THE IMPACT OF EXCHANGE RATE POLICY ON THE SUDANESE AGRICULTURE

Mohamed B. ELGALI (1), Rajaa H. MUSTAFA (2) S. BAUER (3)[1]

Abstract

This paper aims at assessing and quantifying the impact of devaluation of exchange rate policy on the agricultural sector of the Sudan. The main agricultural exports of the Sudan are expected to increase considerably after oil exploitation in 2000; but export volumes have not changed and remained around the same figures before oil exploitation. In this paper a multi-market model is used as a main tool to assess the policy impact on the agriculture. Multi-market analysis is a tool for simulating the effects of agricultural price policies on outcomes considered of interest to policy makers (Braverman et al. 1987). Sudan is modeled as a small open economy on both the import and export side of the agricultural commodities with the exception of sorghum and millet products. The simulation results of the devaluation policy scenario indicate that the increase of producer prices as a result of the implementation of 23% currency depreciation would overall lead to measurable gains in Sudan's agricultural trade. Because of the competitiveness, non-traded food crops are negatively affected, worsening food security situation of the country.

1. Introduction

Sudan economy has been performing significantly well in the recent years. Real GDP growth has reported an average of 6.1% over the period 2001-2006. However, Sudan remains predominantly agricultural economy oriented despite the increasing reliance on oil, with agricultural sector accounting for 40% of the GDP average with a compounded growth rate of 4% over the same period.

The main Agricultural exports of the Sudan are expected to increase considerably after oil exploitation in 2000; but export volumes have not changed and remained around the same figures before oil exploitation figure (1). Furthermore, imports of cereals have sharply increased to reach 1.4 million tons

[1] (1) University of Gezira, Department of Agriculture Economics, Sudan (e.mail moelgali@yahoo.com)
(2) University of Gezira, Department of Agriculture Economics, Sudan
(3) Justus-Liebig-Universität, Institut für Projekt und Regionalplaung, Germany

in 2006. In total, Sudan balance of trade recorded a deficit of 2,416.9 US$ in 2006.Among one of the main reasons behind this situation is the increasing value of local currency against the US dollar, the value of the Sudanese pound has increased by 23% which have made export expensive and cheapened imports. Therefore, devaluation of the local currency arises as one of the policy options to enhance agriculture exports and to reduce the deficit in trade balance.

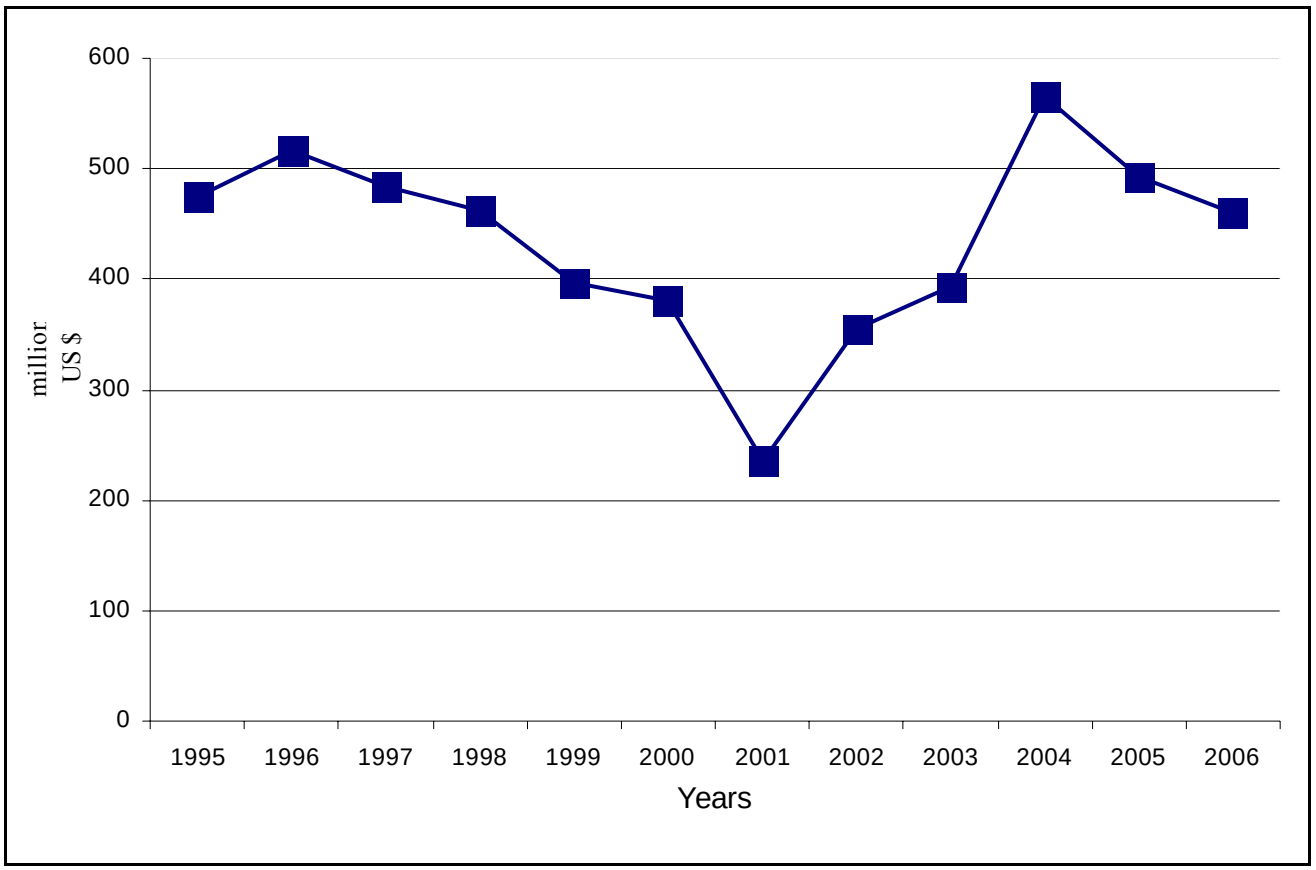

Figure (1) developments of the agricultural exports value 1995-2006

Source: Bank of Sudan

2. Background

The rate-of-exchange policy influences prices paid domestically to producers of export goods. For the rest of the world what counts are prices expressed in foreign currency. Depreciation means that, given the domestic price, the unit price of the exportable, in dollars, decreases. Domestic producers and consumers react to prices in domestic currency: for a given world price, devaluation increases the internal price of the exportable.

Devaluation implies that, for given world prices, prices received per unit of exports or per unit of import substitute (tradables) in national currency increase relative to prices of non-tradables. Therefore,
(1) Productive resources shift from non-tradable to tradables. Production of these commodities is stimulated.
(2) Consumption demand shifts from tradables to non tradables (Cuffaro, 2003).

There are three main reasons why governments sometimes resort to devalue their currencies. The first reason for devaluing is the resulting improvement in the current account, a development the government may believe to be desirable. Second, devaluation allows the government to fight domestic unemployment despite the lack of effective monetary policy. If government spending and budget deficits are politically unpopular, for example, or if the legislative process is slow, a government may opt for devaluation as the most convenient way of boosting aggregate demand. The third motive behind devaluations is their effect on the central bank's foreign reserves. If the central bank is running low on reserves, a sudden, one-time devaluation can be used to draw in more (Maurice, 2003).

When countries devalue their currencies; the local currency price of a commodity at the export market increases by the full proportion of devaluation, if world price does not change. In a competitive market, assuming that the marketing margin bears a proportionate relation to farm gate price, a 10 percent increase in price at export point would be expected to lead to a 10 percent increase in farm gate price. For the exchange rate change to be reflected at farm gate, however, a time lag may be involved (Ahmed and Mellor, 1987).

A depreciation of the exchange rate means that not only does the price of imports increase in terms of domestic currency, but also import substituting commodities become more competitive. For example, devaluation would raise the price of imported cereals and increase demand for domestically produced cereals. The price of domestically produced cereals rises (up to point where it equals the import price), and, production increases replacing imports. Similarly, exchange rate depreciation causes the domestic price of exported commodities to fall in terms of foreign exchange and to rise in terms of domestic currency thus stimulating production (Cuffaro, 2003).

3. Research objectives

This paper aims at assessing and quantifying the impact of devaluation rate of exchange policy on the agricultural sector of the Sudan. The general objective of the paper is to examine the impacts of the devaluation policy on Sudan's agricultural production and trade. The following specific objectives are studied:

i Analyzing the effects of the expected change in producer price of agricultural products evolving from the devaluation policy.
ii Assessing the changes in agricultural trade of Sudan due to the devaluation policy.
iii Analyzing the impacts of this change on the food security situation of the country.

4. Methodology and Data

4.1 A Multi-market Model for Sudan: General Features and Equations

In this paper a multi-market model is used as a main tool to assess the policy impact on agriculture. Multi-market analysis is a tool for simulating the effects of agricultural price policies on outcomes considered of interest to policy makers (Braverman et al. 1987).

Sudan is modeled as a small open economy on both the import and export side of the agricultural commodities with the exception of sorghum and millet products. The model under consideration takes the normal specification of a

standard partial equilibrium model; it is static and consists of a set of demand and supply equations for each commodity with the level of production and demand determined by factors including prices, income, demand and supply-shift variables and various other assumptions about policies (see Kirschke and Jechlitschka, 2002, and Abdel Karim, 2002). In specifying supply and demand functions for each product, domestic prices for one market help to determine the quantity supplied and demanded not only in that market but also in the other market through cross-market price linkages. Price transmission equations in the model establish links between the domestic price, the producer price (for producers of exportable products and of import-substitute products), the consumer price and the world market price taking into account the devaluation policy.

Ten key agricultural commodities of the Sudanese agriculture are considered in the model. The major exports are sesame, ground nut, sugar, cotton, arabic gum and livestock. Wheat and rice are the two major imports; sorghum and millet are the main local non-traded food. The model has been extended to calculate the impact of devaluation on the main economy variables which include exports, imports and the balance of trade. Also, the model is capable of calculating the effects on the food security situation of the country.

4.1.1 The Supply Equations

The supply of each commodity is represented by the quantity produced which is function of its own price and the prices of the competing commodities. The product supply equations represented as follows:

$$q_i^s = c_i * (p_i^s)^{\varepsilon_{ii}} * \prod_{j \neq i} (p_j^s)^{\varepsilon_{ij}}, \qquad i, j = 1,.....,10 \tag{1}$$

Where

q_i^s is the amount of the i th commodity supplied

c_i is the supply calibration coefficient of the i th commodity

p_i^s is the supply price of the i th commodity

p_j^s is the supply price of the j th product

ε_i is the supply price elasticity of the i th product

ε_{ij} is the supply cross price elasticity of the products j th that are competing the i th product

j is the set of relevant product that compete with the i th product.

4.1.2 The Demand Equations

On the other hand, the demand (consumption) quantity of a commodity is set to depend on its own price, the prices of close consumption substitutes or complementary commodities and the consumer per capita income. So, the system of the demand function can be expressed as follows:

$$q_i^d = b_i * (p_i^c)^{\eta_{ii}} * \prod_{i \neq j} (p_j^c)^{\eta_{ij}} * I^{\mu_i}, \qquad i,j = 1,....10 \qquad (2)$$

Where,

q_i^d is the amount of the i th commodity demanded

b_i is the demand calibration coefficient of the i th commodity

p_i^c is the demand price of the i th commodity

I is per capita income

η_i is the demand price elasticity

η_{ij} is the cross price elasticity of the i th commodities that are complementary or substitutes for the j th commodities.

μ_i is the income elasticity of the i th commodity.

4.1.3 Price Transmission in the Model

The illustration of the price-linkage equations assumes that the government could control the domestic price through policy measure of exchange rate. Also, it assumes that the movements in producer and consumer prices are connected to the world price movements. (For exportable products and of import-substitute products). The price of the local traded products is determined by the country's supply and demand, and, not affected directly by the exchange rate policy measure. Therefore, price transmission in the model is represented as follow:

(i) Producer and consumer prices of the export and import-substitute commodity *i* is shown by the following equation:

$$P_i = P_i^w * R\,(1+d) \qquad (3)$$

Where,

P_i is the producer and consumer price for the commodity i

P_i^w is the world price of the commodity i

R is the exchange rate value

d the devaluation percentage

(ii) Producer and consumer price of the local non-traded commodities is shown by the equation:

$$P_i = P_i^o \qquad (4)$$

where,

P_i^o is the domestic price

4.1.4 Imports and Exports

Exports and imports are calculated in the model by summation of exported commodities value or imported commodities at the situation of policy adopted.

Total exports

$$TE = \sum (q_i^s - q_i^d)\,p_i^w, \qquad i = 1,\ldots,6 \qquad (5)$$

Total imports

$$TM = \sum (q_i^d - q_i^s)\,p_i^w, \qquad i = 1,\ldots,2 \qquad (6)$$

4.1.5 Food Security Indicators

USAID defines food security as: ″When all people at all times have both physical and economic access to sufficient food to meet their dietary needs in order to lead a healthy and productive life."

Cereals of sorghum, millet, wheat and rice which are the major staple food for the population are used as the food security component in the model. National macroeconomic indicators of food availability used in the model are food deficit, percentage of vulnerable population, self-sufficiency ratio of cereals (SSR), ratio of imports to production of the imported food, and finally, food import bill.

Food Deficit

$$FD = \sum (Cons. - q_i^s), \qquad i = 1,\ldots,4 \tag{7}$$

Vulnerable population

$$VP = (Cons. - (\sum q_i^s + \sum q_i^{im}))/PCC, \qquad i = 1,\ldots,4 \tag{8}$$

Self sufficiency ratio

$$SSR = \sum q_i^s / Cons., \qquad i = 1,\ldots,4 \tag{9}$$

Raito of imports to production

This ratio is applicable to only import-substitutes commodities

$$RIMP = \sum q_i^{im} / \sum q_i^s, \qquad i = 1,\ldots,4 \tag{10}$$

Food Import Bill

$$FIMB = \sum q_i^{im} * p_i^w \quad i = 1,\ldots,2 \tag{11}$$

whereas: (*Cons.*) = total cereals consumption and

PCC = per capita consumption of cereals.

5. The Scenario Model

The parameters of the supply and demand equations are calibrated so as to reproduce the base year 2006. The devaluation scenario simulate that the Sudanese currency is depreciated by 23% which represents the difference between the value at the year 2000 and the value in 2006.

6. Results

6.1 The Supply Effect

The simulation results of the devaluation effects on the supply of the main agricultural commodity markets covered by the model shows a noticeable increase in the supplies of exports and import- substitute; this is because of the direct effect of the increase in producer prices, while, local non-traded commodities would negatively affected.

Table (1) shows the percentage change in the supply of the main agricultural commodities covered by the model. The supply of major export commodities of arabic gum, cotton and livestock show higher response to the devaluation by supply increase of 10.9, 5.4 and 6.4% respectively. Sesame, ground nut and sugar supplies could increase by 2.9, 2.4 and 0.6%. Imports substitute supplies of wheat and rice also have shown an increase of 6.2% and 6.4% as a result of devaluation.

In the case of local non-traded food crops, output-price variations will basically respond to domestic supply and demand conditions. Therefore, Local traded commodities of sorghum ad millet have been affected negatively. They show a decrease in their supplies of 2.5 and 0.8% respectively. This is clearly attributed to the competitiveness of imports and exports in addition to that they are not gaining the direct increase in producer price from devaluation. This reduction on the supply of local traded crops has a negative effect on the food security of the country.

Table (1) supply effect of devaluation on the major commodities

Market	Base Year Supply (Ton)	Scenario Supply	Δ % Supply
Sesame (Ton)	**400,000.0**	**411,549.4**	**2.9**
Ground nut (Ton)	**555,000.0**	**568,180.0**	**2.4**
Sugar (Ton)	**728,000.0**	**732,535.3**	**0.6**
Arabic gum (Ton)	**20,618.0**	**22,866.5**	**10.9**
Cotton (Bale)	**482,492.0**	**508,646.3**	**5.4**
Livestock (Head)	**50,390,000.0**	**53,618,652.0**	**6.4**
Wheat (Ton)	**416,000.0**	**441,967.7**	**6.2**
Rice (Ton)	**1,000.0**	**1,064.1**	**6.4**
Sorghum (Ton)	**4,327,000.0**	**4,220,834.1**	**-2.5**
Millet (Ton)	**675,000.0**	**669,433.7**	**-0.8**

6.2 The Trade Effects

The simulation results of the devaluation scenario indicate that the increase of producer prices as a result of the devaluation policy implementation would overall lead to measurable gains in Sudan's agricultural trade and for the Sudan economy as a whole. The exports of main agricultural commodities will increase due to the expansion in domestic production leading to a positive growth rate in national income, recovery of the country's balance of trade and to an increase in government revenues. The imports of food products will decrease as the domestic production of import substitutes increases (figure 2).

The effect of devaluation on key export products show a great potentiality in increasing the export value of livestock by more than two fold and half, that export value could increase to 259.3%. The other major exports of ground nut arabic gum, cotton and sesame could increase by 31.1, 23.6, 7.4 and 5.3 % respectively. Although sugar supplies have shown a slight increase, sugar exports would decrease by 1.1% in its exports. This is attributed to the lower sugar's price elasticity of demand compared to income elasticity of demand. In addition to that the model has considered the increase in per capita income resulted from the devaluation in the demand function.

On the other hand, imports of wheat and rice show a decrease in quantity imported by 5% and 1.5% respectively. This is because of the increase of the

consumer price as a result of devaluation. In total the scenario show a significant increase in total exports of 78.8% that is from 431.5 million US$ to 771.7 million US$, while imports would decrease by 4.8% from 349.9 to 332.9 US$ (Table 2).

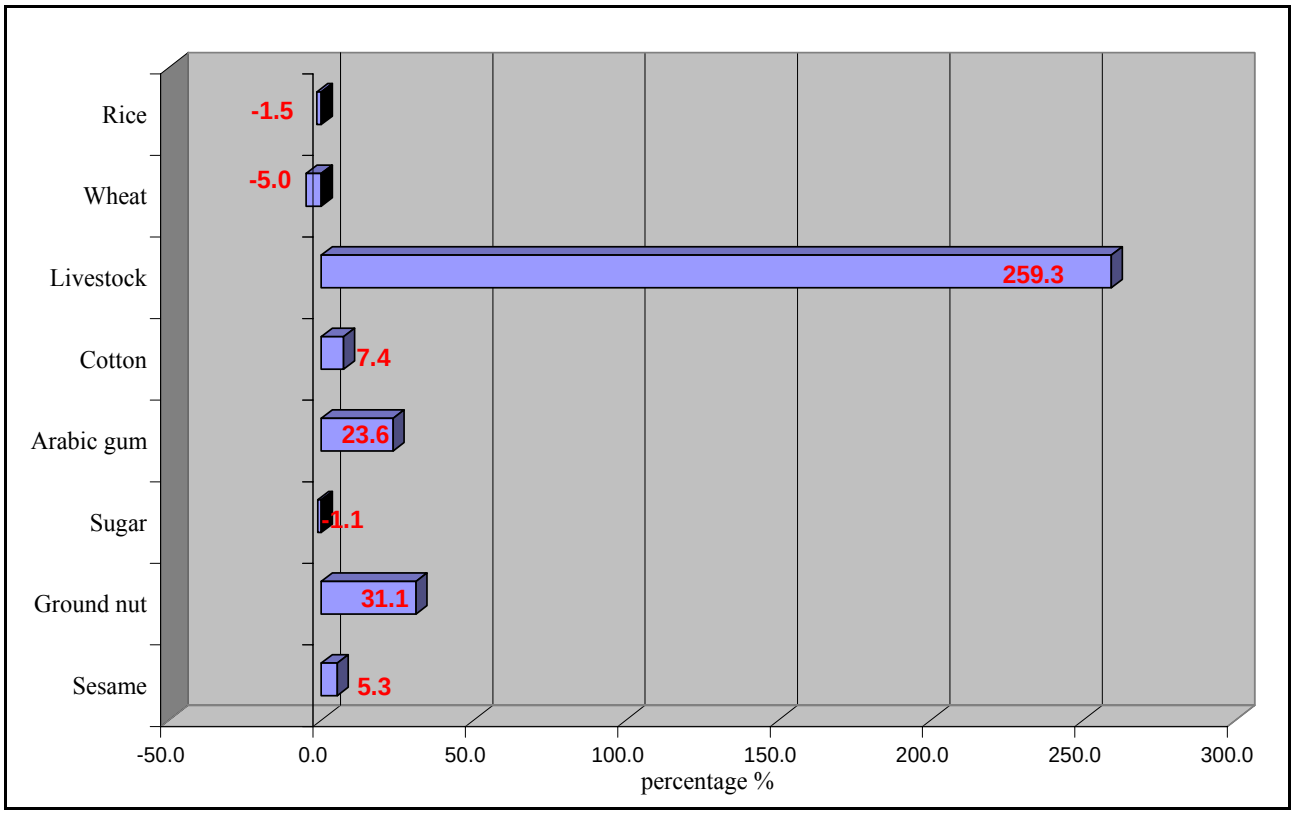

Figure (2) Trade effect of devaluation on the major commodities

Table (2) Trades effect of the devaluation on total exports and imports

Total	Base year	Scenario	Δ %
Exports $	**431,547,000**	**771,693,755**	**78.8**
imports $	**349,866,000**	**332,856,469**	**-4.8**

6.3 Food Security Indicators

Food self-sufficiency (in the sense of the country's ability to produce enough food to meet all its domestic demand) and food security have been major issues of concern in Sudan for quite some time. This concern has grown during the eighties, the years of drought and in the nineties, during the war time, and recently because of the displacement of the refugees in western Sudan. The country production of cereals fluctuates according to rainfall, it is about 3.3 and 5.4 million ton in the years 2005 and 2006 respectively (Bank of Sudan, 2006).

Table (3) exposes some of the food security indicators that reflect the impact of devaluation on food situation. The food deficit indicator explains the amount of food which should be covered from imports and international aids. Food deficit in the country will increase by 4.7% that is from 1,826,000 ton to 1,911,700 ton, because of the substitution effect on the supplies of domestic commodities of sorghum and millet. Accordingly, this will affect the vulnerable population in the country who will increase by 2%. Although, import substitutes of wheat and rice supplies would increase as a result of price incentives caused by devaluation, self sufficiency ratio would decrease by 2% due to the higher reduction in sorghum and millet supplies. Because of the increase in producer prices of the import substitutes, the ratio of imported food to import-substitute production has decreased by 3.3% , and the imported food bill has also decreased by 4.9% (from 349,866,000 to 332,856,469 US$).

The positive effect of devaluation represented by an increase of 5% in per capita income resulting from the improvement in the agriculture production, will compensate the consumers. This shows that, on one hand the devaluation policy has negative effects on food availability. On the other hand, devaluation has positive impact with regard to food accessibility.

Table (3) The devaluation effect on food security indicators

Food security indicator	Base year	Scenario	Δ %
Food Deficit (ton)	**1,826,000**	**1,911,700**	**4.7**
Vulnerable Population (%)	**6.0 (2.2 million)**	**8.0 (2.8 million)**	**2.0**
Self Sufficiency Ratio	**0.748**	**0.736**	**-2.0**
Ratio of Imported to Produced Food*	**0.262**	**0.253**	**-3.3**
Imported Food Bill ($)	**349,866,000**	**332,856,469**	**-4.9**

*for import-substitutes

7. Conclusions

The simulation results of the devaluation policy scenario indicate that the increase of producer prices as a result of the implementation of 23% currency depreciation, would overall lead to measurable gains in Sudan's agricultural trade. The exports of main agricultural commodities will increase due to the expansion in domestic production leading to recovery of the country's agricultural balance of trade and to an increase in government revenues. Because of the competitiveness, non-traded food crops are affected negatively worsening the food situation. The imports of food products slightly decrease as the domestic production of import substitutes increases. Finally, devaluation would increase population access to food while they suffer on the food availability side.

References

Abdel Karim E. E., (2002), The Impact of Uruguay Round Agreement on Agriculture on Sudan's Agricultural Trade. PhD Thesis, HU Berlin, Shaker Verlag

Ahmed R.and Mellor J., (1987), Agricultural Price Policy, the Context and the Approach, IFPRI

Bank of Sudan, Annual Report, Khartoum, Sudan (Various Issues).

Braverman, A., Hammer, J., and Murdoch J., (1987), Wheat and Maize Pricing Policies in Hungary: Tradeoffs between Foreign Exchange and Government Revenue. *Agriculture Economics*

Cuffaro N., (2003), Economic Development, Agriculture and Macroeconomic Policies, National Agriculture policy center. Syria

Kirschke, D., Jechlitschka, K. (2002), Angewandte Mikroökonomie und Wirtschaftspolitik mit Excel. Lehr und Anleitungsbuch für computergestützte Analysen. München, Verlag Vahlen

Paul R. Krugman Maurice, 2003 International Economics, Theory and Policy, Obstfeld