IS CROWD OUT A PROBLEM IN RECESSIONS?

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IS CROWD OUT A PROBLEM IN RECESSIONS?

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ABSTRACT: The crowd out effects of the government deficit is tested by adding it to consumption and investment models which control extensively for other factors. Effects are calculated for recession and non-recession periods, and compared to models with average crowd out, and models without crowd out. Test results indicate 1) deficits crowd out private consumption and investment, are statistically significant, and add substantially to explained variance. They also predict “IS” curve coefficients better than no crowd out models. Crowd out was found to have roughly equal effects in recessions and non-recession periods. Government spending deficits were found to result in complete crowd out, tax cut deficits resulted in more than complete crowd out. Both findings consistent with crowd out theory. Increases in M2, especially its saving (Non-M1) components, in the three years prior to a deficit, were found to offset the crowd out effects of government spending deficits, but not the effects of tax cut deficits. M1 increases were not found effective in eliminating crowd out effects. Foreign borrowing can be used to supplement domestic saving, reducing the possibility of crowd out when deficits occur. This paper uses a one variable definition of the deficit (T-G). This implies marginal effects of spending and tax deficits are the same. In working Paper 1104 of this series, these two kinds of deficits are tested separately to determine if they have separate effects. 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:

\[ \text{GDP} = Y = C + I + G + (X-M) \]  

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

\[ Y = \left(\frac{1}{1-\beta}\right) \cdot \left[ -\beta T + I + G + X - M \right] \]

**MULTIPLIER EFFECT OF ∆ T, ∆ G:**

\[
\begin{align*}
\text{Tax Multiplier} & = \frac{-\beta}{1-\beta} \\
\text{Spending Multiplier} & = \frac{1}{1-\beta}
\end{align*}
\]

The clear expectation of Keynesian stimulus theory is that tax changes in 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 (\(\lambda\)) represents the marginal effect of deficit spending on consumer demand. With this function, the Keynesian model becomes

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

From which we can easily see that the impact of a change in T or G on the GDP depends on \(\lambda\) as well as \(\beta\), and the spending multiplier \(1/(1-\beta)\). The tax multiplier, showing the marginal impact of a change in taxes is now \((-\beta + \lambda)/ (1 - \beta)\). The spending multiplier, showing the marginal impact of a change in government spending, is now \((1-\lambda)/(1-\beta)\). Both T and G marginal 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

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

We can see the impact of a change in T or G on the GDP depends on \(\lambda_{\text{Rec}}\) or \(\lambda_{\text{NonRec}}\) as well as \(\beta\), and the spending multiplier \(1/(1-\beta)\). The tax multiplier, is now \((-\beta + \lambda_{\text{Rec}})/(1 - \beta)\) or \((-\beta + \lambda_{\text{NonRec}})/(1 - \beta)\). If the crowd out effect is less in recessions, the tax multiplier effects will be larger than in non-recession periods. The spending multiplier, showing is now \((1-\lambda_{\text{Rec}})/(1-\beta)\) or \((1-\lambda_{\text{NonRec}})/(1-\beta)\) and if the crowd out effect is less in recessions, the spending multiplier will be larger in recessions than in non-recession periods.

Several conclusions follow from this result

a) If the crowd out effect \(\lambda\) 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 \(\beta\) is larger than the appropriate variant of \(\lambda\). If \(\lambda\) is equal to or greater than \(\beta\), 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 \((1-\lambda_{\text{NonRec}})/(1 - \beta)\). 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.

In Graph 1, 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 given in Graph 2, where the top two curves show the relationship of real investment to real GDP 1960-2000, and how actual investment deviates from the trend relationship with GDP 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...
Table 1
EFFECTS OF CONSUMER CREDIT CROWD OUT ON THE EFFECTIVENESS OF TAXES AND GOVERNMENT SPENDING STIMULUS

<table>
<thead>
<tr>
<th>Without Crowd Out</th>
<th>With Crowd Out</th>
<th>Without Crowd Out</th>
<th>With Crowd Out</th>
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<tr>
<td>Tax coefficient</td>
<td>(-β)</td>
<td>(-β+ λ)</td>
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</tr>
<tr>
<td></td>
<td>(-β)</td>
<td>(-β+ λ_{Rec})</td>
<td>(1- λ)</td>
</tr>
<tr>
<td></td>
<td>(-β)</td>
<td>(-β+ λ_{NonRec})</td>
<td>(1- λ_{NonRec})</td>
</tr>
<tr>
<td>Government Spending Coefficient</td>
<td>1</td>
<td>(1- λ)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
<tr>
<td>Tax Multiplier (Average-All Per.)</td>
<td>(-β)</td>
<td>(-β+ λ)</td>
<td>(1- λ)</td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
<tr>
<td>Government Spending Multiplier</td>
<td>(1)</td>
<td>(1- β)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
<tr>
<td>Tax Multiplier (Recession Period)</td>
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<td>(-β+ λ_{Rec})</td>
<td>(1- λ_{Rec})</td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
<tr>
<td>Government Spending Multiplier (Recession Period)</td>
<td>(1)</td>
<td>(1- λ_{Rec})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
<tr>
<td>Tax Multiplier (Non-Recession)</td>
<td>(-β)</td>
<td>(-β+ λ_{NonRec})</td>
<td>(1- λ_{NonRec})</td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
<tr>
<td>Government Spending Multiplier (Non-Recession Period)</td>
<td>(1)</td>
<td>(1- λ_{NonRec})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1- β)</td>
<td>(1- β)</td>
<td>(1- β)</td>
</tr>
</tbody>
</table>

GRAPH 1
PREDICTED AND ACTUAL LEVELS OF REAL CONSUMPTION 1960 - 2000
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 ($T-G$).

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

where gamma ($\gamma$) indicates the marginal effect of the government deficit on investment spending, and ($\theta$) 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:

$$GDP = Y = \left[\frac{1}{1-\beta}\right] \left[(-\beta+\lambda+\gamma) T + (1-\lambda-\gamma) G - \theta r + (X-M)\right]$$

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 on consumers and investors ($\lambda+\gamma$), due to increased government borrowing out of the savings pool. Tax stimulus effects may switch from negative to positive if the crowd out effects ($\lambda+\gamma$) are larger than the disposable income effect ($\beta$). The effect of a change in government spending is also reduced per dollar of expenditure from ($1$) to ($1-\lambda-\gamma$), 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:

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

$$GDP = Y = \left[\frac{1}{1-\beta}\right] \left[(-\beta+\lambda_{Rec}+\gamma_{Rec}) T + (1-\lambda_{NonRec}-\gamma_{NonRec}) G - \theta r + (X-M)\right]$$
The effects of consumer and investment credit crowd out on the effectiveness of taxes and government spending stimulus

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Without Crowd Out</th>
<th>With Crowd Out</th>
<th>Without Crowd Out</th>
<th>With Crowd Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax coefficient</td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
<td></td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
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<td></td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
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<tr>
<td>Government Spending Coefficient</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
<td>Government Spending Multiplier</td>
<td>1 - (\lambda + \gamma)</td>
<td>1 - (\lambda + \gamma)</td>
<td>1 - (\lambda + \gamma)</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
<td>(Average-All Per.)</td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
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<td>(-\beta)</td>
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<tr>
<td></td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
<td>Tax Multiplier (Recession Period)</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
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<tr>
<td></td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
<td>Tax Multiplier (Non-Recession)</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
<tr>
<td></td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
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</tr>
<tr>
<td></td>
<td>(-\beta)</td>
<td>(-\beta + (\lambda + \gamma))</td>
<td>1</td>
<td>1 - (\lambda + \gamma)</td>
</tr>
</tbody>
</table>

Several conclusions follow from the results 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 \((\beta)\) is larger than the appropriate variant of \((\lambda + \gamma)\). If \((\lambda + \gamma)\) is equal to or greater than \((\beta)\), there is 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 and business credit.

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 \((1-\lambda)_{\text{NonRec}}/(1-\beta)\). 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

\[ Y = C_{D+M} + I_{D+M} + G_{D+M} + (X - M) \]

\(\text{where } M = C_M + I_M + G_M\)

\[ = C_D + I_D + G_D + X \]

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.”


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. Also using a VAR model, Blanchard and Perotti (2002) when testing taxes and government spending obtained the same result for investment, but more Keynesian results for total 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


### 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.

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

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<tr>
<th>Year</th>
<th>Surplus (Billions of 1996 Dollars)</th>
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<td>$41.20</td>
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<td>1960</td>
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<tr>
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<td>227.08</td>
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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 Δ(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
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 R²) 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

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

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_{Avg123}) 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 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 crow 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 than those discussed earlier.

**Variables Found To Be Significant Determinants Of Consumption Or Investment**

\[(Y-T) = \text{Disposable income defined as the GDP minus the government receipts net of those used to finance transfer payments}\]

\[(T-G) = \text{The government deficit, interpreted as a restrictor of consumer as well as investment credit. It was found highly significant in a preliminary study (Heim 2008A), and is regressed as two separate variables because of earlier findings of differential effects.}\]

\[PR = \text{The Prime interest rate for the current period. It is deflated to get the real rate using the average of the past two year’s CPI inflation rate.}\]

\[DJ_{2} = \text{A stock market wealth measure, the Dow Jones Composite Average, lagged two years}\]

\[XR_{AV0123} = \text{The trade - weighted exchange rate (XR) An average of the rate for the current and past three years is used to capture what preliminary studies showed was slow, multiyear process of adjustment to exchange rate changes (Heim, 2007)}\]

\[POP = \text{Population Growth: a factor found systematically related to growth in consumer demand in addition to the factors previously cited}\]

\[POP_{16-24/65} = \text{Percentage of Americans 16-24 relative to adults 65 and over: a factor reflecting the fact that younger populations, with lesser incomes, have less to spend on consumer goods, particularly services which account for over half of all consumer spending. They also need to be saving more out of current income for retirement and children's education costs than older adults.}\]

\[ICC_{1} = \text{Consumer Confidence Levels: as measured by the Conference Board’s Monthly consumer survey (Conference Board, 2009), added because consumer confidence was strongly related to consumer spending, even controlling for income and wealth.}\]

\[M2_{1-3AV} = \text{M2 Money Supply Average: Testing indicated that past three year average M2, particularly the non-M1 parts (savings account deposits, small CD’s, money market mutual funds held by individuals and money market deposit accounts) were systematically related to consumer spending. This build up of savings (liquidity) prior to a spending - generated deficit was systematically related to the deficit’s effect on consumer demand. M1 was not found significant. This non-M1 component of M2 probably reflects a dimension of consumer wealth not picked up by our use of the stock market average. It appears that both affect consumption after a lag.}\]

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.

\[AC\]c = \text{An accelerator variable \(\Delta(Y_{t-1} - Y_{t-1})\), found in many studies the past 50 years to be the most important determinant of investment spending}\]

\[DEP = \text{Depreciation allowances: a large portion of current year sales revenue available tax free to supplement retained earnings as funds available to finance investment}\]

\[CAP_{1} = \text{A measure of last year's capacity utilization. High capacity utilization may signal companies of a need for further investment if demand is expected to grow, or capacity utilization levels currently exceed desired levels.}\]

\[PROF_{2} = \text{A measure of business profitability two years ago.}\]
\[ r_2 = \text{Real Prime interest rate, lagged two periods.} \]

### 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 understated 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, \( R^2 \) 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.

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

<table>
<thead>
<tr>
<th></th>
<th>Stepwise Subtraction</th>
<th>Stepwise Addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption Goods &amp; Services, Domestically Produced</td>
<td>4.7%</td>
<td>14%</td>
</tr>
<tr>
<td>Investment Goods &amp; services, Domestically Produced</td>
<td>16%</td>
<td>48%</td>
</tr>
</tbody>
</table>

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

\[
M/P = \alpha_1 Y - \alpha_2 r
\]

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 \(r = \text{nominal minus average of past two years' CPI}\), yields the following:

\[
r = .007 Y - 1.37 M2/P_{AV0-1} \quad R^2 = 24\% \quad \text{(t) \quad (3.4) \quad (-2.7) \quad D.W. \quad 1.5}
\]

\[
r = .007 Y - 1.58 M2/P_{AV0-1} - 2.27 D \quad R^2 = 41\% \quad \text{(t) \quad (4.1) \quad (-3.4) \quad (-3.2) \quad D.W. \quad 1.6}
\]

Alternate simple formulations tested were as follows:

\[
r = .003 Y - 1.32 M1/P_{AV0-1} - 1.97 D \quad R^2 = 25\% \quad \text{(t) \quad (2.3) \quad (-1.2) \quad (-2.5) \quad D.W. \quad 1.7}
\]

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

\[
r_{Nom} = .006 Y - 1.69 M2/P_{AV0-1} - 1.00 D \quad R^2 = 33\% \quad \text{(t) \quad (3.6) \quad (-4.0) \quad (-1.6) \quad D.W. \quad 1.2}
\]

\[
r_{Nom} = .002 Y - 3.02 M1/P_{AV0-1} - 0.71 D \quad R^2 = 24\% \quad \text{(t) \quad (1.4) \quad (-3.2) \quad (-1.1) \quad D.W. \quad 1.4}
\]
$r_{\text{Nom}} = .006 Y_{-1} -1.42 M_{20}/PAV_{-1} - 1.42 D$

$R^2 = 37%
(t) (4.0) (-4.1) (-2.2)
D.W. 1.5$

$R^2 = 29%
(t) (2.1) (-3.2) (-1.4)
D.W. 1.5$

And using the nominal money supply

$R^2 = 11%
(t) (2.2) (-2.0)
D.W. 1.3$

$R^2 = 14%
(t) (1.9) (-2.4)
D.W. 1.4$

$R^2 = 14%
(t) (1.9) (-2.1) (-0.0)
D.W. 1.4$

$R^2 = 25%
(t) (3.4) (-2.8) (-0.8)
D.W. 1.6$

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 $R^2$ 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 ($r$).

$Y = \beta_1 T + \beta_2 G - \beta_4 r - \beta_5 r_2$

$= \beta_1 T + \beta_2 G - \beta_4 [\frac{M/P}{\alpha_2 + \alpha_1/\alpha_2} Y] - \beta_5 r_2$

$= \frac{1}{1+(\beta_4/\alpha_2)} \left[ \beta_1 T + \beta_2 G + \beta_4/\alpha_2 (M/P) - \beta_5 r_2 \right]$

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, and our 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. The tax variable coefficient in IS equation tests should be negative, but smaller in absolute value than predicted by traditional Keynesian theory; perhaps even positive. If crowd out more than completely offsets the stimulus, the tax variable will have a positive coefficient. For example, if the MPC is 0.80 the stimulus effect of a $1,000 tax cut should increase consumer spending by $800. However, if a bank buys the $1,000 bond issued to finance the tax cut, it reduces the money the bank would otherwise have available to lend to consumers for car or house loans, cutting private spending $1000, i.e., more than totally offset the stimulus effect of $800. In this example, the tax cut also appears to add $200 to available savings, hence reducing the crowd out problem from $1000 to $800, i.e., total but not more than total crowd out. However, this addition to savings is illusory. The net negative stimulus effect of $200, times the multiplier (1/1-MPC), reduces GDP $1000, reducing saving by $200, exactly offsetting the initial $200 saved out of the tax cut, and leaving the net stimulus effect negative.

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 that 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.

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 (β2) in all periods. Definitions for the variables used below are given in Section 4.0.

$$\Delta(C_D) = \beta_1 \Delta(Y-T) + \beta_2 \Delta(T-G) + \beta_4 \Delta PR_{0\cdot} + \beta_5 \Delta DJ_{0\cdot} + \beta_6 \Delta XR_{AV0123}$$

to one which tests for separate effects in recession (β2Rec) and non recession (β2Non-Rec) periods.
\[ \Delta(C_D)_0 = \beta_1 \Delta(Y-T)_0 + \beta_{2Rec} \Delta(T_{Rec} - G_{Rec}) + \beta_{2NonRec} \Delta(T_{Non-Rec} - G_{Non-Rec}) + \beta_4 \Delta PR_0 + \beta_5 \Delta DJ + \beta_6 \Delta XR_{AV0123} \]

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

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

To

\[ \Delta(C_D)_0 = \beta_1 \Delta(Y-T)_0 + (\beta_{2Rec} \Delta T_{Rec} + \beta_{3Rec} \Delta G_{Rec}) \Delta Y = \beta_{4Rec} + \beta_{5Rec} \Delta T + \beta_{6Rec} \Delta G + \beta_{7Rec} \Delta PR + \beta_{8Rec} \Delta XR_{AV0123} \]

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

\[ \Delta I_0 = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP + \beta_4 \Delta(T - G) - \beta_6 \Delta r_2 + \beta_7 \Delta DJ + \beta_8 \Delta PROF + \beta_9 \Delta XR_{AV0123} \]

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

\[ \Delta I_0 = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP + \beta_4 \Delta T + \beta_5 \Delta G + \beta_6 \Delta PR + \beta_7 \Delta DJ + \beta_8 \Delta PROF + \beta_9 \Delta XR_{AV0123} \]

The two-variable form of the investment function is

\[ \Delta I_0 = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP + \beta_4 \Delta T + \beta_5 \Delta G + \beta_6 \Delta PR + \beta_7 \Delta DJ + \beta_8 \Delta PROF + \beta_9 \Delta XR_{AV0123} \]

And is now specified as:

\[ \Delta I_0 = \beta_1 \Delta ACC + \beta_2 \Delta DEP + \beta_3 \Delta CAP + \beta_4 \Delta T + \beta_5 \Delta G + \beta_6 \Delta PR + \beta_7 \Delta DJ + \beta_8 \Delta PROF + \beta_9 \Delta XR_{AV0123} \]

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

\[ \Delta Y = \frac{1}{1 - \beta_{IC}} \left[ (\beta_{IC} + \beta_{2Rec} + \beta_{4Rec}) \Delta T + \beta_{1Y} \Delta(X-M) + \beta_{2Y} \Delta PR + \beta_{3Y} \Delta ACC \right. \]

\[ \left. + \beta_{4Y} \Delta DEP + \beta_{5Y} \Delta CAP + \beta_{6Y} \Delta r_2 + \beta_{7Y} \Delta DJ + \beta_{8Y} \Delta PROF + \beta_{9Y} \Delta XR_{AV0123} \right] \]

And in non-recession years

\[ \Delta Y = \frac{1}{1 - \beta_{IC}} \left[ (\beta_{IC} + \beta_{2NonRec} + \beta_{4NonRec}) \Delta T + (\beta_{1NonRec} + \beta_{2NonRec} + \beta_{3NonRec} + \beta_{4NonRec}) \Delta G + \beta_{1Y} \Delta(X-M) + \beta_{2Y} \Delta PR \right. \]

\[ \left. + \beta_{3Y} \Delta ACC + \beta_{4Y} \Delta DEP + \beta_{5Y} \Delta CAP + \beta_{6Y} \Delta r_2 + \beta_{7Y} \Delta DJ + \beta_{8Y} \Delta PROF + \beta_{9Y} \Delta XR_{AV0123} \right] \]

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 (\(\Delta T_{\text{Rec}}\)) and government spending (\(\Delta G_{\text{Rec}}\)) 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., \((\Delta T_{\text{Rec}}) = \Delta T^*(D_1 \text{ or } D_0)\). National Bureau of Economic Research estimates (NBER 2009) were used to define recession years. Similarly, for non-recession years, to obtain \((\Delta T_{\text{NonRec}})\) and \((\Delta G_{\text{NonRec}})\), the dummy variable is reversed.

The spending multiplier will be \(1/(1 - \beta_{it})\). 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: \(\Delta(T-G)_{\text{Rec}}\) and \(\Delta(T-G)_{\text{NonRec}}\). 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**

The no crowd out model and the (one variable) average crowd out model \(\Delta(T-G)\) 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:
**Consumption**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disposable Income $\Delta(Y-T)$</td>
<td>$\Delta C = 0.63\Delta(Y-T)$</td>
</tr>
<tr>
<td>Crowd Out (Deficit) $\Delta(T-G)$</td>
<td>$\Delta C = -2.75\Delta PR + 1.04 \Delta DJ - 2.95 \Delta XR_{AV} + 414.42\Delta POP - 0.00\Delta POP + 0.84\Delta ICC + 19.54\Delta M2_{AV}$</td>
</tr>
<tr>
<td>Real Prime Interest Rate $\Delta APR$</td>
<td>$\Delta C = 0.21\Delta Y - 1.95\Delta PR + 0.58 \Delta DJ - 2.32 \Delta XR_{AV} - 26.88\Delta POP + 0.05\Delta POP + 0.47\Delta ICC - 12.91\Delta M2_{AV}$</td>
</tr>
<tr>
<td>Wealth Measure ($\Delta DJ_{AV}$)</td>
<td>$\Delta C = 0.43\Delta(Y-T) - 0.22\Delta PR + 0.46 \Delta DJ + 0.63 \Delta XR_{AV} - 414.54\Delta POP + 0.006\Delta POP + 0.37\Delta ICC + 32.45\Delta M2_{AV}$</td>
</tr>
<tr>
<td>Average Exchange Rate ($\Delta XR_{AV}$)</td>
<td><strong>Investment</strong></td>
</tr>
<tr>
<td>Population Age Composition (Ratio of Young To Old: $\Delta POP_{16}$)</td>
<td>$\Delta I = 0.43\Delta ACC + 1.08\Delta DEP + 3.78\Delta CAP + 10.17\Delta r - 0.49 \Delta DJ - 0.39 \Delta PROF - 3.92 \Delta XR_{AV0123} + 0.00\Delta POP$</td>
</tr>
<tr>
<td>Population Size ($\Delta POP$)</td>
<td>$\Delta I = 0.07\Delta ACC + 0.25\Delta DEP + 1.58\Delta CAP + 0.90\Delta r + 0.42 \Delta DJ - 0.11 \Delta PROF - 0.63 \Delta XR_{AV0123} + 0.001\Delta POP$</td>
</tr>
<tr>
<td>Index of Consumer Confidence ($\Delta ICC_{1}$)</td>
<td>Accelerator: Change in GDP ($\Delta ACC$)</td>
</tr>
<tr>
<td>Average M2 Money Supply ($\Delta XR_{AV}$)</td>
<td>Depreciation ($\Delta DEP$)</td>
</tr>
</tbody>
</table>

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.

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**

$\Delta C = 0.63\Delta(Y-T) - 2.75\Delta PR + 1.04 \Delta DJ - 2.95 \Delta XR_{AV} - 414.42\Delta POP + 0.00\Delta POP + 0.84\Delta ICC + 19.54\Delta M2_{AV}$

$\Delta C = 0.21\Delta(Y-T) - 1.95\Delta PR + 0.58 \Delta DJ - 2.32 \Delta XR_{AV} - 26.88\Delta POP + 0.05\Delta POP + 0.47\Delta ICC - 12.91\Delta M2_{AV}$

$\Delta C = 0.43\Delta(Y-T) - 0.80\Delta PR + 0.46 \Delta DJ + 0.63 \Delta XR_{AV} - 414.54\Delta POP + 0.006\Delta POP + 0.37\Delta ICC + 32.45\Delta M2_{AV}$

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**

$\Delta I = 0.43\Delta ACC + 1.08\Delta DEP + 3.78\Delta CAP + 10.17\Delta r - 0.49 \Delta DJ - 0.39 \Delta PROF - 3.92 \Delta XR_{AV0123} + 0.00\Delta POP$

$\Delta I = 0.07\Delta ACC + 0.25\Delta DEP + 1.58\Delta CAP + 0.90\Delta r + 0.42 \Delta DJ - 0.11 \Delta PROF - 0.63 \Delta XR_{AV0123} + 0.001\Delta POP$
$\Delta l = .36\Delta ACC + .83\Delta DEP + 2.21\Delta CAP + 11.07\Delta r - .07\Delta DJ + .51\Delta PROF + 4.55\Delta XR_{AV0123} - .00\Delta POP \quad R^2=.75$

Where $l_T$, $l_M$ and $l_D$ 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 1 - Variable “Average” Crowd Out $\Delta(T-G)$**

$\Delta C_T = .50\Delta(Y-T_G) + .54\Delta(T-G) - 10.28\Delta PR + .59\Delta DJ + 4.32\Delta XR_{AV} - .360.95\Delta POP + .01\Delta POP + .55\Delta CC + .3034\Delta M_{AV}$

$R^2=96.2% \quad D.W. = 2.1$

$\Delta C_M = .14\Delta(Y-T_G) + .28\Delta(T-G) - 5.79\Delta PR + .35\Delta DJ + 3.02\Delta XR_{AV} + 14.14\Delta POP + .000\Delta POP + .32\Delta IC + .7141\Delta M_{AV}$

$R^2=88.0% \quad D.W. = 2.0$

$\Delta C_D = .36\Delta(Y-T_G) + .27\Delta(T-G) - 4.49\Delta PR + .24\Delta DJ + 1.30\Delta XR_{AV} - .375.09\Delta POP + .01\Delta POP + .23\Delta IC + .3775\Delta M_{AV}$

$R^2=86.0% \quad D.W. = 1.9$

**Investment Functions With 1 - Variable “Average” Crowd Out $\Delta(T-G)$**

$\Delta I_T = .60\Delta(Y-T_G) + .27\Delta ACC + .29\Delta DEP + .72\Delta CAP - .679\Delta r + .08\Delta DJ + .32\Delta PROF + 5.16\Delta XR_{AV0123} + .01\Delta POP \quad R^2=.91$

$\Delta I_M = .09\Delta(Y-T_G) + .04\Delta ACC + .12\Delta DEP + 1.10\Delta CAP + 1.43\Delta r + .35\Delta DJ + .13\Delta PROF + .43\Delta XR_{AV0123} + .003\Delta POP \quad R^2=.66$

$\Delta I_D = .51\Delta(Y-T_G) + .23\Delta ACC + .16\Delta DEP - .37\Delta CAP - .822\Delta r - .28\Delta DJ + .44\Delta PROF + 5.59\Delta XR_{AV0123} + .008\Delta POP \quad R^2=.90$

**Predicted IS Curve (No Crowd Out)**

$\Delta Y = -.75\Delta T + 1.75\Delta G + 1.75\Delta X - 1.40\Delta PR + .93\Delta DJ + 9.07\Delta XR_{AV0123} - 725.45 \Delta POP + .01\Delta POP + .65\Delta IC + 56.79\Delta M_2$

$\Delta PROF + .35\Delta PROF + 56.89\Delta M_2 + .36\Delta ACC + 1.45\Delta DEP + 3.67\Delta CAP + 19.37\Delta r + .89\Delta PROF$

**Predicted IS Curve (With 1-Variable Form of Average Crowd Out)**

$\Delta Y = .65\Delta T + .34\Delta G + 1.56\Delta X - 7.00\Delta PR - .06\Delta DJ + 10.75\Delta XR_{AV0123} - 858.15 \Delta POP + .03\Delta POP + .36\Delta IC + 58.89\Delta M_2$

$\Delta PROF + .36\Delta ACC + 2.5\Delta DEP - .58\Delta CAP - 12.82\Delta r + .69\Delta PROF$

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

$\Delta Y = .78\Delta T + .20\Delta G + .61\Delta X - 6.69\Delta PR + .30\Delta DJ + 4.38\Delta XR_{AV} + 505.70 \Delta POP + .05\Delta POP + 1.42\Delta IC + 45.43\Delta M_2$

$\Delta PROF + .58\Delta ACC + 1.6\Delta DEP + 7.97\Delta CAP + .04\Delta r + .21\Delta PROF \quad R^2=97.6%$

$\Delta PROF + .03\Delta PROF + .08 \quad D.W. = 2.3$

The predicted IS curve coefficients for these two models, as well as the actual regression estimates obtained testing the IS curve (which is the same model for the No and average crowd out hypotheses are summarized in Table 5 below:

Notice that

- Adding average crowd out to the domestic consumption model increases significantly our capacity to explain the 1960 - 2000 variation in consumer spending on domestically produced goods. Explained variance increases from 81.3% to 86.0%. For domestic investment, adding average crowd out increases explained variance markedly, from 75% to 90%, making it a major factor affecting consumer spending from year to year.

Heim (2010, Sec. 3.5), using similar models and the stepwise addition regression method, found
that crowd out explained more variance in consumption than any other variable tested, except for disposable income, and that crowd out explained more variance in investment than any other variable tested. The accelerator, found second most important, has historically been considered the most important determinant of investment (though past tests do not seem to have controlled for crowd out).

- Crowd out coefficients in the consumption or investment equations are statistically significant at better than the 1% level, except investment imports, which is significant at the 3% level.

- As predicted by crowd out theory, the government spending variable in the IS curve test has a smaller coefficient than the exports coefficient. If the no crowd out model was the more accurate the coefficients should have been the same.

- The tax variable result shows that if the government issues a bond to pay for a tax cut, and the bond is bought by a bank out of its available funds, the bank may then not loan an equivalent amount to consumers looking for house or car loans and/or businesses looking for investment loans. Hence, the crowd out effect of each $1 of tax cut deficit may be $1. However, the stimulus effect is less: (MPC)\(x\)($1 increase in disposable income), so the net effect of a deficit-inducing tax cut may be to depress the GDP by (1-MPC)\(x\)($1 increase in disposable income), which is what the crowd out theory predicts and very close to what the IS curve test results show.

- $1 government deficit spending, financed by government borrowing of $1 from a bank, may lead to the same initial crowd out effect of $1. But the initial stimulus effect is also $1. Hence, crowd out predicts a net $0 stimulus. This is what the actual IS curve results show (the coefficient on government spending is slightly less than zero, as predicted, but not significantly different from zero). The result is much closer to the actual result than the no crowd out model prediction.

- 10 of 15 actual IS coefficients obtained testing the IS hypothesis are better predicted by the average crowd out model than by the no crowd out model, including the coefficients for the key crowd out theory variables: taxes, government spending, and the size of the government spending coefficient relative to the export variable coefficient.

- The findings for both consumption and investment indicate the crowd out variable has a negative effect on consumer and investment spending throughout the 1960-2000 period. This represents the average effect for the all parts of the business cycle. In the next section we will test separately for effects in recessions and non-recessions.

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

<table>
<thead>
<tr>
<th>IS Model</th>
<th>TR</th>
<th>TNR</th>
<th>GR</th>
<th>GNR</th>
<th>XAV</th>
<th>PR</th>
<th>DJ</th>
<th>XR</th>
<th>POP</th>
<th>POP</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CO Predict.</td>
<td>-.75</td>
<td>-.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>-1.40</td>
<td>.93</td>
<td>9.07</td>
<td>-725.46</td>
<td>.01</td>
<td>.65</td>
</tr>
<tr>
<td>Aver. CO Pred.</td>
<td>.65</td>
<td>.65</td>
<td>.34</td>
<td>.34</td>
<td>1.56</td>
<td>-7.00</td>
<td>-.06</td>
<td>10.75</td>
<td>-585.14</td>
<td>.03</td>
<td>.36</td>
</tr>
<tr>
<td>Aver. CO Actual.</td>
<td>.78</td>
<td>.78</td>
<td>-.20</td>
<td>-.20</td>
<td>.61</td>
<td>-6.69</td>
<td>.30</td>
<td>4.37</td>
<td>505.70</td>
<td>.05</td>
<td>1.42</td>
</tr>
<tr>
<td>Best Predictor</td>
<td>AV</td>
<td>AV</td>
<td>AV</td>
<td>AV</td>
<td>AV</td>
<td>NO</td>
<td>AV</td>
<td>NO</td>
<td>AV</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>IS Model</td>
<td>M2AV</td>
<td>ACC</td>
<td>DEP</td>
<td>CAP</td>
<td>r</td>
<td>PROF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No CO Predict.</td>
<td>56.79</td>
<td>.63</td>
<td>1.45</td>
<td>3.87</td>
<td>-19.37</td>
<td>.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aver. CO Pred.</td>
<td>58.89</td>
<td>.36</td>
<td>.25</td>
<td>-.58</td>
<td>-12.82</td>
<td>.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aver. CO Actual.</td>
<td>45.43</td>
<td>.58</td>
<td>.16</td>
<td>7.97</td>
<td>.04</td>
<td>.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Predictor</td>
<td>NO</td>
<td>NO</td>
<td>AV</td>
<td>NO</td>
<td>AV</td>
<td>AV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

Average crowd out models explain substantial variance in consumption, investment and GDP that no-crowd out models leave unexplained. Deficits appear to crowd out private borrowing, negatively affecting consumption and investment. Crowd out induced by tax cuts may more than fully offset stimulus effects. Crowd out caused by government spending increases were predicted to only cause partial crowd out, but actual IS curve results indicated full crowd out.

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

The next tests examine single variable (T - G) crowd out models to see if effects are different in recession and non-recession periods. The consumption and investment models tested are the same as used in the previous section. Regression results for these models are as follows:

Consumption Functions With Separate Crowd Out Effects estimated For Recessions (T - G)_Rec and Non- Recessions (T - G)_NonRec:

\[
\Delta C_t = 50\Delta Y_{t-T0} + 51\Delta (T-G)_{Rec} + 59\Delta (T-G)_{NonRec}
\]

(l =) \((15.7)\) \((10.0)\) \((7.0)\)

\[
\Delta C_t = 14\Delta(Y_{t-T0}) + 31\Delta(T-G)_{Rec} + 24\Delta(T-G)_{NonRec}
\]

(l =) \((4.2)\) \((4.1)\) \((2.1)\)

\[
\Delta C_t = 36\Delta(Y_{t-T0}) + 20\Delta(T-G)_{Rec} + 35\Delta(T-G)_{NonRec}
\]

(l =) \((6.8)\) \((2.2)\) \((2.2)\)

Investment Functions With Separate Crowd Out Effects estimated For Recessions (T - G)_Rec and Non- Recessions (T - G)_NonRec:

\[
\Delta I_t = 5.7\Delta(T-G)_{Rec} + 6.5\Delta(T-G)_{NonRec} + 0.27\Delta C + 0.15\Delta DEP + 0.84\Delta CAP_{t-1} + 6.46\Delta r_{t-2} + 0.1\Delta DJ + 3.1\Delta PROF_{t-2} + 5.10\Delta XR_{AV(t+123)}
\]

(l =) \((6.3)\) \((3.5)\) \((8.1)\) \((0.5)\) \((0.6)\) \((-3.4)\) \((0.5)\) \((1.8)\) \((6.2)\)

\[
\Delta I_t = 0.07\Delta(T-G)_{Rec} + 0.13\Delta(T-G)_{NonRec} + 0.04\Delta C + 0.02\Delta DEP + 1.19\Delta CAP_{t-1} + 1.69\Delta r_{t-2} + 0.37\Delta DJ + 0.13\Delta PROF_{t-2} + 0.48\Delta XR_{AV(t+123)}
\]

(l =) \((1.4)\) \((2.1)\) \((1.6)\) \((0.1)\) \((1.4)\) \((1.0)\) \((3.7)\) \((-1.2)\) \((0.7)\)

\[
\Delta I_t = +0.50\Delta(T-G)_{Rec} + 0.52\Delta(T-G)_{NonRec} + 0.23\Delta C + 0.13\Delta DEP + 0.35\Delta CAP_{t-1} + 8.15\Delta r_{t-2} - 0.27\Delta DJ + 0.44\Delta PROF_{t-2} + 5.58\Delta XR_{AV(t+123)}
\]

(l =) \((8.3)\) \((3.5)\) \((9.0)\) \((0.5)\) \((-0.3)\) \((-7.0)\) \((-1.4)\) \((4.0)\) \((5.7)\)

Using the parameter estimates from the domestic consumption (C_D) and investment (I_D) equations above, the IS curve parameters are predicted to be:

Predicted IS Curve (With A Separate Crowd Out Variable (T-G) Included For Recessions/Non-recessions)

\[
\Delta Y_t = +0.53\Delta T_{Rec} + 0.80\Delta T_{NonRec} + 0.47\Delta G_{Rec} + 0.20\Delta G_{NonRec} + 1.56\Delta X - 6.35\Delta PR - 0.08\Delta DJ + 10.64\Delta XR_{AV(t+123)} - 640.10\Delta POP_{t-6} + 0.03\Delta POP + 20.0\Delta ICC + 62.43\Delta M2 + 36.0\Delta ACC + 0.20\Delta DEP - 0.55\Delta CAP_{t-1} - 12.71\Delta r_{t-2} + 0.69\Delta PROF_{t-2}
\]
Notice that

- The domestic consumption model explains more variance than the no crowd out model (86.4% vs 81.3%). This is slightly more (0.4%) than the increase resulting from using crowd out in its "average effect" form. For investment adding separate recession and non-recession variables to the no crowd out investment model increases explained variance from 75% to 90%, the same increase as adding average crowd.

- 7 of 12 crowd out variables for both recession and non-recession periods are statistically significant at the 1% level, 4 others at the 5% level or better in the consumption and investment equations. The last (imported investment goods in recessions) was insignificant. Overall, results strongly suggest crowd out has a negative effect in recessions as well as non-recession periods.

- Crowd out appears to have a different effect on consumption in recession and non-recession periods. For domestic consumption, the estimated reduction in private consumption per dollar of deficit is noticeably less in recessions ($0.20) than in non-recessions ($0.35). That said, the standard errors (0.09) allow for considerable overlap of the estimates within confidence intervals, suggesting the true parameters might even be the same for both periods. For domestic investment, the effect is about the same in recessions ($0.50), as in non-recession periods ($0.52). The plus sign on all the coefficients indicates crowd out adversely affects private spending in both recessions and non-recessions.

- Table 6 shows the R/NR model, better predicted nine of seventeen IS curve coefficients than the no crowd out model. The no crowd out model better predicted seven. One was a tie. The standard used for comparison was the actual regression results obtained testing an IS curve model with separate (T) and (G) variables for recession and non-recession periods.

- As shown in Table 7 below, the recession/non-recession model predicted 10 of 17 coefficients better than the no crowd out/average crowd out model when the standard for evaluation was the actual coefficients obtained testing a no-crowd out IS model. These results were the same to our earlier results testing average crowd out predictions (see Table 3). There, 10 of 15 actual IS curve coefficients were better predicted by the crowd out model than by the no crowd out model.

| ΔY = 0.87ΔT_{rec} + 0.60ΔT_{nonrec} - 0.65ΔG_{rec} - 0.23ΔG_{nonrec} + 0.63ΔX - 0.000ΔPR + 0.24ΔD_{j2} + 4.97ΔR_{av} + 445.43ΔPOP_{16} |
|---|---|---|---|---|---|---|---|---|
| (t) | (5.3) | (2.3) | (-1.1) | (-0.6) | (2.0) | (2.2) | (0.6) | (2.6) |
| | (+.05ΔPOP + 1.59ΔICC + 44.51ΔM2 + 59.8ΔACC + 68.4ΔEP + 8.36ΔCAP_{1} - 0.40ΔT_{j} + 22.4ΔPROF_{-2} R2=97.8% |
| | (5.6) | (3.5) | (2.3) | (10.4) | (0.7) | (2.3) | (-0.1) | (0.8) |
| | DW=2.5 |

Table 6 shows the R/NR model, better predicted nine of seventeen IS curve coefficients than the no crowd out model. The no crowd out model better predicted seven. One was a tie. The standard used for comparison was the actual regression results obtained testing an IS curve model with separate (T) and (G) variables for recession and non-recession periods.
predicted by traditional Keynesian “stimulus only” theory. Crowd out theory predicts complete crowd out for government spending, but not more than complete crowd out. Though our coefficients on the government spending variable are negative, suggesting more that complete crowd out, they are statistically insignificant, hence best interpreted as supporting total crowd out predicted by theory.

- Other coefficient estimates in the IS regression changed only slightly or not at all with the change to a two-variable specification (R/NR) of crowd out.

- The findings for the consumption and investment equations indicate crowd out has a statistically significant negative effect on domestic consumer and investment spending in both recession and non-recession periods. This is a hugely important finding, for it is often argued that even if crowd out exists, it is not a problem in recessions, when stimulus programs are needed most. For consumption the effects may be more pronounced in non-recessions, but may also be the same. For investment, no real difference was found between recession and non-recession effects.

- IS curve regression coefficients suggest substantially different recession and non-recession period effects (+0.87ΔT_{Rec} + 0.60ΔT_{NonRec} - 0.65ΔG_{Rec} - 0.23ΔG_{NonRec} ), with deficits causing a substantially worse crowd out problem in recession than non-recessions! Both the (T) and (G) coefficients suggest this result. The tax effects are moderately worse, government spending effects much worse. This may occur because savings fall faster than borrowing in recessions, necessitating a much larger cutback in credit based spending by both consumers and businesses than just that caused by crowd out. This decline would be coincidental with the crowd out effect, but not part of it. That said, though the point estimates indicate that for this sample on average there is a difference, these differences also cannot be considered different with any statistical certainty since the coefficients’ 5% confidence intervals for recessions contains the non-recession point estimate, and vice versa.

The IS curve regression does indicate tax and spending crowd out effects are real and fully or more than fully offset stimulus effects. Left for further testing is a repeat of these tests with an additional 10 or 20 years of data. This would probably tighten the confidence intervals, increasing our chances of determining unambiguously whether there are different sized effects in recession and non-recession periods. Additional data may also help resolve why predicted IS curve results indicate only partial crowd out for government spending, while actual IS curve tests point estimates show complete crowd out.

<table>
<thead>
<tr>
<th>IS Model</th>
<th>T8</th>
<th>TNR</th>
<th>Gr</th>
<th>GR</th>
<th>XAV</th>
<th>PR2</th>
<th>DJ2</th>
<th>XR</th>
<th>POP1.6</th>
<th>POP2</th>
<th>ICC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CO Predict.</td>
<td>-.75</td>
<td>-.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>-1.40</td>
<td>.93</td>
<td>9.07</td>
<td>-725.46</td>
<td>.01</td>
<td>.65</td>
</tr>
<tr>
<td>R/NR Predicted</td>
<td>.53</td>
<td>.80</td>
<td>.47</td>
<td>.20</td>
<td>1.56</td>
<td>-6.35</td>
<td>-.08</td>
<td>10.64</td>
<td>-640.10</td>
<td>.03</td>
<td>.20</td>
</tr>
<tr>
<td>R/NR Actual</td>
<td>.87</td>
<td>.60</td>
<td>.65</td>
<td>-.23</td>
<td>.63</td>
<td>-8.00</td>
<td>.24</td>
<td>4.97</td>
<td>445.42</td>
<td>.05</td>
<td>1.59</td>
</tr>
<tr>
<td>Better Predict. NO NO R/NR R/NR R/NR R/NR NO R/NR TIE NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>IS Model</th>
<th>M2AV</th>
<th>ACC</th>
<th>DEP</th>
<th>CAP2.3</th>
<th>r2</th>
<th>PROF2.2</th>
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<tr>
<td>No CO Predict.</td>
<td>56.79</td>
<td>.63</td>
<td>1.45</td>
<td>3.87</td>
<td>-19.37</td>
<td>.89</td>
</tr>
<tr>
<td>R/NR Predicted.</td>
<td>62.43</td>
<td>.36</td>
<td>.20</td>
<td>-.55</td>
<td>-12.71</td>
<td>.69</td>
</tr>
<tr>
<td>R/NR Actual</td>
<td>44.51</td>
<td>.59</td>
<td>.68</td>
<td>8.36</td>
<td>-.40</td>
<td>.21</td>
</tr>
<tr>
<td>Better Predict. NO NO R/NR NO R/NR R/NR</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Table 6
IS Curve Coefficients Predicted From No Crowd Out and Recession/Non-Recession (R/NR) Models Compared To Coefficients Obtained Testing R/NR Crowd Out IS Model
Table 7
IS Curve Coefficients Predicted From No Crowd Out and Recession/Non-Recession (R/NR) Models Compared To Coefficients Obtained Testing A No/A. Crowd Out IS Model

<table>
<thead>
<tr>
<th>IS Model</th>
<th>TR</th>
<th>TNR</th>
<th>GR</th>
<th>GNR</th>
<th>XAV</th>
<th>PR</th>
<th>DJ2</th>
<th>XR</th>
<th>POPL</th>
<th>POPO</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CO Predict.</td>
<td>-.75</td>
<td>-.75</td>
<td>1.75</td>
<td>1.75</td>
<td>1.75</td>
<td>-.14</td>
<td>-.40</td>
<td>.93</td>
<td>9.07</td>
<td>-725.46</td>
<td>.01</td>
</tr>
<tr>
<td>R/NR Predicted.</td>
<td>.53</td>
<td>.80</td>
<td>.47</td>
<td>.20</td>
<td>1.56</td>
<td>-.63</td>
<td>-.08</td>
<td>10.64</td>
<td>-640.10</td>
<td>.03</td>
<td>.20</td>
</tr>
<tr>
<td>No/Av CO Actual</td>
<td>.78</td>
<td>.78</td>
<td>-.20</td>
<td>-.20</td>
<td>.61</td>
<td>-.69</td>
<td>.30</td>
<td>4.37</td>
<td>505.70</td>
<td>.05</td>
<td>1.42</td>
</tr>
<tr>
<td>Better Predict.</td>
<td>NO</td>
<td>R/NR</td>
<td>R/NR</td>
<td>R/NR</td>
<td>R/NR</td>
<td>R/NR</td>
<td>NO</td>
<td>R/NR</td>
<td>TIE</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IS Model</th>
<th>M2AV</th>
<th>ACC</th>
<th>DEP</th>
<th>CAP</th>
<th>r</th>
<th>PROF</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CO Predict.</td>
<td>56.79</td>
<td>.63</td>
<td>1.45</td>
<td>3.87</td>
<td>-19.37</td>
<td>.89</td>
</tr>
<tr>
<td>R/NR Predicted.</td>
<td>62.43</td>
<td>.36</td>
<td>.20</td>
<td>-.55</td>
<td>-12.71</td>
<td>.69</td>
</tr>
<tr>
<td>No/Av CO Actual</td>
<td>45.43</td>
<td>.58</td>
<td>.16</td>
<td>7.97</td>
<td>-.04</td>
<td>.21</td>
</tr>
<tr>
<td>Better Predict.</td>
<td>NO</td>
<td>NO</td>
<td>R/NR</td>
<td>NO</td>
<td>R/NR</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions
Clearly, as was the case with “average” crowd out models in section 7.2.0.1, recession/non-recession (R/NR) crowd out models here explain substantial variance in consumption and investment that standard Keynesian stimulus models leave unexplained. The findings clearly suggest deficits have a negative effect on private consumption and investment. The findings also suggest that crowd out induced by tax cuts may be more devastating in its impact, more than fully offsetting stimulus effects, causing a net depressing economic effect.

By comparison, crowd out caused by government spending increases may partially (IS curve predictions) or completely (IS curve actual results) offset stimulus effects, but probably do not more than fully offset stimulus, as tax cuts seem to do. The investment and consumption results suggest the crowd out problem exists in recessions and non-recessions, having about the same effect on investment in both periods. The coefficients on consumption indicate less, but still substantial effects during recessions, than in non-recessions, but the confidence intervals on the consumption estimates are so wide as to make the finding of a difference less than certain.

The finding that crowd out is a significant problem in both recession and non-recession periods is a hugely important finding. It is often asserted in the popular press that even if crowd out exists in normal times, in recessions, when stimulus is most likely to be used, it is not a factor. This is based on the theory that, people and businesses borrow less in recessions, leaving savings available to finance. However, this assertion is hard to reconcile with the results shown above. Crowd out may occur in recessions because reductions in savings are as great as reductions in desired borrowing, leaving any new deficit creating the same crowd out problem as in non-recession economic times. Worse, savings may decline more than desired borrowing in recessions. If so, total spending possible out of savings would decline more than just crowd out effects would suggest, creating a coincidence that gives the appearance of greater than total crowd out, creating the appearance of worse crowd out effects in recessions than not recessions when in fact they are the same.

The IS equation’s crowd out coefficients indicate both tax cuts and government spending had larger crowd out effects in recessions than non-recessions, but here again, the confidence intervals on these coefficients were large enough to indicate we cannot say with great certainty there is a difference. We can say with more certainty that crowd out appears to more than fully offset all tax stimulus, but only fully offset government spending stimulus in both periods.
7.2.3. CROWD OUT COMPARISONS: “AVERAGE” VERSUS "RECESSION/NO RECESSION" MODELS

Both average and R/NR crowd out models explain more variance than no-crowd out models, and are better at predicting actual IS curve parameters. Is one of the two markedly better than the other?

Two sets of consumption and investment regressions, and the IS curve predictions are used for the comparison. One set contain a single deficit variable (T-G), taken directly from Section 7.2.0.1., the other two (T-G) variables, one for recessions, one for non-recessions, taken directly from Section 7.2.0.2. IS curve coefficient predictions from each of these sets of consumption and investment equations will be evaluated by comparing how closely they predict actual IS curve coefficients.

Which actual IS curve results should be used as the standard for evaluating predictions? The ones obtained testing the average crowd out (one set of T, G coefficients), or the ones obtained testing the recession/no-recession version (two sets of T, G coefficients)? Will we skew evaluations if we use one versus the other? We deal with this by evaluating each prediction against both sets of actual regression results, to see if using one “actual” vs. the other leads to markedly different results as to which system predicts best. The predictions and actual regression results are given below:

IS Curve Predictions (Repeated From Section 7.2.1.&2.):

Predicted IS Curve (With 1-Variable Average Crowd Out)

\[ \Delta Y = 0.85 \Delta T + 0.34 \Delta G + 1.56 \Delta X - 7.00 \Delta PR - 0.06 \Delta DJ + 10.75 \Delta M2 + (NA) \Delta HSE - 658.14 \Delta POP + 0.03 \Delta POP + 0.36 \Delta ICC + 58.89 \Delta M2 + 0.36 \Delta ICC + 0.25 \Delta DEP + 0.58 \Delta CAP - 12.82 \Delta r + 0.69 \Delta PROF \]

Predicted IS Curve (With A Separate Crowd Out Variable (T-G) Included For Recession/Non-recessions)

\[ \Delta Y = 0.53 \Delta T_{r} + 0.80 \Delta T_{nr} + 0.47 \Delta G_{r} + 0.20 \Delta G_{nr} + 1.56 \Delta X - 6.35 \Delta PR - 0.08 \Delta DJ + 10.64 \Delta M2 + (NA) \Delta HSE - 640.10 \Delta POP + 0.03 \Delta POP + 0.36 \Delta ICC + 62.43 \Delta M2 + 0.36 \Delta ICC + 0.20 \Delta DEP - 0.55 \Delta CAP - 12.71 \Delta r + 0.69 \Delta PROF \]

Actual IS Curve Test Results (From Sections 7.2.1.&2.):

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

\[ \Delta Y = 0.78 \Delta T + 0.20 \Delta G + 0.61 \Delta X - 6.89 \Delta PR + 0.30 \Delta DJ + 4.38 \Delta AV + 505.70 \Delta POP + 0.05 \Delta POP + 0.42 \Delta ICC + 45.43 \Delta M2 \]

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

\[ + 0.58 \Delta ICC + 0.16 \Delta DEP + 0.97 \Delta CAP + 0.3 \Delta PROF \] R2=97.6% (10.0) (0.3) (2.2) (0.0) (0.8) DW=2.3

Actual Test Results (With Separate T And G Variables For Recession/Non-recessions)

\[ \Delta Y = 0.78 \Delta T_{r} + 0.60 \Delta T_{nr} - 0.65 \Delta G_{r} + 0.23 \Delta G_{nr} + 0.63 \Delta X - 8.00 \Delta PR + 0.24 \Delta DJ + 4.38 \Delta AV + 445.43 \Delta POP \]

\[ (t) = (5.3) (2.3) (-1.1) (-0.6) (2.0) (2.2) (0.6) (2.6) (1.3) \]

\[ + 0.05 \Delta POP + 1.59 \Delta ICC + 44.51 \Delta M2 + 0.59 \Delta ICC + 0.83 \Delta DEP + 0.36 \Delta CAP + 0.18 \Delta PROF \] R2=97.8% (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 estimates obtained for both models are summarized in Tables 8 and 9 below:

### Table 8

IS CURVE COEFFICIENTS PREDICTED FROM AVERAGE AND RECESSION/NON RECESSION MODELS COMPARED TO ACTUAL COEFFICIENTS OBTAINED TESTING A RECESSION/NON RECESSION IS MODEL
In Table 8, the average crowd out model better predicted actual IS curve coefficients obtained from testing the R/NR model. The average crowd out model better predicted 8 of 17 coefficients. The R/NR better predicted 5, and 4 were a tie. Generally speaking, both sets of predicted values were close together, so small differences significantly affected the overall “batting average”. In most cases the differences between either of the predicted values and the actual were far greater than between the two predicted values themselves, suggesting a general equivalence of the two models for predicting empirical reality. The exceptions were the crowd out variables, where the R/NR actual results were better predicted 3 of 4 times by the R/NR predictions.

In Table 9, the R/NR crowd out model slightly out-predicted the average model, in predicting average model actual coefficients. The R/NR crowd out model better predicted seven of the 17 actual IS coefficients, the average model six, and four were a tie. However, the same point made about Table 8 results holds here: generally, the predictions from both models were very close together, and the actual result substantially further away from either prediction than the predictions were from each other.
Hence, Tables 9 indicate the average crowd out model was a better predictor of actual regression coefficients for the R/NR model. However, the R/NR model predicted average model coefficients slightly better! This was an unexpected mix of results, and since both sets of results were close, may primarily indicate that separating the two components of the deficit adds little to our total information. (R^2 only increased from 97.6% to 97.8% using the R/NR actual IS model, which adds two additional variables) Any additional information obtained may have been (more than?) offset by the effects of the change in multicollinearity resulting from adding two more variables, since coefficient estimates are a function of the level of multicollinearity between variables, and these levels changed when adding different crowd out variables in the R/NR model.

Conclusions
When testing the one variable (T-G) formulation of crowd out

- Predictions from the average crowd out model predict IS curve coefficients a better (8 to 5) than does the R/NR model when the predictions were measured against the actual R/NR crowd out results, but the R/NR model predicted slightly better (7 to 6) when compared to actual average crowd out model results. When asking whether average or R/NR predicts better, the best answer may be that they are about the same.

- As shown below, the tax coefficients for the R/NR models do not vary a lot from the average coefficient, and though there is more variation for the government spending variable, both the R/NR and average spending coefficients are not significantly different from zero. In that sense, results for the government spending variable are also the same. Also, the statistical significance of the average crowd out coefficient is about the same for the government spending variable and a bit higher than for the tax variable than for the recession/no recession coefficients.

<table>
<thead>
<tr>
<th>TABLE 10 IS CURVE COEFFICIENTS FOR CROWD OUT VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average: ΔY = +0.78ΔT - 0.20ΔG</td>
</tr>
<tr>
<td>R/NR: ΔY = +0.87ΔTRec + 0.60ΔTNonRec - 0.65ΔGRec - 0.23ΔGNonRec</td>
</tr>
</tbody>
</table>

- Virtually no additional variance is explained by adding R/NR crowd out instead of just average crowd out in the consumption and investment equations. Average crowd out adds 4.7% to explained variance in the no crowd out consumption model, 5.3% with R/NR. Both models add 15% to explained variance in the investment equation. Using R/NR instead of average crowd out in the IS equation only adds virtually nothing (0.2%) to explained variance. It is hard not to conclude that average crowd out explains crowd out virtually as well as recession/non-recession models. This implies the crowding out problem is as essentially as real in recessions and non-recession periods, and of roughly the same magnitude.

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 $0.\text{X} \Delta C B \Delta I$ following results: The same functions, with borrowing substituted for spending, are repeated to allow easy comparison with functions estimating the effects of these same determinants on consumer and business borrowing. Though consumers and businesses borrow money because they intend to spend it, not all variables that influence spending necessarily influence borrowing, and vice versa. However, we expect to find at least some of the key determinants of spending are also key determinants of borrowing.

This issue was tested (Heim 2011) on a simpler model which did not allow for 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 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).

8.1. TESTS OF BORROWING SENSITIVITY TO AVERAGE CROWD OUT

Repeated from Section 7.2.1 are regression results for models of consumer and business spending that include estimates of crowd out’s average effect on spending over the course of the business cycle. They are repeated to allow easy comparison with functions estimating the effects of these same determinants on consumer and business borrowing. Though consumers and businesses borrow money because they intend to spend it, not all variables that influence spending necessarily influence borrowing, and vice versa. However, we expect to find at least some of the key determinants of spending are also key determinants of borrowing.

Total Investment Spending Function With 1 - Variable “Average” Crowd Out
\[
\Delta I = -0.60 \Delta(T-G) + 0.27 \Delta\text{ACC} + 0.29 \Delta\text{DEP} + 0.72 \Delta\text{CAP} + 6.79 \Delta r_2 + 0.08 \Delta DJ + 0.32 \Delta\text{PROF} - 5.16 \Delta X R_{AV}^{G} + 0.01 \Delta\text{POP} \\
R^2 = 0.91 \\
(\text{DW} = 2.5)
\]

Total Consumption Spending Function With 1 - Variable “Average” Crowd Out
\[
\Delta C = 0.50 \Delta(Y-T_G) + 0.54 \Delta (T-G) - 10.24 \Delta\text{PR} + 0.59 \Delta DJ + 4.32 \Delta X R_{AV} + 360.95 \Delta POP + 0.07 \Delta POP + 0.55 \Delta ICC + 30.34 \Delta M_{2av} \\
(\text{DW} = 2.1)
\]

The same functions, with borrowing substituted for spending as the dependent variable, yielded the following results:

Total Investment Borrowing Function (\textit{\Delta}lb) With 1 - Variable “Average” Crowd Out
\[
\Delta lb = 0.48 \Delta(T-G) + 0.09 \Delta\text{ACC} + 1.43 \Delta\text{DEP} - 0.59 \Delta\text{CAP} + 13.64 \Delta r_2 - 1.10 \Delta DJ + 0.56 \Delta\text{PROF} - 12.39 \Delta X R_{AV}^{G} + 0.06 \Delta\text{POP} \\
R^2 = 0.91 \\
(\text{DW} = 1.9)
\]

Total Consumption Borrowing Function (\textit{\Delta}Cb) With 1 - Variable “Average” Crowd Out
\[
\Delta cb = 0.39 \Delta(Y-T_G) + 0.42 \Delta(T-G) - 9.28 \Delta\text{PR} - 0.91 \Delta DJ + 7.89 \Delta X R_{AV} + 223.05 \Delta POP - 0.02 \Delta POP + 8.88 \Delta ICC + 11.55 \Delta M_{2av} \\
(\text{DW} = 1.7)
\]

The total estimated drop in consumer and business borrowing per dollar of tax cut induced deficit is $0.90, compared to the estimated spending drop of $1.14. The confidence intervals around the borrowing estimates, is calculated from the estimated standard error of the total borrowing estimate.
(.90): \( \text{v(Var .48 + Var .42)} = .30 \). The 5% level confidence intervals (+.30 to +1.50) around the point estimate 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 and business borrowing is almost as large as the drop in spending, and 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. TESTS OF BORROWING SENSITIVITY TO RECESSION/NON-RECESSION CROWD OUT

Repeated from Section 7.2.2 are regression results for models 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. Though consumers and businesses borrow money because they intend to spend it, not all variables that influence spending necessarily influence borrowing, and vice versa. However, we expect to find at least some of the key determinants of spending are also key determinants of borrowing.

Total Investment Spending Function With 1 - Variable Recession/Non-Recession Crowd Out
\[
\Delta I_t = +.57 \Delta(T-G)_{\text{Rec}} + .65 \Delta(T-G)_{\text{NonRec}} + .27 \Delta CC + .15 \Delta EP + .84 \Delta CAP_{-1} - .46 \Delta DJ_{2} + .10 \Delta DJ_{3} + .31 \Delta PROF_{-2} + 5.10 \Delta XR_{AV_{0123}}
\]
\( t = \) (6.3) (3.5) (8.1) (0.5) (0.6) (-3.4) (0.5) (1.8) (6.2) + .01 \Delta POP \quad R^2 = .907 \quad (3.9) \quad DW = 2.6

Total Consumption Spending Function With 1 - Variable Recession/Non-Recession Crowd Out
\[
\Delta C_t = .50 \Delta(Y-T)_{0} + .51 \Delta(T-G)_{\text{Rec}} + .59 \Delta(T-G)_{\text{NonRec}} - 10.06 \Delta PR + .58 \Delta DJ_{2} + 4.29 \Delta XR_{AV} - 379.52 \Delta POP_{-1} + .01 \Delta POP
\]
\( t = \) (15.7) (10.0) (7.0) (-5.9) (3.5) (5.5) (-2.0) (4.3) + .50 \Delta ICC + 31.54 \Delta M_{2AV} \quad R^2 = .963\%
\( (1.9) \quad (4.4) \quad D.W. = 2.2 \)

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

Total Investment Borrowing Function With 1 - Variable Recession/Non-Recession Crowd Out
\[
\Delta \beta_{t} = +.13 \Delta(T-G)_{\text{Rec}} + .99 \Delta(T-G)_{\text{NonRec}} + .09 \Delta CC - .02 \Delta EP + .65 \Delta CAP_{-1} - 10.08 \Delta DR_{2} - .89 \Delta DJ_{2} + .51 \Delta PROF_{-2} + 11.80 \Delta XR_{AV_{0123}}
\]
\( t = \) (0.5) (3.3) (0.9) (-0.0) (0.2) (-2.0) (-1.8) (1.4) (4.5) + .00 \Delta POP \quad R^2 = .615 \quad (0.0) \quad D.W = 2.0

Total Consumption Borrowing Function With 1 - Variable Recession/Non-Recession Crowd Out
\[
\Delta \beta_{t} = .41 \Delta(Y-T)_{0} + .59 \Delta(T-G)_{\text{Rec}} + .19 \Delta(T-G)_{\text{NonRec}} - 10.44 \Delta PR - .85 \Delta DJ_{2} + 8.05 \Delta XR_{AV} + 320.12 \Delta POP_{-1} + .01 \Delta POP
\]
\( t = \) (4.4) (2.5) (0.8) (-2.0) (-2.6) (5.3) (0.6) (-2.5) + 1.16 \Delta ICC + 5.27.54 \Delta M_{2AV} \quad R^2 = .651\%
\( (1.4) \quad (0.2) \quad D.W = 1.8 \)

In recessions, the estimated total effect on spending of deficits, per dollar of deficit, is $-1.08; the estimated effect on total borrowing is $-0.72. Confidence intervals around this borrowing estimate do not allow us to reject the hypothesis that spending and borrowing effects are equal. In non-recessions point estimates themselves for spending and borrowing effects are nearly identical: $-1.24 for spending, $-1.18 for borrowing.

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 is either strikingly coincidental, or 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 the best science possible to bear on the issue of whether crowd out exists, how much and when. To do so, we have explicitly controlled extensively for other variables (or reasonable proxies for them) that might affect consumption, investment and GDP.

The test results indicate crowd out affects the economy in the way 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 effect on the economy.
- Crowd out more than completely offsets stimulus effects of tax cut deficits, resulting in the tax cut having a net negative effect on the economy.
- 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. This study’s tests find crowd out is a significant problem in both periods, and has about the same effect in recessions as non recession periods. This may be because though private demand for loans may drop in recessions, savings may drop as much, leaving only enough to cover reduced private borrowing needs. Therefore any new borrowing by government to finance a deficit will have crowd out effects in recessions, much as it would in normal economic times.

Specific results by section:

Section 4.1: Adding crowd out variables to a well specified consumption function adds a minimum of 4.7% to explained variance in consumption; to investment adds a minimum of 16%. Hence, empirically, it is hard to argue crowd out is not a factor affecting private spending.

Section 7.2.1: One Variable Average Crowd Out Compared To No Crowd Out

- Adds 4.7% to explained variance for domestically produced consumer goods and services, increasing explained variance from 81.3% to 86.0%; Adds15% to explained variance for investment, raising it from 75% to 90%
- 5 of 6 crowd out variables in consumption and investment models significant at 1% level, one at 3% level.
- 10 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 regression results indicate crowd out associated with government spending deficits completely offsets stimulus effects (coefficient on government spending effects not significantly different from zero), leaving no net stimulus effect. The results indicate more than complete crowd out associated with tax cut deficits (coefficient on tax effects is positive and highly statistically significant), therefore the net stimulus effect is negative:
  \[ \Delta Y = +.78 \Delta T - .20 \Delta G + \ldots \]
  \( (t=) \ (6.0) \ (-0.6) \)

Section 7.2.2: Separate One Variable Crowd Out Parameters For Recessions and Non-Recessions, Compared To No Crowd Out

- Adds 5.1% to explained variance for domestically produced consumer goods and services, increasing explained variance from 81.3% to 86.4%; Adds15% to explained variance for investment, raising it from 75% to 90%
- 11 of 12 crowd out variables in consumption and investment models significant at 5% level or better.
• Consumption function regression coefficients on crowd out variable suggests crowd out less a problem in recessions than non recessions, but each estimate is well within the confidence intervals around the other, suggesting they may be the same.
• Investment function coefficients suggest crowd out effects are the same in recessions and non-recessions.
• 9 - 10 of 17 IS curve variables better predicted by crowd out model than no crowd out model.
• Complete crowd out associated with government spending deficits, leaving no net stimulus effect; more than complete crowd out associated with tax cut deficits, net stimulus effect is negative.
• Actual IS curve Point estimates suggest crowd out somewhat worse in recessions, but confidence intervals around the estimates suggest real effect may be the same.

\[ \Delta Y = +.87 \Delta T_{Rec} + .60 \Delta T_{NonRec} - .65 \Delta G_{Rec} - .23 \Delta G_{NonRec} + \ldots \]

(5.3) (2.3) (-1.1) (-0.6)

Section 7.2.3: Predictive Ability: One Variable Average Crowd Out Models Compared To R/NR Models

• Actual IS curves test results for average and R/NR crowd out show complete crowd out associated with government spending deficits, leaving no net stimulus effect from the spending, and more than complete crowd out associated with tax cut deficits, leaving a net negative stimulus effect (results reported for the same curves in Sections 7.2.1 and 7.2.2)
• Predicted IS curves for average and R/NR crowd out show partial crowd out associated with government spending deficits, leaving some positive net stimulus effect, and more than complete crowd out associated with tax cut deficits, net stimulus effect is negative (as reported for the same curves in Sections 7.2.1 and 7.2.2).
• Comparing actual results from an average crowd out IS curve regression to predictions, average crowd out better predicted actual coefficients for 6 of 17 variables, R/NR predicted 7 better, 4 were tied.
• Comparing actual results from an R/NR crowd out IS curve regression to predictions, average crowd out better predicted actual coefficients for 8 of 17 variables, R/NR predicted 5 better, 4 were tied.

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.

Section 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
- some 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.

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