Determinants Of Demand For Different Types Of Investment Goods

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ABSTRACT

Separate U.S. investment demand functions are developed and econometrically tested using 1960-2000 data for (1) plant and equipment, (2) residential housing, and (3) inventory investment. The models explain 90% of the variance in plant and equipment demand, 85% of housing demand for and 67% of inventory demand. Results are contrasted with a previous study of total investment demand. Findings indicate regression coefficients for a total investment's determinants will not be the sum of the regression coefficients in the separate parts, unless the determinants of each of the parts are exactly the same. For investment, they are not.

1. INTRODUCTION

A previous study (Heim 2008) indicated total demand for U.S. investment goods is driven by

- the current growth rate of the economy (an "accelerator" effect),
- the size of available depreciation allowances,
- credit constraints due to the "crowd out" effects of government deficits,
- interest rates, particularly the prime interest rate
- Corporate profits, and
- the exchange rate.

However, that study did not develop separate demand functions for each of three component parts of investment: plant and equipment, residential housing, and inventory investment

Do these findings for demand overall hold equally for each type of investment? This paper attempts to answer this econometrically by developing demand functions for each type of investment, using data for the period 1960 - 2000. Table 1 below shows trends in U.S. investment and its component parts.

TABLE 1: COMPONENTS OF REAL U.S. INVESTMENT 1960 – 2000 (Billions of 2000 Dollars)

Year	Total Investment	Business plant & equipment	Residential Housing	Inventory Investment .
1960	$ 266.4	$ 140.0	$ 157.2	$ 9.0
1970	426.8	260.1	192.3	4.8
1980	644.0	435.6	239.7	- 7.6
1990	893.3	594.5	298.4	13.8
2000	1,735.5	1,232.1	446.9	56.5
% Total	100%	64.3%	35.7%	2.8% .

Source: Economic Report of the President 2005, Appendix Tables B1, B7

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Overall, from 1960 - 2000, total investment in real 2000 chained dollars averaged 14% of GDP, a significantly smaller percentage than consumption (67%) and government purchases of goods and services (21%). Net exports accounted for the remainder, averaging (-2%) for the period.

2. THEORIES OF DEMAND FOR INVESTMENT GOODS

Keynes' theory of demand for investment goods (Keynes, 1936, pp. 135-151) noted that expectations, interest rates, profitability, stock value, and capacity utilization affected demand. Terragossa (1997) noted depreciation allowances could be important. Spencer & Yohe (1970) and Heim (2008) noted "crowd out". Heim (2008) also found exchange rates could be important.

Residential housing demand is principally a demand by consumers. Keynes (1936), found consumer spending affected by income, taxes, wealth and interest rates. Du Reitz (1977) found average age of the population important. Rosser (1999), found how long you had been in the work force important, and whether you were living with a partner and had children.

Temin (1977) reports little relationship between credit conditions and inventory investment. However, Carpenter, Fazzari and Peterson (1998) provides "new evidence of the importance of financing constraints". Lovell (1964) found the accelerator effect important. King (2003) notes Keynes felt inventory investment should be affected by the same things that affect fixed investment, but also the availability of finance and expectations of sales. Choi and Kim (2001) also note that "inventory fluctuations are largely attributable to unexpected sales shocks, limiting explanatory power.

3. METHODOLOGY

The following eight variables constitute this study's initial hypothesis as to the determinants of demand for plant, equipment and inventories. The hypothesis to be tested is:

(1) $I_{P\&E,INV} = \alpha + \beta_1 (ACC) + \beta_2 (DEP) + \beta_3 (r_{PR} * Y_{-2}) + \beta_4 (T_G - G) + \beta_5 (DJ) + \beta_6 (CAP) + \beta_7 (PROF) + \beta_8 (XR)$

The model of residential housing demand is:

(2) $I_{RES} = \alpha + \beta_2 (Y - T_G) + \beta_1 (ACC) + \beta_3 (r_{MORT} * Y_{-2}) + \beta_4 (T_G - G) + \beta_5 (DJ) + \beta_6 (H_{PRICE}) + \beta_7 (POP) + \beta_8 (XR)$

Variable definitions for both (1) and (2) are provided below.

3.1 DATA USED

Regressions were estimated using 1960 – 2000 data taken from the *Economic Report of the President, 2002*. Data values used are real, not nominal.

Variable (Abbrev. Used)	Table	Definition
Total Investment Goods (I)	B2	plant and equipment, residential housing, Δ inventories
Business Fixed Investment (BUSI)	B18, B7	Nominal deflated using table B7 P&E deflator
Residential Fixed Investment (RESI)	B18, B7	Nominal values deflated using table B7 residential housing costs deflator
Inventory Investment (INV)	B18, B7	Nominal deflated using table B7 business P&E deflator
Accelerator (ACC)	B2	Yearly change in the level of the GDP (ΔY)
Depreciation (DEP)	B26	Yearly business depreciation of fixed plant and equipment
Government Purchases (G)	B2	Total Federal State and Local spending (minus transfer payments). Deflated using Table B7 deflator.
Taxes (T_G)	B82	Consolidated Federal, State and Local Government Receipts (exclusive of transfer payments, deflated using chained 1996 dollars. (Table B7),
Crowd Out (T_G-G)		Taxes (T_G) minus G
Taxes (T_{EX})	B82	T_G - (.26*real GDP), where (.26*real GDP) is the rate at which taxes grow due to income growth. This variable defines exogenous taxes.
Dow Jones Composite Average (DJ)	B95	A measure of how much investment can be financed by a given amount of new stock issuance. (Proxy for Tobin's "q")
Interest rate ($r*Y_{-2}$)	B73	The "real" prime interest rate, i.e., nominal value minus the average of the past two years CPI inflation (Table B60) This is modified by Y to reflect economy size ($r*Y_{-2}$).
Capacity Utilization (CAP)	B54	Manufacturing output as a % of capacity
Corporate Profitability (PROF)	B28	A measure of business profitability.
Exchange Rate (XR_{AV0123})	B110	The Federal Reserve's Real Broad Exchange Rate, averaged over the current and past three years
Business and Personal Income, After Taxes (Y-T_G)	B2, B82	Real GDP minus the portion of taxes used by government to purchase goods and services
Housing Prices, Relative to Income (H_{PRICE})	B2, B3 B34	Census data on nominal house prices deflated using GDP deflator, divided by real per capita disposable income.
House Buying Cohort Size (POP)	B34	Age 16-24 cohort as % of 65 and over cohort. Used To obtain estimate of the net effect on housing demand of changes in the ratio of a major demographic: cohorts who are net house buyers versus net sellers.

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3.2 THE ECONOMETRIC TESTING PROCEDURE

Fully specified models, which included all hypothesized investment determinants, were used to estimate marginal effects (regression coefficients) on investment of each of its determinants. "Stepwise" regression was also used to determine how much each variable contributed to total variance.

To determine the appropriate time lags to use with a variable, individual variables were tested by adding them, with from +3 to -3 year lags, to a preliminary model containing two explanatory variables investment theory suggested important: the accelerator and crowd out. The lag selected was the one

which added the most to explained variance, unless the sign on the variable was theoretically wrong, or the result suggested the direction of causation was backward.

The stepwise procedure is also to assess the stability (robustness) of the marginal effect estimates (regression coefficients) as variables are added or subtracted from the model. Results shown later in this study will show the more variance a regression currently explains, the less likely marginal effect estimates will change when additional variables are added. Hence, for incompletely specified regressions, in which important explanatory variables are left out, the possibility of overstating the marginal effects of a variable, or its statistical significance, are substantial, and results are subject to major change when the omitted variable is added (Goldberger, 1961).

We enhance the likelihood of stable regression coefficients by reducing intercorrelation between explanatory variables using "first difference" rather than "levels" of the data when estimating coefficients, and also reduce autocorrelation problems (Griffiths, Hill, Judge, 1993), and may reduce nonstationarity.

Investment and the explanatory variables (Y) or (ACC = Y_t - Y_{t-1}), are simultaneously determined, since I_t is part of Y_t. Two Stage Least Squares is used to avoid this simultaneous equations bias (Griffiths, Hill, Judge, 1993)). Evidence of heteroskedasticity was found in preliminary testing. Newey West heteroskedasticity corrections were made (Newey West, 1987).

4.1. FINDINGS: DETERMINANTS OF BUSINESS DEMAND FOR PLANT AND EQUIPMENT

Preliminary testing indicates that using the income modified version of the interest rate variable ($\Delta r_{t-2or3} * Y_{t-4or5}$) compared to just (Δr_{t-2or3}) better explains the variation in interest rate effect when the overall economy size changes, as expected. The form chosen caused virtually no change in other regression coefficients during tests. Preliminary testing also indicated that the two variable form of the government deficit (the crowd out measure) was the most appropriate, since their effects on P&E investment differ. Both had negative effects on P&E investment, but spending increases had 1.5 - 2.0 times the effect of same size tax cuts. Other regression coefficients were unaffected by the form of crowd out used.

The most unexpected finding in preliminary tests, given the findings we later report for total investment, was that the two period lagged interest rate variable, was not found even mildly statistically significant. However, the three period lagged version was found very significant (t =2.4 – 3.8).

Table 2 tests the Keynesian and other hypothesized determinants of plant and equipment investment and allows examination of the stability of regression coefficients when changes are made to the model tested. Estimates become more stable as additional variables are added. The most stable results seem to occur when adding variables to models already explaining about 90% of the variance.

Our test findings in table 2 below indicate that all our hypothesized determinants of investment in plant and equipment are systematically related to it, except (prior year levels) of capacity utilization.

TABLE 2: VARIATION IN ESTIMATES AS VARIABLES ARE ADDED TO THE P&E MODEL .

R^2/Adj.R^2 (DW) β (t-stat.*)	ΔDJ_{t-1} $\beta_{1T}(t)$	$\Delta PROF_{t-1}$ $\beta_{1G}(t)$	$\Delta T_{G(t)}$ $\beta_3(t)$	ΔG_t $\beta_2(t)$	ΔDEP_{t-1} $\beta_4(t)$	$\Delta XR_{avt-(t-3)}$ $\beta_5(t)$	$\Delta ACC=\Delta Y_t$ $\beta_6(t)$	$\Delta r_{t-3}*Y_{t-5}$ $\beta_7(t)$	ΔCAP_{t-1} $\beta_8(t)$
2 variable crowd out; (r income modified);									
48/48% (1.3)	1.37(11.3)								
67/66% (1.5)	1.30(14.5)	.50 (5.1)							
75/73% (1.2)	.98 (9.3)	.40 (3.9)	.22 (4.0)	- .01 (-0.1)					
82/80% (1.2)	.69 (8.9)	.36 (4.1)	.26 (5.5)	- .26 (-2.2)	. 67 (3.6)				
89/88% (2.1)	.54 (6.3)	.50 (4.9)	.26 (5.4)	- .39 (-4.3)	.86 (8.4)	4.22 (4.1)			
91/89% (2.0)	.55 (6.2)	.54 (5.2)	.23 (5.2)	- .35 (-3.9)	.85 (6.3)	4.18 (4.1)	.04 (3.1)		
93/91% (2.0)	.66(8.6)	.48 (5.5)	.21 (5.7)	- .35 (-3.5)	.83 (7.2)	3.87 (4.4)	.05 (3.8)	-.64 (-3.7)	
93/91% (1.8)	.65 (8.6)	.43 (4.6)	.19 (5.3)	- .37 (-3.8)	.89 (7.6)	3.79 (4.0	.06 (3.8)	-.53 (-2.7)	1.19 (1.5)
(The regression below modified to use ($Y-T_G$) Defn. of ACC variable instead of $ACC_t=Y_t$ used immediately above)									
92/90% (1.8)	.57 (7.6)	.45 (4.8)	.26 (7.5)	- .39 (-3.9)	.87 (8.1)	3.97 (3.9)	.06 (3.5)	-.51 (-2.4)	.33 (0.5)

*t-Statistics OF 2.0, 2.7 =5%, 1% Significance Levels Respectively.

Table 3 below uses the stepwise addition and subtraction regression procedures to calculate both the maximum and the minimum amount of variance attributable to any one explanatory variable.

TABLE 3: RANGE OF POSSIBLE CONTRIBUTIONS TO EXPLAINED VARIANCE IN P&E MODEL

Variable	Method: Stepwise Addition		Stepwise Subtraction
DJ_{-1}	47.7%		25.8%
$PROF_{-1}$	19.2	-	7.3
$(T, G)_{(2\ VAR.)}$	8.3	-	17.8
DEP_{-1}	7.0	-	9.6
XR_{AV}	7.1	-	17.2
$ACC_{(Y)}$	1.7	-	N.A.*
r_3y_5	1.4	-	N.A.*
$CAP_{-1\ OR\ -2}$	0.1%	-	16.8%

*Negative R^2 due to lack of constant term

Table 3 indicates the four variables whose movement was most related to change to the changes in P&E investment are:

- A company's stock value, a Tobin's q proxy, (DJ_{-1})
- company profits ($PROF_{-1}$)
- availability of credit (the crowd out variables Tand G) and
- the exchange rate. XR_{AV}

These are important findings since two of these variables (profits, credit availability) are policy - controllable, implying P&E investment can be stimulated by appropriate public policy. Depreciation, which explained a moderate amount of variance, is also policy controllable via tax preference effects.

The accelerator and interest rates, though statistically significant, explained little of the variance in P&E. This can occur when a variable does not vary much over time, or has but a small marginal effect.

Finally, Table 3 results suggest that capacity utilization is so intercorrelated with other variables, it shows no contribution to explained variance if entered last in a regression, or a significant amount if entered first. Hence, it is difficult to make any judgments as to its actual impact in the period studied.

4.2 DETERMINANTS OF DEMAND FOR RESIDENTIAL HOUSING

Table 4 tests the Keynesian and other hypothesized determinants of residential housing demand and allows examination of the stability of regression coefficients when changes are made to the model tested. Estimates become more stable as additional variables are added. The most stable results seem to occur when adding variables to models already explaining about 80% of the variance.

The results are clearly consistent with the hypothesis that disposable income, credit crowd out, the income modified mortgage interest rate, wealth, and housing prices are significant determinants of housing demand. Less clear was whether the ratio of 15-24 year olds in the population to those 65 and over was a factor. The statistic was significant when the interest rate used was not income modified; when the interest rate was income modified, it wasn't. The exchange rate was not found significant.

Preliminary tests suggested that there is an accelerator affect on housing demand as well as business investment demand. Including the accelerator variable added 2% to explained variance. Testing the accelerator variable indicated the disposable income version $\Delta(Y\text{-}T_G)$ worked best.

The results for the two variable formulation of the government deficit/crowd out problem shown in Table 4 suggest that raising the government deficit by raising government spending or cutting taxes has about the same effect on demand for residential investment.

Neither the one or two variable form of the crowd out variable, or the use (or not) of an economy size modifier seem to affect the marginal effect estimates for the other variables in the model. Using stepwise regression, Table 5 below provides estimates of how much the total variation in residential investment can be attributed to any one variable, using both addition and subtraction variants of the method.

Explaining the most variance in residential housing demand were: 1) the price of housing relative to per capita income (P_{HOUSE}), 2) crowd out, and 3)mortgage interest rates. The results also suggest that three other variables also had a more minor effect: consumer wealth, (DJ_{-2}); demographic changes in the population (POP), and the exchange Rate (XR_{AV0123}). The estimated effect of disposable income ($Y\text{-}T_G$), varied so much with order of entry that little can be said with confidence about its contribution.

TABLE 4: VARIATION WHEN ADDITIONAL VARIABLES ARE ADDED TO THE HOUSING MODEL

R^2/Adj.R^2 (DW) B (t-stat.**)	$\Delta P_{HOUSE(t)}$ $\beta_{1T}(t)$	$\Delta T_{G(t)}$ $\beta_{2T}(t)$	ΔG_{tt} $\beta_{2G}(t)$	$\Delta r_{MORT} Y_{-4}$ $\beta_3(t)$	ΔACC_t $\beta_4(t)$	$\Delta(Y-T_{G(t)})$ $\beta_5(t)$	ΔDJ_{t-2} $\beta_6(t)$	ΔPOP_{16-24} $\beta_7(t)$	$\Delta XR_{AVt-(t-3)}$ $\beta_8(t)$
(r income modified); 2 separate (T_G, G) crowd out variables used;									
37/37% (1.3)	-.042(-6.0)								
68/66% (1.7)	-.047(-7.8)	.24 (8.7)	-.14 (-1.6)						
74/72% (1.7)	-.042(-6.1)	.23 (8.5)	-.12 (-1.8)	-1.54 (-2.4)					
79/76% (1.4)	-.031(-3.4)	.23 (6.7)	-.11 (-1.7)	-1.60 (-2.8)	.08 (3.0)				
80/77% (1.4)	-.027(-3.4)	21(5.6)	-.21 (-2.3)	-1.98 (-3.7)	.06 (1.8)	.04 (1.4)			
82/79% (1.5)	-.026(-3.4)	.23 (5.3)	-.21 (-2.3)	-1.96 (-3.7)	.06 (1.8).	05 (1.9)	-.17 (-1.6)		
83/79% (1.5)	-.023(-3.1)	.23 (5.0)	-.22 (-2.1)	-2.15 (-5.0)	.06 (2.2)	.06 (2.2)	-.19 (-1.7)	136.5(1.3)	
83/78% (1.5)	-.021(-2.4)	.22 (5.3)	-.24 (-2.4)	-2.13 (-4.6)	.05 (2.0)	.07 (2.4)	-.22 (-2.0)	122.2(1.1)	.70 (1.2)
83/78% (1.6) ***	-.017(-1.7)	.17 (3.6)	-.23 (-2.2)	-2.19 (-4.5)	.05 (1.7)	.07 (2.5)	-.17 (-1.5)	147.5(1.4)	.70 (1.2)
(Same as above except for consistency with P&E, INV models, Acc=ΔY, DJ_{-1} is used, and the lag on mort*Y is -2. Using this formulation reduces biasing effects of multicollinearity when adding component parts of investment together, by reducing the number of explanatory variables by two. Virtually the same results are obtained for each variable in the residential demand model.)									
83/79% (1.8)	-.015(-1.5)	.19 (5.4)	-.20 (-1.5)	-2.22(-5.4)	.05 (1.7)	.07 (2.2)	-.19 (-2.0)	158.5(1.6)	.62 (1.1)
83/79% (1.5)	-.022(-3.1)	.23* (5.7)	(N.A.)*	-2.10 (-5.3)	.06 (2.1)	.06 (2.8)	-.22 (-2.1)	121.3(1.1)	.67 (1.3)
(r not income modified)									
85/81% (1.6)	-.017(-2.3)	.24 (7.3)	-.27 (-2.9)	-13.06(-6.9)	.05 (2.0)	.06 (2.4)	-.27 (-2.7)	201.5(2.2)	.80 (1.7)
85/82% (1.5)	-.018(-3.2)	.24* (7.5)	(N.A.)*	-12.73(-7.8) .	05 (2.2)	.06 (2.6)	-.27 (-2.7)	197.1(2.2)	.73 (1.8)

Δ Acc= Δ(Δ(Y-T_G))
(*) Government Deficit Reported As One Variable (T_G-G)
(**) t- statistics of 2.0 = 5% significance; t - statistics of 2.7 = 1% level of significance.
(***) Same as immediately preceding equation, except accelerator = Δ(ΔY), not Δ(Δ(Y-T_G))

TABLE 5: RANGE OF POSSIBLE CONTRIBUTIONS TO EXPLAINED VARIANCE IN HOUSING MODEL

Variable	Stepwise Addition		Range of Variation Subtraction
P_{HOUSE}	37.1%		11.9
$(T, G)_{(2 VAR.)}$	31.4	-	25.2
MORT	7.2	-	10.8
$ACC_{(Y-TG)}$	4.4	-	9.7
DJ_{-2}	1.4	-	0.3
$(Y-T_G)$	1.9	-	24.6
POP	1.6	-	0.9
XR_{AV0123}	0.8%	-	2.0

4.3 DEMAND FOR INVENTORY INVESTMENT

Table 6 below presents the results of regressing inventory investment on the determinants hypothesized earlier and allows examination of regression coefficient stability as variables are added in stepwise fashion to the model. With only five or six variables in the model, and only 2/3 of the variance explained, there is less coefficient stability than for plant and equipment and housing investment. Nonetheless, overall, coefficients stay reasonably stable Neither the form of the crowd out variable, or the use of an economy size modifier affected other regression coefficients in the same model.

Found related to current year changes in inventory levels were:

Δ in the (current year) rate of growth of the economy - the accelerator: (ACC_0),

Δ in depreciation reserves to finance inventories (DEP_0),

Δ in access to credit to finance inventories, measured by deficit/crowd out variables ($T_{G(0)}$, G_0)

Δ in interest rates modified to reflect the size of the economy($r_{PR-2}Y_{-4}$)

Δ in consumer demand (C_0)

TABLE 6: VARIATION WHEN ADDITIONAL VARIABLES ARE ADDED TO THE INVENTORY MODEL.

R^2/Adj.R^2 (DW) B (t-stat.**)	ΔACC_0 $\beta_{1T}(t)$	$\Delta T_{G(0)}$ $\beta_{2T}(t)$	ΔG_0 $\beta_{2G}(t)$	$\Delta r_{PR-2}Y_{-4}$ $\beta_3(t)$	ΔC_0 $\beta_4(t)$	ΔDEP_0 $\beta_5(t)$
(r income modified);						
47/47% (2.9)	.14 (6.0)					
58/56% (2.6)	.12 (5.0)	.15 (3.4)	-.19 (-3.4)			
60/56% (2.5)	.12 (5.2)	.13 (3.5)	-.14 (-1.7)	-.41 (-1.3)		
63/58% (2.6)	.14 (5.7)	.16 (3.7)	.00 (0.1)	-.48 (-1.5)	-.05(-2.0)	
67/62% (2.4)	.17 (5.3)	.17 (3.5)	.02 (0.1)	-.70 (-1.9)	-.16(-2.7)	.54 (2.4)
65/61% (2.4)	.16 (5.4)	.17*(4.0)*	(N.A.)*	-.58 (-1.8)	-.12 (-2.7)	.51 (2.5)
(r not income modified;						
67/62% (2.5)	.17 (5.3)	.16 (3.5)	.01 (0.1)	-3.24 (-1.9)	-.16(-2.7)	.55 (2.3)
65/61% (2.4)	.16 (5.6)	.15* (4.1)*	(N.A.)*	-2.75 (-1.9)	-.12 (-2.7)	.52 (2.4)

Δ Acc = Δ (Δ (Y))

(*) Government Deficit Reported As One Variable (T_G-G)

(**) t- statistics of 1.8 = 8% significance; 2.0 = 5% significance; 2.7 = 1% level of significance.

The first four seem quite sensible. More puzzling is the 5th variable, consumption. Changes in the level of consumer demand seemed to be negatively related to changes in inventories (likely dominated by consumer goods). Our hypothesis as to why this occurs is fundamentally Keynesian: production increases lag demand increases, causing inventory decline. If so, one might expect similar negative relationships between inventory change and the other components of the GDP: I, G and X. However, these additional variables were not significant, perhaps because changes in inventories due to them are relatively small, as they are smaller parts of the GDP. Also, since roughly 1/3 of the total fluctuation in inventory investment seems to be random, smaller movements in inventory due to changes in P&E or housing investment, government purchases, or exports may isolate from the random influences

Table 7 below utilizes the stepwise addition and subtraction methods to estimate contributions to explaining variance by each variable. The two most important variables related to inventory investment were the accelerator (ACC_0) and credit 'crowd out" variables (T, G).

TABLE 7: RANGE OF CONTRIBUTIONS TO EXPLAINED VARIANCE IN INVENTORY MODEL

Variable	Stepwise Addition	Range of Variation Subtraction
$+ACC_{(Y-T)}$	47.0%	35%
$+(T, G)_{(2\ VAR.)}$	11.0	- 17
+C	2.0	- 5.8
$+r_2Y_4$	3.0	NA*
$+DEP_0$	4.0	9.O
Total Expl. Variance:	67.0%	67.8%

* Negative R^2 due to lack of constant term

The results also suggest that, though they seem statistically related to inventory investment, the following variables were less influential:

- changes in consumer demand which inversely affect inventories
- changes in the prime interest rate which affects production (and inventory) today.
- Availability of depreciation reserves for inventory purchases.

4.4. SUMMARY AND CONCLUSIONS

Table 8 summarizes our findings as to the determinants of P&E, housing, and inventory investment. For comparison, the estimated effects of variables found related to total investment (TOT^4) in a separate study (Heim 2008) are included. Also for comparison, table 8 shows the estimated effects on from a regression of total investment (TOT^5) on all the variables found to influence any of the 3 parts.

TABLE 8: SUMMARY OF REGRESSION RESULTS FOR THE THREE PARTS OF INVESTMENT

R^2/Adj.R^2 (DW)	ΔT_G $\beta_{1t}(t)$	ΔG $\beta_{1G}(t)$	ΔACC_t $\beta_3(t)$	ΔDEP_t $\beta_2(t)$	$\Delta r_{PR-2}Y_{-4}$ $\beta_4(t)$	ΔDJ_{t-1} $\beta_5(t)$	$\Delta PROF_{t-1}$ $\beta_6(t)$	$\Delta XR_{AV(t-3)}$ $\beta_7(t)$	ΔCAP_{t-1} $\beta_8(t)$
(P&E)[1] .93/91%(1.8)|	.19 (5.3)	- .37 (-3.8)	.06 (3.8)	.89 (7.6)		.65 (8.7)	.43 (4.6)	3.79 (4.0)	1.19 (1.5)
(INV)[2] .67/62% (2.4)	.17 (3.5)	.02 (0.1)	.17 (5.3)	.54 (2.4)	- .70(-1.9)				
(RES)[3] .83/78%(1.5)	.22 (5.3)	- .24 (-2.4)						.70 (1.2)	
Sum of 1,2,3 ($\Sigma\beta_i$)	.58	-.59	.23	1.43	- .70	.65	.43	4.49	1.19
90/87%(2.2) (TOT^4)	.43 (4.4)	- 39 (-2.2)	.29(8.5)	.86 (3.0)	-1.17(-2.5)	.50 (3.2)	.38 (2.6)	3.77 (2.2)	.17 (0.2)

TABLE 8 (CON'D.)

(Table.8 Continued)	$\Delta P_{HOUSE(-1)}$ $\beta_9(t)$	$\Delta(Y-T_{G(t)})$ $\beta_{10}(t)$	ΔPOP_{16-24} $\beta_{11}(t)$	ΔC_t $\beta_{12}(t)$	$\Delta r_{PR-3}Y_{-5}$ $\beta_{13}(t)$	$\Delta r_{Mor(0)}*Y_{-4}$ $\beta_{14}(t)$	ΔDJ_{t-2} $\beta_{15}(t)$	$\Delta ACC_{t(Y-TG)}$ $\beta_{16}(t^*)$
(P&E)[1]					- .53 (-2.7)			
(INV)[2]				-.16 (-2.7)				
(RES)[3]	- 021(2.4)	.07 (2.4)	122.24 (1.1)			-2.13(-4.6)	-.22(-2.0)	.05 (2.0)
Sum of 1,2,3($\Sigma\beta_i$)) (TOT^4)	-.021	.07	122.24	-.16	- .53	-2.13	-.22	.05

(**) t- statistics of 2.0 = 5% level of significance; 2.7 = 1% level of significance.
Sources: [1]Table 2; [2]Table 6; [3]Table 4; [4]Total regression results (TOT^4) taken from Heim, 2008, p.10.

In evaluating the Table 8 results, we notice that the three different parts of total investment have some common determinants: the accelerator (ACC) and crowd out variables, (T_G, G). Hence we should them related to total investment. Should the three separate effects for a variable to equal the separately estimated total effect on investment? The answer appears to be yes for functions whose component

TABLE 9: ESTIMATES WHEN SAME DETERMINANTS ARE HYPOTHESIZED FOR EACH PART

R^2/Adj.R^2 (DW) β (t-stat.*)	$\Delta T_{G(t)}$ $\beta_{1t}(t)$	ΔG_t $\beta_{1G}(t)$	ΔACC_t $\beta_3(t)$	ΔDEP_t $\beta_2(t)$	$\Delta r_{t-2}*Y_{t-4}$ $\beta_4(t)$	ΔDJ_{t-1} $\beta_5(t)$	$\Delta PROF_{t-1}$ $\beta_6(t)$	$\Delta_{XRAV(t-3)}$ $\beta_7(t)$	ΔCAP_{t-1} $\beta_8(t)$
87/84% (2.2) (P&E)	.19(4.2)	- .34 (-3.2)	.07 (3.5)	.80 (4.6)	.22 (0.7)	.59(5.2)	.35 (2.8)	3.28 (2.8)	2.12 (2.3)
70/61% (1.7) (RES)|	.10 (4.0)	.04 (0.4)	.12 (6.6)	.10 (0.4)	- .95 (-1.6)	- .07 (-0.6)	-.01(-0.1)	1.20 (2.1)	-1.79 (-1.3)
61/50% (2.6) (INV)	.15 (3.3)	- .08 (-0.8)	.11 (3.9)	-.05 (-0.3)	- .56 (-1.6)	- .04 (-0.3)	-.01 (-0.1)	-.66 (-0.9)	- .81 (-0.8)
Sum of Parts(TOT)	.44	- .38	.30	.85	- 1.29	.48	.33	3.82	- .48
90/87% (2.1)(TOT^1)|	.44 (4.7)	- .39 (-2.4)	.30 (9.1)	.85 (3.0)	-1.29 (-2.5)	.48 (3.1)	.34 (2.5)	3.83 (2.2)	- .48 (-0.5)

[1]The dependent variable TOT^1 = the sum of P&E, RES and INV values.

parts have the same determinants (e.g., table 9 example). The answer appears to be no if they are not. Our work for different parts of investment indicates they are not, and so results to do not add. Table 9 shows regressions for each part of total investment. Each part uses the same explanatory variables. Regression coefficients in each add to the coefficient in the total investment regression.

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