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# Foreign Capital Inflow and Domestic Savings:
## A Model with a Latent Variable

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In this paper we have constructed and estimated a reduced form equation based on a macroeconomic model to examine the effect of foreign savings on the saving behavior of a small scale advanced economy with a developed capital market. In addition to the conventional macroeconomic variables our model contains a latent variable collectively reflecting time and country specific risk and policy factors as well as other unobservable variables. All estimations were done based on a set of pooled data on eight small developed countries covering the period 1965 through 1986.

Our results generally suggest that contrary to the findings by Gupta and others, which were mostly based on their study of developing countries, foreign savings do not substitute domestic savings. We showed that government expenditures and export positively influence domestic savings. According to our estimation exchange rate has a positive effect on domestic savings whereas interest rates seem to affect the savings income ratio negatively.

## I. Introduction

Any attempts to investigate the effect of foreign capital inflows on the levels of domestic savings and investment, we believe, should involve the analysis of the interactions among basic macroeconomic aggregates. Some previous studies — e.g., Leff and Sato (1980) and Fry (1980) —, addressing these relationships from the perspective of developing countries, take

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the supply of foreign savings (foreign capital inflows) as being perfectly inelastic (exogenous). This assumption may, to some extent, be justified in the case of many developing countries where capital markets are not well developed and there is little capital mobility. There are, on the other hand, a number of studies in which the supply of foreign savings is assumed to be perfectly elastic. For example, see Khan and Knight (1983) and Fry (1980).

It may, however, be more realistic to take the middle road and argue that under most circumstances the inflow of foreign capital could be triggered by economic as well as non-economic factors. In other words, an upward sloping supply of foreign savings seems more appropriate. In fact, Eaton and Gersovitz (1981) show that the foreign saving function is not perfectly elastic at the world interest rate adjusted for a country's specific risk factor. Sachs (1983) shows that the position and the slope of the foreign saving curve are determined by economic factors.

As mentioned earlier, although the prevailing argument in many recent studies seems to suggest that foreign savings (capital inflows) are nearly perfect substitutes for domestic savings, the nature of the links between capital transfers and the domestic capital market, through which other macroeconomic variables are affected, is not clearly spelled out. This may partly be due to the fact that most of the work done on this issue involves developing countries where functioning capital markets are almost nonexistent.

The approach taken in this paper differs from previous studies in three major ways. First, in order to be able to construct and test a true small-scale open macroeconomic model with perfect capital mobility, we depart from the tradition of looking at developing countries, where capital mobility is limited and domestic capital markets are underdeveloped. Our model is estimated based on a set of pooled data on eight OECD countries covering the period 1965 through 1986.[1] Second, the foreign savings variable is defined and identified as endogenous to the model. Third, in addition to the normal macroeconomic variables, the model presented in this paper contains a latent variable reflecting time and country specific risk factors and other unobservable variations. Based on a technique suggested by Hausman and Taylor (1977), the model has been estimated free from any time and/or country specific error components caused by the latent variable. It is important to note that the choice of the eight

[1] The countries included in the study are Austria, Belgium, Denmark, Finland, Greece, the Netherlands, Norway and Sweden.

OECD countries were quite deliberate. Unlike the developing countries — where capital transfers are more of a "policy variable" and other effects on domestic savings and other macroeconomic aggregates depend on the fiscal and monetary "policies" taken by the government in direct connection with such transfers — the selected OECD countries all have reasonably developed financial markets well connected to the international financial centers with little or no controls.

The pooled data allows us, first, to estimate the model free from any error components. Second, a transformed version of the data set enables us to look at the dynamics of the relationships among some of the variables.

## II. The Model

An exogenously effected capital inflow could both directly and indirectly, through its impact on interest rates, affect the level of output which would in turn increase domestic consumption, the level of import, and domestic saving. On the other hand, the lower interest rates brought about by capital inflow could have a negative effect on domestic savings. This will make the net effect of capital inflow on domestic savings ambiguous. Alternatively, a capital inflow (or outflow) could be regarded as a response to domestic macroeconomic changes — i.e., an economic expansion and increased demand for loanable funds and, thus, higher interest rates, with the exchange rate and foreign interest rates remaining the same. In the context of a simple Keynesian model, we will try to disentangle some of these relationships and identify and estimate the model.

We assume a small open economy with perfect capital mobility. That is, at equilibrium only one effective interest rate prevails. Short run interest rate discrepancies will result in the movements of funds into or out of the country. We further assume a constant return to scale and fixed prices: changes in the level of output will not result in price changes. The economy consists of three markets: the commodity market, the money market and the exchange market. We will analyze each market separately.

### *A. The Commodity Market*

Let us begin by writing a Keynesian equilibrium equation for the commodity market of the ith country at time period t.

$$(1.1) \qquad S_{it} + T_{it} + M_{it} = I_{it} + G_{it} + X_{it}$$

where S is saving, T is tax, M represents import, I is investment, G denotes government expenditures and X is export.

We assume at any given exchange rate domestic consumption, C, and saving, S, are determined by the level of disposable income, $Y_d$, and the domestic interest rate, r:

(1.2) $C = C(Y_d, r ; R)$

(1.3) $S = S(Y_d, r; R)$

where R represents the exchange rate.

The saving function can be written explicitly as:[2]

(1.3) $S = \overline{S} + s\,Y_d + \varphi r$

where s and $\varphi$ are the marginal propensity to save and the interest rate coefficient respectively. Assuming a proportional tax rate denoted by $\zeta$, we write:

(1.4) $S = \overline{S} + s(1-\zeta)Y + \varphi r.$

We follow the tradition of assuming that import, M, is also a function of disposable income. So we write:

(1.5) $M = M(Y_d ; R) ; \dfrac{\partial M}{\partial Y_d} > 0.$

And, again, assuming a proportional tax rate $\zeta$, we can write (1.5) explicitly as:

(1.6) $M = \overline{M} + (m - m\zeta)Y.$

We define investment as a function of interest rate and the level of disposable income:

(1.7) $I = I(Y_d, r ; R)$

$$\text{where } \frac{\partial I}{\partial Y_d} > 0 ; \quad \frac{\partial I}{\partial r} < 0.$$

[2] For the sake of clarity in notation time and country subscripts are only used when required.

Again, assuming a proportional tax rate, we can write (1.7) as a linear function:

$$(1.8) \qquad I = \overline{I} + (\phi - \phi\zeta)Y + \gamma\, r$$

where $\phi$ is the marginal propensity to invest and $\gamma$ is the interest coefficient which is expected to be negative. Substituting (1.4), (1.6) and (1.8) into the equilibrium equation, we can write the IS curve equation as:

$$(1.9) \qquad r = \frac{1}{\varphi - \gamma}\ \overline{Z} - \frac{s + m + \zeta(1 - s - m + \phi) - \phi}{\varphi - \gamma}$$

where $\overline{Z}$ represents all of the exogenous variables. That is:

$$\overline{Z} = \overline{I} + G + X - \overline{M} - \overline{S}.$$

It is important to note that a devaluation (or depreciation) of the country's currency will result in a shift of the IS curve to the right.

*B. The Money Market*

Our demand for money is defined by a typical Keynesian money demand equation with asset and transaction demands:

$$(1.10) \qquad H^d = \alpha Y + \beta r\ ;\ \alpha > 0\ ;\ \beta < 0$$

where $H^d$ represents demand for money and Y and r, as before, denote output and interest rate respectively.

Unlike the Keynesian money supply, the supply of money in our model is not totally exogenous. We assume that the money supply is at least partially dependent upon the changes in the country's reserve, E, where:

$$(1.11) \qquad E = X - M + F$$

and F is the net capital flow.[3]

[3] It is assumed that if the central bank adopts an accommodating policy then the money supply will also be directly dependent upon the level of output. Even if the central bank does not adopt an accommodating policy, the money supply will be indirectly affected by the level of output through its effect on import.

Let us assume the money supply, $H^s$, is proportionally related to the country's reserve. So we write:

$$(1.12) \quad H^s = \overline{H} + wE \; : \; w > 0.$$

Substituting (1.11) into (1.12), and recalling the import equation from the previous section, we can write:

$$(1.13) \quad H^s = \overline{H} + w(\overline{X} - \overline{M} - (m - m\zeta)\, Y + F).$$

We assume that the capital flow is made up of two parts: an exogenous part determined outside the system, $\overline{F}$, and an endogenous part which responds to the changes in the interest rate, given an exchange rate. We write:

$$(1.14) \quad F = F(r \; ; \; R) \; ; \frac{dF}{dr} > 0.$$

For simplicity, let us write (1.14) also as a linear equation:

$$(1.14)' \quad F = \overline{F} + \delta r.$$

Now adding (1.14)' to (1.13) and equating it to the money demand equation (1.10), we can write the LM curve equation as follows:

$$(1.15) \quad r = \frac{-1}{\delta w - \beta} \quad (\overline{H} + w\overline{X} - w\overline{M} + w\overline{F}) + \frac{\alpha + w(m - \zeta m)}{\delta w - \beta}\, Y$$

Recalling that $\alpha > 0$ ; $w > 0$ ; $m > 0$ ; $\zeta > 0$ ; $\delta > 0$ and $\beta < 0$, we can conclude that the slope of the LM curve is positive, and an exogenous change in X or F will result in a shift of the LM curve to the right.

*C. The Exchange Market: The Balance of Payments*

Based on the bookkeeping principle of the balance of payments, if the official reserve is to remain unchanged then the sum of the trade balance and the net capital flow must add up to zero:

$$(1.16) \quad X - M + F = 0$$

If $X - M + F > 0$, then the central bank experiences an increase in its reserve, and the opposite is true when $X - M + F < 0$. As mentioned before, we assume that the reduction and increases in reserve will result in changes in the money supply. On the other hand, the imbalances in the balance of payments (That is the imbalance between the trade balance and capital flow) under a flexible exchange rate system is expected to affect the exchange rate. So assuming that the demand for foreign exchange comes from import, capital outflow and official purchases, and that the supply of foreign exchange is a function of export, capital inflow and official selling, we write:

(1.17) $R = R(X, M, F, W)$

where R, X, M, F are defined as before and W represents some measure of the central bank's intervention in the exchange market. Recalling that import, M, was a function of Y and the capital flow, F, was at least partially determined by the interest rate (1.17) can be rewritten as:

(1.18) $R = F(X, Y, r, W)$.

## III. The Estimation

A reduced form equation resembling Gupta's model was derived from equations (1.3), (1.9), (1.13), (1.14) and (1.17). For easy reference let us rewrite them:

(1.3) $S = \bar{S} + (s - s\zeta)\, Y + \phi r$

(1.9) $r = \dfrac{1}{\varphi + \gamma} Z - \dfrac{s + \zeta(1 - s - m + \phi) - \phi}{\varphi + \gamma} Y$

(1.15) $r = \dfrac{-1}{\delta w - \beta} (\bar{H} + w\bar{X} - w\bar{M} + w\bar{F}) + \dfrac{\alpha + w(m - \zeta m)}{\delta w - \beta} Y$

(1.13)' $F = \bar{F} + \delta r$

(1.18) $R = R(X, Y, r, w)$.

We can simplify (1.3), (1.9) and (1.13) as follows

(1.3)' $S = a_0 + a_1 Y + a_2 r$

(1.9)' $r = b_0 - b_1 Y$

(1.15)' $r = c_0 + \acute{c}Y$.

Now by combining (1.3)′ and (1.13)′, we get

$$(1.18)\quad S = k_0 + a_1 Y + k_1 F, \;;\; k_1 = \frac{a_2}{\delta};\; k_0 = a_0 - \frac{a_2}{\delta}\bar{F}$$

which when divided by Y will give us the basic skeleton of our reduced form model:[4]

$$(1.19)\quad \frac{S}{Y} = \text{Constant} + k_0 \frac{1}{Y} + k_1 \frac{F}{Y}.$$

Now considering (1.17), (1.19)′ and (1.13)′, and adding government expenditure and exports as exogenous variables, we arrive at a reduced form equation similar to that of Gupta:

$$(1.20)\quad \frac{S}{Y} = \text{constant} + d_1 \frac{G}{Y} + d_2 \frac{X}{Y} + d_3 \frac{F}{Y} + d_4 R + d_5 r.$$

Table 1 shows the results of our estimation of a reduced form equation (without a latent variable) which resembles the original Gupta model. Based on a set of pooled annual data on eight small European countries, covering the period 1965 through 1986, the model was estimated through OLS, maximum likelihood, and 2 SLS methods.[5]

As expected, all three methods of estimation consistently produce positive and statistically significant coefficient for government expenditure, G, and net export. These estimates confirm the theory that the export income carries a high propensity to save and are consistent with a study by Singh (1985) based on a set of cross-section data on 73 countries.

In the OLS and maximum likelihood estimation the exchange rate, which is measured in terms of the value of the domestic currency in U.S. dollar, does not appear to be significant. But according to our 2SLS estimation, where exchange rate is treated as endogenous, it significantly

[4] It is important to note that our measure of savings is an aggregate one — which includes the government saving (or dissaving). Thus, a change in national saving ratio (caused by a capital inflow) could partly be due to a change in the size of government deficit (or surplus). In any event, our results do not support the argument that capital inflows, through their effect on the domestic interest rate or a wealth effect, cause reductions in the domestic national saving ratio.

[5] Except for interest rates and exchange rates, all variables are in terms of U.S. dollar. All the necessary data were collected from various issues of International Financial Statistics Yearbook, Washington, D.C., International Monetary Fund. When using 2SLS method, exchange rate and interest rates are treated as endogenous.

**Table 1**

$$S/Y = F(G/Y, X/Y, F/Y, R, r)$$

| | Const | G/Y | X/Y | F/Y | R | r | SE |
|---|---|---|---|---|---|---|---|
| 2SLS | −0.0150<br>(−0.238) | 0.1689<br>(1.839) | 0.3543<br>(4.461) | −0.00058<br>(−1.154) | 0.00211<br>(4.181) | −0.0161<br>(−3.146) | 0.0722 |
| MAX. LIK. | 0.1328<br>(9.129) | 0.0907<br>(1.844) | 0.2663<br>(5.924) | 0.00027<br>(2.000) | 0.00008<br>(1.027) | (−.00166)<br>(−1.432) | 0.8353 |
| OLS | 0.1218<br>(8.505) | 0.1221<br>(2.720) | 0.2607<br>(7.474) | −0.00031<br>(−0.026) | 0.00031<br>(0.2997) | −0.0041<br>(−3.155) | 0.0431 |

influences the saving income ratio. This implies that a devaluation of a currency directly, and possibly indirectly, through its effect on capital flows results in a reduction in domestic savings.

We believe mostly due to endogenity and multicollinearity problems these estimation fail to produce consistent estimates for the coefficient of interest rate. The 2SLS estimates, however, indicate that interest rates have a negative impact on savings.

Now let us turn to capital flow which is the primary focus in this work. The results of both OLS and 2SLS estimations seem to suggest that capital flows have no signficant impact on domestic saving behavior. These results imply that Haavelmo's argument that in developing countries foreign capital is not necessarily a substitute for domestic savings is also valid in the case of more advanced economies. In fact, our maximum likelihood estimate of capital flow coefficient suggests that a capital inflow could intensify domestic saving. These results are in contrast with those of Gupta (1985) which were based on a cross-section study of forty developing countries. Gupta found a strong negative relationship between capital inflows and domestic savings.

As indicated earlier, we see no theoretical basis to assume that a capital flow as a perfectly inelastic variable results in reductions in domestic savings. Even if, because of domestic economic and political factors, capital flows into and out of a country are totally unaffected by macroeconomical factors, their impact on domestic saving income ratio should at best be ambiguous — i.e., an inflow of capital, ceteris paribus, is expected to result in an increase in income; its impact on savings will be through income, interest rate and exchange rate.

### A. Estimation of the Model with a Latent Variable

Let us suppose that in addition to our observable variables, the saving behavior of a country is directly and indirectly (through other equations) affected by an unobservable "policy" variable which varies both over time and across different countries. We express this unobservable variable in terms of two error components. Let us write our saving function simply as:

(2.1) $$S_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + U_{it}$$

where $E(\mu_i) = E(\lambda_t) = E(U_{it}) = 0$ ; $Var(\lambda_t) = \sigma\lambda^2$ ;

$Var(\mu_i) = \sigma\mu^2$ ; $Var(U_{it}) = \sigma_U^2$

Here $Y_{it}$ and $X_{it}$ are two sets of explanatory variables of which variables $Y_{it}$ are correlated with $\mu_i$ and $\lambda_t$. If the equation is averaged over t, i and over both t and i, we obtain respectively:

(2.2) $$\overline{S}_{i\cdot} = \beta_0 + \beta_1 \overline{Y}_{i\cdot} + \beta_2 \overline{X}_{i\cdot} + \mu_i + \overline{U}_{i\cdot} \ ,$$

(2.3) $$\overline{S}_{\cdot t} = \beta_0 + \beta_1 \overline{Y}_{\cdot t} + \beta_2 \overline{X}_{\cdot t} + \lambda_t + \overline{U}_{\cdot t} \ ,$$

(2.4) $$\overline{S}_{\cdot\cdot} = \beta_0 + \beta_1 \overline{Y}_{\cdot\cdot} + \beta_2 \overline{X}_{\cdot\cdot} + \overline{U}_{\cdot\cdot} \ ,$$

where $\overline{S}_{i\cdot} = \sum_{t=1}^{T} S_{it}/T$, $\overline{S}_{\cdot t} = \sum_{i=1}^{N} S_{it}/N$

$\overline{S}_{\cdot\cdot} = \sum_{i=1}^{N} \sum_{t=1}^{T} S_{it}/NT$. Others are defined similarly. By subtracting (2.2) and (2.3) from (2.1) and adding (2.4) we get:

(2.5) $$S_{it} - \overline{S}_{i.} - \overline{S}_{\cdot t} + \overline{S}_{\cdot\cdot} = \beta_1(\overline{Y}_{it} - \overline{Y}_{i\cdot} - \overline{Y}_{\cdot t} + Y_{\cdot\cdot}) + \beta_2(X_{it} - X_{i\cdot} - X_{\cdot t} + X_{\cdot\cdot}) + \zeta_{it}$$

(2.6) where $\zeta_{it} = U_{it} - U_{i.} - U_{\cdot t} + U_{\cdot\cdot}$ and

$$var(\zeta_{it}) = \sigma_U^2 \left( \frac{NT-T-N-1}{NT} \right)$$

Note that (2.5) is free of the unobservable error components. Since we are treating $Y_{it}$'s as endogenous variables, the usual 2SLS procedure on (2.5) will yield consistent estimates of $\beta_1$ and $\beta_2$ free of the "policy" bias. However, this technique will give inefficient estimates because (2.5) is used only within variations. This technique can also be interpreted as 2SLS with dummy variables (2SLSDV).

In the context of (2.1) where none of the error components are correlated with any of the explanatory variables, Fuller and Battese (1974) have proposed a very convenient means for calculating the GLS estimator. The procedure amounts to running an OLS on:

$$S^*_{it} = \beta^*_0 + \beta_1 Y^*_{it} + \beta_2 X^*_{it} + U^*_{it} \tag{2.7}$$

where $S^*_{it} = S_{it} - \alpha_1 \overline{S}_{i.} - \alpha_2 \overline{S}_{.t} + \alpha_3 \overline{S}_{..}$

and $\alpha_1 = 1 - (\sigma_U / \sigma_1)$, $\alpha_2 = 1 - (\sigma_U / \sigma_2)$

$$\alpha_3 = \alpha_1 + \alpha_2 - 1 + (\sigma_U / \sigma_3)$$

$$\sigma_1^2 = T\sigma_U^2 + \sigma_U^2,\ \sigma_2^2 = N\sigma\lambda^2 + \sigma_U^2 \text{ and}$$

$$\sigma_3^2 = \sigma_U^2 + T\sigma\mu^2 + N\sigma\lambda^2$$

$Y^*_{it}$ and $X^*_{it}$ are defined in a similar fashion. In this case, since we expect $Y_{it}$ to be highly correlated with the error components, we apply an instrumental variable technique (2SLS) to the GLS transformed equation (cf. Hausman and Taylor (1981)). We estimated $\sigma^2_U$ from the residuals $\zeta_{it}$ in (2.6) after applying the 2SLDV technique to (2.5). $\sigma_1^2$ and $\sigma_2^2$ were directly estimated by applying 2SLS to (2.2) and (2.3) respectively. The following is the GLS estimation of our reduced form equation free from any error components caused by possible unobservable variables.

$$\frac{S}{Y} = \underset{(2.655)}{0.0164} + \underset{(3.767)}{0.2731} \frac{G}{Y} + \underset{(3.170)}{0.2707} \frac{X}{Y} + \underset{(2.476)}{0.0036} \frac{F}{Y}$$

$$- \underset{(-.373)}{0.00004R} - \underset{(-3.297)}{0.0100r} \qquad \bar{R}^2 = 0.1299$$

Again, as our earlier results indicated, both government expenditures and export positively affect the saving income ratio. In this estimation the sign and significance level of interest rate are also consistent with the results of the 2SLS estimation of the original model; that is negative and significant.

The elimination of the error components appears to have affected our estimates of the coefficients of interest rates and capital flow most significantly. While our estimates do not show exchange rate to be a significant determinant of savings, they suggest a capital inflow has a positive and statistically significant effect on the saving behavior of the receiving country. This result implies that at least in the case of small developed countries the Gupta's argument that foreign capital inflows substitute domestic savings does not hold. In fact such inflows seem to enhance domestic savings.

*B. Estimation with Indexed Variables*

To eliminate possible measurement errors in the observed variables the 2SLS was finally applied to a set of indexed data reflecting changes in each variable relative to its first period value. Let us rewrite the reduced form equation as follows:

$$(1.20)' \quad \left(\frac{S_{it}}{Y_{it}}\right)_x = \Omega_0 + \Omega_1 \left(\frac{G_{it}}{Y_{it}}\right)_x + \Omega_2 \left(\frac{X_{it}}{Y_{it}}\right)_x + \Omega_3 \left(\frac{F_{it}}{Y_{it}}\right)_x + \Omega_4 (R_{it})_x + \Omega_5 (r_{it})_x$$

where , for example, $\left(\frac{S_{it}}{Y_{it}}\right)_x = \dfrac{\frac{S_{it}}{S_{i0}}}{\frac{Y_{it}}{Y_{i0}}}$. All other variables are defined similarly. The following are the results of this estimation.

$$\underset{}{\frac{S}{Y}} = \underset{(0.167)}{1.6215} + \underset{(4.043)}{0.2620}\frac{G}{Y} + \underset{(4.527)}{0.3757}\frac{X}{Y} + \underset{(0.067)}{0.00009}\frac{F}{Y} + \underset{(2.822)}{0.4603}\frac{R}{Y}$$

$$\underset{(-2.327)}{-0.1505r} \qquad \bar{R}^2 = 0.8888$$

Here, the coefficients of government expenditure and export remain positive and significant, whereas capital inflow does not seem to have any impact on the domestic saving income ratio. This suggests that although we cannot positively assert that foreign capital inflows promote domestic savings, our results consistently imply that foreign savings do not substitute domestic savings. The effect of exchange rate on saving income ratio is positive and significant. This suggests that stronger domestic currencies tend to encourage domestic savings.

As for the interest rate, our estimates show that the overall effect of interest rate on saving income ratio is negative and significant. That would mean that an increase in interest rates attracts foreign savings which in turn result in higher income. When the impact of such increase on income (via capital inflow) is greater than its possible (positive) effect on savings, the saving income ratio would go down.

## IV. Conclusion

In this paper we have constructed and estimated a reduced form equation based on a macroeconomic model to examine the effect of foreign savings (capital inflows) on the saving behavior of a small scale advanced economy with a developed capital market. In addition to the conventional macroeconomic variables our model contains a latent variable collectively reflecting time and country specific risk and policy factors as well as other unobservable variables. Using a technique suggested by Hausman and Taylor (1977), the model was estimated free from any time and/or country specific error components caused by the latent variable. In order to eliminate the possibility of any measurement errors, we also estimated the model using the indexed value of the variables. All estimations were done based on a set of pooled data on eight small developed countries covering the period 1965 through 1986.

Our results generally suggest that contrary to the findings by Gupta and others, which were mostly based on their study of developing countries, foreign savings do not substitute domestic savings. We showed that government expenditures and export positively influence domestic savings. According to our estimation exchange rate has a positive effect on domestic savings whereas interest rates seem to affect the savings income ratio negatively.

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