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DO TAX CUT AND SPENDING DEFICITS HAVE DIFFERENT CROWD OUT EFFECTS?

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DO TAX CUT AND SPENDING DEFICITS HAVE DIFFERENT CROWD OUT EFFECTS?

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ABSTRACT: The crowd out effects of government deficits are tested by adding deficit variables to consumption and investment models which extensively control for other factors. Separate variables are added for deficits resulting from tax cuts and spending increases. Effects are calculated for recession and non-recession periods, and compared to models with average crowd out effects for the whole business cycle, and models without crowd out. Test results indicate 1) deficits crowd out private consumption and investment, are statistically significant, and explain substantial variance. They predict “IS” curve coefficients better than no crowd out models. In both recessions and non-recessions, government spending deficits were associated with complete crowd out, leaving no observable net stimulus effect. Tax cut deficits resulted in more than complete crowd out, resulting in net negative economic effects. Both findings are consistent with crowd out theory. Crowd out was found to have roughly equal effects in recessions and non-recession periods. Results are corroborated by independent testing of borrowing data; total declines in private spending were about equal to total declines in borrowing associated with deficits. Financing deficits by monetary expansion may avoid some crowd out problems, but only if the expansion is in the savings components of M2, and occurs in years immediately before the deficit is incurred, limiting its practicality. Foreign borrowing, to supplement domestic savings, can reduce the potential for crowd out. JEL Codes: C50, C51, E12, E21, E22

Keywords: Consumption, Investment, Deficits, Savings, Borrowing, Stimulus

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1.0 INTRODUCTION

Demand driven models infer that if demand is insufficient to keep employment and GDP levels up, it can be increased by governmental decisions to increase government spending or cut taxes which result in government deficits (or reduced surpluses). The deficits could be financed by borrowing, by increasing the money supply, or by both (accommodating monetary policy). This paper empirically tests whether government deficits, accommodated or unaccommodated, actually serve as a net stimulus to the economy when crowd out effects are taken into consideration. In particular, the paper, examines whether the net stimulus effect of deficits is different in recession and non-recession periods, when crowd out is considered. This paper extends the findings of Heim (2010), which present findings for “average” crowd out effects for the whole 1960-2000 period, but says nothing specific about whether they are greater or less in recessions than non-recession periods during this time. The concept of crowd out has been criticized on the grounds that, if it exists at all, it isn’t a problem in recessions when fiscal stimulus is needed the most, since there is less demand for private borrowing, leaving funds available to finance deficits without crowding out private borrowing. This paper attempts to extend Heim 2010 by testing for differences in crowd out effects in recessions and non recessions.

2.0. CROWD OUT THEORY

In a typical demand driven model of the economy without crowd out, the impact of taxes and government spending can be derived using the GDP identity:

$$GDP = Y = C + I + G + (X-M) \quad (1)$$

A simple consumption function might be given as a linear function of disposable income (Y-T)

$$C = \beta(Y-T)$$

substituting C into (1) gives

$$Y = \left[\frac{1}{1-\beta} \right] * [-\beta T + I + G + X-M]$$

MULTIPLIER EFFECT OF ΔT , ΔG :

$$\begin{array}{cc} \left[\frac{-\beta}{1-\beta} \right] & \left[\frac{1}{1-\beta} \right] \\ \text{Tax Multiplier} & \text{Spending Multiplier} \end{array}$$

The clear expectation of Keynesian stimulus theory is that tax changes are expected to be negatively related to the GDP, with a multiplier effect $-\beta/(1-\beta)$. Changes in government spending and net exports are related to GDP in the positive direction, with a multiplier effect $1/(1-\beta)$ and should when tested, have the same coefficients. In Section 2 below, we will test these expected relationships to see if actual econometric estimates yield the predicted results for variables.

2.1. CROWD OUT AND CONSUMER SPENDING

However, to test the hypothesis that savings used to finance consumer credit is diverted to finance government deficits (T-G), our simplified consumption function must be modified to add the crowd out - causing factor:

$$C = \beta (Y-T) + \lambda(T-G)$$

where lambda (λ) represents the marginal effect of deficit spending on consumer demand. If the marginal effects of deficits on consumption is different for spending-induced deficits and tax cut-induced deficits, the consumption function becomes

$$C = \beta (Y-T) + \lambda_1(T) - \lambda_2(G)$$

If (T) and (G) deficits have the same marginal effects, the Keynesian model becomes

$$\begin{aligned} \text{GDP} = Y &= \beta (Y-T) + \lambda(T-G) + G + I + (X-M) \\ &= [1/(1-\beta)] [(-\beta + \lambda) T + (1-\lambda) G + I + (X-M)] \end{aligned}$$

or, if (T) and (G) deficits have different marginal effects, it becomes

$$= [1/(1-\beta)] [(-\beta + \lambda_1) T + (1-\lambda_2) G + I + (X-M)]$$

From which we can easily see that the impact of a change in T or G on the GDP depends on λ as well as β , and the spending multiplier $1/(1-\beta)$. The tax multiplier, showing the marginal impact of a change in taxes is now $(-\beta + \lambda)/(1-\beta)$ or $(-\beta + \lambda_1)/(1-\beta)$. The spending multiplier, showing the marginal impact of a change in government spending, is now $(1-\lambda)/(1-\beta)$ or $(1-\lambda_2)/(1-\beta)$. If the marginal effects of tax cut and spending deficits are the same, $\lambda_1 = \lambda_2$, if not, they will be different. In either case, if crowd out exists, *Both T and G marginal effects, including multiplier effects, on the GDP will be smaller (in absolute terms) than they would have been without crowd out effects.*

If crowd out has different effects in recession (Rec) and non-recession periods (NonRec), the formulation becomes

$$\begin{aligned} \text{GDP} = Y &= \beta (Y-T) + \lambda_{\text{Rec}}(T-G) + \lambda_{\text{NonRec}}(T-G) + G + I + (X-M) \\ &= [1/(1-\beta)] [(-\beta + \lambda_{\text{Rec}})T + (-\beta + \lambda_{\text{NonRec}})T + (1-\lambda_{\text{Rec}}) G + (1-\lambda_{\text{NonRec}}) G + I + (X-M)] \end{aligned}$$

or, if (T) and (G) deficits have different marginal effects

$$= [1/(1-\beta)] [(-\beta + \lambda_{1\text{Rec}})T + (-\beta + \lambda_{1\text{NonRec}})T + (1-\lambda_{2\text{Rec}}) G + (1-\lambda_{2\text{NonRec}}) G + I + (X-M)]$$

We can see the impact of a change in T or G on the GDP depends on λ_{Rec} or λ_{NonRec} , and any differences in marginal effects of tax cut-induced and spending-induced deficits ($\lambda_{1\text{Rec}}$, $\lambda_{1\text{NonRec}}$, $\lambda_{2\text{Rec}}$ and $\lambda_{2\text{NonRec}}$). as well as β and the spending multiplier $1/(1-\beta)$. The tax multiplier, is now $(-\beta + \lambda_{1\text{Rec}})/(1-\beta)$ or $(-\beta + \lambda_{1\text{NonRec}})/(1-\beta)$. If the crowd out effect is less in recessions, the tax multiplier effects will be larger than in non-recession periods. The spending multiplier, is now $(1-\lambda_{2\text{Rec}})/(1-\beta)$ or $(1-\lambda_{2\text{NonRec}})/(1-\beta)$ and if the crowd out effect is less in recessions, the spending multiplier will be larger in recessions than in non-recession periods. Lambda may be different for tax cuts and government spending deficits.

Several conclusions follow from this result"

- a) If the crowd out effect (λ or λ_1) is positive, the stimulus effect of tax changes on the GDP will be smaller than the Keynesian model predicts. Reducing taxes has a net stimulus effect only if (β) is larger than (λ or λ_1). If (λ or λ_1) is equal to or greater than (β), there is complete crowd out or more than complete crowd out. Crowd out theory hypothesizes the stimulus is partially (or fully) offset because of declining availability of consumer credit resulting from the government financing the deficit out of available saving, reducing what is available for consumer to borrow.
- b) The government spending multiplier of $(1/1-\beta)$ in the "no - crowd out" model, has also declined. It is now $(1-\lambda)/(1-\beta)$, $(1-\lambda_{\text{Rec}})/(1-\beta)$, or $(1-\lambda_{\text{NonRec}})/(1-\beta)$. If government spending deficits have different marginal crowd out effects than tax cut deficits, the previous expression becomes $(1-\lambda_2)/(1-\beta)$, $(1-\lambda_{2\text{Rec}})/(1-\beta)$, or $(1-\lambda_{2\text{NonRec}})/(1-\beta)$. Stimulus due to increased government spending is

now offset by reductions in consumer spending caused by crowd out

- c) The multiplier effect of net export spending stays the same. Relatively speaking, this means that if crowd out exists, a dollar increase in net exports should have a larger multiplier effect than a dollar of government spending, a testable hypothesis.

Table 1
EFFECTS OF CONSUMER CREDIT CROWD OUT ON THE EFFECTIVENESS OF TAXES AND GOVERNMENT SPENDING STIMULUS*

	Without Crowd Out	With Crowd Out		Without Crowd Out	With Crowd Out
Tax coefficient	$(-\beta)$ $(-\beta)$ $(-\beta)$	$(-\beta + \lambda_1)$ $(-\beta + \lambda_{1Rec})$ $(-\beta + \lambda_{1NonRec})$	Government Spending Coefficient	1 1 1	$(1 - \lambda_2)$ $(1 - \lambda_{2Rec})$ $(1 - \lambda_{2NonRec})$
Tax Multiplier (Average-All Per.)	$\frac{(-\beta)}{(1-\beta)}$	$\frac{(-\beta + \lambda_1)}{(1-\beta)}$	Government Spending Multiplier	$\frac{(1)}{(1-\beta)}$	$\frac{(1-\lambda_2)}{(1-\beta)}$
Tax Multiplier (Recession Period)	$\frac{(-\beta)}{(1-\beta)}$	$\frac{(-\beta + \lambda_{1ec})}{(1-\beta)}$	Government Spending Multiplier (Recession Period)	$\frac{(1)}{(1-\beta)}$	$\frac{(1-\lambda_{2ec})}{(1-\beta)}$
Tax Multiplier (Non-Recession)	$\frac{(-\beta)}{(1-\beta)}$	$\frac{(-\beta + \lambda_{1NonRec})}{(1-\beta)}$	Government Spending Multiplier (Non-Recession Period)	$\frac{(1)}{(1-\beta)}$	$\frac{(1-\lambda_{2NonRec})}{(1-\beta)}$

*Where λ_1 and λ_2 are the same unless tax cut and spending deficits have different marginal effects.

- d) The multiplier effect of net export spending stays the same. Relatively speaking, this means that if crowd out exists, a dollar increase in net exports should have a larger multiplier effect than a dollar of government spending, a testable hypothesis.

In Graph 1 below, actual consumption tends to be below its normal trend as a function of disposable income in the 1980's and 1990's, a period of crowd out, until 1998 - 2000 when budget deficits (crowd out) disappeared and budget surpluses occurred. (the late 80's were an exception due to the "dot-com" bubble in the economy. The lowest curve on the graph merely indicates the real dollar amount, in billions of 1996 dollars, by which actual consumption exceeded predictions (read using left scale).

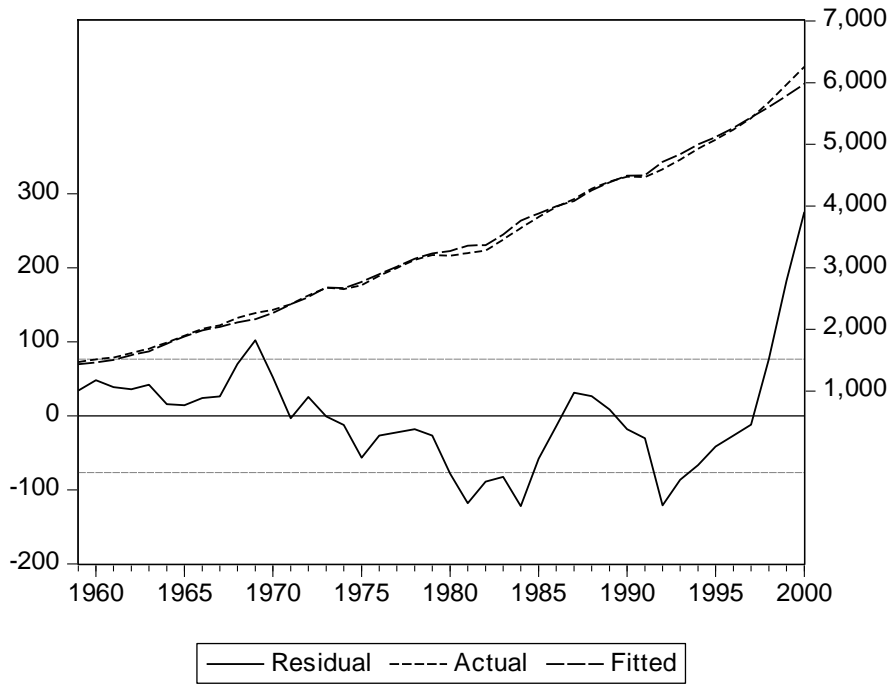
2.2. CROWD OUT AND INVESTMENT SPENDING

How the crowd out problem may affect investment is suggested by trends shown in Graph 2. In Graph 2, one of the top two curves show the general trend line of real investment to real GDP 1960-2000. The second shows how actual investment deviated from the trend each year. Note particularly that during the high deficit years in the mid and late eighties, investment fell well below long term averages, but in the 1996-98 surplus years, actual investment exceeded long term averages. The lowest curve on the graph merely indicates the real dollar amount, in billions of 1996 dollars, by which actual investment exceeded predictions (read using left scale)

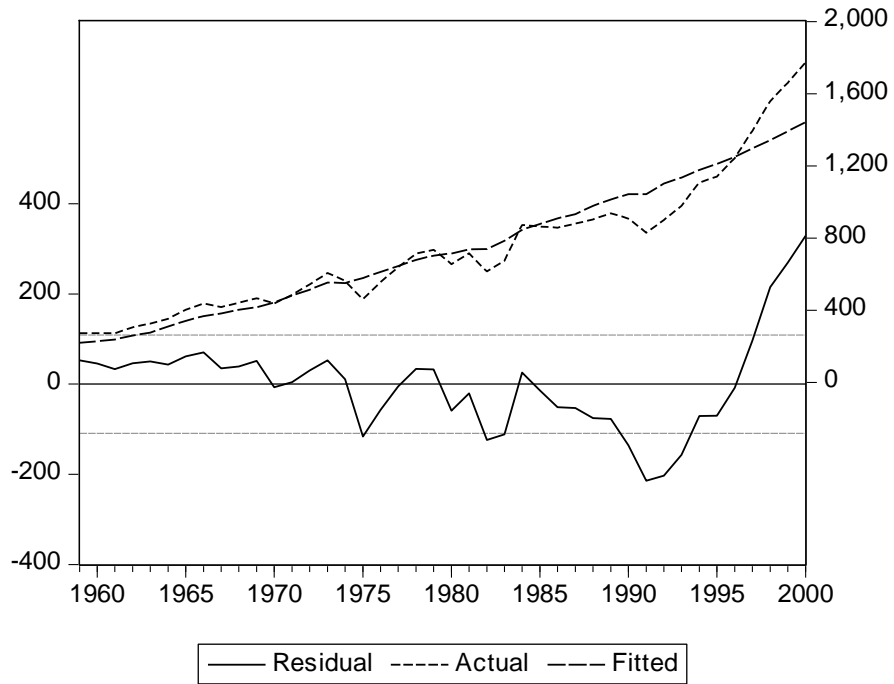
We can expand the consumption crowd out model of section 2.1. to include effects of crowd out on investment spending. Assume a simple investment model in which investment is determined by real interest rates (r) and access to credit, which varies with the government deficit ($T-G$).

$$I = -\theta r + \gamma(T-G)$$

GRAPH 1
PREDICTED AND ACTUAL LEVELS OF REAL CONSUMPTION 1960 - 2000



GRAPH 2
PREDICTED AND ACTUAL LEVELS OF REAL INVESTMENT 1960 - 2000



Or, if tax cut - induced deficits have different marginal effects than spending - induced deficits

$$I = -\theta r + \gamma_1 T - \gamma_2 G$$

where gamma (γ , or γ_1 , γ_2) indicates the marginal effect of the government deficit on investment spending, and (θ) represents the marginal effect of real interest rates (r).

If we replace investment in the GDP identity with its hypothesized determinants, we obtain a typical Keynesian IS equation:

$$GDP = Y = [1/1-\beta] [(-\beta + \lambda + \gamma) T + (1 - \lambda - \gamma) G - \theta r + (X-M)]$$

Or, if the marginal effects tax cut and spending deficits are different

$$GDP = Y = [1/1-\beta] [(-\beta + \lambda_1 + \gamma_1) T + (1 - \lambda_2 - \gamma_2) G - \theta r + (X-M)]$$

In this IS equation, the normal stimulating impact of tax cuts on the GDP ($-\beta$) is offset in part by the effects of the deficit reducing consumers and investors ability to buy out of borrowed funds ($\lambda + \gamma$ or $\lambda_1 + \gamma_1$), due to increased government borrowing out of the savings pool to finance the deficit. Tax stimulus effects may switch from negative to positive if the crowd out effects are larger than the disposable income effect (β). The marginal effect of a change in government spending is also reduced per dollar of expenditure from (1) to $(1 - \lambda - \gamma)$ or $(1 - \lambda_2 - \gamma_2)$, and stimulus effects are either reduced, or actually become negative if crowd out effects ($\lambda + \gamma$) are greater than stimulus effects (1). Again, the net exports multiplier effect stays the same, now becoming an even stronger stimulus relative to government spending or tax cuts. Results are shown in Table 2.

If crowd out effects are different in recessions than in non-recessions, the investment and IS functions change as follows:

$$I = -\theta r + \gamma_{Rec} (T-G) + \gamma_{NonRec} (T-G)$$

Or

$$I = -\theta r + (\gamma_{1Rec} T - \gamma_{2Rec} G) + (\gamma_{1NonRec} T - \gamma_{2NonRec} G)$$

$$GDP = Y = [1/1-\beta] [(-\beta + \lambda_{1Rec} + \gamma_{1Rec}) T + (1 - \lambda_{2Rec} - \gamma_{2Rec}) G - \theta r + (X-M)] \text{ in recessions}$$

Or, if the marginal effects tax cut and spending deficits are different, in non-recessions:

$$GDP = Y = [1/1-\beta] [(-\beta + \lambda_{1NonRec} + \gamma_{1NonRec}) T_{NonRec} + (1 - \lambda_{2NonRec} - \gamma_{2NonRec}) G_{NonRec} - \theta r + (X-M)]$$

And in recessions

$$GDP = Y = [1/1-\beta] [(-\beta + \lambda_{1Rec} + \gamma_{1Rec}) T_{Rec} + (1 - \lambda_{2Rec} - \gamma_{2Rec}) G_{Rec} - \theta r + (X-M)]$$

Several conclusions follow from the results, and are shown in Table 2. They are the same, except for magnitude as for the earlier model in which crowd out affected consumption only:

- a) If the crowd out effect ($\lambda + \gamma$) is positive, the stimulus effect of tax changes on the GDP will be smaller than the Keynesian model predicts. Reducing taxes has a net stimulus effect only if (β) is larger than the crowd out effect $(\lambda + \gamma)_{Rec \text{ or } NonRec}$ or $(\lambda_1 + \gamma_1)_{Rec \text{ or } NonRec}$. If the crowd out effect is equal to or greater than (β), there is complete, or more than complete, crowd out. Crowd out theory hypothesizes the stimulus may be partially (or fully) offset because of declining availability of consumer credit resulting from government financing of deficits out of available saving, reducing what is available for private use by consumers and businesses.

Table 2
EFFECTS OF CONSUMER AND INVESTMENT CREDIT CROWD OUT ON THE EFFECTIVENESS OF TAXES AND GOVERNMENT SPENDING STIMULUS

	Without Crowd Out	With Crowd Out		Without Crowd Out	With Crowd Out
Tax coefficient	(-β)	-β+ (λ+ γ)	Government Spending Coeffic.	1	1-(λ+γ)
	(-β)	-β+ (λ ₁ + γ ₁) _{Rec}		1	1-(λ ₂ +γ ₂) _{Rec}
	(-β)	-β+ (λ ₁ + γ ₁) _{NonRec}		1	1-(λ ₂ +γ ₂) _{NonRec}
Tax Multiplier (Average-All Per.)	(-β) (1-β)	-β+ (λ+ γ) (1- β)	Government Spending Multiplier	1 (1-β)	1-(λ+γ) (1-β)
Tax Multiplier (Recession Period)	(-β) (1-β)	-β+ (λ ₁ + γ ₁) _{Rec} (1- β)	Government Spending Multiplier	1 (1-β)	1-(λ ₂ +γ ₂) _{Rec} (1-β)
Tax Multiplier (Non-Recession)	(-β) (1-β)	-β+ (λ ₁ + γ ₁) _{NonRec} (1- β)	Government Spending Multiplier	1 (1-β)	1-(λ ₂ +γ ₂) _{NonRec} (1-β)

- b) The government spending multiplier of $(1/1- \beta)$ in the “no - crowd out” model, has also declined. It is now $(1-\lambda- \gamma)/(1- \beta)$ or $(1-\lambda_2- \gamma_2)_{Rec}/(1- \beta)$, or $(1-\lambda_2- \gamma_2)_{NonRec}/(1- \beta)$. Stimulus due to increased government spending is now offset in part by reductions in consumer spending caused by crowd out
- c) The multiplier effect of net export spending stays the same. Relatively speaking, this means that if crowd out exists, a dollar increase in net exports should have a larger multiplier effect than a dollar of government spending, a testable hypothesis.

The model we shall test later in this paper is an alternate form of the model shown above. The model above was based on the usual formulation of the GDP identity

$$Y = C + I + G + (X-M)$$

Hence, we can alternatively write

$$Y = C_{D+M} + I_{D+M} + G_{D+M} + (X-M) \quad (\text{where } M = C_M + I_M + G_M)$$

$$= C_D + I_D + G_D + X$$

This is an important distinction in calculating multipliers because only spending on domestically produced consumer goods generates the multiplier effect on the GDP. Similarly, for investment, an accelerator variable like the Samuelson accelerator is likely to affect spending on both domestic and imported investment goods (I). But accelerator effects will only be felt on the GDP though the growth in domestic investment (I_D). Hence, the last formulation of the GDP identity may be the better form to use when calculating IS curve parameter estimates, since multiplier effects are more correctly estimated. (We abstract from effects on exports of growth in import demand).

Because the data available to us does not allow separation of government purchases of goods and services into domestic goods and imports, the (approximate) form of the model we will test is:

$$Y = C_D + I_D + G + X)$$

This then presents the standard model of Keynesian demand model mechanics, with its stimulus implications for deficits, with crowd out implications added. Should the crowd out problem exist in reality

as well as in theoretical conjecture, scientific (econometric) testing of this model should reveal it. Only testing, can show whether conjectures in the minds of theoreticians, like crowd out theory, exists in reality as well. After examining some previous efforts to test crowd out theory, we will test the models above, with and without crowd out, for recession and non-recession periods.

2.3 LITERATURE REVIEW

A major part of stimulus theory hangs on whether or not borrowing-financed deficits crowd out private borrowing, and therefore private spending. Yet there has been little scientific work done testing the connection of borrowing to deficits, and little done, by testing the relationship between deficits and actual private spending. Actual scientific testing of the hypothesis that crowd out has different effects in recessions and non-recessions is simply nonexistent.

That said, the popular press is full of discussion of crowd out effects that are based on the *assumption* that crowd out does or does not work. For example:

1. Chan, S. (*NY Times*, 2/7/10, p.A16): reported the I.M.F. warned on Jan. 26 that rising sovereign debt "could crowd out private sector credit growth, gradually raising interest rates for private borrowers and putting a drag on the economic recovery."
2. Barley, R. (*Wall Street Journal*, 2/24/10 p.C14): "any government-bond buying by banks is another form of crowding out, potentially reducing supply of consumer and corporate lending"
3. Krugman, P. (*New York Times*, 9/28/09) notes that in recessions, the accelerator effect is likely to dominate any crowd out effect, leaving a net stimulus effect of government spending increases or tax cuts.

In the professional literature, studies examining crowd out have been entirely, or principally, reports on other people's science (or lack of it), i.e., literature reviews. For example, Spencer and Yohe, (1970), in reviewing the literature, found that the dominant view the past two hundred years from all types of studies has been that government deficits cause crowding out. Friedman's work (1978) is largely theoretical, though it contains some references to his and others' empirical work. He shows portfolio theory suggests the LM curve may shift in response to an IS shift due to a fiscal stimulus like a government deficit, and that elasticity of substitution between bonds and stocks when interest rates rise (due to deficit borrowing) is key: elasticities less than one lead to crowd out; greater than one: crowd in. Therefore crowd out effects are indeterminate theoretically. Friedman's own empirical tests, based on money demand models, were more ambiguous.

Gale and Orszag's work (2004) does include some empirical testing indicating crowd out matters. Consumer demand was hypothesized to be a function of current and one period lagged Net National Product (NNP), government purchases, taxes, transfer payments, interest payments and the size of the government debt. A negative relationship between taxes and GDP were taken as a sign that crowd out, if it existed, was not complete. That said, their tested hypothesis did not include the government deficit as an explanatory variable. This can result in stimulus effects of tax cuts being overstated (Heim 2010, and section 2.2 above). Other tests also indicated a positive relationship between interest rates and deficits, taken as an indicator of crowd out, but does not address the fact that the interest rates most systematically associated with the GDP are exogenously determined rates, the federal funds and prime interest rates, not supply and demand driven rates (Heim, 2008).

Using a VAR methodology, Montford and Uhlig (2008) found investment falls in response to both spending increases *and tax increases* (finding the same sign on both spending and tax effects is inconsistent with both Keynesian stimulus theory and crowd out theory) The VAR specified consumption or investment as being a function of six lagged values of each of ten variables: GDP, C, G, Taxes, real wages, private non-residential I, adjusted reserves, the PPI index and the GDP deflator. Interpreting VAR

model findings can be difficult, since the tested hypotheses typically are somewhat-atheoretical. Using a VAR model, Blanchard and Perrotti (2002) when testing taxes and government spending obtained the same result for investment, but Keynesian results for output, and non-Keynesian results for consumption.

Furceri and Sousa (2009) examine 145 countries using a VAR methodology to determine if government spending as a % of GDP was related to consumption and investment spending as a % of GDP, They conclude government spending is adversely related. Fundamentally the model tests consumption and investment spending against right - side variables fixed effects variables for the individual countries and the current and four lagged values of the government spending/ GDP variable. While many of the government spending variables had statistically significant adverse effects, the lack of controls for other structural variables makes it difficult to be sure the finding truly represent the government spending effect, and not perhaps occur because government spending can proxy for non-included variables.

2.4. REAL GOVERNMENT DEFICITS 1959 - 2000

Table 3 below shows combined real federal, state and local government budget surpluses and deficits. It shows a period generally characterized as one of government surpluses up until 1970, sizable deficits from 1970 until 1992, reductions in the deficit 1992-97, and surpluses 1998-2000.

TABLE 3
GOVERNMENT SURPLUS/DEFICITS 1960-2000 (BILLIONS OF 1996 DOLLARS)

1959	\$ \$41.20	1970	\$-28.69	1980	\$-80.466	1990	\$-200
1960	65.74	1971	-74.34	1981	-75.204	1991	-253.4
1961	38.26	1972	-23.4	1982	-206.02	1992	-335.7
1962	42.29	1973	14.209	1983	-248.24	1993	-294.9
1963	59.27	1974	-13.21	1984	-201.51	1994	-214.8
1964	38.10	1975	-174.8	1985	-209.95	1995	-181
1965	49.97	1976	-112.2	1986	-228.29	1996	-115.4
1966	51.98	1977	-73.48	1987	-175.75	1997	-21.91
1967	-6.18	1978	-17.9	1988	-153.59	1998	81.469
1968	27.44	1979	3.1822	1989	-135.18	1999	151.34
1969	74.70					2000	227.08

Source: *Economic Report of the President, 2002.*

3.0 METHODOLOGY

Consumer and investment demand models are used to test for the existence of the crowd out problem, and the extent to which it varies from recession to non recession period. Many economists argue such models are central to our understanding of how economies work. For example:

1. (Demand driven models) ...“provide the foundation of much of our current understanding of economic fluctuations “ ... (Mankiw, 2007),
2. ...negatively sloped “IS” curve is central to the Federal Reserve’s thinking about how monetary policy works... (Blinder, AER, 1997)

3. ...part of the usable core of macroeconomics is any ... empirically successful set of equations describing aggregate demand. Most ... are ... something like IS - LM...(Solow, AER, 1997)
4. ...*"It's Demand, Stupid!"* ... (C. Romer, 2010)
5. In addition, some economists have found demand models predict better than VAR or rational expectations models (Gale & Orszag, 2004, p.152), (Fernandez-Villaverde, JEL, 2008), (Fair 1984)

This study tests for crowd out using consumption and investment equations from a large scale, Cowles Commission style structural model of the U.S. economy. The model contains eighteen equations, eight of which are behavioral. The behavioral equations include three consumer demand equations, three investment demand equations, an export demand equation, and an equation estimating the relationship of tax revenues to GDP growth. The three consumption equations are for domestically produced, imported, and total consumer goods, the three investment equations are for domestically produced, imported, and total investment goods. All six of these equations are used in this paper.

The econometric approach is patterned after the more detailed (30 behavioral equations) demand – driven econometric models of Ray Fair (2004). Fair, for example, has four separate behavioral equations for household demand. Fair's model estimates the GDP additively, from behavioral equation estimates of consumer, investment, export and import demand. This paper uses an IS curve. In both models, government spending on goods & services is treated as exogenous. Finally, like Fair's model, the model here is Keynesian i.e., demand driven in orientation, as were their antecedents produced by Lawrence Klein and the Cowles Commission.

There are some differences between the models aside from size. All imports in Fair's model are estimated as one variable and imports are modeled as simple functions of GDP growth. In the model used here, consumer and investment imports are modeled separately and as functions of the same large number of specific determinants found to be important determinants of demand for domestically produced consumer and investment goods, such as wealth, profits, interest rates, depreciation, credit crowd out, etc. In Fair's model exports are exogenous, but in the model used here exports are endogenous. They are determined by the exchange rate and a proxy for our trading partners' economic growth rate. Another difference is that Fair commonly uses lagged values of an equation's dependent variable on the right hand side of an equation to explain the movement in the dependent variable; the model used here does not. Its main objective is to explain the past influence of specific variables, especially the real exchange rate, on consumption, investment and the GDP. Lagged values of dependent variables may improve the accuracy of predictions, which is a core objective of Fair's model, but tend to hide from us the underlying variables that drive them (as well as the current dependent variable). Hence, they provide an inadequate explanation of underlying structural relationships. They may predict well, but not explain much. That said, in quarterly data models, such as Fair's, they may be needed simply to capture lagged adjustment effects. The annual data used in this model reduces that need appreciably.

Also because of Fair's findings, equations in this model do not include variables to account for rational expectations –driven behavior, since Fair, like others before him, found little support for these issues in extensive tests in his own models, (Fernandez-Villaverde, 2008). Fair also found his own model (a Cowles – Commission type model, like the model used here) performed better than a VAR model against which he tested it, and generally better in tests against an autoregressive components (AC) model. (Fernandez-Villaverde, 2008). Heim (2008) also found rational expectations models of how income affected consumption, such as the average income models in Modigliani's and Friedman's work, performed far less better predicting consumption patterns than simple Keynesian current income models.

A significant difference between this study and Fair's models is the way in which autocorrelation is treated. Generally, here it is dealt with by first differencing data. In Fair, it is dealt with by leaving the data in levels and using standard autocorrelation control AR(i) variables. Generally, though not always, the first differencing used here was successful in bringing Durbin Watson statistics up to desirable levels. This approach also provided two critically important additional benefits:

1. First differencing significantly reduced multicollinearity between the variables thought to be determinants of consumption or investment. This provided for much more stable regression coefficients on variables in the model when changes to the model were made, and therefore, more reliable estimates of marginal impact.
2. First differencing eliminates the irrational tendency for the regression coefficients on a particular variable (e.g., the exchange rate) in imports and domestic goods demand equations not to add up to same variable's coefficient in total demand equation when using standard AR(i) controls. The two parts together (demand for imports and demand for domestically produced goods) definitionally equal total consumption or investment. Adding the estimated effects of a particular variable on import demand and domestic demand should tell us precisely how total demand is affected. Statistical results should yield the same result, assuming regression does not provide illogical results. Statistical results do equal the arithmetic sum of these two parts, unless AR(i) controls are used with any of the equations.

Extensive efforts were made in Heim (2007, 2009a, b & c) to determine what theoretically – postulated variables belonged in the investment and consumption equations and which lagged value of the variables was the most appropriate to use. The consumption and investment models used here utilize the findings from those studies. They are described further below.

All data used in those studies was taken from the Council of Economic Advisors' statistical appendix to the *Economic Report of the President, 2002*. Data Tables B2, B3, B7, B26, B54, B60, B73, B82, B90, B95, B104, B106 and B110. However, additional multilateral trade weighted value of the dollar, i.e., the foreign exchange rate data, is taken from Table B110 of the *Economic Report of the President, 2001* and Table B108 of the 1997 *Economic Report of the President, 1997*. Exchange rate values 1960 - 1970 were assumed constant at 1970 levels, per the Bretton Woods protocols. All data are expressed in real 1996 dollars, or converted to same using the GDP deflator in Table B3.

Each regression below shows the estimated marginal effect (regression coefficient) for the explanatory variables, the t statistic associated with it, the percent of variance explained and the Durbin Watson serial correlation statistic. Durbin Watson was used as most appropriate for small sample sizes such as the time series data used here (Griffiths, Hill Lim, 2010). Depending on the particular regression test and the number of lags used, our sample size was 36-38 observations from the 1960-2000 period. With this number of observations, throughout the remainder of the paper, marginal effects with a t-statistic of 1.8 are significant at the 8% level, 2.0 are significant at the 5% level and t-statistics of 2.7 are significant at the 1% level

Because of the simultaneity between the total consumption variable (C) in the GDP accounts, or its component part, domestic consumer goods (C_D), and income (Y) inherent in these equations, two stage least squares estimates of disposable income $\Delta(Y-T_G)_0$ were used. The remaining right hand side variables were used as first stage regressors. Newey-West heteroskedasticity corrections were also made, generally improving t - statistics. Two Stage least Squares was also used with the investment equations because of simultaneity between investment and the economy's growth rate (the accelerator variable). 2SLS was used as the most appropriate form of instrumental variables for use in multiple regressions (Griffiths, Hill, Lim, 2010)

There is some difficulty separating consumer imports out of total imports in the *Economic Report of the President*. The Bureau of Economic Analysis (BEA) has confirmed it does not categorize import and export data into same "C" and "I" and "G" categories used elsewhere in the national GDP accounts. Absent official determinations by BEA, economists must make their own evaluations of how to divide the data. For example, it is not clear from Table 104 in the *Economic Report of the President* how much of the value of motor vehicle imports or petroleum imports should be treated as business (inventory) investment vs. direct final use by consumers. Data on imported services (Table B-106) does not distinguish between imports of services by businesses and consumers, though one might suspect the former dominate. Nor do the services data extend back beyond 1974. Hence, no deduction from total

imports for business services imports could be made in calculating consumer imports.

Following Heim (2010), we then take as our definition of consumer goods and services imports all imports except for imports of capital goods and industrial supplies and materials. The theory behind this choice was that the best definition of “consumer” imports was the one whose variation was best explained (highest R^2) by the variables theoretically thought to drive demand for consumer imports. Other definitions of consumer imports, did not explain consumer behavior as well and were rejected.

Hence, for consumer imports, the definition used is

$$(C_M) = \text{Total Imports (M)} - (\text{Capital Goods Imports} + \text{Imported Industrial Supplies and Materials}(I_M))$$

These definitions appear to be reasonable, if not exact, given the data available. Separate regressions were then run on total consumer demand, and separately for imported consumer goods alone. Results for the imports equation were subtracted from the results for the total consumption (C_T) equation, to estimate demand for domestically produced consumer goods. As noted earlier when discussing autocorrelation, the coefficients obtained in this manner (arithmetically) for each variable are exactly the same as those obtained statistically by regressing these same determinants on domestically produced consumer goods (C_D) where $(C_D) = (C_T - C_M)$.

Investment imports (I_M) were defined using the same process as imports of capital goods plus imports of industrial supplies and materials, i.e., total imports minus consumer imports.

Preliminary testing suggested that exchange rates have some lagged effects that go back as far as three years ago, so the average exchange rate for those years (XR_{AV0123}) was used. Individual variables for each year's exchange rate were not used. High levels of multicollinearity between the individual years' exchange rates made coefficient values for any one year change dramatically when another year's exchange rate variable was added or deleted. However, the coefficients on the average exchange rate variables tended to precisely or approximately add up to the sum of the coefficients when separate exchange rate variables were used for each year. In addition, adding an additional year's lag to the average increased explained variance, up through the three year lag. This suggests that the full effects of exchange rate changes take that long to achieve. For example, peoples' demand may be conditioned on what they recall price has been in the recent past as well as what it is today. It may also be that there are long lead times required for delivery of some items, e.g., machinery. If so, this year's actual purchases may have been the result of a prior year's decision to purchase, based on a prior year's price determined in part by that year's exchange rate. Multi-year contracts for international goods may also specify payment in dollars reflecting exchange rates in existence at the time the contract was let, not current rates, and may change only as contracts expire in the future.

4.0. VARIABLES INCLUDED IN THE CONSUMPTION AND INVESTMENT MODELS

A large number of variables and their lagged values commonly thought to affect consumer and investment demand, were tested by Heim (2009a). Using stepwise regression testing, he found the explanatory variables (and lag levels) shown below to be the most statistically significant determinants of consumption or investment. (C_T, I_T) represent total consumption and investment, (C_M, I_M) represent imports of the same goods, and (C_D, I_D) represent domestically produced consumer and investment goods. The components of the deficit variable ($G-T$) were entered separately in the regression to test whether they had different effects on C, I and Y . Additional variables were tested and added in 2010. All were used as controls in this study to ensure that crowd out variables would not be found significantly related to consumption or investment, simply because they were proxying for some left out determinant of those variables. Results below repeat in more abbreviated form from those discussed earlier.

Variables Found To Be Significant Determinants Of Consumption Or Investment

- (Y-T) = Disposable income defined as the GDP minus the government receipts net of those used to finance transfer payments
- (T-G) = The government deficit, interpreted as a restrictor of consumer as well as investment credit. It was found highly significant in a preliminary study (Heim 2008A), and is regressed as two separate variables (T) and (G), because of earlier findings of differential effects.
- PR = The Prime interest rate for the current period. It is deflated to get the real rate using the average of the past two year's CPI inflation rate.
- DJ₋₂ = A stock market wealth measure, the Dow Jones Composite Average, lagged two years
- XR_{AV0123} = The trade - weighted exchange rate (XR) An average of the rate for the current and past three years is used to capture what preliminary studies showed was slow, multiyear process of adjustment to exchange rate changes (Heim, 2007)
- POP = Population Growth: a factor found systematically related to growth in consumer demand in addition to the factors previously cited
- POP_{16-24/65} = Percentage of Americans 16-24 relative to adults 65 and over : a factor reflecting the fact that younger populations, with lesser incomes, have less to spend on consumer goods, particularly services which account for over half of all consumer spending. They also need to be saving more out of current income for retirement and children's education costs than older adults.
- ICC₋₁ = Consumer Confidence Levels: as measured by the Conference Board's Monthly consumer survey (Conference Board, 2009), added because consumer confidence was strongly related to consumer spending, even controlling for income and wealth.
- M2_{1-3AV} = M2 Money Supply Average: Testing indicated that past three year average M2, particularly the non-M1 parts (savings account deposits, small CD's, money market mutual funds held by individuals and money market deposit accounts) were systematically related to consumer spending. This build up of savings (liquidity) prior to a spending - generated deficit was systematically related to the deficit's effect on consumption. M1 was not found significant. This non-M1 component of M2 probably reflects a dimension of consumer wealth not picked up by our use of the stock market average. It appears that both affect consumption after a lag.

The variables included in the Investment model include some cited above and the following, all of which were found significant determinants of investment spending in some prior studies. Lags used with these variables indicate levels found most systematically related to current year investment levels. Procurement of capital goods often requires multiple periods for design, construction and procurement, hence lags on variables determining investment are not unexpected.

- ACC = An accelerator variable $\Delta(Y_t - Y_{t-1})$, found in many studies the past 50 years to be the most important determinant of investment spending
- DEP = Depreciation allowances: a large portion of current year sales revenue available tax free to supplement retained earnings as funds available to finance investment
- CAP₋₁ = A measure of last year's capacity utilization. High capacity utilization may signal companies of a need for further investment if demand is expected to grow, or capacity utilization levels currently exceed desired levels.
- PROF₋₂ = A measure of business profitability two years ago.
- r₋₂ = Real Prime interest rate, lagged two periods.

4.1. HOW MUCH VARIANCE DOES CROWD OUT EXPLAIN?

Heim (2010) found that when crowd out variables were added to well specified domestic consumption functions (C_D), explained variance increased significantly. In section 7 below we show the increase to be from 81.3% to 86.0%. When added to the domestic investment function, it increased explained variance

from 74 to 90%. These results indicate the minimum percentage of the variation in C and I that can be attributed to crowd out. This estimate may understate the actual amount of variance crowd out explains, since it only represents the variance in C and I that crowd out uniquely explains. There is additional variance in C and I that can be explained by crowd out, but also other variables as well, because crowd out is correlated with them. If crowd out is dropped, the regression assigns this variance to the variables remaining that can also explain it, and their coefficients and t statistics change. This is an unavoidable ambiguity that occurs when using the subtraction or “first out” form of stepwise regression.

Using the stepwise addition or “first in” form of stepwise regression, when the crowd out variable(s), are entered early in the stepwise process, they pick up not only the variance that they uniquely can explain, but also any variance that can be explained by some variable not yet entered in the regression with which it is correlated. Using the “first in” process, when calculating how much variance each variable in the consumption function explained, the following results were found:

- For total consumer demand and demand for domestically produced consumer goods, the crowd out variables, when used separately, explained the second largest portion of explained variance in consumption (16% and 10%) after disposable income (68% and 64% respectively). When used as one variable (T-G), they were third most important, adding 5%. The single variable formulation was beat out for second place in the total consumer demand model by consumer wealth (DJAV₋₂), and by the (M2_{AV}) variable in the domestic consumption model.
- On a “first out” basis, R² was reduced 8.9% points for total consumption and 4.7% for domestic consumption when the deficit variables were removed from the full consumption model.
- For consumer imports, disposable income again explained the most variance. Crowd out was again the third most important contributor (again after wealth). Adding the deficit in third added 10% to explained variance. On a “first out” basis, removing the deficit reduced explained variance 13%.

For investment, the following results were obtained:

- crowd out explained the most variance in both total and domestically produced investment goods; 50% and 48% respectively.
- For investment imports, the Tobin’s q proxy, (DJAV₋₂) tied with the accelerator for explaining the most variance; crowd out and depreciation tied for second, each adding 12% to explained variance when added second.

As we noted earlier, these contributions may be overstated by the stepwise addition process. For the same reason, it may be understated when using stepwise subtraction, as shown in Table 4 below

**TABLE 4
CROWD OUT: RANGE OF CONTRIBUTIONS TO EXPLAINED VARIANCE
USING THE STEPWISE REGRESSION METHOD**

	<u>Stepwise Subtraction</u>	<u>Stepwise Addition</u>
Consumption Goods& Services, Domestically Produced	4.7%	14%
Investment Goods & services, Domestically Produced	16%	48%

These figures may be viewed as upper and lower bounds of crowd out’s contribution to explained variance. Note that even the lower estimates are substantial, indicating crowd out explains significant amounts of variance no other determinants of consumption or investment could explain. This suggests *crowd out should be one of the variables routinely included in any theory of what drives the economic*

system, and its effects should be factored in when projecting the impact of changes to taxes or government spending to stimulate the GDP.

5.0. THE MODEL AS A COMPLETE IS-LM SYSTEM

Adding M2 to the IS curve incorporates a simple LM curve to the model, giving us (Y) as determined by both the determinants of demand for real GDP (the IS curve) and the demand for money (LM curve effects), as the following example shows. This gives us the full IS-LM system. Equilibrium in this version of Keynesian system occurs at the point where the IS and LM curves cross (Hicks, 1937).

The ease with which our partial equilibrium (IS curve) solution to the crowd out problem can be extended to the general equilibrium (IS-LM) system can be illustrated using simplified versions of both curves. A simple Keynesian closed economy IS curve (without crowd out) may be specified as follows:

$$Y = f(Y-T, r) + f(r_{-2}) + G$$

$$= -\beta_1 T + \beta_2 G - \beta_4 r - \beta_5 r_{-2}$$

(using an earlier finding (Heim 2010) that the current prime interest rate affects consumer spending (r) and the two period lagged value (r₋₂) affects investment)

A simplified Keynesian LM curve derived from the real money balances demand function might be

$$M/P = \alpha_1 Y - \alpha_2 r$$

$$\text{Or } r = \alpha_1/\alpha_2 Y - 1/\alpha_2 M/P \quad (\text{in equilibrium, where } M/P_{D=S})$$

Estimating this function, using the current period real prime interest rate (r = nominal minus average of past two years' CPI), yields the following:

$$r = .007 Y - 1.37 M2_0/P_{AV0-1} \quad R^2 = 24\%$$

$$(t) \quad (3.4) \quad (-2.7) \quad \text{D.W. } 1.5$$

$$r = .007 Y - 1.58 M2_0/P_{AV0-1} - 2.27 D \quad R^2 = 41\%$$

$$(t) \quad (4.1) \quad (-3.4) \quad (-3.2) \quad \text{D.W. } 1.6$$

Alternate simple formulations tested were as follows:

$$r = .003 Y - 1.32 M1_0/P_{AV0-1} - 1.97 D \quad R^2 = 25\%$$

$$(t) \quad (2.3) \quad (-1.2) \quad (-2.5) \quad \text{D.W. } 1.7$$

And using the nominal current period prime interest rate (r_{Nom})

$$r_{Nom} = .006 Y - 1.69 M2_0/P_{AV0-1} - 1.00 D \quad R^2 = 33\%$$

$$(t) \quad (3.6) \quad (-4.0) \quad (-1.6) \quad \text{D.W. } 1.2$$

$$r_{Nom} = .002 Y - 3.02 M1_0/P_{AV0-1} - 0.71 D \quad R^2 = 24\%$$

$$(t) \quad (1.4) \quad (-3.2) \quad (-1.1) \quad \text{D.W. } 1.4$$

$$r_{Nom} = .006 Y_{-1} - 1.42 M2_0/P_{AV0-1} - 1.42 D \quad R^2 = 37\%$$

$$(t) \quad (4.0) \quad (-4.1) \quad (-2.2) \quad \text{D.W. } 1.5$$

$$r_{Nom} = .002 Y_{-1} - 2.91 M1_0/P_{AV0-1} - 0.94 D \quad R^2 = 29\%$$

$$(t) \quad (2.1) \quad (-3.2) \quad (-1.4) \quad \text{D.W. } 1.5$$

And using the nominal money supply

$$r_{\text{Nom}} = .005 Y - 0.07 M_{2-0} \quad R^2 = 11\%$$

$$(t) \quad (2.2) \quad (-2.0) \quad \text{D.W. } 1.3$$

$$r_{\text{Nom}} = .003 Y - 0.02 M_{1-0} \quad R^2 = 14\%$$

$$(t) \quad (1.9) \quad (-2.4) \quad \text{D.W. } 1.4$$

$$r = .003 Y_{-1} - 0.02 M_{1-0} - 0.02 D \quad R^2 = 14\%$$

$$(t) \quad (1.9) \quad (-2.1) \quad (-0.0) \quad \text{D.W. } 1.4$$

$$r_{\text{Nom}} = .008 Y_{-1} - 0.01 M_{1-0} - 0.55 D \quad R^2 = 25\%$$

$$(t) \quad (3.4) \quad (-2.8) \quad (-0.8) \quad \text{D.W. } 1.6$$

where D = dummy variable showing additional influence of Fed on interest rate during recessions.

This is the simplest expression of the money demand function. No other combinations of current and prior year periods for the Y and M variables provided as much explanatory power in this simple model. Adding additional determinants of the supply and demand for money (e.g., Taylor rule and portfolio balancing effects) would probably raise the R² and D.W. statistics markedly.

In equilibrium, IS = LM. We can express Y as a function of the IS determinants, with the determinants of the current period prime interest rate (Y, M/P) substituted in for current period (r).

$$Y = -\beta_1 T + \beta_2 G + -\beta_4 r - \beta_5 r_{-2}$$

$$= -\beta_1 T + \beta_2 G + -\beta_4 [-M/P / \alpha_2 + \alpha_1 / \alpha_2 Y] - \beta_5 r_{-2}$$

$$= [1 / (1 + \beta_4 \alpha_1 / \alpha_2)] [-\beta_1 T + \beta_2 G + \beta_4 / \alpha_2 (M/P) - \beta_5 r_{-2}]$$

Our prior investment equation results indicate the current value of the GDP is determined by the real interest rate two years earlier, and this section shows current interest rates determined by the current GDP. Current interest rates in turn determine the GDP two years in the future, which in turn determine then - interest rates, etc. Equilibrium is reached through a discrete Cobweb Theorem function or its analog among continuous functions, the dampened Bessel function.

Though illustrative, much work remains before the LM curve can be considered well enough developed for use in this analysis as part of an integrated IS-LM system. That remains the subject of future research; testing below will focus on the IS curve.

6.0 CRITERIA FOR EVALUATING WHETHER CONSUMPTION AND INVESTMENT MODELS SHOW CROWD OUT

If deficits crowd out private consumption or investment spending

1. Tests should show the deficit to be negatively related to consumption and investment, be statistically significant and increase explained variance, when added to (already well defined) consumption and investment models.
- 2.
3. The coefficient on the government spending variable in IS equation tests should be smaller than the exports coefficient, and may be zero if total crowd out occurs.
4. IS curve coefficients should be better predicted from consumption and investment crowd out model regression results than by no - crowd out models, simply because IS curve coefficients are derived from consumption and investment functions. Hence, predictions are made from such equations that more accurately state the underlying economic reality.

5. Similarly, if crowd out effects are different in recession and non-recession (R/NR) periods, then (R/NR) crowd out models ought to predict IS curve coefficients better than models estimating average crowd out effects for the whole period 1960-2000.

In Section 7 below, all five of these hypotheses are tested.

7.0. TEST RESULTS

Heim (2010) determined that on average during the 1960 - 2000 period; when crowd out resulted from deficits caused by tax cuts, crowd out was *more* than total, and at least partial, perhaps total when the deficit was caused by increased government spending. Heim (2011) showed that the monetary mechanism causing it was the deficit's effect on private borrowing. However, neither of those studies examined whether crowd out is less of a problem in recessions, when deficit - financed stimulus programs are most common. It is sometimes argued that even if it is a problem in normal times, crowd out is not a problem in recessions, since consumers and businesses borrow less, leaving savings available to finance government deficits without crowding out private borrowing. However, private savings may also drop in recessions due to falling incomes. If savings decline as much or more than private borrowing demand, deficits will still cause crowd out. Hence, arguments for and against crowd out in recessions can be made theoretically. Below, we test empirically to see which is more consistent with U.S. economic behavior 1960-2000.

In examining the effect of deficits, all testing is done expressing the deficit as two separate variable variables, taxes (T) and government spending (G), so that testing for different effects of the two types of deficits can be undertaken.

7.1. MODELS TESTED

To test if crowd out has different effects on spending in recessions and non-recession periods, we need to estimate the model with separate deficit variables for both periods, rather than just an "average" effect for all periods. The single variable consumption function specification of the deficit (T, G), changes from a hypothesis which tests for the "average" effect (β_2) in all periods to one which tests for separate effects in

$$(C_D)_0 = \beta_1 \Delta(Y-T)_0 + \beta_2 \Delta(T-G) + \beta_4 \Delta PR_0 + \beta_5 \Delta DJ_{-2} + \beta_6 \Delta XR_{AV0123}$$

recession (β_{2Rec}) and non recession ($\beta_{2Non-Rec}$) periods:

$$\Delta(C_D)_0 = \beta_1 \Delta(Y-T)_0 + \beta_{2Rec} \Delta(T_{Rec} - G_{Rec}) + \beta_{2NonRec} \Delta(T_{Non-Rec} - G_{Non-Rec}) + \beta_4 \Delta PR_0 + \beta_5 \Delta DJ_{-2} + \beta_6 \Delta XR_{AV0123}$$

And the two - variable formulation of crowd out (the deficit) changes from

$$\Delta(C_D)_0 = \beta_1 \Delta(Y-T)_0 + \beta_2 \Delta T_{G(0)} + \beta_3 \Delta G_0 + \beta_4 \Delta PR_0 + \beta_5 \Delta DJ_{-2} + \beta_6 \Delta XR_{AV0123}$$

To

$$\Delta(C_D)_0 = \beta_{1C} \Delta(Y-T)_0 + (\beta_{2CRec} \Delta T_{Rec} + \beta_{3Rec} \Delta G_{0Rec}) + (\beta_{2CNon-Rec} \Delta T_{Non-Rec} + \beta_{3Non-Rec} \Delta G_{0Non-Rec}) + \beta_4 \Delta PR_0 + \beta_5 \Delta DJ_{-2} + \beta_6 \Delta XR_{AV0123}$$

The single variable form of the "average crowd out" investment function is

$$\Delta I_D = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP_{-1} + \beta_4 \Delta(T - G) - \beta_6 \Delta r_{-2} + \beta_7 \Delta DJ_{-2} + \beta_8 \Delta PROF_{-2} + \beta_9 \Delta XR_{AV0123}$$

For testing the hypothesis of separate recession/non-recession effects, this becomes

$$\Delta I_D = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP_{-1} + \beta_4 \Delta (T_{Rec} - G_{Rec}) + \beta_5 \Delta (T_{Non-Rec} - G_{Non-Rec}) - \beta_6 \Delta r_{-2} + \beta_7 \Delta DJ_{-2} + \beta_8 \Delta PROF_{-2} + \beta_9 \Delta XR_{AV0123}$$

The two - variable form of the investment function is

$$\Delta I_D = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP_{-1} + \beta_4 \Delta T_G + B_5 \Delta G - \beta_6 \Delta r_{-2} - \beta_7 \Delta DJ_{-2} + \beta_8 \Delta PROF_{-2} + \beta_9 \Delta XR_{AV0123}$$

And is now specified as:

$$\Delta I_D = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP_{-1} + (\beta_4 \Delta T_{Rec}) + (B_5 \Delta G_{Rec}) + (\beta_4 \Delta T_{Non-Rec}) + (B_5 \Delta G_{Non-Rec}) - \beta_6 \Delta r_{-2} + \beta_7 \Delta DJ_{-2} + \beta_8 \Delta PROF_{-2} + \beta_9 \Delta XR_{AV0123}$$

Substituting into the GDP identity $Y = C_D + I_D + G_D + X$, (as defined earlier) yields the following IS curve in recessions

$$\Delta Y = \left[\frac{1}{1 - \beta_{1C}} \right] \left[\begin{aligned} &(-\beta_{1C} + \beta_{2Rec} + \beta_{4Rec}) \Delta T + (1 - B_{3Rec} - B_{5Rec}) \Delta G + \beta_{1Y} \Delta(X-M) + \beta_{2Y} \Delta PR + \beta_{3Y} \Delta ACC \\ &\quad \text{(tax stimulus \& crowd out effects)} \quad \quad \quad \text{(Gov't. spending stimulus \& crowd out effects)} \\ &+ \beta_{4Y} \Delta DEP + \beta_{5Y} \Delta CAP_{-1} - \beta_{6Y} \Delta r_{-2} - \beta_{7Y} \Delta DJ_{-2} + \beta_{8Y} \Delta PROF_{-2} + \beta_{9Y} \Delta XR_{AV0123} \end{aligned} \right]$$

And in non-recession years

$$\Delta Y = \left[\frac{1}{1 - \beta_{1C}} \right] \left[\begin{aligned} &(-\beta_{1C} + \beta_{2CNonRec} + \beta_{4NonRec}) \Delta T + (1 - B_{3CNonRec} - B_{5NonRec}) \Delta G + \beta_{1Y} \Delta(X-M) + \beta_{2Y} \Delta PR \\ &\quad \text{(tax stimulus \& crowd out effects)} \quad \quad \quad \text{(Gov't. spending stimulus \& crowd out effects)} \\ &+ \beta_{3Y} \Delta ACC + \beta_{4Y} \Delta DEP + \beta_{5Y} \Delta CAP_{-1} - \beta_{6Y} \Delta r_{-2} - \beta_{7Y} \Delta DJ_{-2} + \beta_{8Y} \Delta PROF_{-2} + \beta_{9Y} \Delta XR_{AV0123} \end{aligned} \right]$$

One test of robustness of statistical estimates one is to test how well they predict other parameters in the same system. Parameter estimates from consumption and investment regressions can be used to predict what IS curve coefficients *derived*, should look like when estimated, given the consumption and investment model regression results. If the actual regression results better match those predicted from crowd out theory consumption and investment parameter estimates, we have additional evidence crowd out is real. Successful prediction also serves to bolster our confidence in our original consumption and investment function parameter estimates. By the same reasoning, if the IS curve is better predicted by including separate recession/non-recession crowd out variables in the consumption and investment functions, it provides some evidence for the notion that crowd out has different effects in recession and non-recession periods. Poor ability to predict suggests either the consumption and investment regression results were spurious, or that the IS relationship was incorrectly deduced from the consumption and investment results. A third alternative, of course, is econometric problems; for example, multicollinearity levels between variables are different in the IS equation and the consumption/investment equations. Since coefficient estimates are a function of multicollinearity (Fox 1968), this could cause differences between predictions and actual results due to the less than perfect ability of econometrics to discern empirical reality.

To obtain separate tax (ΔT_{Rec}) and government spending (ΔG_{Rec}) variables for recession periods and, (T) and (G) are multiplied by a dummy variable taking the value (1) when there is a depression at some time during the data year, and (0) in non-recession years, e.g., $(\Delta T_{Rec}) = \Delta T \cdot (D_1 \text{ or } D_0)$. National Bureau of Economic Research estimates (NBER 2009) were used to define recession years. Similarly, for non-recession years, to obtain (ΔT_{NonRec}) and (ΔG_{NonRec}) , the dummy variable is reversed.

The spending multiplier will be $1/(1 - \beta_{1C})$. In theory, tax and government spending coefficients for recession and non-recession years will be the same if crowd out effects are the same. However, if crowd out offsets stimulus more in non-recessionary periods we would see smaller net stimulus effects in non-recessions, and smaller -sized negative coefficients on the (T) variable in non-recessions (or even positive coefficients, if crowd out effects exceed stimulus, as in our earlier tax cut example), compared to recessions. if crowd out had its largest effect in recessionary periods, opposite results would obtain.

The (T) and (G) coefficients in the IS curve show the net effects of stimulus and crowd out, as follows:

(T) Coefficient = Negative stimulus coefficient. in C + positive crowd out coefficients in C and I

(G) Coefficient = Positive stimulus coefficient in IS + Negative crowd out coefficients in C and I

7.2. TEST RESULTS, FINDINGS

Overview

Section 7.2.1 develops “no crowd out” and “average crowd out” models and their test results for the 40 year period 1960-2000. These baseline results, patterned closely after Heim (2010) will indicate whether

- adding the government deficit variable (T-G) is statistically significant and increases explained variance in consumption and investment, and whether
- “average crowd out” IS models predict coefficients in IS curves better than “no crowd out” models.

In Section 7.2.2, no crowd out models are compared to models allowing for different recession and non-recession (R/NR) period effects, rather than just average effects. Such models will include two single variable crowd out variables: $\Delta(T-G)_{Rec}$ and $\Delta(T-G)_{NoRec}$. Again, the criteria for evaluation will be

- are the crowd out variables statistically significant ,
- do they add to explained variance in consumption and investment, and
- do they predict actual IS curve coefficients better than the no crowd out model.

In Section 7.2.3, we compare average crowd out results to (R/NR) models results to see which of these two models better predict actual IS curve coefficients.

7.2.1. BASELINE COMPARISONS: “AVERAGE CROWD OUT” VERSUS “NO CROWD OUT” MODELS

One interpretation of crowd out theory implies deficits induced by tax cuts and spending increases have different marginal effects:

- A dollar borrowed from a bank to finance a deficit may reduce lending by as much, but through tax cuts only stimulates by $(1-MPC)$ times the dollar tax cut, since part of all disposable income increases is saved. Hence, the net effect of tax cuts on the economy may be negative, if the tax cut results from a deficit financed with borrowed money. If so, the coefficient on the tax variable component of the deficit may be positive and statistically significant, if the two components of the deficit are tested separately. If crowd out is less than complete, the coefficient may be negative, but smaller than predicted by traditional stimulus theory.
- However, if the dollar borrowed is used to finance government spending, a dollar decline in private lending may be just offset by the dollar increase in government spending. Statistically, this should lead to estimates of the marginal net effect of deficit induced government spending being zero, if the deficit is financed with borrowed money. If crowd out is less than complete, the coefficient will be positive, but smaller than predicted by traditional stimulus theory.

In the next three sections we compare no-crowd out to average and R/NR crowd out models, but the government deficit is tested as two separate variables taxes (T) and government spending (G). Marginal effects and their statistical significance are estimated for each, to see if they are the same or different. If they are the same, the single variable deficit formulation (T-G) provides as much information as the two variable form. If not, the single variable formulation obscures the real underlying relationship, and is less preferred.

The no crowd out model and the average crowd out model are tested below. The consumption and investment functions tested use the same variables used as determinants of consumption and investment used in Heim (2010), and discussed in Section 4.0. of this paper. They include the following:

<u>Consumption</u>	<u>Investment</u>
Disposable Income $\Delta(Y-T)$	Crowd Out (Deficit) $\Delta(T), \Delta(G)$
Crowd Out (Deficit) $\Delta(T), \Delta(G)$	Real Prime Interest Rate (ΔPR_{-2})
Real Prime Interest Rate (ΔPR)	Tobin's q Proxy (ΔPR_{-2})
Wealth Measure (ΔDJ_{-2})	Average Exchange Rate (ΔXR_{AV})
Average Exchange Rate (ΔXR_{AV})	
Population Age Composition (Ratio of Young To Old: ΔPOP_{16})	Population Size (ΔPOP)
Population Size (ΔPOP)	
Index of Consumer Confidence (ΔICC_{-1})	Accelerator: Change in GDP (ΔACC)
Average M2 Money Supply (ΔXR_{AV})	Depreciation (ΔDEP)
	Capacity Utilization (ΔCAP_{-1})
	Profit Levels $(\Delta PROF_{-2})$

Exhaustive attempts were made utilizing these variables to ensure that all significant determinants of consumption and investment were controlled for. Doing so minimizes chances the crowd out variable, would appear significant when it actually was not, simply because it was correlated with variables left out of the regression. Except for capacity utilization, all included variables were found to be statistically significant determinants of consumption or investment in some or all regression tests. Where not significant, they were left in the regression on theoretical grounds, or simply because some variables seem more related to demand for domestically produced goods than imports (or vice versa). Also, fully specified models may clarify the importance of other variables in the model. Incompletely specified models may show some variables as statistically insignificant that in a more fully specified model, with less "noise" distorting results, would be statistically significant. In this study, the current period interest rate variable (PR) is an example. In consumption functions without crowd out variables, it is insignificant, but generally becomes significant when the same regressions are rerun with crowd out variables included.

From these consumption and investment function regression results, predictions of IS curve coefficients from "no crowd out" and "average crowd out" consumption and investment models are developed, and compared to actual IS curve regression coefficients obtained. The regression results were as follows:

Consumption Functions - No Crowd Out)

$$\Delta C_T = .63\Delta(Y-T_G) - 2.75\Delta PR + 1.04 \Delta DJ_{-2} + 2.95 \Delta XR_{AV} - 441.42\Delta POP_{16} + .00\Delta POP + .84\Delta ICC_{-1} + 19.54\Delta M2_{AV} \quad R^2=87.5\% \\ (t =) (8.2) \quad (-1.2) \quad (4.4) \quad (1.4) \quad (-1.1) \quad (0.2) \quad (2.0) \quad (1.5) \quad D.W.= 2.0$$

$$\Delta C_M = .21\Delta(Y-T_G) - 1.95\Delta PR + .58 \Delta DJ_{-2} + 2.32 \Delta XR_{AV} - 26.88\Delta POP_{16} + .005\Delta POP + .47\Delta ICC_{-1} - 12.91\Delta M2_{AV} \quad R^2=75.8\% \\ (t =) (3.7) \quad (-1.5) \quad (6.7) \quad (2.4) \quad (-0.2) \quad (1.1) \quad (2.2) \quad (1.4) \quad D.W.= 2.2$$

$$\Delta C_D = .43\Delta(Y-T_G) - .80\Delta PR + .46 \Delta DJ_{-2} + .63 \Delta XR_{AV} - 414.54\Delta POP_{16} + .006\Delta POP + .37\Delta ICC_{-1} + 32.45\Delta M2_{AV} \quad R^2=81.3\% \\ (t =) (7.1) \quad (-0.3) \quad (2.3) \quad (0.4) \quad (-1.5) \quad (1.7) \quad (1.1) \quad (4.2) \quad D.W.= 1.8$$

Where C_T , C_M and C_D represent total consumer demand, consumer imports demand, and domestically produced consumer goods demand. Our models are demand driven and assume supply responds to demand annually, as least to a degree of approximation given by demand + inventory change.

Investment Functions - No Crowd Out

$$\Delta I_T = .43\Delta ACC + 1.08\Delta DEP + 3.78\Delta CAP_{-1} - 10.17\Delta r_{-2} + .49\Delta DJ_{-2} + .39\Delta PROF_{-2} + 3.92\Delta XR_{AV0123} + .00\Delta POP$$

(t=)	(8.3)	(1.7)	(1.7)	(-3.2)	(1.5)	(1.8)	(2.6)	(0.2)
------	-------	-------	-------	--------	-------	-------	-------	-------

$R^2 = .75$
 $DW = 2.5$

$$\Delta I_M = .07\Delta ACC + .25\Delta DEP + 1.58\Delta CAP_{-1} + .90\Delta r_{-2} + .42\Delta DJ_{-2} - .11\Delta PROF_{-2} - .63\Delta XR_{AV0123} + .001\Delta POP$$

(t=)	(3.2)	(1.2)	(1.7)	(0.6)	(3.8)	(1.1)	(-0.7)	(0.6)
------	-------	-------	-------	-------	-------	-------	--------	-------

$R^2 = .60$
 $DW = 2.0$

$$\Delta I_D = .36\Delta ACC + .83\Delta DEP + 2.21\Delta CAP_{-1} - 11.07\Delta r_{-2} + .07\Delta DJ_{-2} + .51\Delta PROF_{-2} + 4.55\Delta XR_{AV0123} - .00\Delta POP$$

(t=)	(8.7)	(1.5)	(1.2)	(-3.9)	(0.3)	(2.9)	(4.8)	(-0.2)
------	-------	-------	-------	--------	-------	-------	-------	--------

$R^2 = .75$
 $DW = 2.5$

Where I_T , I_M and I_D represent total investment demand, demand for imported investment goods, and demand for domestically produced investment goods. Here again, the models are demand driven and assume supply responds promptly to demand, as least to a degree of approximation given by demand + inventory change for investment.

Consumption Functions With 2 Variable "Average" Crowd Out

$$\Delta C_T = .49\Delta(Y - T_G) + .54\Delta T - .75\Delta G - 10.75\Delta PR + .63\Delta DJ_{-2} + 4.70\Delta XR_{AV} - 490.76\Delta POP_{16} + .01\Delta POP + .61\Delta ICC_{-1}$$

(t=)	(12.7)	(12.3)	(-3.6)	(6.5)	(3.1)	(5.6)	(-1.6)	(4.7)	(2.4)
------	--------	--------	--------	-------	-------	-------	--------	-------	-------

$R^2 = 96.4\%$
 $D.W. = 2.2$

$$\Delta C_M = .15\Delta(Y - T_G) + .28\Delta T - .01\Delta G - 5.19\Delta PR + .29\Delta DJ_{-2} + 2.54\Delta XR_{AV} + 177.83\Delta POP_{16} - .001\Delta POP + .25\Delta ICC_{-1}$$

(t=)	(5.4)	(4.9)	(-0.1)	(2.9)	(2.8)	(4.0)	(1.1)	(-0.5)	(1.1)
------	-------	-------	--------	-------	-------	-------	-------	--------	-------

$R^2 = 89.1\%$
 $D.W. = 2.1$

$$\Delta C_D = .34\Delta(Y - T_G) + .27\Delta T - .74\Delta G - 5.56\Delta PR + .34\Delta DJ_{-2} + 2.17\Delta XR_{AV} - 668.59\Delta POP_{16} + .01\Delta POP + .36\Delta ICC_{-1}$$

(t=)	(6.5)	(3.2)	(-3.2)	(2.0)	(1.7)	(2.5)	(-2.2)	(4.0)	(1.1)
------	-------	-------	--------	-------	-------	-------	--------	-------	-------

$R^2 = 87.7\%$
 $D.W. = 2.0$

Investment Functions With 2 - Variable "Average" Crowd Out

$$\Delta I_T = +.59\Delta T - .84\Delta G + .28\Delta ACC + .32\Delta DEP + 1.75\Delta CAP_{-1} - 5.52\Delta r_{-2} + .10\Delta DJ_{-2} + .32\Delta PROF_{-2} + 5.70\Delta XR_{AV0123}$$

(t=)	(6.6)	(-4.9)	(7.6)	(1.0)	(1.1)	(-2.9)	(0.4)	(1.9)	(4.9)
------	-------	--------	-------	-------	-------	--------	-------	-------	-------

$R^2 = .91$
 $DW = 2.6$

$$\Delta I_M = +.09\Delta T - .20\Delta G + .05\Delta ACC + .14\Delta DEP + 1.57\Delta CAP_{-1} + 2.02\Delta r_{-2} + .36\Delta DJ_{-2} - .12\Delta PROF_{-2} - .18\Delta XR_{AV0123}$$

(t=)	(2.3)	(-1.8)	(1.8)	(0.7)	(1.6)	(1.2)	(3.7)	(-1.1)	(-0.3)
------	-------	--------	-------	-------	-------	-------	-------	--------	--------

$R^2 = .67$
 $DW = 2.1$

$$\Delta I_D = +.50\Delta T - .64\Delta G + .23\Delta ACC + .18\Delta DEP + .18\Delta CAP_{-1} - 7.54\Delta r_{-2} - .27\Delta DJ_{-2} + .44\Delta PROF_{-2} + 5.88\Delta XR_{AV0123}$$

(t=)	(7.6)	(-3.8)	(9.6)	(0.6)	(0.1)	(-6.9)	(-1.2)	(4.0)	(4.8)
------	-------	--------	-------	-------	-------	--------	--------	-------	-------

$R^2 = .90$
 $DW = 2.3$

Predicted IS Curve (No Crowd Out)

$$\Delta Y = -.75\Delta T + 1.75\Delta G + 1.75\Delta X - 1.40\Delta PR + .93\Delta DJ_{-2} + 9.07\Delta XR_{AV0123} - 725.45\Delta POP_{16} + .01\Delta POP + .65\Delta ICC + 56.79\Delta M2$$

$+ .63\Delta ACC + 1.45\Delta DEP + 3.87\Delta CAP_{-1} - 19.37\Delta r_{-2} + .89\Delta PROF_{-2}$

Predicted IS Curve (With 2-Variable Form of Average Crowd Out)

$$\Delta Y = +.65\Delta T - .56\Delta G + 1.52\Delta X - 8.45\Delta PR + .11\Delta DJ_{-2} + 12.24\Delta XR_{AV0123} + (NA)\Delta HSE - 1016.26\Delta POP_{16} + .03\Delta POP + .55\Delta ICC_{-1}$$

$+ 71.35\Delta M2 + .35\Delta ACC + .27\Delta DEP + .27\Delta CAP_{-1} - 11.46\Delta r_{-2} + .67\Delta PROF_{-2}$

Standard errors of the crowd out coefficients were calculated from the sum of the square route of the sum of the variances of the relevant consumption and investment function coefficients used in calculating these coefficients, and converted to t statistics shown above.

Due to minor differences in multiplier rounding in the equation immediately above, there are very slight differences with Heim (2010), which uses the exactly the same model. No results are affected.

Actual test Results (The Same Hypothesis Tests No Crowd Out and Average Crowd Out Models Above)

$$\Delta Y = +.78\Delta T - .20\Delta G + .61\Delta X - 6.69\Delta PR + .30\Delta DJ_{-2} + 4.38XR_{AV} + 505.70\Delta POP_{16} + .05\Delta POP + 1.42\Delta ICC_{-1} + 45.43\Delta M2$$

(t=) (6.0) (-0.6) (-2.1) (2.4) (0.8) (2.4) (1.4) (6.7) (2.8) (3.0)

$$+ .58\Delta ACC + .16\Delta DEP + 7.97\Delta CAP_{-1} + .04r_{-2} + .21\Delta PROF_{-2}$$

(10.0) (0.3) (2.2) (0.0) (0.8) DW=2.3 R2=97.6%

Table 5 below summarizes findings as to whether the no-crowd out or average crowd out models best predict IS curve coefficients obtained from testing the IS curve hypothesis. The predicted and actual IS curve coefficient values above are repeated in this table.

**TABLE 5
COEFFICIENTS PREDICTED FROM “NO CROWD OUT” AND “AVERAGE CROWD OUT” IS MODELS
COMPARED TO ACTUAL COEFFICIENTS FROM TESTING THE NO/ AVERAGE CROWD OUT HYPOTHESIS**

IS Model	T_R	T_{NR}	G_R	G_{NR}	X_{AV}	PR_0	DJ_{-2}	XR	POP_{16}	POP_0	ICC_{-1}
No CO Predict.	-.75	-.75	1.75	1.75	1.75	-1.40	.93	9.07	-725.46	.01	.65
Aver.CO Predict.	.65	.65	-.56	-.56	1.52	-8.45	.11	12.24	-1016.26	.03	.55
Aver.CO Actual	.78	.78	-.20	-.20	.61	-6.69	.30	4.37	505.70	.05	1.42
Best Prediction	AV	AV	AV	AV	AV	AV	AV	NO	NO	AV	NO

IS Model	$M2_{AV}$	ACC	DEP	CAP_{-1}	r_{-2}	$PROF_{-2}$
No CO Predict.	56.79	.63	1.45	3.87	-19.37	.89
Aver.CO Predict.	71.35	.35	.27	.27	-11.46	.67
Aver.CO Actual	45.43	.58	.16	7.97	-.04	.21
Best Prediction	NO	NO	AV	NO	AV	AV

Notice that

- Of the six tax and six spending crowd out coefficients in the (six) consumption and investment equations, nine of twelve are statistically significant at the 1% level or better. Government spending was not statistically significant for consumer imports, and for investment imports only at the 8% level. The tax variable in consumer imports was only significant at the 3% level. By comparison, using the one variable form (T-G) in Section 7.2.0.1, 5 of 6 crowd out variables were significant at 1% level and one significant at the 3% level (investment imports).
- Adding the separate crowd out variables to the domestic consumption model increases explained variance moderately from 81.3% to 86.7%. Adding separate crowd out variables to domestic investment increased explained variance substantially, from 75% to 90%. Section 7.2.0.1 findings for the one variable form (T-G) were the same for investment, but increased explained consumption variance 0.7% less: (to 86.0%). As noted in 7.2.0.1, Heim (2010) found crowd out added more to explained variance in the consumption equation than any other tested except disposable income, and that for investment, it added more to explained variance than any other variable including the accelerator, commonly thought to be investment’s most important determinant.

- 9 of 15 actual IS coefficients obtained testing the average/no crowd out IS hypothesis (the IS curve tested is the same for both) are better predicted by the average crowd out model, including the coefficients for the crowd out variables: taxes and government spending, and the coefficient for government spending compared to exports. Six were better predicted by the no-crowd out model.
- The crowd out effect predictions from the two variable crowd out consumption and investment regression results indicate more than full crowd out effects for both crowd out variables..
- The actual IS curve coefficients also indicate more than complete crowd out caused by deficits, whether generated by tax cuts or government spending increases as indicated by the positive sign on the tax variable and negative sign on the spending variable in the actual test (+.78 Δ T, -.20 Δ G). However, the government spending coefficient is statistically insignificant. Therefore it is more statistically accurate to say crowd out fully offsets the stimulus effects of spending, leaving the no net effect.

Though the IS curve coefficients appear to show conclusively that tax cuts have the stronger negative crowd out effect compared to government spending, whether we examine the predicted or the actual IS curve results, we notice that in both the consumption and investment equations, the coefficients suggest the opposite. Later, when calculating IS curve coefficients we subtract from the government spending crowd out effect the government spending stimulus effect (1.00), (about three times as large as the tax cut stimulus effect (0.34) shown in the domestic consumption equation). This leaves the IS results indicating a weaker crowd out effect for government spending (-.56 predicted, -.20 actual) than for tax cuts (+.65 predicted, +.78 actual).

Simply examining the consumption and investment equations individually, it is not clear why the crowd out coefficients suggest the opposite, in fact not clear why they are not the same. Holding income constant, as these equations do, the crowd out variables should measure only reduced borrowing potential, whether the reduction was due to borrowing for a tax cut or for government spending. The sum of the effects on consumption and investment of a \$1 reduction in funds available for private borrowing should sum to \$1, *ceteris paribus*. Instead, using the domestic consumption and investment equations as an example, they sum to \$0.77 for tax cuts and \$1.38 for government spending.

There are two possible explanations:

Multicollinearity between the crowd out variables and other variables in the consumption and investment equations. Removing the POP and POP₁₆ variables from the consumption equation brings the crowd out coefficients to near equality (as does removing the M2_{AV} variable, but there is some theoretical grounds for that, namely, that should happen if spending deficits are subject to monetary accommodation). For investment, removing either the POP or ACC variables brings them into near equality.

Alternatively, we can calculate confidence intervals around our .77 point estimate for the total crowd out effect of tax cuts on consumption and investment. The square root of the VAR .27 + Var .50 = .105 = the standard error of .77; at the 5% confidence level we can say the true value lies between .56 and .98; at the 1% confidence level between 0.46 and 1.08. Hence, our expectation of a total effect of (1) is within the 1% confidence interval, and close to within the 5% level.

Similarly, we can calculate confidence intervals around our 1.38 point estimate for the total crowd out effect of spending deficits on consumption and investment. The square root of the VAR -.74 + Var -.64 = .285 = the standard error of 1.38; at the 5% confidence level we can say the true value lies between (-.81, and - 1.95); at the 1% confidence level between (-.53, and - 2.24). Hence, our expectation of a total effect of (1) is within both the 5% and 1% confidence intervals.

In light of the breadth of the confidence intervals and the possibility of multicollinearity distortion, we conclude the coefficients for tax and spending crowd out effects in both the consumption and investment

equations are probably not significantly different. In addition, even if different and showing government spending to have the greater effect, it would not *a priori* contradict the IS curve finding that spending deficits had a less serious crowd out effect (no net economic impact), than tax cut deficits (net negative economic impact). This is because in the IS equation, these effects are presented net of their stimulus effects, which our regression results indicate is much larger for government spending than for tax cuts, and offsets more of the larger point estimates for government spending effects. This leads to IS curve predictions, derived from these coefficients, that tax cut deficits will have more of a crowd out effect than government spending deficits. The actual IS curve regression results strongly affirm this prediction.

Conclusions

Two variable average crowd out models explain substantial variance in consumption, investment and GDP that standard Keynesian stimulus models leave unexplained

- Crowd out models do not replace Keynesian demand - driven models, they merely indicate we should increase the number of variables standard models include: standard Keynesian models without crowd out already explain 81% of consumption and 75% of Investment. Without them it would be difficult to empirically explain most of the variation in consumption, investment and the GDP. Crowd out model results suggest standard Keynesian stimulus theory is incomplete, and because incomplete, perhaps misleading in some of its implications, including Keynes's stimulus implications for borrowing - financed deficits.
- The public policy implications of crowd out theory are profound: they imply that deficit fiscal policy, *financed by borrowed money*, does not result in stimulus to the economy. If the deficit is incurred by increased government spending, actual test results suggest there is no net effect on the economy; if the deficit due to tax cuts, test results suggest the effect is negative.
- The consumption and investment function estimates of crowd out effects roughly indicate a combined drop in consumption and investment equal to the spending or tax cut deficit, *holding income (stimulus) effects constant*. This is as it should be. The government spending results actually suggest more than total crowd out, but the confidence intervals and multicollinearity issues suggest total crowd out may actually be the underlying relationship. This is as it should be, since these equations calculate crowd out effects holding constant the stimulus effects of deficits on other variables that affect consumption and investment, such as disposable income, profits, etc. The IS curve crowd out coefficients include stimulus effects, which are much larger for spending deficits, and offset more of the crowd out effect. The net result is that the IS curve shows spending deficits to have less of an adverse affect on the economy than tax cut deficits.

7.2.2. BASELINE COMPARISONS: "RECESSION/NO RECESSION" VERSUS "NO" CROWD OUT MODELS

This section examines models with separate (T) and (G) deficit variables for recession and non-recession periods to see if they add to the explanatory power of traditional consumption and investment models, and determine how well they predict IS curve coefficients. The consumption and investment equations resulting from testing these models are as follows:

Total Consumption Equation

$$\Delta C_{TOTAL}(t) = .49\Delta(Y-T_G)_0 + .52\Delta T_{Rec} + .57\Delta T_{NonRec} - .72\Delta G_{Rec} - .76\Delta G_{NonRec} - 10.58 \Delta PR_0 + .62 \Delta DJ_{-2} + 4.65 \Delta XR_{AV0123} - 488.58 \Delta POP_{16} + .01 \Delta POP_0 + .58 \Delta ICC_{-1} + 34.65 \Delta M2_{AV234}$$

(12.3) (8.4) (5.4) (-2.2) (-3.3) (-5.9) (2.8) (5.2) (-1.5) (3.7) (2.0) (4.9)

R²=96.4%
D.W.=2.2

Consumer Imports

$$\Delta C_M(t) = .13\Delta(Y-T_G)_0 + .22\Delta T_{Rec} + .30\Delta T_{NonRec} - .62\Delta G_{Rec} + .09\Delta G_{NonRec} - 4.59 \Delta PR_0 + .28 \Delta DJ_{-2} + 2.55 \Delta XR_{AV0123} + 127.70 \Delta POP_{16} - .00 \Delta POP_0 + .14 \Delta ICC_{-1} - 16.05 \Delta M2_{AV234}$$

(3.7) (4.3) (3.3) (-3.6) (0.4) (-2.3) (2.9) (4.0) (0.8) (-0.2) (0.5) (-1.9)

R²=90.8%
D.W.=2.2

Predicted IS Curve Values

Substituting the coefficients for the R/NR crowd out model for domestic consumption and investment into the GDP identity gives the predicted coefficients in the IS function as

$$\Delta Y = +.66\Delta T_{Rec} + .58\Delta T_{NonRec} - .84\Delta G_{Rec} - .67\Delta G_{NonRec} + 1.56\Delta X - 9.34\Delta PR + .00\Delta DJ_{-2} + 12.62XR_{AV0123} - 961.40\Delta POP_{16} + .03\Delta POP_{(t)} \\ (3.2) \quad (1.5) \quad (-1.0) \quad (-1.5) \\ + .69\Delta ICC_{-1} + 79.09\Delta M2 + .36\Delta ACC + .67\Delta DEP + .19\Delta CAP_{-1} - 11.82r_{-2} + .69\Delta PROF_{-2}$$

Standard errors of the crowd out coefficients were calculated from the sum of the square route of the sum of the variances of the relevant consumption and investment function coefficients used in calculating these coefficients, and converted to t statistics shown above.

The No crowd Out Predicted IS curve, repeated from Section 7.2.1, is

Predicted IS Curve (No Crowd Out)

$$\Delta Y = -.75\Delta T + 1.75\Delta G + 1.75\Delta X - 1.40\Delta PR + .93\Delta DJ_{-2} + 9.07XR_{AV0123} - 725.45\Delta POP_{16} + .01\Delta POP + .65\Delta ICC + 56.79\Delta M2 \\ + .63\Delta ACC + 1.45\Delta DEP + 3.87\Delta CAP_{-1} - 19.37r_{-2} + .89\Delta PROF_{-2}$$

Regression Results for the Model

$$\Delta Y = +.87\Delta T_{Rec} + .60\Delta T_{NonRec} - .65\Delta G_{Rec} - .23\Delta G_{NonRec} + .63\Delta X - 8.00\Delta PR_0 + .24\Delta DJ_{-2} + 4.97XR_{AV0123} + 445.43\Delta POP_{16} + .05\Delta POP_{(t)} \\ (5.3) \quad (2.3) \quad (-1.1) \quad (-0.6) \quad (2.0) \quad (-2.2) \quad (0.6) \quad (2.6) \quad (1.3) \quad (5.6) \\ + 1.59\Delta ICC_{-1} + 44.51\Delta M2_{AV} + .59\Delta ACC + .68\Delta DEP + 8.36\Delta CAP_{-1} - .40\Delta r_{-2} + .22\Delta PROF_{-2} \quad R^2=97.8\% \\ (3.5) \quad (2.3) \quad (10.4) \quad (0.7) \quad (2.3) \quad (-0.1) \quad (0.8) \quad D.W.=2.5$$

The reader may notice the general trend in the consumption and investment regressions for government spending to appear to have the stronger crowd out effect, while the predicted (and actual) IS curve coefficients indicate the opposite, since the IS curve coefficients are “net”, that is, subtract stimulus effects from these crowd out coefficients. Since stimulus effects for spending (1.00) are 2.8 times larger than for tax cuts (0.36), the result is that IS curve coefficients showing a net crowd out effect from government spending smaller than the tax cut effect. A more detailed examination of this issue is presented in Section 7.2.1.

Conclusions

- As shown in Table 6 below, the recession/no-recession crowd out model predicted ten of seventeen actual IS regression coefficients better than the no crowd out model. The no-crowd out model predicted six better. The actual IS coefficients used for comparison were from the IS regression that included two sets of (G, T) variables
- As shown in Table 7 below, the recession/non-recession model also predicted 11 of 17 coefficients better when the actual no crowd out IS curve coefficients were used as the standard of comparison. These results were roughly the same as our earlier results testing average crowd out predictions. There, 10 of 15 IS curve coefficients in the actual no crowd out regression model were better predicted by the average crowd out model than the no crowd out model. This suggests the crowd out model's underlying consumption and investment equations, because they were more accurately estimated, yielded better predictions of other values in the same economic system.
- The crowd out model's predicted IS curve coefficients suggest more than a 100% crowd out of government spending stimulus efforts in both recessions (\$-0.84), and non-recessions (\$-0.67), though confidence intervals around these estimates suggest their net stimulus effect is zero. Traditional (no-crowd out) Keynesian stimulus models tested here estimate the effect of government spending deficits to be positive: (\$+1.75) per dollar of deficit. The crowd out model also estimates tax cuts will lead to more than full crowd out both in recessions (\$+0.66 reduction

in GDP per dollar of tax cut) and non-recessions (\$+0.57 reduction), though the non-recession coefficient is not significantly different from zero. Hence, the predictions say tax cut deficits have no net stimulus effect in non-recession periods, and a net negative stimulus effect in recessions. By comparison, the no crowd out model estimates the tax effect at (\$ -.75) per dollar of deficit caused by cutting taxes, i.e., a \$0.75 increase in GDP per dollar of tax cut.

- The crowd out model's actual IS curve regression results indicate more than 100% crowd out of the positive effects of fiscal stimulus for government spending (\$-0.65) in recessions, (-0.23) in non-recessions), but the coefficients are not significantly different from zero. The tax variables also showed more than complete crowd out (\$+0.87) in recessions, (\$+0.60) in non-recessions, and these findings were statistically significant. Both tax and spending results are consistent with crowd out theory, but contradictory to the IS curve signs predicted by traditional Keynesian stimulus theory. The larger effects in recessions may reflect a larger business need for borrowing in recessions, when profits typically used to finance part of investment are low.
- Of the eight crowd out variables used in the domestic consumption and investment equations, the most important equations in the analysis, five were significant at the 1% level, one at the 5% level one at the 9%, and one insignificant.
- The consumption and investment function estimates of crowd out effects roughly indicate a combined drop in consumption and investment equal to the spending or tax cut deficit, suggesting total crowd out. The government spending results actually suggest more than total crowd out, but the confidence intervals and multicollinearity issues suggest total crowd out may actually be the underlying relationship. This is as it should be, since these equations calculate crowd out effects holding constant the stimulus effects of deficits on other variables that affect consumption and investment, such as disposable income, profits, etc. The IS curve crowd out coefficients include these stimulus effects, which are much larger for spending deficits, and offset more of the crowd out effect. The net result is that the IS curve shows spending deficits to have less of an adverse affect on the economy than tax cut deficits.

We conclude R/NR crowd out models do explain variance in consumption and investment that standard no - crowd out models leave unexplained, and do so in a statistically significant way controlling for other influences most economists would consider important: wealth, interest rates, profits, stock prices, etc. In addition, these models predict actual IS curve coefficients markedly better than no crowd out models.

TABLE 6
IS CURVE COEFFICIENTS PREDICTED FROM NO CROWD OUT AND R/NR MODELS
COMPARED TO COEFFICIENTS OBTAINED TESTING R/NR CROWD OUT IS MODEL

IS Model	T _R	T _{NR}	G _R	G _{NR}	X _{AV}	PR ₀	DJ ₋₂	XR	POP ₁₆	POP ₀	ICC ₋₁
No CO Predict.	-.75	-.75	1.75	1.75	1.75	-1.40	.93	9.07	-725.46	.01	.65
R/NR Predicted	.66	.58	-.84	-.67	1.56	-9.34	.00	12.62	-961.40	.03	.69
R/NR Actual	.87	.60	-.65	-.23	.63	-8.00	.24	4.97	445.42	.05	1.59
Better Predict.	NO	R/NR	R/NR	R/NR	R/NR	R/NR	R/NR	NO	NO	TIE	R/NR

IS Model	M2 _{AV}	ACC	DEP	CAP ₋₁	r ₋₂	PROF ₋₂
No CO Predict.	56.79	.63	1.45	3.87	-19.37	.89
R/NR Predicted.	79.09	.36	.67	+.19	-11.82	.69
R/NR Actual	44.51	.59	.68	8.36	-.40	.22
Better Predict.	NO	NO	R/NR	NO	R/NR	R/NR

TABLE 7
IS CURVE COEFFICIENTS PREDICTED FROM NO R/NR CROWD OUT MODELS
COMPARED TO COEFFICIENTS OBTAINED TESTING A NO/AVERAGE CROWD OUT IS MODEL

IS Model	T _R	T _{NR}	G _R	G _{NR}	X _{AV}	PR ₀	DJ ₋₂	XR	POP ₁₆	POP ₀	ICC ₋₁
No CO Predict.	-.75	-.75	1.75	1.75	1.75	-1.40	.93	9.07	-725.46	.01	.65
R/NR Predicted	.66	.58	-.84	-.67	1.56	-9.34	.00	12.62	-961.40	.03	.69
No/Av CO Actual	.78	.78	-.20	-.20	.61	-6.69	.30	4.37	505.70	.05	1.42
Better Predict.	R/NR	R/NR	R/NR	R/NR	R/NR	R/NR	R/NR	NO	NO	TIE	R/NR

IS Model	M2 _{AV}	ACC	DEP	CAP ₋₁	r ₋₂	PROF ₋₂
No CO Predict.	56.79	.63	1.45	3.87	-19.37	.89
R/NR Predicted.	79.09	.36	.67	+1.19	-11.82	.69
No/Av CO Actual	45.43	.58	.16	7.97	-.04	.21
Better Predict.	NO	NO	R/NR	NO	R/NR	R/NR

7.2.3. CROWD OUT COMPARISONS: "AVERAGE" VERSUS "RECESSION/NO RECESSION" MODELS

Using the two-variable deficit form of crowd out, both average and R/NR crowd out models predict IS curve coefficients better than no crowd out models. This section examines whether either average or recession/non-recession crowd out predicts IS coefficients better than the other. To address this issue, the predictions from both crowd out models will be compared to actual IS curve coefficients. The question of which standard of comparison to use arises: the actual IS curve coefficients obtained testing the average crowd out model (one set of T, G variables) or the coefficients obtained testing the R/NR model (two sets of T, G variables)? Below, we compare actual IS curve coefficients from both models separately to the predictions to see if there is any skewing tendency resulting from the standard used for comparison.

IS Curve Predictions (Repeated From Section 7.2.1 & 7.2.2):

Predicted IS Curve (Using 2-Variable Average Crowd Out (T, G))

$$\Delta Y = +.65\Delta T - .56\Delta G + 1.52\Delta X - 8.45\Delta PR + .11\Delta DJ_{-2} + 12.24\Delta XR_{AV0123} - 1016.26 \Delta POP_{16} + .03\Delta POP + .55\Delta ICC_{-1} + 71.35\Delta M2 + .35\Delta ACC + .27\Delta DEP + .27\Delta CAP_{-1} - 11.46r_{-2} + .67\Delta PROF_{-2}$$

(t=) (3.7) (-1.3)

Predicted IS Curve (Using Both Recession and Non-recession Crowd Out Variables)

$$\Delta Y = +.66\Delta T_{Rec} + .58\Delta T_{NonRec} - .84\Delta G_{Rec} - .67\Delta G_{NonRec} + 1.56\Delta X - 9.34\Delta PR + .00\Delta DJ_{-2} + 12.62\Delta XR_{AV0123} - 961.40 \Delta POP_{16} + .03\Delta POP + .69\Delta ICC_{-1} + 79.09\Delta M2 + .36\Delta ACC + .67\Delta DEP + .19 \Delta CAP_{-1} - 11.82r_{-2} + .69\Delta PROF_{-2}$$

(3.4) (1.5) (-1.0) (-1.5)

IS Curves Test Results (From Sections 7.2.1&2):

Actual test Results (Average Crowd Out Model)

$$\Delta Y = +.78\Delta T - .20\Delta G + .61\Delta X - 6.69\Delta PR + .30\Delta DJ_{-2} + 4.38\Delta XR_{AV} + 505.70\Delta POP_{16} + .05\Delta POP + 1.42\Delta ICC_{-1} + 45.43\Delta M2 + .58\Delta ACC + .16\Delta DEP + 7.97\Delta CAP_{-1} + .04r_{-2} + .21\Delta PROF_{-2}$$

(t=) (6.0) (-0.6) (-2.1) (2.4) (0.8) (2.4) (1.4) (6.7) (2.8) (3.0) (10.0) (0.3) (2.2) (0.0) (0.8) DW=2.3

Actual IS Curve Test Results (Recession/Non-Recession Model)

$$\Delta Y = +.87\Delta T_{Rec} + .60\Delta T_{NonRec} - .65\Delta G_{Rec} - .23\Delta G_{NonRec} + .63\Delta X - 8.00\Delta PR + .24\Delta DJ_{-2} + 4.97\Delta XR_{AV} + 445.43\Delta POP_{16} + .05\Delta POP + 1.59\Delta ICC_{-1} + 44.51\Delta M2 + .59\Delta ACC + .68\Delta DEP + 8.36\Delta CAP_{-1} - .40r_{-2} + .22\Delta PROF_{-2}$$

(t=) (5.3) (2.3) (-1.1) (-0.6) (2.0) (2.2) (0.6) (2.6) (1.3) (5.6) (3.5) (2.3) (10.4) (0.7) (2.3) (-0.1) (0.8) DW=2.5

The predicted coefficients for the average and R/NR models, as well as the actual regression obtained were presented in sections 7.2.1. & 2. and are summarized in Tables 8 and 9 below:

TABLE 8
IS CURVE COEFFICIENTS PREDICTED FROM AVERAGE AND R/NR MODELS
COMPARED TO ACTUAL IS COEFFICIENTS OBTAINED TESTING A R/NR MODEL

IS Model	T _R	T _{NR}	G _R	G _{NR}	X _{AV}	PR ₀	DJ ₋₂	XR	POP ₁₆	POP ₀	ICC ₋₁
Aver. Predicted	.65	.65	-.56	-.56	1.52	-8.45	.11	12.24	1016.26	.03	.55
R/NR Predicted	.66	.58	-.84	-.67	1.56	-9.34	.00	12.62	-961.40	.03	.69
R/NR Actual Coef.	.87	.60	-.65	-.23	.63	-8.00	.24	4.97	445.42	.05	1.59
Best Prediction	R/NR	R/NR	AV	AV	AV	AV	AV	AV	R/NR	TIE	R/NR

IS Model	M2 _{AV}	ACC	DEP	CAP ₋₁	r ₋₂	PROF ₋₂
Aver Predicted.	71.35	.35	.27	.27	-11.46	.67
R/NR Predicted.	79.09	.36	.67	+.19	-11.82	.69
R/NR Actual Coef.	44.51	.59	.68	8.36	-.40	.21
Best Prediction	AV	R/NR	R/NR	R/NR	AV	AV

Table 8 shows the average crowd out model did better predicting actual R/NR coefficients than the R/NR model itself, though results were close. The average model better predicted nine of seventeen, the R/NR model seven, and one was a tie.

TABLE 9
IS CURVE COEFFICIENTS PREDICTED FROM AVERAGE AND R/NR MODELS
COMPARED TO IS COEFFICIENTS OBTAINED TESTING AN AVERAGE CROWD OUT MODEL

IS Model	T _R	T _{NR}	G _R	G _{NR}	X _{AV}	PR ₀	DJ ₋₂	XR	POP ₁₆	POP ₀	ICC ₋₁
Aver. Predicted	.65	.65	-.56	-.56	1.52	-8.45	.11	12.24	-1016.26	.03	.55
R/NR Predicted	.66	.58	-.84	-.67	1.56	-9.34	.00	12.62	-961.40	.03	.69
Aver. Actual Coef.	.78	.78	-.20	-.20	.61	-6.69	.30	4.37	505.70	.05	1.42
Better Prediction	R/NR	R/NR	AV	AV	AV	AV	AV	AV	R/NR	TIE	R/NR

IS Model	M2 _{AV}	ACC	DEP	CAP ₋₁	r ₋₂	PROF ₋₂
Aver Predicted.	71.35	.35	.27	.27	-11.46	.67
R/NR Predicted.	79.09	.36	.67	.19	-11.82	.69
Aver. Actual Coef.	45.43	.58	.16	7.97	-.04	.21
Better Prediction	AV	R/NR	AV	AV	AV	AV

In Table 9, the average model better predicted actual coefficients from an average crowd IS model in eleven of seventeen cases. The R/NR model better predicted five, and one was a tie.

Hence, Tables 8 and 9 do not indicate that the standard used to evaluate crowd out predictions affected the results. Predictions from average crowd out models predicted actual IS coefficients better when tested against actual R/NR model results making it the superior model i.e., the better predictor. The average model also predicted 2-variable average crowd out coefficients better. Hence considering the results of Tables 8 and 9, we find the average crowd out form of crowd out better predicted actual IS curve coefficients.

Overall, then we find that when using the two - variable (T, G) form of crowd out

- For consumption, average crowd out coefficients are noticeably more significant (both at 1% level) than the statistical significance of the R/NR coefficients (2 significant at 1% level, 1 at 9%, and one insignificant).

- For investment, both crowd out coefficients in the average and R/NR models were significant at the 1% level.
- For 2 variable models, virtually no additional variance is explained in the IS curve using the more detailed R/NR form (97.8%) of crowd out compared to average form (97.6%).
- Explained variance in consumption grows from 81.3% to 87.7 (6.4% increase) adding crowd out in its average form, and grows to slightly more to 88.4% (7.1% increase) with R/NR. Both models add about the same amount to investment’s explained variance: from 74.7% to 90.0 (+15.3 %) for average crowd out, and raising it to 90.3%.(+15.6%) for R/NR
- These results suggest using the R/NR form adds little additional information to our knowledge of crowd out behavior, compared to average model results. This suggests crowd out affects the economy in about the same way in recession and non-recession periods.
- The results do indicate crowd out is a significant factor offsetting stimulus in both recession and non-recession phases of the business cycle, as shown in Table 10 below:

**TABLE 10
T-STATISTICS ON (2-VARIABLE FORM) CROWD OUT VARIABLES**

	T_{Rec}	T_{NonRec}	$T_{Average}$	G_{Rec}	G_{NonREC}	$G_{Average}$
Consumption “t”	(3.2)	(1.7)	(3.2)	(-0.2)	(-3.6)	(-3.2)
Investment “t”	(7.3)	(2.5)	(7.6)	(-5.5)	(-3.5)	(-3.8)

- In addition, the average crowd out model better predicted actual IS curve coefficients (from IS curve tested with average crowd out) than the R/NR model in three of four cases:

**TABLE 11
AVERAGE CROWD OUT VS. R/NR PREDICTION RECORD**

Average Crowd Out (C/O) Predicts Better
Than R/NR, When Tested Against _____.

Actual IS, Using 2 var. Average C/O (11,5,1)
Actual IS, Using 2 var. R/NR C/O (9,7,1)

* Variables better predicted given in
the following order: (Av., R/NR, Tie)

8.0. SUPPORTING EVIDENCE: DATA ON PRIVATE BORROWING

Section 7 tests focused on whether changes in government deficits were systematically related to changes in consumer and investment spending. The tests indicate there is a negative relationship. It has been *theorized* that the mechanism causing this negative relationship was crowd out, i.e., reduced funds available for consumers and businesses to borrow to meet their needs when deficits increase the portion

of total loanable funds allocated for government use. Does the data on consumer and business borrowing show deficits associated with the same decline in we see when we look at how these deficits are related to spending? The Federal Reserve's Flow of Funds data on business and consumer debt are used to examine this relationship. We test the same total consumption and investment models tested above, except the dependent variable is not consumer and business spending, but rather consumer and business borrowing (annual changes in debt levels) , to see if deficits are as systematically related to borrowing, as to total spending. Our theory is that many of the same factors that drive consumer demand drive consumer borrowing, since borrowing is but one way of manifesting demand. If crowd out is the *only*, or *principal* mechanism through which deficits affect demand, testing should show about the same coefficients on the deficit variables in regressions on borrowing as previously obtained in regressions on demand (spending).

This issue was tested (Heim 2011) on a simpler model which did not allow for different tax and government spending crowd out effects, or different effects in recession and non-recession periods, as this study has done. Results from this earlier study indicated that the coefficient on the deficit variable (T-G) was virtually identical when borrowing and spending were tested. This was taken as strong evidence forced reductions in private borrowing is the mechanism through which deficits adversely affect consumption and investment.

8.1. TESTING BORROWING SENSITIVITY TO AVERAGE CROWD OUT

The Section 7.2.1 model for separate tax and government spending crowd out effects, averaged for recession and non recession periods, are repeated here to allow easy comparison with the borrowing model results:

Total Investment Spending Function With 2 - Variable "Average" Crowd Out

$$\Delta I_T = +.59 \Delta T - .84 \Delta G + .28 \Delta ACC + .32 \Delta DEP + 1.75 \Delta CAP_{-1} - 5.52 \Delta r_{-2} + .10 \Delta DJ_{-2} + .32 \Delta PROF_{-2} + 5.70 \Delta XR_{AV0123} + .01 \Delta POP$$

(t =) (6.6) (-4.9) (7.6) (1.0) (1.1) (-2.9) (0.4) (1.9) (4.9) (4.9) R²=.91
DW = 2.6

Total Consumption Spending Function With 2 - Variable "Average" Crowd Out

$$\Delta C_T = .49 \Delta(Y-T_G) + .54 \Delta T - .75 \Delta G - 10.75 \Delta PR + .63 \Delta DJ_{-2} + 4.70 \Delta XR_{AV} - 490.76 \Delta POP_{16} + .01 \Delta POP + .61 \Delta ICC_{-1} + 34.41 \Delta M2_{AV}$$

(t =) (12.7) (12.3) (-3.6) (6.5) (3.1) (5.6) (-1.6) (4.7) (2.4) (5.8) R²=96.4%
D.W.= 2.2

The same functions, with borrowing, not spending, as the dependent variable, yielded the following results:

Total Investment Borrowing Function With 2 - Variable "Average" Crowd Out

$$\Delta I_T = +.45 \Delta T - 1.41 \Delta G + .14 \Delta ACC + 1.56 \Delta DEP + 3.33 \Delta CAP_{-1} - 8.77 \Delta r_{-2} - 1.02 \Delta DJ_{-2} + .57 \Delta PROF_{-2} + 14.49 \Delta XR_{AV0123} + .001 \Delta POP$$

(t =) (2.6) (-2.6) (1.4) (1.3) (0.8) (-1.5) (-1.8) (1.3) (4.2) (0.1) R²=.62
DW = 1.9

Total Consumption Borrowing Function With 2 - Variable "Average" Crowd Out

$$\Delta C_T = .36 \Delta(Y-T_G) + .42 \Delta T - 1.12 \Delta G - 10.89 \Delta PR - .76 \Delta DJ_{-2} + 9.19 \Delta XR_{AV} - 217.35 \Delta POP_{16} - .01 \Delta POP + 1.08 \Delta ICC_{-1} + 25.36 \Delta M2_{AV}$$

(t =) (3.9) (1.9) (-1.8) (2.9) (2.1) (3.4) (-0.3) (-2.4) (1.4) (0.7) R²=65.5%
D.W.= 1.8

The total estimated drop in borrowing per dollar of tax cut induced deficit is \$0.87, compared to the spending drop of \$1.13. The total estimated drop in borrowing per dollar of government spending induced deficits is \$2.53, compared to the spending drop of \$1.59. In the case of tax cuts, both the borrowing and spending estimates of deficit effect are very close to the deficit size. For government spending, both the spending and borrowing results indicate more than a dollar drop in private spending

per dollar of deficit, but the confidence intervals around the borrowing estimates (+/-0.56 for tax cuts and +/-1.65 for government spending) do not allow us to reject the hypothesis the drop is equal to the drop in spending.

In short, the borrowing data strongly support the theory that crowd out is the mechanism through which deficits affect consumption and investment. The point estimates suggest the drop in consumer borrowing is a little less than the drop in consumer spending, and that the drop in investment borrowing is a bit more than the drop in spending, but the confidence intervals around these estimates indicate that the drops in borrowing and spending may be equal, or nearly so. This suggests crowd out is either the major or only monetary channel through which crowd out affects consumer and business spending.

8.2. TESTING BORROWING SENSITIVITY TO RECESSION/NON-RECESSION CROWD OUT

Repeated from Section 7.2.2 are regression results for models of the determinants of consumer and business spending. They are repeated to allow easy comparison with functions estimating the effects of these same determinants on consumer and business borrowing. It is not necessarily true that all variable that determine spending also determine borrowing; some may not, though since consumers and businesses borrow money because they intend to spend it, we expect to find that some of the key determinants of spending are also key determinants of borrowing.

Total Investment Spending Function With 2 - Variable Recession/Non-Recession Crowd Out

$$\Delta I_T = .57\Delta T_{Rec} + .56\Delta T_{NonRec} - 1.48\Delta G_{Rec} - .81\Delta G_{NonRec} + .27\Delta ACC + .52\Delta DEP + 1.70\Delta CAP_{-1} - 5.55\Delta r_{-2} + .04\Delta DJ_{-2}$$

(t=)	(8.5)	(2.5)	(-5.7)	(-4.2)	(6.8)	(1.2)	(1.1)	(-2.8)	(0.2)		
								+ .32 $\Delta PROF_{-2}$	+ 5.79 ΔXR_{AV0123}	+ .01 ΔPOP	R ² =91.5 DW =2.6
								(1.8)	(6.3)	(3.4)	

Total Consumption Spending Function With 2 - Variable Recession/Non-Recession Crowd Out

$$\Delta C_{TOTAL} = .49\Delta(Y-T_G)_0 + .52\Delta T_{Rec} + .57\Delta T_{NonRec} - .72\Delta G_{Rec} - .76\Delta G_{NonRec} - 10.58\Delta PR_0 + .62\Delta DJ_{-2} + 4.65\Delta XR_{AV0123}$$

(t=)	(12.3)	(8.4)	(5.4)	(-2.2)	(-3.3)	(-5.9)	(2.8)	(5.2)					
									-488.58 ΔPOP_{16}	+ .01 ΔPOP_0	+ .58 ΔICC_{-1}	+ 34.65 $\Delta M2_{AV234}$	R ² =96.4% D.W.=2.2
									(-1.5)	(3.7)	(2.0)	(4.9)	

And the borrowing functions for the same models are as follows:

Total Investment Borrowing Function With 2 - Variable Recession/Non-Recession Crowd Out

$$\Delta I_B = .15\Delta T_{Rec} + .79\Delta T_{NonRec} - 2.10\Delta G_{Rec} - 1.38\Delta G_{NonRec} + .11\Delta ACC + .80\Delta DEP + 2.71\Delta CAP_{-1} - 7.94\Delta r_{-2} - 1.01\Delta DJ_{-2}$$

(t=)	(0.6)	(2.9)	(-1.6)	(-2.5)	(1.0)	(0.7)	(0.6)	(-1.4)	(2.0)			
									+ .53 $\Delta PROF_{-2}$	+ 13.42 ΔXR_{AV0123}	+ .00 ΔPOP	R ² =64.4 DW =2.0
									(1.2)	(4.7)	(0.1)	

Total Consumption Borrowing Function With 2 - Variable Recession/Non-Recession Crowd Out

$$\Delta C_B = .43\Delta(Y-T_G)_0 + .85\Delta T_{Rec} + .01\Delta T_{NonRec} - .17\Delta G_{Rec} - 1.34\Delta G_{NonRec} - 14.97\Delta PR_0 - .59\Delta DJ_{-2} + 9.98\Delta XR_{AV0123}$$

(t=)	(5.6)	(6.8)	(0.0)	(-0.2)	(-2.3)	(-3.1)	(-1.5)	(4.1)					
									-127.07 ΔPOP_{16}	- .01 ΔPOP_0	+ 1.90 ΔICC_{-1}	+ 30.29 $\Delta M2_{AV234}$	R ² =71.8% D.W.=1.9
									(-0.2)	(-2.1)	(2.5)	(1.0)	

In recessions, the estimated total spending effect of tax cut deficits, on consumption and investment per dollar of deficit is \$1.09; the estimated total borrowing effect is \$1.00. In non-recessions spending effects of tax cut deficits are is \$1.13; borrowing effects \$0.80. Total spending deficit effects in recessions is

\$2.20; borrowing effects \$2.27. In non-recessions, government spending deficits have a total effect on spending of \$1.57; borrowing effects are estimated to be \$2.72.

In the first three of these four cases, the estimates of the effects of deficits on total borrowing and total spending are virtually the same. In the fourth case (government spending in non-recessions) the point estimates suggest crowd out has a larger effect on borrowing than on spending, but when standard errors are taken into consideration we cannot reject the hypothesis they are equal.

Hence, we conclude that the recession/non-recession crowd out models, like the average crowd out models, indicate that the decline in spending associated with deficits and the decline in borrowing are about the same. This strongly suggests the deficit's effect in crowding out private borrowing is the mechanism which explains why deficits are negatively associated with total business and consumer spending.

9.0. FINANCING DEFICITS BY FOREIGN BORROWING AS A MEANS OF AVOIDING CROWD OUT

Heim (2011) noted the Federal Funds accounts require a savings-investment identity in which government and private investment to always equal available saving. Foreign saving borrowed by public or private United States borrowers is included as part of the savings component. Heim noted that during the 1981-83 recessionary period, the Federal Funds Accounts indicated domestic saving fell considerably more than borrowing, but that this was offset by the growth in foreign borrowing during the same period to compensate for lost domestic savings. Hence, government deficits may *not* cause crowd out if the government (or private borrowers) can borrow needed funds from foreign sources.

10.0. FINANCING DEFICITS BY MONETARY EXPANSION AS A MEANS OF AVOIDING CROWD OUT

In theory, deficits can be financed by monetary expansion as well as by borrowing. Monetary expansion should avoid the crowd out problem. However, in Heim (2010) and in this study, regression coefficients on variables in the consumption and IS models vary little using the (M2-M1) formulation for the money variable instead of the (M2) formulation, suggesting the parts of M2 that are significantly affecting the economy in this model are the non-M1 components, i.e., the parts that represent savings. This may suggest that monetary expansion, as a means of financing a stimulus deficit, may only offset crowd out if it is saved, i.e., used to replace savings lost to financing the government deficit. There is some evidence of this offered in Heim (2010), where it is noted that without M2 controlled for, government spending deficits seem to have no effect on consumption. Only when M2 is controlled for do we see government spending deficits have a crowd out effect. However, there are many dimensions to this issue, and more extensive research is needed on the extent to which deficit induced crowd out problems can be offset by monetary expansion.

11.0. CONCLUDING METHODOLOGICAL NOTE

One cannot help but notice that though almost all the variables in the C and I equations used to predict IS equation coefficients were statistically significant, many IS coefficients were not. The lower levels of statistical significance in the larger IS equation, which combines the variables in the consumption and investment equations, plus exports, results from two things:

- relative few observations (32) for the number of coefficients estimated (17) in the IS equation, and
- considerable multicollinearity, even with first differencing of the data. Multicollinearity can distort regression coefficients in sign, magnitude and statistical significance. As a result, regression results are often messy and unreliable, with considerable variation between predicted and actual

results occurring due to distortions caused by multicollinearity and sometimes other problems as well. As noted earlier, Heim (2009b) has shown that predictions for one equation in a system deduced from regression results on other equations in the same system will *only* match actual regression results for the equation being predicted under certain conditions, *not met here*. The conditions are that each equation used to predict another regression's results must contain exactly the same variables as the regression being predicted (An alternative condition would be that all intercorrelations between explanatory variables be zero), and the dependent variable has to be the sum of dependent and exogenous variables in the functions from which it is predicted.

12.0. SUMMARY AND CONCLUSIONS

This paper has attempted to bring science to bear on the issue of whether crowd out exists, how much so, and when. To do so, we have explicitly controlled for other variables (or reasonable proxies for them) that might affect consumption, investment and GDP.

The test results strongly indicate crowd out affects the economy as crowd out theory suggests it will when deficits are financed by borrowing:

- Crowd out completely offsets the stimulus effects of government spending deficits, resulting in the government spending having no net economic effect.
- Crowd out more than completely offsets stimulus effects of tax cut deficits, resulting in net negative economic effect.
- Some critiques of crowd out theory argue that even if it occurs in normal times, it doesn't occur in recessions, when loan demand is low, and when the need for deficits to stimulate the economy is the greatest. Test results here find the crowd out problem is significant in both periods, and about equally so. We hypothesize that the reason for this is that savings drops as much (or more) than private loan demand for in recessions. Therefore any deficit financed by borrowing will crowd out restrict funds available for private borrowing in recessions, as it would in non-recessions.
- The consumption and investment function estimates of crowd out effects roughly indicate a combined drop in consumption and investment equal to the spending or tax cut deficit This is as it should be, since these equations calculate crowd out effects holding constant the stimulus effects of deficits on other variables that affect consumption and investment, such as disposable income, profits, etc. The IS curve crowd out estimates include these stimulus effects, which are much larger for spending deficits, and offset more of the crowd out effect. The net result is that the IS curve shows spending deficits to have neither a positive or negative effect on the economy, but show tax cut deficits to have a net negative effect on the economy.

Specific results by section:

Section 4.1: Contributions To Explained Variance

- Adding crowd out variables to a *well specified* total consumption function adds a minimum of 4.7% to explained variance in consumption; to well specified investment models it adds a minimum of 16%. This is variance in consumer and business behavior is not explained by the variables in standard stimulus models. Hence, empirically, we must conclude the crowd out is real and a factor adversely affecting private spending.

Section 7.2.1. Baseline Comparisons: “Average Crowd Out” Versus “No Crowd Out” Models

- Adds 5.4% to explained variance for domestically produced consumer goods and services, increasing explained variance from 81.3% to 87.7%; Adds 15% to explained variance for investment, raising it from 75% to 90%
- 9 of 12 crowd out variables in consumption and investment models significant at 1% level, one each at the 8% and 3% level, and one was insignificant.
- Crowd out explains more variance in consumption than any variable except disposable income. Crowd out explains more variance in investment than any other variable, including the accelerator. (This result taken from Heim 2010)
- 9 of 15 IS curve regression coefficients better predicted by crowd out models of consumption and investment, than models that did not include a crowd out variable (the government deficit).
- Actual IS curve test results indicate total crowd out associated with government spending deficits, indicating no net stimulus effect; for tax cut deficits, more than complete crowd out was associated with the deficits, leaving net stimulus negative effect. (the appropriate actual IS equation used is the same as used for one variable crowd out in section 7.0.2.1.)

$$\Delta Y = \underset{(t=)}{+.78\Delta T} - \underset{(-0.6)}{.20\Delta G} + \dots$$
- Predicted IS curve results also indicate total crowd out for government spending deficits, leaving no net stimulus effect, and more than total crowd out for tax cut deficits, leaving a negative net stimulus effect. This is because the government spending crowd out effect in the consumption and investment equations is much larger when estimated separately (-.74ΔG for consumption), (-.64ΔG for investment), than from the tax effect (+.27ΔT for consumption), (+.50ΔT for investment). In Section 7.2.0.1, they were estimated with one coefficient (+.27ΔT, -.27ΔG for consumption), (+.51ΔT, -.51ΔG for investment). The one variable form assumes the marginal effects of tax cut and spending deficits are the same. Results in this section conform to crowd out theory, which tells us this is not the case, and implies the 2 variable specification of crowd out is the more correct for testing purposes. Traditional stimulus theory, by comparison, predicts positive net stimulus effects for both tax cut and spending deficits.

Section 7.2.2. Baseline Comparisons: “Recession/No Recession” Versus “No Crowd Out” Models

- Adds 7.1% to explained variance for domestically produced consumer goods and services, increasing explained variance from 81.3% to 88.4%; Adds 15.6% to explained variance for investment, raising it from 75% to 90.6%
- 8 of 12 crowd out variables in consumption models significant at 1% level, one each at 5% and 9% levels, two insignificant. For investment, 6 of 12 were significant at 1% level, 2 at 2% level, and one each at 8% and 10% levels.
- 10 -11 of 17 IS curve regression coefficients better predicted by crowd out models of consumption and investment, than models that did not include crowd out variables.
- Consumption function regression coefficients on the tax crowd out variable suggests crowd out is about as much of a problem in recessions (+.27) as non recessions (+.31), and their confidence intervals also suggest they may be the same. Consumption function regression coefficients on the government spending crowd out variable suggests crowd out is more of a problem in non-recessions (-.84) than in recessions (-.10). Confidence intervals around the estimates confirm the likelihood a difference exists.
- Investment function coefficients suggest tax crowd out effects are the same in recessions (+.47) and non-recessions(+.46), but government spending deficits may create worse crowd out effects in recessions (-1.44) than non-recessions (-.59). Confidence intervals on these coefficients indicate little potential for overlap, supporting this conclusion.
- Actual IS curve coefficients for government spending are negative, suggest more than complete crowd out, but the estimates are not significantly different from zero, and therefore are better described as indicating full crowd out. The positive tax cut coefficients and their confidence intervals suggest more than complete crowd out, implying tax cut deficits yield a negative net stimulus effect.

- Actual IS curve coefficients, viewed in isolation, suggest crowd out somewhat worse in recessions, but each estimate is well within the confidence interval around the other, suggesting real effect may be roughly the same in both periods. This is consistent with our earlier finding that consumption effects were greater in non-recessions, but investment effects greater in recessions.

$$\Delta Y = \underset{(t=)}{+.87} \Delta T_{\text{Rec}} + \underset{(2.3)}{+.60} \Delta T_{\text{NonRec}} - \underset{(-1.1)}{.65} \Delta G_{\text{Rec}} - \underset{(-0.6)}{.23} \Delta G_{\text{NonRec}} + \dots$$

- Predicted IS curve coefficients also show the same thing as actual coefficients: *more than total* crowd out for government spending deficits in recessions (-.84) and non-recessions (-.67), however, the 5% confidence intervals around these predictions are large enough so that we cannot reject the hypothesis their true coefficients are zero, i.e., no net stimulus effect on the economy. Results in this section conform to crowd out theory, which tells us this is not the case, and implies the 2 variable specification of crowd out is the more correct for testing purposes. For tax cut deficits, the predicted coefficients are (+.66) in recessions and (+.58) non-recessions, indicating tax cut deficits have a net negative effect on the economy. 5% confidence intervals indicate the tax effect in recessions is significantly greater than zero, but for non-recessions we cannot reject the hypothesis the true effect is zero. These findings are the same as for the actual IS curve coefficients, except there, non recession tax effects were also significantly greater than zero. By comparison, traditional deficit stimulus models, without crowd out, show positive stimulus effects from both tax cut and spending deficits.

Section 7.2.3: Crowd Out Comparisons: "Average" Versus "Recession/No Recession" Models

- Actual IS curves both show more than complete crowd out (negative marginal effect estimates) associated with government spending deficits, however these estimates are not statistically different from zero, implying full crowd out, leaving no net stimulus effect. Tax cut deficits marginal effect estimates suggest more than complete crowd out associated with tax cut deficits, hence, the estimated net stimulus effect is negative (as reported for the same curves in Sections 7.2.1 and 7.2.2)
- Predicted IS curves show more than full crowd out associated with government spending deficits, and with tax cut deficits. Confidence intervals are not available to see if the spending estimates differ significantly from zero. Hence, the net stimulus effect is predicted to negative (as reported for the same curves in Sections 7.2.1 and 7.2.2.). Crowd out theory predicts a zero net effect of spending deficits and more than full crowd out for tax cut deficits, which is what our actual IS curve results also show.
- Average crowd out predictions were better for 11 of 17 variables, R/NR predictions better for 5 using actual results from an average crowd out IS curve regression as the standard of comparison, 1 was tied.
- Average crowd out predictions were better for 9 of 17 variables, R/NR predictions better for (7) using actual results from an R/NR crowd out IS regression as the standard of comparison, 1 was a tie.

Section 8.1 and 8.2. Corroborating Evidence: Private Borrowing: Sensitivity to Crowd Out

Retesting the consumption and investment spending models, substituting consumer and business borrowing for spending, produces estimates of crowd out effects on borrowing very similar to those effects found on total spending. This strongly suggests that the negative effects on private borrowing is the channel through which deficits adversely affect private spending, negating Keynesian-type stimulus effects.

Section 9.0. Financing Deficits By Foreign Borrowing As A Means Of Avoiding Crowd Out

If governments can borrow from foreign sources to finance the deficit, no crowd out need occur. If government utilizes domestic savings, but private borrowers can borrow from foreign sources, no crowd out need occur.

Section 10.0. Financing Deficits By Monetary Expansion As A Means Of Avoiding Crowd Out

Deficits can be financed by monetary expansion as well as by borrowing. Theoretically, this should avoid the crowd out problem. However, in Heim (2010) and the study above, regression coefficients on variables in the consumption and IS models vary little using the (M2-M1) formulation for the money variable instead of the (M2) formulation, suggesting the parts of M2 that are significantly affecting the economy in this model are the non-M1 components, i.e., the parts that represent savings. This may suggest that monetary expansion, as a means of financing a stimulus deficit, may only offset crowd out if it is saved, i.e., used to replace savings lost to financing the government deficit. There is some evidence of this offered in Heim (2010), where it is noted that without M2 controlled for, government spending deficits seem to have no effect on consumption. Only when M2 is controlled for do we see government spending deficits have a crowd out effect. However, there are many dimensions to this issue, and more extensive research is needed on the extent to which deficit induced crowd out problems can be offset by monetary expansion.

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One cannot help but notice that though almost all the variables in the C and I equations used to predict IS equation coefficients were statistically significant, many IS coefficients were not. The lower levels of statistical significance in the larger IS equation, which combines the variables in the consumption and investment equations, plus exports, results from two things:

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