

INVESTMENT VOLATILITY AND GROWTH IN TURKEY

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The purpose of this paper is to analyze the relationship between investment volatility and growth performance in Turkey. In view of both output and investment volatility in Turkey, an investigation of their relationship appears appropriate. We specifically test the hypothesis that the more volatile is the investment the smaller its return is, in terms of output gains.

1. Relationship Between Investment Volatility and Output Performance

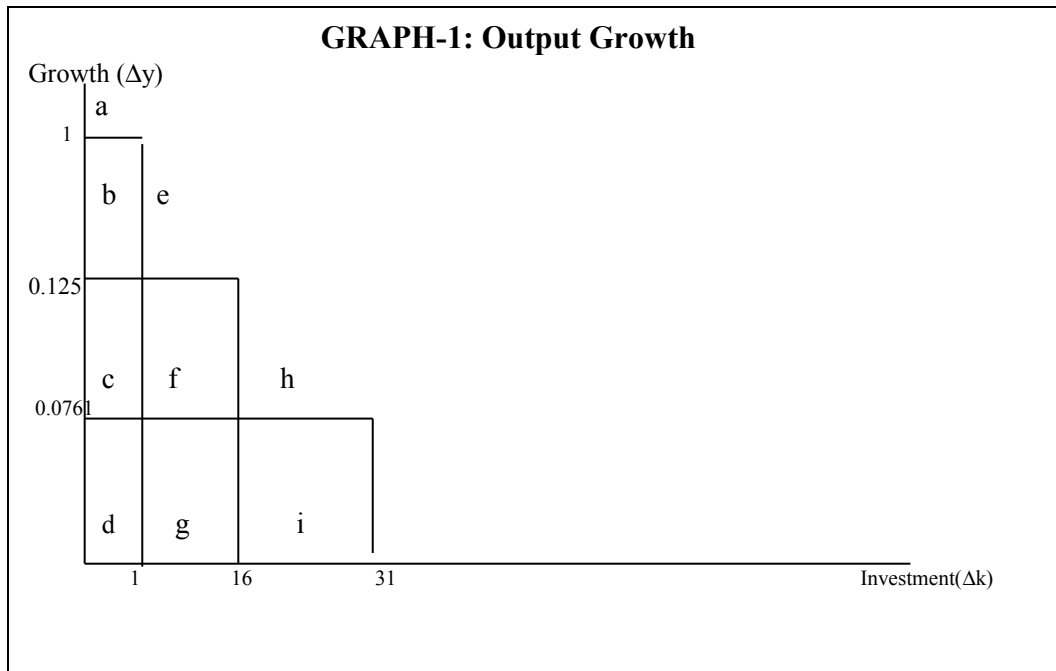
Assuming that the production function has a constant or diminishing returns to scale. Hence, an increase in the capital stock increases the output more at the lower levels of capital stock than at the higher levels of capital stock.. In other words, decreasing returns to capital implies that incremental output gains associated with the increases in capital stock will fall as the capital stock rises. To demonstrate this point more clearly, consider the following production function that shows the relationship between per capita level of output and capital stock:

$$(1) y = k^\alpha; \quad \text{where } 0 < \alpha < 1$$

Taking the time derivative of this function yields an expression for growth over time:

$$(2) \Delta y / \Delta t = (\alpha - 1) k^{1-\alpha} \cdot (\Delta k / \Delta t)$$

For a specific example, let us assume that $\alpha = 0.25$. Accordingly, Graph 1 plots the growth function in equation (2) against investment:



Based on Graph 1, Table 1 below provides a numerical example on the relation between investment and output. In Table 1, we present two scenarios: in Scenario 1, the change in capital stock in both periods is 16; in Scenario 2, the change of capital stock in Period 1 is 1 and in Period 2 it is 31. Hence, in both scenarios, the addition to the capital stock is 32 by the end of Period 2. Under Scenario 1, the corresponding increases in output are identical in both periods, as expected, adding up to 0.25 units of increase in output (changes in output are computed by integrating Equation (2) over the relevant areas determined by the changes in the capital stock). Scenario 2 indicates, however, that investment volatility, or variable additions to the capital stock, leads to a smaller aggregate increase in the level of output. Hence, if the production function exhibits decreasing returns to the capital stock, the effect on growth performance of investment that is evenly distributed over time is greater than the case where investment shows fluctuations over time.

Table –1 : Output Under Different Scenarios

	Scenario 1		Scenario 2	
	Increase in Capital Stock	Change in Output ¹	Increase in Capital Stock	Increase in Output
Period 1	16	0.5	1	0.25
Period 2	16	0.5	31	0.59
Total Increase in Output	32	1	32	0.84

We can also show the mentioned point with the following exercise, reading the regions of Graph 1, further clarifies the above statement. Under Scenario 1, we simply add up the regions a, b, c, d, e, f and g twice: $2*(a+b+c+d+e+f+g)$. Under Scenario 2, however, the additions to output amount to: $a+b+c+2*d+g+i$. Hence, so long as $(a+b+c+e+f) > (g+i)$, the first scenario of stable capital accumulation leads to greater output gains than the second scenario of volatile investment.

2. Investment Volatility and Output Performance in Turkey

We next apply the above analysis to the Turkish economy to see whether Turkish output growth suffers from investment volatility. To investigate the validity of this argument, we perform an econometric analysis, where we regress the seasonally adjusted real growth rate of Gross Domestic Product on a constant; seasonally adjusted fixed capital formation (in ratio of GDP); and the moving variance of the ratio of fixed capital formation to GDP. In addition, we include the lagged values of investment in the set of right hand side variables to incorporate the dynamic effects of investment on production.

The data is quarterly and range through **1989:1 to 1999:1**. Volatility of investment (M_INV) is measured over two years (in moving averages over eight quarters).² The following table summarizes the regression results:

¹ Calculated with the integral of $k^{-0.75}$

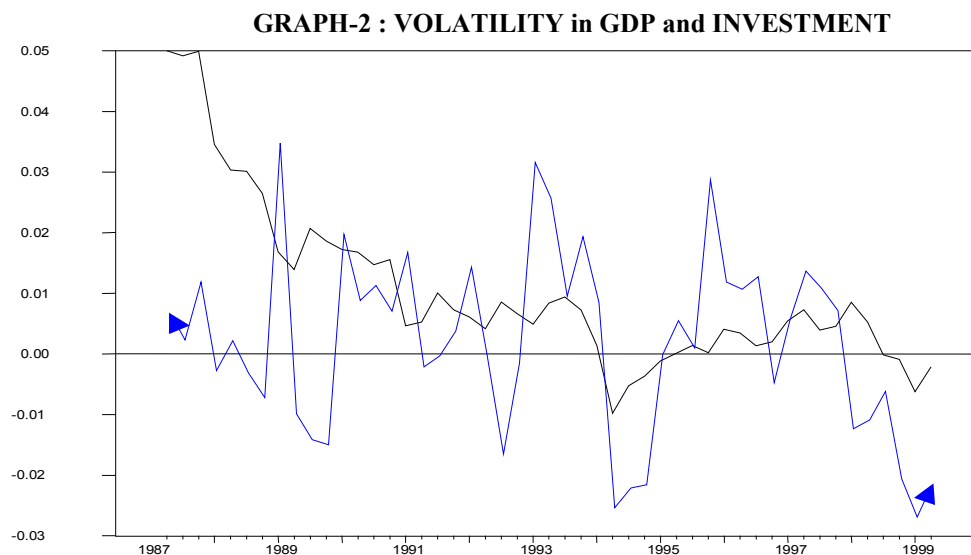
² To control for the effect of growth on investment and thus to overcome the problems due to possible simultaneity we use the instrumental variable technique with robust standard errors.

**Table : Regression Results (Dependent Variable:
Growth of deseasonalized quarterly GDP)**

Variables	Estimates	t-ratios:
Constant	0.10	5.67
INV_R	0.41	1.58
INV_R{1}	-0.56	-1.37
INV_R{2}	0.28	0.90
INV_R{3}	-0.10	-0.32
INV_R{4}	-0.36	-1.25
INV_R{5}	0.02	0.05
INV_R{6}	0.26	0.85
INV_R{7}	-0.07	0.81
INV_R{8}	-0.23	-1.62
M_INV	-89.92	32.39

The main result of this analysis is the negative significance of the coefficient of M_INV. Neither the contemporaneous nor the lagged values of investment (INV_R), however, are significant at conventional levels. We also perform a robustness test to investigate the effect on growth of the volatility of investment over a year (i.e. 4 quarters), the results are still robust.³

Graph-2 demonstrates the volatility in fixed capital formation (in percentages of GDP) presented by the arrow-ended line along with that of per capita output variance which is shown by the smooth line.



³ We also regressed the growth rate of GDP on the seasonally adjusted investment-GDP ratio and volatility of investment measures. The results are robust.

As can be seen in Graph-2, both GDP growth and investment (fixed capital investment in ratio to GDP) in Turkey show a high degree of volatility. Combining this observation with the results of the econometric analysis, we may conclude that highly variable fixed capital formation generates an important source of output volatility in Turkey. As the sudden jerks and breaks (i.e. lurching behavior) on economic conditions reflects volatility of aggregate demand management in Turkey, their effect on investment volatility generates an additional source of growth volatility.