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STABILIZATION OF ECONOMIC FLUCTUATION AND COMMODITY PRICE

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I. INTRODUCTION[1]

The wide and rapid fluctuations in the world market prices of primary products was described as one of the greatest evils in international trade by Keynes [see: Singer 1996]. In an article published in the Economic Journal 1938 Keynes has shown that the average annual price range of four representative commodities (rubber, cotton, wheat and lead) over the last ten years had been 67 per cent. He therefore proposed initially a world currency based on a bundle of 30 primary commodities to stabilize automatically their average price while not ruling out fluctuations of market prices of individual commodities against this average. [see: Singer & Jolly, 1996, p 6]. as Singer pointed out „A world commodity based currency would also have contributed to global macroeconomic

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[1] Paper written for the international meeting of the School of Business and Finance of the University of Split (Croatia): „J.M.Keynes: Fifty Years After and Beyond" at Dubrovnik, 8 - 10. November 1996

I am very indebted to Hans W. Singer. The topic of this paper is mainly due to several earlier discussions with him and his publications cited in this paper. I want also to appriciate the valuable comments from Richard Hule and Herbert Stocker. Of course I am solely responsible to all errors remain.

stability; in slack times when commodity prices were low international buffer stocks would have been accumulated, thus injecting additional liquidity into the world economy, and vice versa in the case of inflationary demand pressures and high commodity prices", [see: Singer, p 2]. Thus, though full employment is the main issue of the Keynesian Consensus the stabilization of primary commodity prices was regarded to be very important by Keynes who was a fervent supporter of such stabilization as was appreciated by Singer and Jolly.

In the Bretton Woods system proposed by Keynes there was in addition to the IMF and World Bank an essential third pillar: an International Trade Organisation with commodity price stabilization as its major function [see Singer + Jolly, 1996].

Economic policy measures, especially measures concerned with primary commodities, have been mainly designed and implemented in order to achieve other effects than to stabilize prices (for instance, support prices have been implemented to support the income of commodity producers; acreage allotment system have been implemented to reduce the surplus of primary commodity production; sales taxes have been introduced to collect tax revenue for the government etc.) Economic policy measures, however, usually have also effects on the volatility of commodity prices, even if they are implemented to achieve other effects than to influence the volatility of the commodity prices [see: Just, 1990; Chen, 1994].

In this paper the effects of a commodity based currency proposed by J.M.Keynes to stabilize will be studied.

This paper is organized as following:

In the Section 2 a simple partial equilibrium model with an additive stochastic error term for a competitive commodity market will be constructed to study the effects of economic policy measures on the volatility of commodity prices. In the Section 3 the buffer-stock measure inplemented to stabilize price of primary commodities will be studied as a preparation for analysing the effects of a commodity based currency which links the buffer-stock with the supply of money. In the Section 4 the basic macroeconomic model to study the Keynes proposal is constructed.

The proposal of a commodity based currency by Keynes will be discussed in more detail in Section 5 & 6. The commodity based currency is studied in the framework of a macroeconomic IS-LM-model with a primary commodity.

A brief summary will be given in the Section 7. Throughout this paper the volatility of a variable is represented by its variance.

II. A BASIC MODEL FOR PRIMARY COMMODITY:

A simple basic model for a perfect competitive market of a primary commodity with stochastic demand and supply functions is constructed for discussing the influences of economic policy on the volatility of commodity prices. The contrast between perfect competitiveness on the market for primary commodities and imperfect competition for manufacturies is argued by some economists to contribute to the long-run deterioration of terms of trade against the primary commodities [see: Bloch & Sapsford 1991]. Therefore, perfect competition seems to be a representative market form for most primary commodities, although elements of imperfect competition are found in at least some primary product markets.

The stochastic elements in the model are introduced to capture the disturbances due to factor such as droughts, wars, natural disasters, etc. Both the disturbances on the demand and supply side of primary commodity markets are assumed to be independent and not autocorrelated.

In applying the equilibrium approach a perfect competitive market of primary commodity can be modelled by the following linear demand and supply function with a stochastic additive disturbance term respectively:

$$Q = a_0 - a_1 P + a_2 Y + u \quad \text{(demand function)} \qquad ...(1)$$

$$Q = b_0 + b_1 P + b_2 X + v \quad \text{(supply function)} \qquad ...(2)$$

where Q: transaction amount, P: price of primary commodity Y: an exogenous variable in the demand function, for instance,

income, etc., X: an exogenous influence factor in the demand function, e.g. factor price, technical change), u,v: random disturbances on demand and supply of the commodity

A linear partial equilibrium model is constructed because of its analytictractability.

With the exception of b_0 all parameters are specified as non-negative, i.e. $a_0, a_1, a_2, b_1, b_2 \geq 0$.

The equilibrium price, and transaction quantity, the volatility of commodity price of the above model are given by solving the above model as follows:

$$P^* = \frac{a_0 - b_0 + a_2 Y - b_2 X + u - v}{a_1 + b_1} \tag{3}$$

$$Q^* = \frac{a_1 b_0 + a_0 b_1 + a_2 b_1 Y + a_1 b_2 X + b_1 u + a_1 v}{a_1 + b_1} \tag{4}$$

$$\sigma^2_{P^*} = E(P^* - EP^*)^2 = \frac{\sigma^2_u + \sigma^2_v}{(a_1 + b_1)^2} \tag{5}$$

$$\sigma^2_{Q^*} = E(Q^* - EQ^*)^2 = \frac{1}{(a_1 + b_1)^2}(b_1^2 \sigma^2_u + a_1^2 \sigma^2_v) \tag{6}$$

The variances are calculated under the assumption that both X and Y are non stochastic exogenous variables and u and v are stochastically independent

$$\text{and } \sigma^2_u = E(u - Eu)^2 \text{ with } Eu = 0 \text{ and}$$

$$\sigma^2_v = E(v - Ev)^2 \text{ with } Ev = 0$$

are the variance of disturbances in the demand and supply function respectively. E is used as expectation operator. The expectation of both random disturbances is assumed to be zero. Primary commodities like metals and cotton are bought by producers of final products. Thus the demand for primary commodities is a

derived demand which is determined by price of product and factors as well as output. The same approach is followed by Bloch & Sapsford [1996]. Most primary commodities can also be used by consumers. In this case the demand is determined by prices of primary commodities and income according to the utility maximization principle. Thus the demand function specified in the above basic model can be interpreted as intermediates bought by producers or as consumer's good bought by consumers.

The linear demand and supply functions specified in the basic model for primary commodities in this section do not fullfil all the properties derived for the utility maximization behavior of consumers or profit maximization behavior of producers for the demand and supply function, respectively. For instance, both the demand function and supply function of primary commodity in the basic model do not fullfil the property of freedom of monetary illusion of the consumer and producer correspondingly, as the demand and supply function specified in the basic model are not homogenous. The main reason for this simple model is the analyticatractability of a linear model. Another form of demand and supply functions which are also easy to analyzed is a logarithmical linear model. The later case has two shortcomings for this paper; first, it implies a special stochastic property that the variance is no more constant as assumed in the basic model above; second, there are some problems for combining the basic model with a macroeconomic model to study the linkage effect (feed-back-effect) between primary commodity sector and the macroeconomic sector.

III. BUFFER-STOCK:

Buffer-stocks are one of the most discussed measures to stabilize commodity prices. There are different variants of buffer-stock measures. In this Section we want to consider the case that the buffer-stock is used to stabilize the commodity price at a special level T. The basic model is modified for this case as follows:

$$D = a_0 - a_1 q + a_2 Y + u \qquad \text{demand function} \qquad (7)$$

$$S = b_0 + b_1 q + b_2 X + v \qquad \text{supply function} \qquad (8)$$

$$I = D - S \qquad \text{buffer-stock change}$$

$$\int_0^t Idr = buffer - stock \qquad (9)$$

with q: target price
D: demand
S:supply
I: buffer-stock change

To be able to stabilize the market price at the level $\bar{q}$ the authority should buy or sell the amount of commodity I = D - S on the market, i.e. if the market price rises above the goal price the authority should sell D - S on the market to keep the price at q. If the market price is going to decrease the authority should buy the amount of primary commodity S - D on the market.

Therefore the buffer-stock authority must have financial resources amount $q(S-D)$ to be able to keep the market price at the goal level q, if $S(q) > D(q)$, and a quantity of the primary commodity D - S, if $D(q) > S(q)$,where $D(q)$ and $S(q)$ are the active demand and supply at the price q respectively.

In the case that the buffer-stock authority can fullfil the above conditions the price of primary commodities can be stabilized at the goal level.

In the implementation of buffer-stocks many failures have occured either because of unsufficient stock accumulated for damping the pressure of increasing price in the period of a negative random shock in the production of primary commodity of unsufficient financial resources to buy commodities on the market for damping pressure of increasing commodity price due to positive random shocks in the commodity production. Therefore to provide sufficient financial resources for the implementation of buffer-stock has been an important issue [see: Singer, 1996, p 4-5].

IV. A MACROECONOMIC MODEL OF A COMMODITY BASED CURRENCY:

A commodity based currency combines the buffer-stock measure with the quantity of money. The central bank has the obligation to buy and sell the primary commodities at the price set by the buffer-stock authority from and to the private audience who sells or buys primary commodities to or from the central bank. Due to this obligation [of a commodity based currency] the central bank can print (increase) money to buy primary commodities. Thus the problem of financing the buffer-stock can be solved. The price of primary commodities can be stabilized at the level set by the buffer-stock authority. In implementing the commodity based currency the central bank becomes the authority to run the buffer-stock.

Summarizing this short despription of the proposal for a commodity based currency by Keynes there are two main properties which have to be considered in the model:

(1) The buffer-stock is used to stabilize the price of primary commodities at a level set by the authority; and

(2) There is a direct connection between the implementation of buffer-stock measure and the quantity of money in the economy.

To consider the first point we modify the basic model for primary commodity given in the Section II as follows:

$$D = a_0 - a_1 q + a_2 Y \tag{10}$$

$$S = b_0 + b_1 q + v \tag{11}$$

$$I = S - D \tag{12}$$

with D,S: demand and supply of primary commodity
q: goal price of primary commodity set by the buffer-stock authority
I: buffer-stock change (increase if I > 0 and decrease if I < 0)
Y: national income (endogenous variable)
v: random disturbance on the supply side with Ev = 0

In the above modified model there are two sorts of participators on the market for primary commodities, i.e. the producers and users of primary commodities and the buffer-stock authority who has to keep the market price stable at the goal price level. The former ones are called active and the later ones the passive participators of the commodity markets. To keep the model simple we consider only one commodity. The most important difference between the basic and the modified model for a commodity based currency is that the price in the first model varies to arrive the equilibrium of the demand and supply on the market. In the later model the price is set at q. The usual market mechanism of the price to arrive at the equilibrium of active demand and active supply is removed. Therefore only in average the market of the active demand and supply be in the equilibrium .

A further simplification in the modified model is made by assuming that random disturbances occurre only on the active supply side.

Now a macroeconomic model of the IS-and LM-type is attached to study the interdependence of a commodity based currency on primary commodity and national income.

$$Y = \alpha_{10} - \alpha_{11} r + \alpha_{12} G \qquad \text{(IS-curve)} \qquad (13)$$

$$Y = \alpha_{20} + \alpha_{21} r + \alpha_{22} (\bar{M} + m) \qquad \text{(LM-curve)} \qquad (14)$$

$$m = I.q \qquad \text{(link between buffer-stock and money supply)} \qquad (15)$$

where Y: national income;
r: interest rate
G: public spending;
$\bar{M}$: independent money supply
m: change of quantity of money due to buffer-stock activity of the central bank.
$I = S - D > 0$: commodity bought by the buffer-stock authority
$I < 0$: commodity sold by the buffer-stock authority
$\alpha_{ij} > 0$ for i = 1,2; j = 0,1,2
Both the IS-and LM-curve are assumed to have the usual properties, i.e. $\alpha_{ij} > 0$ and $\alpha_{11} + \alpha_{22} \neq 0$

The last equation shows the link between the buffer-stock activity of the central bank and the supply of money. This can be explained by „Keynes's favorite idea of a linkage between commodity control and macroeconomic monetary control" [see: Singer, 1996, p 6].

V. NEUTRAL BUFFER-STOCK GOAL PRICE:

The goal price of the buffer-stock is set by the authority. Since there are several ways of modelling the buffer-stock measure according to the kind of setting the goal price by the authority. The first case to be considered is that the goal price is set at the expected equilibrium market price of the active demand and supply. This price is called the neutral buffer-stock goal price since the authority will not influence the trend of the commodity price. The active demand and supply are demand of buyers and producers on the commodity market, respectively. In this case the goal price can be determined at

$$E(D) = E(S) \quad \text{i.e.}$$

$$a_0 - a_1 q + a_2 Y = b_0 + b_1 q \tag{16}$$

Thus

$$q = \lambda_1(\lambda_0 + a_2 Y) \tag{17}$$

where $\lambda_1 = (a_1 + b_1)^{-1}$; $\lambda_0 = a_0 - b_0$

At this global price the expected active market transaction quantity is given by

$$EQ = \lambda_1(a_1 b_0 + a_0 b_1 + a_2 b_1 Y) \tag{18}$$

Now a complete commodity based currency macroeconomic IS-LM model with a neutral buffer-stock goal price can be given als follows:

$$Y = \alpha_{10} - \alpha_{11} r + \alpha_{12} G \tag{19}$$

$$Y = \alpha_{20} + \alpha_{21} r + \alpha_{22}(\bar{M} + m) \tag{20}$$

$$m = I.q \tag{21}$$

$$D = a_0 - a_1 q + a_2 Y \tag{10}$$

$$S = b_0 + b_1 q + v \tag{11}$$

$$I = S - D \tag{12}$$

Following the neutral buffer-stock goal price

$$\bar{q} = \lambda_1(\lambda_0 + a_2 Y) \tag{22}$$

where $\bar{q} = Eq$

$\lambda_1 = (a_1 + b_1)^{-1}$

$\lambda_0 = a_0 - b_0$

$$I = -\lambda_0 + \lambda_1^{-1} q - a_2 Y + v = v \tag{23}$$

$$m = \bar{q}\, v = \lambda_1(\lambda_0 + a_2 Y)v \tag{24}$$

The solutions of the complete model are

$$Y^* = \frac{A_{11} + \lambda_0\lambda_1\alpha_{22}v}{B - \lambda_1 a_2 \alpha_{11}\alpha_{22}v} \tag{25}$$

$$r^* = \frac{A_{21} - (\lambda_0 - a_2\alpha_{12}G)\lambda_1\alpha_{22}v}{B - \lambda_1 a_2 \alpha_{11}\alpha_{22}v} \tag{26}$$

$$q^* = \lambda_1\lambda_0 + a_2\lambda_1 Y^* \tag{27}$$

where $A_{11} = \alpha_{11}(\alpha_{20} + \alpha_{22}\,\bar{M}) + \alpha_{12}\alpha_{21}G + \alpha_{21}\alpha_{10}$

$B = \alpha_{11} + \alpha_{21} > 0$

$A_{21} = \alpha_{12}G + \alpha_{20} + \alpha_{22}\,\bar{M} + \alpha_{10}$

To avoid a senseless solution we assume that

$$B - \lambda a_1 \alpha_{11} \alpha_{22} v > 0$$

To compare the solutions of the usual IS-LM model and the commodity based currency IS-LM model with neutral buffer-stock goal price the solutions of the usual IS-LM model are stated below:

(a) National income $Y^* = \frac{A_{11}}{B}$

(b) Interest rate $r^* = \frac{A_{21}}{B}$

The comparison shows that both the solutions for national income and interest rate in the commodity based currency IS-LM model have an additional random term not only in the denominator but also in the numerator, respectively.

It's easy to show the following results:

(1) The multipliers of changing public spending and money supply in the commodity based currency model are equal to those of the usual IS-LM model if v = 0 (i.e. if there is no disturbance in the commodity sector.

(2) A positive random disturbances (shock) in the commodity sector has positive effect on the national income (which implies also an positive effect on employment) due to the commodity based currency.

A positive disturbance, i.e. v > 0 will have a negative effect on the commoditiy price due to increasing active supply in usual case without commodity based currency. In the later case the central bank who is responsible for the commodity based currency will buy the additional supply on the market to keep the buffer-stock goal price and due to this action additional quantity of money is inserted into the economy and induces therefore a multiplier effect for national income and employment.

A negative random disturbance, i.e. v < 0 will have an opposite effect on the national income and employment. In this case

the central bank should sell commodity to keep the commodity price at the buffer-stock goal level.

(3) A positive random disturbance in the commodity sector will have a negative effect on the interest rate in the commodity based currency model while there is no such effect in the usual IS-LM model.

(4) Due to the commodity based currency the random disturbance in the commodity sector is passed through to the macroeconomic sector by changing money supply connected with the buffer-stock activities of the authority.

(5) The volatility of national income induced by the commodity based currency is approximately equal to

$$[\frac{(a_0 - b_0)}{a_2 \alpha_{11}}]^2$$

where three out of four factors which determine the volatility of national income are factors in the commodity sector, i.e. $a_0, b_0, and\ a_2$. Another factor α_{11} is a combination by factors which determine the sensibility of dependence of investment on interest rate and the marginal propensity to saving.

Surprisingly, the interest rate elasticity of demand for money does not have an influence on the volatility of national income.

(6) There is a random disturbance factor on the buffer-stock goal price induced by the national income linked between macroeconomic activity and commodity sector by the commodity based currency.

(7) The volatility of buffer-stock goal price is approximately equal to

$$[\frac{(a_0 - b_0)}{(a_1 + b_1)\alpha_{11}}]^2$$

since the commodity price is influenced by national income on the demand side.

(8) The commodity based currency induces a built-in flexibility for the macroeconomic acitivities as well as a stabilization effect on the commodity price due to the buffer-stock measures and ist links to the supply of money.

Keynes originally proposed a basket of thirty primary commodities (both agricultural and metals) to supplement gold as part of the international currency reserves [see: Singer 1996, p 4]. As Singer explained „in this way the average price (price index) of the thirty primary commodities would have been automatically stabilized while leaving the price of each individual commodity to fluctuate in relation to the average to specific market conditions, and maintaining neutrality between the commodities included in the basket". A question open to be answered with a basket of commodities is the problem of the „bimetal currency."

VI. CONSTANT BUFFER-STOCK GOAL PRICE:

Keynes seems to have proposed a neutral buffer-stock goal price [see: Keynes 1938]. In this section a case of constant buffer-stock goal price will be studied. The commodity based currency model is modified for this case as follows:

$$Y = \alpha_{10} - \alpha_{11} r + \alpha_{12} G \tag{19}$$

$$Y = \alpha_{20} + \alpha_{21} r + \alpha_{22} (\bar{M} + m) \tag{20}$$

$$m = I.q \tag{21}$$

$$D = a_0 - a_1 q + a_2 Y \tag{10}$$

$$S = b_0 + b_1 q + v \tag{11}$$

$$I = S - D \tag{12}$$

where $\bar{q}$ is kept constant by the buffer-stock authority.

For simplicity $\bar{q}$ is set at 1. Thus

$$m = I = (b_0 - a_0) + (a_1 + b_1) - a_2 Y + v \tag{28}$$

After inserting the above equation for m into the macroeconomic model:

$$Y - \alpha_{11} r = \alpha_{10} + \alpha_{12} G \tag{29a}$$

$$(1 + a_2\alpha_{22})Y - \alpha_{21} r = \alpha_{20} + \alpha_{22}[\bar{M} + (b_0 - a_0) + (a_1 + b_1) + v] \tag{29b}$$

The last equation is the LM-curve under consideration of the links between the monetary and commodity sector due to the commodity based currency. The equilibrium solutions of the national income and interest rate of the above model are:

$$Y^* = \frac{\alpha_{21}(\alpha_{10} + \alpha_{12}G) + \alpha_{11}\alpha_{20} + \alpha_{11}\alpha_{22}[\bar{M} + (b_0 - a_0) + (a_1 + b_1) + v]}{\alpha_{21} + \alpha_{11}(1 + a_2\alpha_{22})} \tag{30}$$

$$r^* = \frac{(1 + a_2\alpha_{22})(\alpha_{10} + \alpha_{12}G) - \alpha_{20} - \alpha_{22}[\bar{M} + (b_0 - a_0) + (a_1 + b_1) + v]}{\alpha_{21} + \alpha_{11}(1 + a_2\alpha_{22})} \tag{31}$$

$$m^* = (b_0 - a_0) + (a_1 + b_1) - a_2 Y^* + v \tag{32}$$

Now some comparisons between the multipliers in the usual IS-LM model and in the above model of a commodity based currency with a constant buffer-stock goal price can be easily shown:

(1) The multipliers of public spending and money supply on the national income and interest rate are smaller in the commodity currency based model. Thus the commodity based currency with constant buffer-stock currency has a built-in flexibility effect on the macroeconomic acitivities.

(2) There is link from the random disturbance in the commodity sector to the macroeconomic sector due to the

commodity based currency. The volatility of national income is equal to

$$\sigma_Y^2 = [\frac{\alpha_{11}\alpha_{22}}{\alpha_{21} + \alpha_{11}(1 + a_2\alpha_{22})}]^2 \sigma_v^2 \tag{33}$$

The volatility of national income will be higher if the multiplier of changing money supply on the national income is higher, and vice versa.

(3) The interest rate under the commodity based currency is also influenced by the random disturbances in the commodity sector. The volatility of interest rate is given as follows:

$$\sigma_r^2 = [\frac{\alpha_{22}}{\alpha_{21} + \alpha_{11}(1 + a_2\alpha_{22})}]^2 \sigma_v^2 \tag{34}$$

(4) The volatility of money supply linked by the commodity based currency is given:

$$\sigma_m^2 = a_2^2\sigma_Y^2 + \sigma_v^2 - a_2\sigma_{Yv}^2$$

$$= \{1 - \frac{a_2\alpha_{11}\alpha_{22}(\alpha_{21} + \alpha_{11})}{[\alpha_{21} + \alpha_{11}(1 + a_2\alpha_{22})]^2}\}\sigma_v^2 \tag{35}$$

VII. SUMMARY:

The influences of economic policy on the volatility of commodity markets are studied in this paper. Many economists are concerned about the volatility of commodity development. But the influences of economic policy on the volatility of commodity prices have been rarely discussed though policy for stabilization of commodity prices have been intensively studied in the literature of development economics.

Policy measures implemented to achieve other effects also have influences on the volatility of commodity prices. The cases studied in this paper show clearly the relevance of policy measure with respect to the volatility of price. Though the models constructed in this paper are very simple but the results seem to be relevant for policy makers for their decisions.

To stabilize the strong fluctuation of commodity prices Keynes once proposed to introduce a commodity based currency. Due to the links between buffer-stock activities and the money supply by a commodity based currency Keynes proposed that the commodity price would be stabilized and also the macroeconomic fluctuations.

To study this Keynes' proposal a macroeconomic model connected with a simple model for a primary commodity is constructed in this paper.

The links between commodity sector and the macroeconomic sector, especially the monetary sector, are explicitly considered in the model. Two cases of buffer-stock measures are studied in combination with the macroeconomic acitivities in this paper.

The first case concerns a buffer-stock goal price which is set at an average equilibrium market price of active market demand and supply. In this case the commodity price is determined by fundamental market forces. This price of commodity should not be changed by buffer-stock measure. Therefore the buffer-stock is neutral with respect to the market price. The stabilization achieved by the buffer-stock is restricted on the price fluctuations due to the random shock occurs in the commodity sector.

The second case deals with a constant buffer-stock goal price for the commodity. In this case the commodity market will in

general not be in equilibrium. The buffer-stock authority has to intervene in commodity market by buying or selling commodities to keep the price of primary commodity at the constant goal price. The links between buffer-stock activities and the supply of money induce an indirect effect of the buffer-stock activities on the commodity market.

The multipliers of public spending as well as supply of money in the model of a commodity based currency are lower than those in the usual IS-LM model. Thus, the links of buffer-stock acitivites and supply of money due to a commodity based currency has an implication of built-in flexibility for the macroeconomic activities. Therefore a commodity based currency does not only stabilize the price of primary commodities but also makes the macroeconomic development more smoothly. A commodity based currency as the Keynes's proposal might have a problem like the bimetal currency known as the Gresham's law. Since in this paper only one primary commodity is considered we don't touch at this point. But it seems to be relevant to consider this problem in more detail.

The very benefit of a commodity based currency as a policy measure to stabilize the price of primary commodity is that the problem of providing financial resources for implementing buffer-stock measure is automatically solved since there is free convertibility between primary commodity and currency due to a commodity based currency.

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