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COMMITTEE ON COMMODITY PROBLEMS

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| **INTERGOVERNMENTAL GROUP ON TEA** |
| **Twenty-first Session** |
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| **IMPACT OF MACROECONOMIC FACTORS ON THE GLOBAL TEA ECONOMY** |

I.   INTRODUCTION

1.   After a couple of decades of depressed prices, a slow but sustained increase in international tea prices began, reaching a 24-year high of USD 2.65 per kg in August 2008. After a slight correction occurred in the last quarter before prices surged to reach a record level of USD 3.90 in November 2009, the highest price since the FAO Tea Composite Price (FTCP) was created in 1989. Prices retreated in early 2010 but remained high by historical standards through to the end of 2013.

2.   The rise in world tea prices occurred against the background of tight global supplies due to the restructuring of the tea market over the previous decade, bringing supplies in line with demand, adverse weather experienced by some major tea producers and a steady growth in world demand, notably in emerging markets. It also occurred against the background of a general increase in commodity prices: crude oil, copper, zinc, coffee and as well as food prices and other major commodities, particularly between 2006 and 2008 (Figure 1). The increasing trend of commodity prices during this period was reflected in the International Monetary Fund (IMF) commodity price index which rose by a cumulative 10 percent in 2008, following a 30 percent increase over the previous 12 months (December 2006 to December 2007), and an overall increase of 194 percent for the decade (2002-2011). Although, commodity specific factors, such as supply shocks, can explain movements in prices, the general rise in commodity markets indicated that there were common factors that influenced the upward movement in commodity values. These factors were demand related and macroeconomic in nature (Gilbert, 2010)1. The extent to which these factors contributed to changes in tea prices and their impact on the tea market is the subject of this document.

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[1] Gilbert, C. "How to understand high food prices". Journal of Agricultural Economics, Vol. 61, No2, (2010)

Figure 1. Changes in selected commodity prices in index form
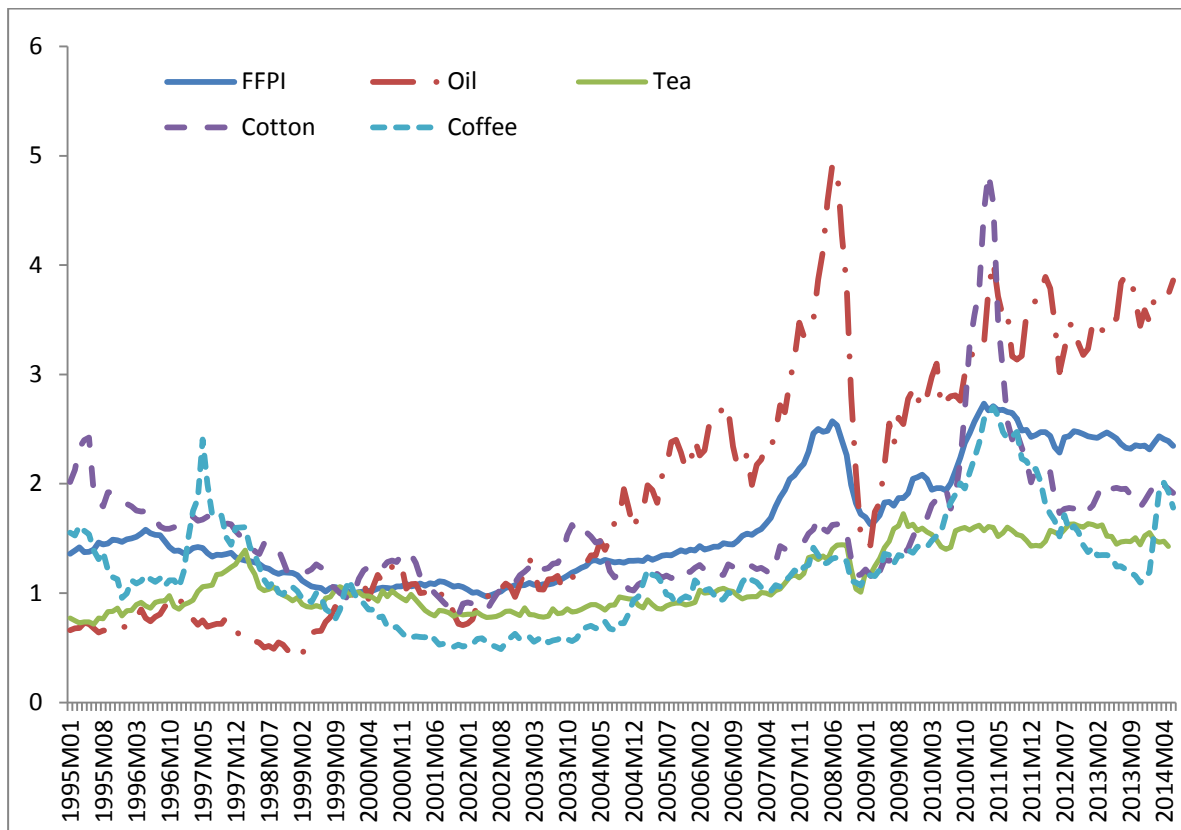
Note: Oil: crude oil WTI; Tea: FAO Tea Composite price; FFPI: FAO Food Price Index; coffee: coffee Arabica; cotton: cotton A Index.

3.   The general consensus is that there was no single factor responsible for the price surge of agricultural commodities, but rather a set of factors. Headly and Fan(2008)[2] explained that commodity specific factors, such as weather related shocks, were less likely to increase in international prices of a range of agricultural commodities than factors that were common across commodities, such as: i) growing aggregate demand of emerging markets; ii) depreciation of the United States dollar (USD); iii) rise in energy prices; and iv) expansion in monetary policy.

II.   METHODOLOGY AND APPROACH

4.   Apart from the tight supplies in the tea market in 2008 and 2009, the upward trend in prices was also influenced by factors driving the boom in other commodity markets. One of these factors was expanding per capita income levels, particularly in emerging economies. Although tea consumption is considered a habit, rising per capita income does increase consumption of higher quality teas, which are higher priced and hence, drive up the value of tea purchased. Another cross commodity factor was the depreciation of the USD against major currencies which helped shore up aggregate demand because the USD is the main currency used in international tea trade. Among the major tea importers, the Russian Federation, the largest tea importing country, the rouble strengthened by 19 percent between 2003 and 2008, rendering less costly imports of tea. Similarly, the Egyptian pound gained 10.6 percent over the same period. Another factor that contributed to the increase in commodity prices was energy prices. The IMF energy index grew by 358 percent between July 2003 and July 2008. In the case of tea, higher energy prices meant higher production costs and greater costs for transporting

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[2] Headly, D., and Fan, S. "Anatomy of a crisis: The causes and consequences of surging food prices". Agricultural Economics, Vol .39, (2008).

tea from the field to the processing factory and ultimately to the consumers. Another factor that impacted on the prices of commodities was an expansionary monetary policy adopted by most OECD countries which kept central bank rates at historical lows. As a result, credit to the economy grew at the expense of credit quality and contributed to rapid increases in aggregate demand for goods and services. For tea, easier access to credit may have boosted demand for tea through, for example, increased accumulated inventory of made tea.

5.   The quantitative analysis in this paper was carried out in two stages. First, in order to provide empirical evidence linking demand related factors to international tea price movements in the long-run, a set of pairwise Granger causality tests was applied using the FTCP and four cross-cutting factors, described in the previous paragraph:

1) Changes in the value of the USD relative to a broad group of major currencies (XR);
2) United States three-month Treasury Bill, as a measure of world liquidity (INT_RATE);
3) Imports of goods and services into emerging developing countries, as a proxy for growth in GDP per capita in emerging economies (IMP_EM); and
4) Energy prices as a measure of changed in the cost of energy (ENER).

6.   The analysis period was from January 2000 to July 2014 and deflated using the World Bank Manufacturing Unit Value (MUV), while real interest rates were computed as nominal interest rates minus inflation rates, with the United States CPI used to generate the inflation rate series. In the second stage of the analysis, the FAO World Tea Model was used to quantify the impact of changes in per capita GDP and crude oil prices, on world tea consumption, production, trade and prices.

III.   MAIN RESULTS

A.   GRANGER CAUSALITY ANALYSIS

7.   The Granger causality test is an econometric tool that determines whether one variable X is useful in predicting the value of another variable Y (see equation 1). If that is the case, then it is useful to include variable X as an explanatory variable in a causal model. The analysis carried out looked at whether changes in the FAO tea composite price could be explained by cross commodity factors (USD exchange rate, real interest rates, imports of goods and services into emerging developing countries, and energy prices) discussed in the previous section and being viewed as important.

$$P_t = \theta_0^{P,M} + \sum_{i=1}^{n} \alpha_i^{P,M} P_{t-i} + \sum_{i=1}^{n} \beta_i^{P,M} M_{t-i} + \epsilon_t^{P,M} \tag{1}$$

With P = FTCP and M = XR, INTER_RATE, IMP_EM, ENER

The Granger test is conducted by testing the following null hypothesis:

$$H_0^{P,M} = \beta_1^{P,M} = \beta_2^{P,M} = 0 \tag{2}$$

8.   The tests would reveal if the estimated coefficient of the explanatory variables was significantly different from zero. For example, if the estimated coefficient for XR were significantly different from zero, then XR would cause movements in the FAO Tea Composite Price (FTCP). If the coefficient was not significantly different from zero, then XR would not help predict changes in FTCP.

9.   Prior to running the test, it was important that the variables used in the Granger causality test be stationary. This meant that their mean and variance should not change over time and should not follow any trends. Stationarity was tested using the Augmented Dickey-Fuller (ADF) test. The application of the test showed that all variables were integrated of order 1, implying that they were not stationary. Often, variables that were stationary could become stationary after differencing them. All differenced variables for this analysis were found to be stationary, and hence, the Granger causality

test was applied to the selected variables in their differenced form. Finally, the number of lags was chosen on the basis of information criterion, such as the Akaike information criterion (AIC) and the Schwarz information criterion (SC).

10.   It was also important to note that the Granger causality approach had two drawbacks. First, it did not reveal anything about contemporaneous causation, as the explanatory variables entering the model needed to be specified in lag terms. Second, it suffered from missing variable bias. That is, a third variable Z (not explicitly specified in the model) might be causing both variable P and M to move together, although no causation relationship existed between both P and M. Despite these shortcomings, the Granger causality approach provided preliminary responses regarding causal relationship amongst specific variables.

11.   Results showed that Granger causality was established for the FTCP, with respect to all four factors, meaning that XR, INT_RATE, IMP_EM, and ENER, caused changes in the FTCP over the sample range (See Table 1). For example, the statistical test could detect a causal link between imports into the emerging markets (IMP_EM), as a proxy for development in per capita income, and the FTCP at the five percent level of significance. This supported the claim that common demand-side factors such as per capita GDP and USD exchange rates, contributed to price changes in tea. A causal relationship between energy and tea prices was also established at the 5 percent level. Increases in energy prices were transmitted to the tea sector through increases in transportation, fertilizer and manufacturing costs, which shifted the supply curve to the left and pushed prices upwards. Non-fundamental factors such as changes in monetary policy also influenced movements in the FTCP. A monetary policy that was accommodative led to downward pressure on the cost of money, with interest rates settling at low levels. This situation tended to boost asset and commodity prices Frankel (2014)[3]. Agricultural futures markets might have provided a possible route through which movements in interest rates were transmitted to agricultural commodities. Given the existence of strong co-movements between agricultural products, including tea[4], it emerged that changes in interest rates caused movements in the FTCP. Low interest rates also tended to boost aggregate consumption for goods and services and that was another channel through which changes in interest rates could transmit to commodity markets, including tea.

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[3] Frankel, Jeffrey A. "Effects of speculation and interest rates in a "carry trade" model of commodity prices" Journal of International Money and Finance, vol. 42(C), (2014).
[4] For example, correlation between FAO food price index and the FAO Tea composite price was found to equal 85 percent over the sample period and significant at the 5 percent level.

Table 1. Results from the Granger test

VAR Granger Causality test

Sample: 2000M01 2014M07

Included observations: 167

Dependent variable: D(TEA)

	Chi-sq	df	Prob.
D(XR)	9.315496	3	0.0254
D(IMP_EM)	10.10137	3	0.0177
D(ENER)	10.61964	3	0.014
D(INT_RATE)	8.095735	3	0.0441
All	31.89194	12	0.0014

Note: D, means in difference term

XR: United States dollar exchange rate

IMP_EM: Imports from developing and emerging markets

ENER: Energy price index

INT_RATE: United States 3-month Treasury-Bill

12.   Several implications could be drawn from this first stage of the analysis. There was evidence that demand related factors, such as per capita GDP, represented by changes in import demand for goods and services from emerging and developing markets, as well as other variables such as changes in USD exchange rates, money supply through its effect on interest rates, and energy prices, impacted movements in tea prices over the long-run. Market or crop specific factors, such as drought in Kenya and India in 2008 and 2009, respectively, were important in explaining tea price behaviour. However, the analysis showed the need to look beyond those factors inherent in the tea market itself in order to isolate the full range of factors contributing to price movements. A good understanding of those factors would help policy makers in the design of well targeted policy responses.

B.   FAO WORLD TEA MODEL - SIMULATION RESULTS

13.   After exploring the statistical causal relationship between the FAO Tea composite price and a selection of macroeconomic variables, the FAO World Tea Model was used to simulate the effect of changes in per capita GDP and oil prices on the world tea market, to measure the macroeconomic impact on production, consumption, trade and world tea prices.

14.   The analysis was carried out on black tea only, as historical data on green tea was incomplete. First an ex-ante simulation was run, wherein per capita GDP in some of the main tea consuming and producing countries was increased by 10 percent. Results of this simulation were compared with the baseline estimates for the medium-term outlook presented in the Current Situation document (CCP:TE 14/Inf.2), with the difference between simulated values and actual values being attributed to the change in GDP per capita. Similarly, a second ex–ante simulation was run wherein world crude oil price was raised by 50 percent. Other exogenous variables were kept at their baseline levels. The approach used for this analysis was to assess the impact of increases in income and crude oil prices

individually. This was done in order to isolate their separate effects on the tea market. More often than not, an expansion in economic activity was concomitant with increases in crude oil prices.

## C.   HIGHLIGHTS OF THE MAIN SCENARIO RESULTS

15.   The scenario using higher GDP had the effect of raising world tea prices by 8 percent over the projection period, in comparison to the baseline. Impact was particularly pronounced in the short term with an average price increase of 13 percent. Supply response in the longer term resulted in lower prices in the latter years of the projections. World consumption was simulated to increase by 4.6 percent, implying an average income elasticity of about 0.46. This was in line with expectations, given the relatively small income elasticity of demand that characterises the international tea markets.

16.   Results showed that the percentage change in consumption following a 10 percent increase in GDP ranged between 1 and 12 percent (Table 2). Traditional import markets of the United States and United Kingdom recorded changes of about 1.3 percent and 1.4 percent, respectively, as income elasticities were relatively small. Pakistan showed the largest percent change (+11.6), followed by Kenya (+6.8), China (+5.3), Indonesia (+3.9) and Bangladesh (+3.8). India showed an increase in consumption of 3.6 percent, implying an income elasticity of demand of 0.36. These results showed that although income changes were found to be statistically significant in explaining movements in tea prices (as illustrated in the previous section), their effects on tea consumption was generally relatively moderate. World tea trade, measured by total imports, also increased moderately by 4.2 percent.

Table 2. Changes in tea consumption following a 10 percent increase in GDP per capita (in metric tonnes)

	Simulation	Baseline	% Change
Pakistan	148274.7	132873.6	11.6
Kenya	30855.8	28881.5	6.8
China	303837.4	288495.6	5.3
World	3567905.8	3410003.6	4.6
Indonesia	34485.7	33194.8	3.9
Bangladesh	68863.9	66356.7	3.8
India	1118650.0	1079466.2	3.6
Sri Lanka	39978.6	38730.3	3.2
United Kingdom	121877.5	120223.1	1.4
United States	124386.5	122747.4	1.3
EU27	200396.9	198016.2	1.2
The Russian Federation	162585.3	160980.3	1.0

Source: Secretariat of the FAO IGG on tea

Figure 2. Impact of high crude prices on world tea quotations
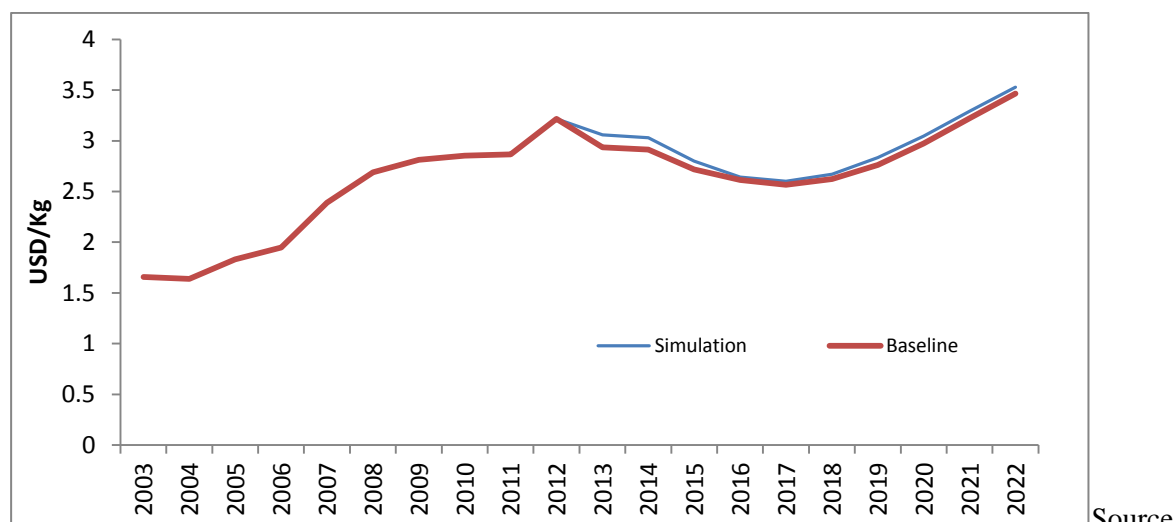
Source:

Source: Secretariat of the FAO IGG on Tea.

17.   The second scenario of higher crude oil prices had the effect of a modest increase in world tea prices of about 2.5 percent, compared to the baseline. The impact was larger in the short-term with an average price increase of 4 percent, before tapering off, as higher prices stimulated a positive supply response. Also, the overall impact on production was small (-0.25 percent), highlighting the relatively low energy intensive crop production systems. However, one of the options to offset rising labour cost, as discussed during the last meeting of the IGG, was to increasingly rely on mechanised systems of production. This would strengthen the linkages between energy prices and production costs, and eventually lead to a much larger impact of energy prices on world tea prices and markets. As with other trade models, an increase of 50 percent in oil prices should be read as indicative only, because of the complex linkages that exist between energy and agricultural markets.

IV.   CONCLUSIONS

18.   The objective of this analysis was to isolate the effect of some cross-cutting commodity factors that contributed to the recent general surge in commodity markets on movements in international tea prices. These factors were generally macroeconomic in nature and demand related. For this analysis, four macroeconomic factors were selected, these included: i) growing aggregate demand from emerging markets; ii) depreciation of the USD; iii) rises in energy prices; and 4) expansion in monetary policy. The results showed that while the effect of these macroeconomic variables on changes in world tea prices was statistically significant over the sample range, their impact on the tea market, using the FAO World Tea Model, was relatively small, although not negligible. Indeed, two simulation exercises were developed, where per capita income was increased by 10 percent, and then crude oil prices were raised by 50 percent. In the first case, international prices increased by 8 percent, while in the second case, they rose by 2.5 percent.

19.   This analysis implied that market specific factors, such as supply shocks, explained most of the movements in tea prices. Droughts and pests that curtail production had larger effects on prices. Any over-reaction to the recent improvements in tea prices by expending output uncontrollably, particularly in terms of bringing new areas under tea, would lead to a significant reduction in prices. Previous analysis conducted by the Secretariat showed that long-run elasticity estimates for major producing countries confirmed that several countries were likely to respond to rising prices, while one in particular showed the opposite, possibly because of an articulated policy to limit area expansion. A large positive shift in supply could favour an increase in exports and alter the supply/demand balance at the world level, which in turn would depress tea prices.

20.   Some gaps had been recognized while conducting the analysis and suggestions on areas for further research are presented below. The Group is requested to consider these and recommend priorities for future research:

- Key parameters of the FAO World Tea model need to be revised/updated, including income and price elasticities of demand. The Group, through the Task force on Statistics and Projections, is requested to collaborate with the Secretariat to carry out the required revisions and updates. The Task Force is also requested to provide the Secretariat with reliable macroeconomic data to help towards the development of a more accurate market outlook for tea.
- Speculation in commodity futures markets had often been cited as a likely cause for the recent surge in international commodity prices. However, as tea is not traded in futures markets, future research could perhaps analyse the speculative effect of tea sold at auctions, as well as other parts of the value chain.