A Comparison of Capital Formation in Industrialized Countries

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Abstract

Capital formation in other industrialized nations requires our attention particularly because of the volatile changes in Europe and the Soviet Union. Using the multiple regression technique on data drawn from International Financial Statistics from 1976 through 1990, this study compares the impact of economic variables namely GNP, money supply, short- and long-term interest rates on capital formation in eight industrialized countries. The Changes in GNP, followed by long term interest rate and money supply, have a greater impact on capital formation than cost of funds as represented by short-term interest rates.

Introduction

Predicting capital formation in the United States strengthens our government's stabilization policies and deserves our attention especially after the volatile changes in Europe and the Soviet Union in the past year. Yet, important as this subject is, little attention has been paid to capital formation in other industrialized nations. The exception, Malkiel (1979), reported sluggish capital formation in these countries and projected a shortage of capital in the United States. Others conducted similar studies including Buiter (1985), Fuss and Waverman (1985), and Hyashi (1985), Enzler, Conrad and Johnson (1963) determined that the gross rate for capital formation in the United States remained somewhat steady over the last ten years, but it has been low when compared to most industrialized countries. The ratio of gross fixed capital formation to GNP in the United States averages 18 percent. Its range is 2 to 4 percent higher (20 to 24 percent) for other countries abroad. Such data have been hard to come by, in spite of their impact on strategies for capital formation. Economists have yet to look with confidence on models reflecting wide-ranging parameters, including short- and long-term interest rates. As a result, they draw conflicting conclusions about the value of various models Ebersole, (1985); Feldsten, (1982); Fellner, (1976); Gilbert, (1976); Kuh and Meyer, (1963); Saving; (1967); Vining, (1976). In this paper, we will first examine the relationships between capital formation itself and money supply, short-term interest rates and long-term interest rates, and Gross National Product (GNP). Then we will compare the capital formation of eight industrialized countries. We conclude that, among these variables, GNP, followed by changes long-term interest rates and in money supply, have relatively the greatest influence on capital formation.

Moreover, the cost of funds, represented in the analysis by short-term interest rates has less impact.

Approaches to Capital Formation

Empirical approaches to capital formation take into account a country's need for additional investment capital based on priorities for national projects—energy, increased employment, or payments for international obligations. Chenery's (1952) and Koyck's (1954) flexible accelerator model assumes that long-range considerations determine desired capital. Thus, changes in desired capital may be rendered into investment expenditures by a distributed lag function. Yet, the list of those advocating explanations of simple acceleration is impressive: Eisner-Stroz (1963) identifies desired capital stock as the major determinant; Hart (1965) holds that capital appropriations predict investment expenditure accurately, while these appropriations may be projected from an orders-capacity index. Advocates of simple acceleration theories, whether they argue for the capacity of or change in the level of activity types, refer to zero elasticity. They thus deny short-run relationships between interest and the level of investment.

Methodology

We used the multiple regression technique to examine the relationships among the percentage change in capital formation (PCF), percentage change in money supply (PM), percentage change in short-term interest rate (PST), percentage change in long-term interest rate (PLT), and percentage change in Gross National Product (GNP) in

eight industrialized nations—Australia, Canada, France, West Germany, Italy, Japan, the United Kingdom, and the United States. We obtained quarterly data from International Financial Statistics, International Monetary Fund for 1976 through 1990. The general form of the regression models is

$$PCF_t = f(\ PM_{t-i}\ ,\ PST_{t-i}\ ,\ PLT_{t-i}\ ,\ PGNP_{t-i})$$

where

$$t = time\ period$$

$$i = 1, 2, 3, 4$$

We assumed that higher percentage change in capital formation would occur if the expected percentage change of money supply and GNP is high and percentage change in short- and long-term interest rates, is low. Using the models, we tested the following hypotheses about the relationship between the percentage change in capital formation and the percentage change in the four variables. These hypotheses are formulated thus:

$$H_0:\quad PCF_t / PM_{t-i}\ = 0$$

$$Ha:\quad PCF_t / PM_{t-i}\ > 0$$

$$H_0:\quad PCF_t / PST_{t-i}\ = 0$$

$$H_a:\quad PCF_t / PST_{t-i}\ < 0$$

$$H_0:\quad PCF_t / PLT_{t-i}\ = 0$$

$$H_a:\quad PCF_t / PLT_{t-i}\ < 0$$

$$H_0:\quad PCF_t / PGNP_{t-i} = 0$$

$$H_a:\quad PCF_t / PGNP_{t-i} > 0$$

We tested these hypotheses for each country individually, using four quarterly lags. The results of these regression equations, found in Tables 1 through 4, reveal the regression coefficients of the four independent variables for each country. Those tables also show the R^2 and F values for each equation. Table 5 summarizes the significant variables of Tables 1-4.

Australia

The findings for Australia reveal that the percentage change in GNP was not significant in the four lags. Yet, the percentage change in money supply was a significant variable in one out of four lags (4 quarter lag). In addition, the percentage change in long-term interest rates was significant in one out of four lags (4 quarter after lag). Percentage changes in short-term interest rates were not at all significant.

TABLE 1
Capital Formation Lagging One Quarter

	Intercept	M_{t-1}	S_{t-1}	LT_{t-1}	GNP_{t-1}
Australia	0.042	0.119	0.233	0.608	-0.352
	(2.249)**	(0.475)*	(-1.086)	(1.400)*	(-0.972)*
	$R^2 = 0.178$	F = 2.870			
Canada	0.009	0.098	0.096	-0.040	0.326
	(1.650)**	(1.266)	(2.584)**	(-0.554)	(2.245)**
	$R^2 = 0.192$	F = 3.095*			
France	0.030	-0.090	0.028	0.009	-0.245
	(5.676)*	(-1.096)**	(0.889)	(0.108	(-1.969)**
	$R^2 = 0.090$	F = 1.315			
Germany	0.042	-0.319	0.086	-0.235	-1.443
	(2.624)*	(-1.705)**	(0.964)	(-1.315)	(-1.626)
	$R^2 = 0.117$	F = 1.763			
Italy	0.034	-0.003	0.132	-0.049	0.150
	(2.554)*	(-0.449)	(0.865)	(-0.318)	(0.575)
	$R^2 = .027$	F = .374			
Japan	0.015	-0.021	-0.007	0.069	0.191
	(4.032)*	(-0.502)	(-0.354)	(2.768)*	(1.097)**
	$R^2 = 0.158$	F = 2.485			
U. K.	0.012	0.066	-0.015	-0.222	0.516*
	(0.852)	(0.253)	(-0.167)	(-1.129)	(2.390)**
	$R^2 = 0.150$	F = 2.329			
U. S.	0.021	0.004	0.050	0.009	-0.011
	(5.117)*	(1.221)*	(1.038)	(0.112)**	(-2.996)*
	$R^2 = 0.189$	F = 3.082*			

*Significant at the 1% confidence level.
**Significant at the 5% confidence level.
Numbers in parentheses are the t-Statistics.

Canada

Of the four variables, percentage changes in short term interest rates and GNP seem to play the most important roles in the capital formation of Canada. Percentage changes in, GNP, and short-term interest rates appeared as significant variables only once in four lags. The percentage change in long-term interest rates and money supply, moreover, was not significant in any lag.

France

Percentage changes in GNP were significant in all but the third lag. Percentage change in money supply was significant only in the second lag; percentage changes in short- and long-term interest rates were not significant in any lag.

TABLE 2
Capital Formation Lagging Two Quarter

	Intercept	M_{t-1}	S_{t-1}	LT_{t-1}	GNP_{t-1}
Australia	0.035	0.163	-0.007	0.111	-0.128
	(1.693)**	(0.593)	(-0.030)	(0.233)	(-0.323)
	$R^2 = 0.009$	F = 0.118			
Canada	0.018	-0.045	0.005	0.018	0.126
	(3.222)*	(-0.539)	(0.119)	(0.237)	(0.795)
	$R^2 = 0.022$	F = 0.293			
France	0.025	0.137	0.008	0.106	-0.235
	(4.787)*	(1.723)**	(0.258)	(1.389)	(-1.977)**
	R2 = 0.192	F = 3.083			
Germany	0.018	-0.136	0.098	-0.074	-0.422
	(1.036)	(-0.689)	(1.032)	(-0.389)	(-0.443)
	$R^2 = 0.031$	F = 0.420			
Italy	0.035	-0.005	0.079	-0.138	0.125
	(2.583)**	(-0.613)	(0.509)	(-0.878)	(0.471)
	$R^2 = 0.020$	F = 0.266			
Japan	0.018	-0.019	-0.011	0.019	0.024
	(4.344)*	(-0.417)	(-0.486)	(0.661)	(0.125)
	$R^2 = 0.013$	F = 0.172			
U. K.	0.049	0.322	-0.013	-0.101	0.300
	(3.332)*	(1.184)	(-0.138)	(-0.496)	(1.334)
	$R^2 = 0.075$	F = 1.058			
U. S.	0.020	0.003	0.006	0.025	-0.002
	(4.315)*	(0.618)	(0.115)	(0.276)	(-0.560)
	$R^2 = 0.018$	F = 0.232			

*Significant at the 1% confidence level.
**Significant at the 5% confidence level.
Numbers in parentheses are the t-Statistics.

TABLE 3
Capital Formation Lagging Three Quarter

	Intercept	M_{t-1}	S_{t-1}	LT_{t-1}	GNP_{t-1}
Australia	0.041	0.125	0.182	-0.202	-0.337
	(1.946)**	(0.457)	(0.761)	(-0.420)	(-0.848)
	$R^2 = 0.018$	F = 0.232			
Canada	0.018	0.101	0.028	-0.089	0.014
	(3.152)*	(1.226)	(0.704)	(-1.162)	(-0.090)
	$R^2 = 0.081$	F = 1.097			
France	0.027	-0.040	-0.046	0.021	-0.083
	(4.744)*	(-0.472)	(-1.403)	(0.249)	(-0.649)
	$R^2 = 0.077$	F = 1.058			
Germany	-0.012	-0.191	-0.054	0.207	2.293
	(-0.078)	(-0.939)	(-0.603)	(1.147)	(2.517)**
	$R^2 = 0.152$	F = 2.287			
Italy	0.044	0.006	-0.054	-0.022	-0.147
	(3.176)*	(0.740)	(-0.341)	(-0.135)	(-0.546)
	$R^2 = 0.020$	F = 0.263			
Japan	0.016	0.041	0.034	-0.059	0.102
	(4.146)*	(0.973)	(1.607)	(-2.241)**	(0.574)
	$R^2 = 0.115$	F = 1.653			
U. K.	0.038	0.0174	-0.050	-0.033	-0.565
	(2.629)**	(0.656)	(-0.535)	(-0.163)	(-2.586)**
	$R^2 = 0.142$	F = 2.112			
U. S.	0.018	0.005	0.037	-0.067	-0.005
	(3.960)*	(1.231)	(0.709)	(-0.758)	(1.228)
	$R^2 = 0.062$	F = 0.841			

*Significant at the 1% confidence level.
**Significant at the 5% confidence level.
Numbers in parentheses are the t-Statistics.

Germany

Percentage changes in money supply were significant in two out of the four lags. But the percentage change in long-term interest rates and GNP were significant in only one lag out of four. From these data we may infer that percentage changes in GNP and money supply play more significant roles in Germany's capital formation than the cost of money, especially short-term cost.

Italy

The percentage changes in money supply, short-term interest rates, and GNP were not significant factors in the four lags. Only the percentage change in long-term interest rate was significant in the fourth lag. We may con-clude that none of the four economic factors has a significant impact on capital formation in Italy.

Japan

Percentage change in money supply was significant in the fourth lag, and long-term interest rates were significant in the first and third lags. The four lags percentage changes in GNP and short-term interest rates were not significant in any lag.

United Kingdom

Percentage change in GNP was significant in the first, third, and fourth lags. Percentage changes in money supply and short- and long-term interest rates were not significant in any lag.

TABLE 4

Capital Formation Lagging Four Quarter

	Intercept	M_{t-1}	S_{t-1}	LT_{t-1}	GNP_{t-1}
Australia	0.044	-0.485	0.329	-0.850	0.256
	(2.185)**	(-1.858)**	(1.451)	(-1.865)**	(-0.675)
	$R^2 = 0.114$	F = 1.607			
Canada	0.022	0.057	0.025	-0.067	-0.019
	(3.698)*	(0.656)	(0.598)	(0.820)	(-0.115)
	$R^2 = 0.031$	F = 0.392			
France	0.009	-0.026	0.037	-0.078	0.565
	(1.908)**	(-0.363)	(1.421)	(-1.180)	(5.538)*
	$R^2 = 0.443$	F = 9.956			
Germany	0.013	0.533	0.066	-0.319	-0.632
	(0.817)	(2.542)**	(0.723)	(-1.720)**	(-0.629)
	$R^2 = 0.181$	F = 2.766			
Italy	0.029	-0.002	0.162	-0.262	0.230
	(2.122)**	(-0.210)	(1.055)	(-1.681)**	(0.879)
	$R^2 = 0.085$	F = 1.168			
Japan	0.016	0.095	0.001	0.034	0.037
	(4.185)*	(2.190)**	(0.057)	(1.166)	(0.205)
	$R^2 = 0.104$	F = 1.445			
U. K.	0.011	0.090	0.044	0.066	0.436
	(0.721)	(0.330)	(0.441)	(0.302)	(1.901)**
	$R^2 = 0.097$	F = 1.350			
U. S.	0.018	0.002	-0.020	0.065	0.004
	(3.970)*	(0.471)	(-0.367	(0.725)	(1.101)
	$R^2 = 0.049$	F = 0.649			

*Significant at the 1% confidence level.

**Significant at the 5% confidence level.

Numbers in parentheses are the t-Statistics.

TABLE 5

Summary of the Significant Variables for Each Lag and Each Country

	Lag/Variable	Gap	M	ST	LT	F-Ratio
Australia	1	N	N	-N	N	X
	2	N	N	N	N	X
	3	N	N	-N	-N	X
	4	N	-X	N	X	X
	A	0	1	0	1	
	B	0	0	0	4	
	C	NA	0	NA	1	
Canada	1	X	N	-X	N	X
	2	-N	N	N	N	N
	3	N	N	N	N	N
	4	N	N	N	N	N
	A	0	0	1	0	
	B	0	0	0	0	
	C	NA	NA	1	0	
France	1	-X	N	N	N	N
	2	-X	X	N	N	N
	3	N	N	N	N	N
	4	X	N	N	N	X
	A	3	1	0	0	
	B	0	0	0	0	
	C	1	1	NA	NA	
Germany	1	N	-X	N	N	X
	2	N	N	N	N	N
	3	X	N	N	N	X
	4	N	X	N	X	X
	A	1	2	0	1	
	B	2	1	0	2	
	C	1	1	NA	1	
Italy	1	N	N	N	N	N
	2	N	N	N	N	N
	3	N	N	N	N	X
	4	N	N	N	X	X
	A	0	0	0	1	
	B	2	1	0	2	
	C	NA	NA	NA	1	
Japan	1	N	N	N	-X	N
	2	N	N	N	N	N
	3	N	N	N	X	N
	4	N	X	N	N	N
	A	0	1	0	2	
	B	0	0	0	0	
	C	NA	1	NA	1	
United Kingdom	1	X	N	N	N	X
	2	N	N	N	N	X
	3	-N	N	N	N	X
	4	X	N	N	N	X
	A	3	0	0	0	
	B	1	0	0	0	
	C	2	NA	NA	NA	
USA	1	-X	N	N	N	X
	2	N	N	N	N	X
	3	N	N	N	N	N
	4	N	N	N	N	N
	A	1	0	0	0	
	B	2	0	0	0	
	C	0	NA	NA	NA	

X: Significant at 1% or 5% confidence level.

N: Not significant at 1% or 5% confidence level.

-: Coefficient with wrong sign.

A: Total number of significants of that variable in all four lags.

B: Total number of significants of that variable in all four lags given F-Ratio is significant.

C: Total number significants of that variable with correct sign in all four lags.

United States

Percentage changes in GNP were significant in only one out of four lags. None of the other three variables has a significant impact in capital formation in the U.S.

Overall Results

Overall, few economic factors in some of the lags seem to influence capital formation in the eight industrialized countries. Supporting this conclusion is the significance of the intercept in the regression equations. The economic factors have had less an impact in capital formation in seven countries than they had in Germany where their influence appeared in the second, third, and fourth lags.

TABLE 6

**Overall Summary of All Significant Variables
For All Countries**

	GNP	M	S	L
D	8	5	1	5
E	1	3	1	4
F	4	3	1	4

X: Significant at 1% or 5% confidence level.

N: Not significant at 1% or 5% confidence level.

-: Coefficient with wrong sign.

A: Total number of significants of that variable in all four lags.

B: Total number of significants of that variable in all four lags given F-Ratio is significant.

C: Total number significants of that variable with correct sign in all four lags.

D: Overall total of A.

E: Overall total of B.

F: Overall total of C.

* GNP = gross national product, M = money supply, S = short term interest rate, and L = long term interest rate.

As Tables 5 and 6 reveals, percentage change in GNP had the most impact in eight out of thirty-two possible significants (eight countries each having four). Percentage changes in money supply and long-term interest rates were significant in five cases. Percentage changes in short-term interest rates of money was less important because it held significance in only one case. In addition, percentage changes in GNP supported the earlier hypothesis in four out of thirty-two cases, money supply in three, long-term interest rates in four, and short-term interest rates in one. Thus, these findings did not support our earlier hypothesis.

Based on this analysis of quarterly data for eight industrial countries, the percentage changes in GNP plays the most important role, followed by long term interest rates and money supply, in bdetermining the level of percentage changes in capital formation. Moreover, percentage change in short-term interest rates are, with one exception, insignificant. Changes in long-term interest rates have relatively more impact than short-term interest rates.

The over all conclusion is that changes in capital formation is properly dependent on future expectations of the economic factors and that it may have little relationship with the past factors.

Summary and Conclusions

The findings of this study indicate that weak relationships exist between lagged changes in GNP, money supply, short-term interest rates, and long-term interest rates, on the one hand, and changes in capital formation in eight industrialized countries, on the other hand.

Changes in GNP, followed by changes in long term interest rates and money supply, seem to be relatively more significant, overall, in influencing capital formation than short-term interest rates do. The intercept of the equation was significant in most 32 cases. This suggests that the four lagged economic variables—GNP, money supply, short- and long-term interest rates— have less impact on capital formation than reported by Benkato and Haddad [1] whose different methodology found an increased correlation in economic factors among the industrialized countries.

The results of this study , to say the least, are compatible with empirical evidence which supports alternative theories of investment behavior in the United States. However, it would be hasty to suggest that the models in our methodology cover the diversity and complexity of cross-country capital formation. If anything, our study suggests that further investigation should include the effect of other variables such as socio-economic infrastructure, tax system, corporate profit before taxes, employment, productivity, gross national savings, gross disposable income, inflation, exchange rates, and balance of payment accounts.

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