TAX HOLIDAYS, COST OF CAPITAL AND INVESTMENT BEHAVIOUR: JORGENSON APPROACH

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The concession of tax holidays is being used as an important fiscal measure to encourage rapid industrialization, and to alleviate regional imbalances in developing countries. This generous concession can however, potentially lead to a important issue which will be our focal point in the present paper. The issue is that whether the concession has really led to new investment in the economy- investment that might not have taken place in the absence of these concessions- or whether the concessions have just been enjoyed as a windfall gain by those firms that would have invested even in their absence.

This issue needs to be examining more carefully if it is offered along with other concessions like accelerated depreciation allowances. Mintz (1990) discusses the efficacy of tax holidays in the presence of accelerated depreciation allowances concludes that if the assets are long-lived, and the income tax system allows deductibility of accelerated depreciation but cannot be deferred, then the tax holidays, by preventing depreciation deduction in the early period may actually penalize investment during the tax holiday. If on the other hand the depreciation allowances is deferred till the end of tax holiday period, the tax system is genuinely generous and provides a real incentive for capital formation.

The objective of the paper is therefore two folded, first, to test the effects of tax holidays on the cost of capital hence on investment in the presence or absence of accelerated depreciation allowances and second, to estimate the economic cost of tax holidays to the treasury. The concession of tax holidays extended to the investment that would have taken place without these concessions provide the base for economic estimates (cost) of tax expenditure. The issue will be examining at a macro level within the Jorgenson framework for which the methodology will be discussed in section 1.

[1]Author is thankful to Colin Lawson, Chris Heady and Hafiz Pasha for this valuable suggestion. However, the usual disclaimer applies.

The organization of the remaining paper is as follow. Section 1 will derive the costs of capital under different policy options. In section 2 methodology and results are discussed followed by the section 3 on the conclusions and policy implications.

I

In this section we will use the neo-classical investment model developed by Jorgenson (1967) to derive the costs of capital under different scenarios. Eric Bond (1981) has used the same model to explore tax holidays and investment behaviour in Puerto Rico. In the neo-classical framework under competitive assumptions, the effects of the tax holidays on investment may be examined through the rental cost of capital. The basic relationship between the price of capital and the discounted value of all the future services derived from this capital good can be written as follows:

$$q(t) = \int_o^N e^{-r(s-t)}\, c(s)\, e^{-\delta(s-t)}\, ds + \int_N^\infty e^{-r(s-t)} \left[(1-u)\, c(s)\, e^{-\delta(s-t)} + u\, \bar{q}(t)\, D(s-t) \right] ds \qquad \textbf{(1)}$$

which can also be written as:

$$q(t) = \int_o^N e^{-r(s-t)}\, c(s)\, e^{-\delta(s-t)}\, ds + \int_N^\infty e^{-r(s-t)}\, (1-u)\, c(s)\, e^{-\delta(s-t)}\, ds + \int_N^\infty e^{-r(s-t)}\, u\, \bar{q}(t)\, D(s-t)\, ds \qquad \textbf{(2)}$$

Where

u	=	tax rate in the absence or after the tax holiday period.
c	=	cost of capital
q	=	price of capital
N	=	period of tax holiday
D(s)	=	depreciation deductible for tax purposes.
r	=	rate of interest
δ	=	rate of depreciation

Assuming static expectations in which $\frac{\partial q(t)}{\partial t} = 0$ [3], equation (2) can be written as,

$$q = \int_0^N e^{-(r+\delta)s}\, c\, ds + \int_N^\infty (1-u)\, c\, e^{-(r+\delta)s}\, ds + \int_N^\infty u\, e^{-rs}\, \bar{D}(s)\, q\, ds \qquad \textbf{(3)}$$

The equation (3) will be used to evaluate the cost of capital for the four scenarios mentioned below. a) Computation of the cost of capital, when neither a tax holiday nor depreciation allowance is offered. b) Computation of the cost of capital when only tax holidays is offered. c) Computation of the cost of capital when only depreciation allowance is offered. d) Computation of the cost of capital, when both tax holidays and depreciation allowances is offered.

Scenario I

When neither tax holidays nor depreciation allowances are offered, the relationship between the price of capital goods and the discounted value of future services from these capital goods can be derived from following equation,

$$q = \int_O^\infty (1-u)\, c\, e^{-(r+\delta)s}\, ds \qquad \textbf{(4)}$$

This equation when integrated, yields

$$c = \frac{(r+\delta)\, q}{1-u} \qquad \textbf{(5)}$$

Equation (5) gives the cost of capital, when income tax laws do not provide tax holidays and tax saving depreciation allowances.

Scenario II

When only tax holidays are offered the relationship between the price of capital goods and the discounted values of future services from these capital goods can be derived from following equation.

$$q = \int_O^N e^{-(r+\delta)s}\, c\, ds + \int_N^\infty (1-u)\, c\, e^{-(r+\delta)s}\, ds \qquad \textbf{(6)}$$

This equation can be written as:

$$q = \int_{O}^{N} e^{-(r+\delta)s}\, c\, ds + \int_{N}^{\infty} e^{-(r+\delta)s}\, c\, ds$$

$$- \; - u \int_{N}^{\infty} e^{-(r+\delta)s}\, c\, ds \qquad \textbf{(7)}$$

Simplification yield

$$c = \frac{(r+\delta)\; q}{1 \;-\; u\, e^{-(r+\delta)N}} \qquad \textbf{(8)}$$

This equation gives the cost of capital when only a tax holiday is offered in the tax system.

Scenario III

When only a depreciation allowances are offered, the relationship between the price of capital goods and the discounted values of future services from these capital goods can be derived from following equation.

$$q(t) = \int_{t}^{\infty} e^{-r(s-t)} \left[(1-u)\, c(s)\, e^{-\delta(s-t)} + u(1-k)\, q(t)\, D(s-t) \right] ds + kq(t) \qquad \textbf{(9)}$$

This yields,

$$c \;=\; \frac{q\,(\,r+\delta\,)}{1-u}\,(\,1-uz\,) \qquad \textbf{(10)}$$

This is the cost of capital when only depreciation allowances are allowed to claim against tax liability.

Scenario IV

When both tax holidays and depreciation are offered, the price of capital will equate the discounted values of the services of capital goods in the following equation.

$$q = \int_{O}^{N} e^{-(r+\delta)s}\, c\, ds + \int_{N}^{\infty} (1-u)\, c^{-(r+\delta)s}\, ds + \int_{N}^{\infty} e^{-rs}\, u\, D(s)\, q\, ds \qquad \textbf{(11)}$$

Simplification of (11) yields,

$$c = \frac{q\,(r+\delta)(1-u\,z)}{1-u\,e^{-(r+\delta)N}} \qquad \textbf{(12)}$$

Equation 12 gives the cost of capital when both tax holidays and tax saving depreciation allowance are offered.

In the first scenario the cost of capital would be maximum as no concession is offered. In this case the cost of capital would depend on the price of capital goods, the depreciation rate, the interest rate and the corporate tax rate. Increase in any of these four factors will increase the cost of capital. In the second scenario, when only a tax holiday is granted the relevant cost of capital is adjusted by an additional term $ue^{-(r+\delta)N}$. This term shows that this tax policy option affects the cost of capital via two factors. One is the length of the tax holiday period and other is the extent of the reduction of the corporate tax rate in the tax holiday period. The first factor inversely affects the cost of capital i.e. longer the period of tax holiday, lower would be the cost of capital. This means an increase in the tax holiday period increases the denominator, which results in the lower cost.

In the third scenario when only a depreciation allowance is deductible against the tax liability, the relevant cost of capital is now adjusted by an additional term (1-uz) where u is corporate tax rate and z is the present value of the depreciation allowance deductible for tax purposes. This suggests that the increase in the present value of the depreciation allowance reduce the cost of capital. The present value of the depreciation allowance depends upon the initial depreciation allowance, normal depreciation allowance, the interest rate and the life of the machinery. Among them, the first two factors positively affects the present value of the depreciation allowance. This implies that if the rate of initial depreciation is high and depreciation is allowed to be deducted in the early period of the machinery's life, the present value of the depreciation deduction would be high and consequently the cost of capital will be low. On the other hand, the interest rate and the length of life of the machinery inversely affect the cost of capital.

In the fourth scenario the cost is adjusted by two factors. The factor (1-uz) lies in the numerator and $e^{-(r+\delta)N}$ in the denominator of the equation. This implies that the cost of capital can be reduced either by increasing the depreciation allowance or by increasing the tax holiday concession. The depreciation allowance may be increased by increasing the initial depreciation allowance, or by increasing the normal depreciation allowance or by reducing the interest rate, whereas increasing the tax holiday period may increase the efficiency of a tax holiday.

Table 1 gives the present value of the depreciation allowance for developed and underdeveloped areas. The computation is based on different clauses of 2nd schedule of the Income Tax Ordinance 1979.The income tax code of Pakistan allows, in non-tax holiday areas, an initial depreciation of 25 percent of the cost of capital plus a 10% normal depreciation each year. Therefore the firm charges 35% of the cost of machinery in the first year and the remaining 65% in the subsequent 6.5 years. However, in the tax holidays areas firms are not allowed to deduct the initial depreciation allowance. But they can claim normal depreciation allowance after the expiry of the tax holiday period. So firms can claim 10 percent normal depreciation annually from the 6th year to the 10th year.[2]

Column 3 of Table 1 shows the value of the present value of depreciation in the developed area when both initial and normal depreciation can be claimed with straight-line depreciation method. Column 4 of Table 1 shows the amount of depreciation, which can be claimed by any firm, located in the tax holiday zone. This depreciation allowance is computed on the basis of that the firm is not allowed to claim initial depreciation but can claim normal depreciation after the expiry of the tax holiday, the depreciation during a tax holiday period cannot be claimed in the post tax holiday period. Column 5 of Table 1 shows the discounted value of depreciation when the depreciation can be deferred in the tax holidays period.

[2]If initial depreciation is not allowed, then the life of machinery would be 10 years for tax purpose as 10% normal depreciation is allowed each year. Usually tax holidays are offered for five years.

TABLE 1 PRESENT VALUE OF THE DEPRECIATION ALLOWANCES				
1	**2**	**3**	**4**	**5**
1	0.107000	0.766468	0.171000	0.467400
2	0.115000	0.753310	0.167000	0.445100
3	0.115000	0.752031	0.160700	0.445100
4	0.115000	0.752508	0.160700	0.445100
5	0.120000	0.744208	0.154500	0.436700
6	0.118000	0.747360	0.157000	0.437100
7	0.119000	0.746500	0.155700	0.434400
8	0.122000	0.741413	0.152100	0.426500
9	0.122000	0.735170	0.152100	0.426500
10	0.128000	0.732100	0.145100	0.411200
11	0.126000	0.734670	0.147400	0.416300
12	0.130000	0.729081	0.142900	0.406300
13	0.136000	0.719856	0.136400	0.391500
14	0.131000	0.727278	0.141800	0.403700
15	0.137000	0.720690	0.135300	0.389200
16	0.141000	0.712740	0.131200	0.378400
17	0.143000	0.710030	0.129100	0.375200
18	0.140000	0.714323	0.132200	0.382100

Table 2 gives the cost of capital in each policy scenario discussed in previous section. Column 2 of table 2 gives the cost of capital when no concession (tax holiday or depreciation) was offered, column 3 gives the cost of capital when only a tax holiday is offered. Column 4 shows the cost of capital in an underdeveloped area when a tax holiday and a normal depreciation allowance for the post tax holiday period are offered, and column 5 gives the cost of capital in the developed area when only a depreciation allowances is offered. Finally, column 6 gives the cost of capital when in a tax holiday region the depreciation allowances can be deferred.

TABLE 2

COSTS OF CAPITAL UNDER DIFFERENT TAX POLICIES					
1	**2**	**3**	**4**	**5**	**6**
1	0.342663	0.196468	0.176202	0.185079	0.141371
2	0.342662	0.196468	0.177442	0.187784	0.143999
3	0.330376	0.201322	0.183562	0.193727	0.152038
4	0.222324	0.150110	0.136834	0.130309	0.113362
5	0.231506	0.154726	0.141588	0.136748	0.117563
6	0.237778	0.157845	0.144024	0.140040	0.119898
7	0.382856	0.224449	0.205180	0.225665	0.170824
8	0.331477	0.201816	0.184947	0.196309	0.154475
9	0.367403	0.217722	0.199436	0.218846	0.166650
10	0.409909	0.236087	0.217228	0.244857	0.182694
11	0.422263	0.241351	0.221814	0.251640	0.186090
12	0.371248	0.219401	0.202157	0.222379	0.170373
13	0.292966	0.184256	0.170453	0.176975	0.144581
14	0.379684	0.223073	0.205698	0.227809	0.173543
15	0.245333	0.161566	0.149491	0.148260	0.126981
16	0.263353	0.185250	0.173488	0.178887	0.153706
17	0.273525	0.190936	0.179839	0.186130	0.158698
18	0.233161	0.168071	0.158068	0.158213	0.139172

Table 2 reveals a) As was expected, the cost of capital was highest (column 2) when no concession was offered and lowest (column 6) when in the tax holiday region the depreciation allowances can be deferred. This was a hypothetical computation because the Income Tax Ordinance (1979) does not contain a deferral clause. b) A comparison of columns 4 and 5 shows the cost of capital in a developed area is very close to that of an underdeveloped area. In fact in some years the cost of capital in the non-tax holidays area is lower than the cost in the tax holidays areas. In these perticular years (1979-82), due to the low interest rate, the depreciation allowances were a more attractive concession than the tax holidays. This finding is consistent with the findings of Mintz (1990) who shows that if the tax rule does not offer a deferral of the depreciation allowance, the concession of a tax holiday may penalize a firm by preventing them enjoying the depreciation allowances in the early period.

II

Estimation and Simulation of the Investment Model

The purpose of this sub-section is to test empirically the effects of different fiscal concessions on the investment level in the tax holiday region and to find the nature of the increased investment. In other words, how much investment has been generated following a reduction in the cost of capital in the backward area, and how much investment has been diverted from the developed areas to the backward areas to enjoy windfall gains.

In order to obtain the `generated' and `diverted' components of investment in the underdeveloped area we have estimated three investment equations, two for the overall economy and one for an under developed area. Real investment (RI) in equation 1 is the dependent variable and the change in the output (DRPQ), the cost of capital in the underdeveloped area (RC0UD), the cost of capital in developed areas (RC0), the public sector development plan (RPSDP) and a dummy for the political and economic environment (DUMPOL) are the independent variables. The second equation is also estimated at the national level, however, in this equation instead of two separate cost variables we used the weighted average costs of capital (WRC). Similarly the third equation specifies that the investment in the backward area depends upon the change in the output, the cost of capital in the backward areas, the public sector development plan, and dummy for the political and economic environment.

This analysis requires time series data on the aggregate investment level, the investment level in the backward area, the cost of capital in the developed and backward areas, the weighted average costs of the two areas, and the public sector development plan. Since the separate figures on the level of investment in underdeveloped and developed areas are not published by any government department. Therefore, we have had to construct these variables. We have constructed the data on investments in developed and underdeveloped areas with the help of few available figures on the gross fixed investment and the area-wise Excise Duty collections. The weighted average of the cost of capital is a ratio of the costs of capital in the two areas weighted by their respective share in investment.[3]

We have carried out stationarity tests on all variables, which have been used, in our analysis. The

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[3] Details can be seen in author's Ph.D thesis, 1997.

results of unit root test given in the thesis do not reject the hypothesis that net investment is non-stationary in level. The unit root tests for other variables also do not reject the hypothesis that these variables are also non-stationary in level.

However, various studies show that the stationarity test can not be applied to small data set [Benerjee and et.al, 1986; Pagan And Wicken, 1989; Molinas, 1986; Schwert, 1987; and Hall, 1986]. The poor power of the test suggests that it is necessary to consider other evidence to decide whether to treat investment, and other variables as stationary.

Many studies show that the macro economic series are non-stationary in levels but most of them are stationary in first difference.[Nelson and Plosser, 1982; Gordon, 1992; Tang and Buliong, 1994; Schwert, 1987; and Diebold and Nerlove, 1990;].

From a theoretical point of view, it can be argued that the capital stock series is supposed to be non-stationary in levels (integrated of order 1), but it's first difference, net investment is stationary at level. This suggests that we should treat private and public investment as stationary in levels. In contrast the level of output is expected to be non-stationary in levels but stationary in first difference. This suggests that its first difference should be used in the estimated equation. There is no clear theoretical reason for deciding the order of integration for the cost of capital. However, the ADF value for cost is shown in the author's thesis to be relatively high in level. Given the poor power of the test in small samples, it is not unreasonable to regard it as stationary.

Finally the two steps results obtained using co-integration techniques (given in the author's thesis) shows that the variables are insignificant and have the wrong signs. For example the coefficient of the cost of capital is positive and the change in output is negative and both are insignificant. The coefficient of public investment is positive but also insignificant. Only the dummy variable and residual from level equation are significant. These poor results confirm that it is best to proceed on the assumption that investment is stationary. Therefore in our analysis we will not use cointegration results and in the following sub-sections we will stick to the results obtained using OLS or GLS techniques.

In the first equation (Column 2) of table 3 estimated at national level shows that due to high multicollinearity both cost variables are insignificant, one corresponding to underdeveloped areas bears wrong sign. Therefore, equation 2 was also estimated at the national level in which we replaced both cost variables by a weighted average cost of capital. The results shows that the weighted average cost of capital, the real public sector development plan, and the dummy for the political and economic environment are significant variables, whereas the change in output remains insignificant. This equation shows that 75% variation in the dependent variable is explained by this set of independent variables, the Durbin-Watson statistics at 2.19 is also satisfactory.

TABLE 3
INVESTMENT EQUATIONS FOR DEVELOPED AND UNDERDEVELOPED AREAS

Variables	Eq.1	Eq.2	Eq.3
DRPQ	.09394 (.38)	.2912 (.89)	.293 (1.15)
RC0UD	27544 (.42)	--	-17619 (-2.19)**
RC0	-49367 (-.894)	---	---
WRC	- -	-24355 (-2.41)**	---
RPSDP	.3001 (2.75)**	.329 (3.05)***	.212 (2.56)**
DUMPOL	2503 (2.02)**	3631.5 (3.00)***	2306 (2.57)**
MA (1)	-	.695 (2.77)	.758 (3.05)
ADJ.R^2	.707	.75	.72
D.W. STAT.	1.90	2.19	2.06
F-STAT	11.29	13.80	12.26

Parentheses shows t statistics.

Table 3 also shows the results of the investment equation (Column 4) estimated for underdeveloped areas. In this equation, the independent variables the cost of capital in underdeveloped areas, the real public sector development plan and the dummy for the economic and social environment were significant, where as the change in the output in manufacturing sector remains insignificant. The results show that the R^2 (.72) and the Durbin-Watson statistics (2.06) are satisfactory.

Our one of the main objective of this chapter is to have the economic estimate of the tax expenditures on the concession of tax holidays. We have already argued that the concessions granted to diverted investment provide the base of a economic estimates of tax expenditure. In order to compute diverted investment to the backward areas, we have used equations 2 and 3 (Table 3). The second equation predicts investment at the national level and the third investment level in underdeveloped areas. From these equations we have computed the `generated' and `diverted' components of investment in the underdeveloped areas as follow:-

Step I.

From equation 2 of table 3, which corresponds to nation-wide investment, we predict two investment levels. The first investment level (PRIDAW) is predicted by using the variables of the weighted cost of capital, and second, level of investment (PRIDAW1) is predicted by using the cost of capital of the developed areas. The difference between these two predicted levels (DRIWE) is the level of investment that has been generated in the economy due to the difference in costs. The predicted values PRIDAW, PRIDAWI and DRIWE are given in table 4.

TABLE 4
PREDICTED INVESTMENTS IN DEVELOPED AND UNDERDEVELOPED AREAS

(Rs. Million)

Obs	Priud	Priud1	Driud	Pridaw	Pridaw1	Driwe	Taxexp.
1	761	605	156	1727	1590	136	5.40
2	395	213	182	867	698	169	3.50
3	213	34	179	639	472	167	3.20
4	1128	1243	-114	1877	1987	110	00
5	1555	1640	-85	2457	2540	83	00
6	2938	3008	-70	4410	4466	-56	00
7	1250	889	360	2069	1785	283	20.79
8	1387	1186	200	2220	2062	158	11.34
9	4164	3819	341	6522	6288	233	29.16
10	4375	3889	486	6790	6472	317	45.63
11	3666	3140	525	5756	5358	397	34.56
12	3598	3242	356	5432	5135	296	16.20
13	2975	2860	114	5167	5071	95	5.13
14	4035	3646	389	6261	5879	382	1.89
15	4774	4796	-21	7861	7882	-20	00
16	5375	5280	95	8445	8351	94	.27
17	6690	6579	110	10500	10396	104	1.62
18	7893	7891	2.55	11959	11956	2.37	.07

Step 2

From equation 3 of Table 3 we also predict two levels of investment in the underdeveloped areas. First the level of investment (PRIUD) by using the cost of capital of the underdeveloped areas, and the second (PRIUD1) by using the cost of capital of the developed areas. The difference between the two predicted investment levels (DRIUD) shows the increase in the level of investment in underdeveloped areas which resulted from the difference in their respective costs. The predicted values PRIUD, PRIUD1 and DRIUD given in table 4.

Step 3

The difference between the two predicted levels of investment in underdeveloped areas (DRIUD) shows the total increase in the investment in the underdeveloped areas. This includes both components i.e. the generated investment and the diverted investment. Whereas the difference between the predicted levels of investment in developed areas (DRIWE) shows the increase in total investment in whole economy i.e. generated investment. Therefore the difference between two differences (DRIUD-DRIWE) is the diverted component of investment in the backward areas. The output and subsequently the profit generated from this investment will make the economic cost of tax expenditure on the tax holidays. Hypothetically the economic estimates of tax expenditures of this investment to the national exchequer can be computed as follows.

$$\begin{aligned} \textit{Tax Expenditure} &= (\textit{DRIUD} - \textit{DRIWE}) * (\textit{Capital output ratio}) \\ & * \ (\textit{Profitibility}) * \ \overline{(\textit{Corporate Tax Rate})} \end{aligned}$$

We assume capital output ratio 3, profitability ratio 20% and corporate tax rate 45% in our computation. The amount of tax expenditures along with the differences in predicted values in developed and non-developed areas, are shown in Table 4. For example in 1977 the total increased investment in underdeveloped area was Rs. 156 millions, which includes both ` generated' and ` diverted' components. In the same year the total nation-wide increased investment was Rs. 136 millions. This was `generated' investment, therefore, the `diverted' investment in the backward areas was (156-136) = 20 millions. The economic estimates of tax expenditure in this particular year was (20 *.45 * .20 * 3) = 5.4 millions. Table 4 shows that the economic estimates of tax holidays vary with the difference in the cost of capital in the two areas. This in turn depends upon the value of the depreciation and the tax holidays. In those years when the value of depreciation allowances was very high, the resulting cost of capital in the developed areas was lower than that in the underdeveloped areas. The resulting efficacy of tax holidays was very poor in these years, in fact it provides negative incentives for investment. On the contrary in those years when the value of depreciation was low the tax holidays were a better incentive for investment than depreciation. The results also shows that on average the total increase in investment in the underdeveloped areas remains less than 5 % of total investment.

III

Conclusions and Policy Implication

This paper compute the costs of capital for (a) without considering any fiscal concession, (b) when only a tax holiday is offered, (c) when both tax holidays and depreciation allowances are allowed to be deducted against tax liability in backward areas, (d) when depreciation allowances (accelerated and normal) are offered in the non-tax holiday region, and (e) when depreciation allowances can be deferred in tax holidays areas (hypothetical) .

The paper shows that in the absence of any fiscal concessions the cost of capital would depend upon the price of capital goods, the depreciation rate, the interest rate and the corporate tax rate. The fiscal concession of the tax holidays reduces the cost of capital and the efficacy of this concession depends upon the reduction in the tax rate (zero in extreme case) and the length of the tax holiday period. The greater the reduction in the tax rate or the longer the period of the tax holiday offered in the concession, the lower would be the cost of capital. Similarly the fiscal concession of the depreciation allowance also reduces the cost of capital and the extent of the reduction depends upon the interest rate. The value of the tax saving depreciation will be higher when a lower interest rate prevails in the economy, which will result in greater reductions in the cost of capital. The computation shows that the cost of capital is expectedly highest when no fiscal concession is offered and lowest when depreciation allowances in the tax holidays areas are allowed to be deferred. The results also show that the generated investment is less than 5 % of total investment, this shows that the benefits of the tax holidays are enjoyed by those investors who would have invested anyway.

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