyclical for each individual commodity. Collectively it exerts a stabilising influence on the real value of the currency, and thence on the economy.

Figure 3: Collective Level of Reserves of Pakistan CRD and Cumulative Changes in Rupee Money Supply



For this reason, as for the traditional gold standard, there would generally be no need for the State Bank to neutralise the variations caused in the money supply by the CRD, and *a fortiori* no need to raise taxes to pay for the CRD's reserves. Indeed, it is likely that the State Bank would generally choose to amplify the CRD's effects, in order to increase its stabilising influence on the real value of the Rupee, resisting both deflation and inflation. The only cost of implementing the system are the cost of preparing storage facilities, and the cost of a small administrative staff (Grondona specified that all costs of appraisal and transport of reserves would be paid by the commercial buyer or seller).

Potential for improved simulation

In the above simulation it is notable that reserves of copper, lead and zinc fell to zero within two years of the start of the simulation, and did not accumulate again during the decade of the simulation, due to the metals' Rupee market prices remaining above the CRD's initial buying prices. Grondona's proposed that the prices in the CRD's price-schedule for any of its commodities rise annually by a pre-specified annual percentage if the CRD went for two years (or other pre-specified time) without holding reserves, until it eventually accumulated reserves again. This could reduce the number of years during which the CRD held no reserves. Future simulations will illustrate this possibility, by specifying that the CRD's lower points (buying prices) of various commodities rise annually as required until reserves accumulate.

The staff responsible for deciding the initial conditions for the CRD's operation cannot be expected to achieve theoretically optimal terms of implementation – as can be done *post facto* using hindsight. Nevertheless, prior consultation with professionals would include expert views on not only trade in each commodity – including the price cycle, import quantities, world trade quantities and domestic and

international industry trends – but also on trends in macroeconomic variables including economic growth, exchange rate and inflation. This would clearly enable more nearly optimal gearing than the simulation above, which used a single fixed rule-of-thumb to decide the gearing for all the different commodities.

Another way to improve the simulations would be to include a factor to simulate the effect that a CRD might have in partially stabilising commodity market prices. Any such effect will depend primarily on the scale of the CRD, and most importantly on the size of each Block of reserves of each commodity relative to the average quantity of daily trade in that commodity, and the range of fluctuations in this. Most trade in primary commodities is done via medium-term contracts, and does not pass through commodity spot-markets, which represent the marginal trades: consequently, even a relatively small Block of CRD reserves could have a significant influence on spot-market prices.

Future implications

In the following some of the more important issues arising from the simulation are discussed.

a) Stabilising influence on exchange-rates: The above simulation clearly shows the counter-cyclical timing of the CRD's operations as it partially stabilises the real value of the Rupee in terms of selected commodities. Since movements in the Rupee exchange-rate alter commodity prices expressed in Rupees, they will lead to offsetting purchases or sales of reserves by the CRD that tend to stabilise the exchange-rate. In this way the CRD will exert an indirect stabilising influence on the exchange-rate, which, even on a small scale, is desirable in helping to resist destabilising "one-way" movements in foreign exchange markets.

b) Multi-national implementation: A particularly interesting aspect of the Grondona system is that if several countries established CRDs, the monetary effects of their operations would be closely correlated, since they are activated by the same commodity market price movements, and all the CRDs' actions are similar in principle, purchasing reserves when market prices fall below the long-term average, and selling them as market prices rise again. That is, even if their implementation was not formally coordinated in any way, they would nevertheless operate synergistically, provided that they were established following the same guidelines. The CRDs will therefore exert an overall stabilising influence on all the different countries' mutual exchange-rates, since the different countries' domestic money supplies would expand and contract in response to broadly the same commodity market price-movements. This is potentially an extremely promising "side-effect" of implementing the Grondona system, which could subsequently be enhanced through increasing the number of countries establishing a CRD, and increasing their scale, as well as through consultation and coordination of their terms of implementation. In addition, multiple CRDs' influence in stabilising commodity markets – both trade quantities and prices – would be greater than any CRD acting alone, by increasing the scale of predictable, counter-cyclical stock-holding of the commodities involved.

c) Towards conditional gold convertibility: Grondona did not include gold in his system, because it is not a major industrial commodity, and is not imported in large quantities, so that stabilising its trade would not in itself have a major stabilising influence on the economy. However, there is no problem preventing its inclusion within a CRD's scope, although the conditions on which it should be included would need different considerations than for other primary commodities. Hence the introduction of *conditional* gold convertibility could be a low-risk step towards reviving the monetary role of gold. As experience accumulated, the CRD's gearing could be progressively "tightened", narrowing the range between the CRD's lower and upper "points" and/or increasing the size of the "Blocks".

d) Potential benefits of implementation by D-8 member-countries: The Research Center for Islamic Economics (IKAM), in collaboration with the Scientific Studies Association (ILEM) and the Turkish Entrepreneurship and Business Ethics Association (IGIAD), organized the 7th Islamic Economics Workshop at Marmara University in April, 2019, on the theme of "Monetary Issues in Islamic Economics" (Final Declaration, 2019). The central issue is to design effective policy measures that will help to free Islamic and other countries from the present-day, international "*Riba*" system of privately controlled, debt-based fiat money which is used throughout the world. The Workshop's Final Declaration included a number of summary statements referring to this:

> . . . few reserve currencies are ruling over international markets with exorbitant advantage over others, leaving the weaker ones exposed to daily artificial fluctuations of exchange-rates . . .
>
> . . . countries should reduce their dependence on reserve currencies and vehicle currencies, specially the US Dollar, in their bilateral trade . . .

> . . . the need for devising pragmatic policies towards achieving an Islamic monetary system was accentuated . . . (Final Declaration, 2019).

The above simulation of the Grondona system as it could operate in Pakistan shows that it has the potential to contribute substantially to all three of these requirements. That is, it will help to insulate the economies of countries which implement the system from fluctuations in exchange-rates; it will facilitate wider use of implementing countries' national currencies in international trade; and the ability to implement it independently makes it a "*pragmatic policy*", which could contribute greatly towards achieving an Islamic monetary system.

Perhaps most importantly, without the need for any prior coordination, different countries' systems automatically follow the same counter-cyclical timing of stock-holding. Hence, if the D-8 countries each implemented the Grondona System on approximately the same scale relative to their national economies, the total quantity of reserves held by the 8 CRDs would be several times larger than any country alone, leading to proportionately much greater stabilising influence on primary commodity trade and prices.

In addition, the mutual exchange-rate-stabilising influence of the 8 CRDs would also be proportionately greater. Indeed, this influence will benefit from the "Network Effect" that has become famous as the factor that drives Internet services to grow rapidly to large scale: each additional country that establishes a CRD will benefit from its mutual exchange-rate stabilizing influence with all the other countries that have already established a CRD. Consequently, the more countries that establish a CRD, the greater their mutual exchange-rate-stabilising influence will become, increasing proportionately more than the essentially linear increase in their collective stabilising influence on commodity markets.

This effect of the adoption of the Grondona System by several countries has many further benefits. Reducing mutual exchange-rate fluctuations will facilitate the use of each other's currencies in mutual trade, instead of using a 3rd-party currency such as the US dollar. This will in turn facilitate agreements such as the sharing of data and use of currency swaps between central banks as measures to resist and/or ameliorate currency crises and other problems. Further still, as experience of the systems' operation accumulated, their growing stabilising influences on the group of currencies of the implementing countries would evolve naturally into an informal currency "bloc", as they make the same monetary responses to external shocks, in a way which might later even develop into the basis of a common, commodity-backed currency.

In Conclusion

While the simulation discussed in this paper is encouraging, it is important to recognise the limits of the present study. The most important of these is the assumption made that the system would have no influence on world commodity market prices nor on the national exchange-rate. Any influence on world commodity prices will depend primarily on the scale of the CRD, and most importantly on the size of each Block of reserves of each commodity relative to the average quantity of daily world trade in that commodity, and the range of variation in this. Most trade in primary commodities is done via medium-term contracts, and does not pass-through commodity "spot" markets, which represent the marginal trades: consequently, even a relatively small Block of CRD reserves could have a significant influence on spot market prices. For example, large excursions in spot prices sometimes occur at times of thin trading: in such cases a CRD could well have a significant stabilising influence. The importance of this in relation to the above simulation is that the frequency and scale of CRD transactions would be less than seen above, the greater its stabilising influence on market prices. The less reserves the CRD was required to buy and sell, the less profits it would earn from sales, and so less of the cost of maintaining the CRD's storage facilities would be offset, increasing the cost to government. However, more

stable market conditions would of course have many other benefits, which could well outweigh this cost. This limitation of the above simulation could be reduced by including a factor to represent the effect that the CRD might have in partially stabilising commodity market prices, at the cost of increasing both the complexity and uncertainty of the model.

Similarly, the expansion and contraction of the money caused by the CRD's operations might at times have an influence on the exchange-rate, though this would likely occur only during times of thin trading on foreign exchange markets. In addition, the uncertainty about any likely effect on exchange-rate expectations, as discussed above, makes this difficult to predict and so to include in the simulation. Although additional factors could be introduced to simulate either pro-cyclical or counter-cyclical expectations, it is not clear that these would be sufficiently important to include, and so they seem less of a priority for further analysis.

Finally, overall, the above discussion suggests that the D-8 countries in particular could benefit considerably from implementing the Grondona System of conditional currency convertibility based on primary commodities, as simulated above for the case of Pakistan. That is, the independent, counter-cyclical, macro-economic stabilising influence of the *Shariah*-compliant Grondona System has the potential to re-introduce an element of commodity-based convertibility of the currency used. This would be a welcome step away from the purely fiat currencies that are currently in use world-wide, despite their well-understood flaws. Implementing the Grondona System could also help countries defend their economies against external shocks, whether economic or geo-political in origin. It therefore seems desirable that D-8 member-states perform detailed feasibility studies of possible implementation of the Grondona System, including selection of candidate commodities and grades thereof, planning and simulation of optimal "gearing" for each, sizing and site-planning of warehouses, and drafting of the legislation needed for establishment of national CRDs.

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