THE IMPACT OF ECONOMIC STIMULUS TARGETED TO INCOME GROUPS:

A MODIFICATION OF THE FAIR MODEL

by

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ABSTRACT

The most effective way of stimulating the economy, with the goal of accelerating the recovery from a recession, is the subject of much debate. In this thesis, I modify a macro-economic model developed by Ray Fair. My modifications allow the model to forecast how economic stimulus in the form of transfer payments to households will impact the economy if the stimulus payments are targeted at low, middle, or high income households. The model predicts that stimulus targeted at low income households will result in a faster decrease in the unemployment rate and a higher GDP growth rate than economic stimulus targeted at middle and high income households.

Chapter 1

INTRODUCTION

1.1 Economic Stimulus Aimed at Income Cohorts

As a result of the recent recession, lots of debate surrounds the topic of economic stimulus, how effective it is, and how stimulus can best be structured. Many economists have used models to predict the impact stimulus will have on economic growth, but there is widespread disagreement about how much stimulus is optimal, and about where it should be spent.

A common way of assessing the impact of stimulus is through large macroeconomic models, of the type originally developed by Lawrence Klein in the 1960s. Many government agencies as well as private research firms now have their own version of such models.

1.2 Macroeconomic Models

Large scale macroeconomic models consist of multiple simultaneous equations, sometimes numbering in the hundreds. Each equation is estimated, using econometric techniques, over the period from 1952 to the first quarter of 2010. Then, the model is solved over the forecast time period, the second quarter of 2010 through 2010. Since the equations are simultaneously run, the same variable will be exogenous in one equation, and endogenous in another. Typically, only one variable, frequently

population projections, is purely exogenous throughout the entire model. Thus, a shift in one variable will filter through the rest of the model. A forecast is generated using the estimated equations. These models can be used to evaluate the impact various policy programs by overwriting the variables directly impacted by the program, and then seeing how the altered data impacts the model's forecast. Examples of these models include the Moody's Economy.com model, developed by Mark Zandi, and the Fair Model, developed by Ray Fair, the Wharton Econometrics Model, and some models developed by the Federal Reserve.

1.3 Overview

In this paper I modify the Fair model to assess the impact of economic stimulus in the form of transfer payments that are targeted to low, medium, or high income households. The resulting model shows how the differing marginal propensities to consume of each of these groups causes economic stimulus targeted to the low income cohort to be the most effective at increasing GDP.

This paper is organized as follows: In Chapter 2, I review the related literature. In Chapter 3, I show my methodology for creating the income groupings, assuming marginal propensities to consume, and modifying the consumption equations. In Chapter 4, I use my model to generate forecasts for when economic stimulus is targeted at each respective income group. In Chapter 5, I summarize the paper.

Chapter 2

LITERATURE REVIEW

2.1 Studies that Analyze Stimulus Efficacy

In the wake of the financial crisis, and the government's varying efforts to restore economic activity, there have been a wide variety of studies assessing what forms of stimulus are most effective, as well as how much impact economic stimulus will have on the economy as a whole. Since most studies either look at the impact of the entire stimulus bill, using a very broad measure of stimulus, or estimate multipliers for very specific subsets of the stimulus plan, the results of most of these studies are not directly comparable. I outline a few of these below. My thesis is an attempt to combine these two approaches, by loosely differentiating different types of stimulus in a large macroeconomic model.

2.2 Macroeconomic Models

Econometrically estimated macroeconomic models are one way of assessing fiscal stimulus. Creating a system of simultaneous equations allows the impacts of a policy change on all sectors of the economy to be forecasted, when the relevant change is added to the model.

2.2.1 Fair's Model

Ray Fair's produced a study of the estimated economic impacts of the 2009 stimulus bill. He used the Fair Multi Country Model, which is comprised of the Fair U.S. model, combined with an additional global model, that allows trade linkages to be built in. The model is estimated using two-stage least squares. Two-stage least squares allows the estimated equations to be consistent, even when the independent variables are correlated with the error term.

For the purposes of his model, Fair broke the stimulus bill into two categories: government purchases of goods and transfers to households. So, tax cuts as well as money given to states were put into the transfers to households category, since they result in dollars going into the hands of consumers. The stimulus dollars were put into the model using a CBO estimate of when the money was going to enter the economy; this was spaced out between 2009 and 2012. His analysis provides a broad measure of the impact of economic stimulus; however, since Fair does not build equations into his model for specific types of stimulus, his analysis cannot be used to evaluate the efficacy of one form of government economic stimulus over another.

Fair found that the economic impact (on GDP) of government purchases was higher than for transfer payments. The peak multiplier for goods purchases was 1.94, in the fourth quarter of 2009, and the peak multiplier for transfer payments was 1.08, in the first quarter of 2010.

2.2.2 Zandi's Model

Mark Zandi, a former student of Klein, published an analysis of the Obama stimulus package, using the Moody's Economy.com model which he developed. He forecasted the overall economic impact of the stimulus on GDP, as well as calculated the multiplier effect for the various forms of stimulus included in the bill.

2.3 Multiplier Based Studies

Another way of assessing stimulus is developing individual stand-alone equations for the stimulus measures, and then applying multipliers derived from econometric estimates and input-output analysis. This method, however, cannot account for every way in which economic stimulus may filter through the economy.

2.3.1 Congressional Budget Office Study

The CBO's analysis analyzed the impacts of various forms of stimulus, rather than the overall impact of the entire stimulus bill. The CBO methodology involved first measuring the output gap between actual and potential GDP, measuring how much the output gap would be changed by the economic stimulus, and then finally estimating how firms would react to the stimulus. Also in contrast to Fair and Zandi methods, the CBO published ranges of multipliers for each variable, instead of one specific estimate. This makes it impossible to directly compare the results of the studies.

While Fair looked at economic impacts broken down by quarter, the CBO measured the cumulative effects of GDP, with dollars of benefit per cost. Its estimated multipliers range between 0.10-0.4, for reducing income taxes in 2011, to 0.7-1.9, for increasing aid to the unemployed.

A CBO study also estimated a multiplier for the tax cuts direct at different income groups in the American Recovery and Reinvestment act of 2009. It found a multiplier of 1.7 when one-year tax cuts are directed at lower and middle income people, and a lower multiplier of 0.5 for one-year tax cuts for higher income people. (Auerbach, Gale, & Harris, 2010)

The closest comparison to Fair's analysis of government purchases is the CBO's measure of investing in infrastructure. While Fair found government purchases to be a more effective stimulus than transferring income to households, the CBO's analysis is more nuanced. The CBO found that infrastructure investments (impact range of 0.5-1.2) were a less effective form of stimulus than increasing aid to the unemployed, but infrastructure was estimated as more effective than reducing employee payroll taxes, providing additional social security payments, and providing refundable tax credits. This is because unemployed people are likely to spend most of each additional dollar they receive, while a substantial portion of transfer payments given to a broader selection of households would not be spent immediately.

2.3.2 Romer and Bernstein

Similarly to the CBO analysis, Romer and Bernstein's analysis of the stimulus bill also used multipliers culled from other models; in this case, they averaged the multipliers from the Federal Reserve's FRB/US model and those from the private firm, Macroeconomic Advisors. They then estimated the impacts of the stimulus bill on GDP and employment by applying these multipliers. Their study was both earlier and simpler than the other papers mentioned in this thesis; they only used two multipliers: one for increases in government spending, and one for tax cuts. They then made some rather large assumptions, lowering the multiplier impact for federal stimulus transfers to states, because a portion of the money given to states will be put into rainy day funds, rather than immediately spent.

Like the other studies, Romer and Bernstein's multipliers were roughly 50% larger for government purchases than for tax cuts. The multipliers also grew over time; this is due to lags built into the model.

2.4. IMF Comparison of Fiscal Stimulus Models.

Given the varying approaches to measuring the impact of stimulus money, it can be difficult to decide which model and approach to use. In March 2010, the IMF published a study evaluating the various forms of economic models used to measure the impact of stimulus. Overall, the IMF's findings were somewhat heartening, given the known problems with economic models.

It found that while each model produced a (generally slightly) different multiplier, most of the multipliers were within a similar range. Also, different modeling methods tended to agree that the most effective form of stimulus is direct government investment, followed by transfer payments to households groups that have a high marginal propensity to consume.

According to the IMF, one problem of econometrically estimated models, such as Fair and Zandi's is that they are designed to look at the impact of economic stimulus during normal economic conditions. Thus, during periods of economic crisis, their estimated equations are not always relevant. In particular, the IMF analysis indentified four problems with these models:

> *"First, the amount of available identifying information is often very small, making estmation results subject to considerable uncertainty. Second, there are many possibilities for omitted variable bias and reverse causation (most notably the two-way linkages between economic activity and fiscal balances), which reduce confidence in the results. Third, the amount of identifying information is far too small to allow us to say very much about issues like the interaction between monetary and fiscal policies, the distinction between different types of fiscal instruments, the distinction between automatic stabilizers and discretionary stimulus, leakages into imports, the effects of government financing constrains due to insufficient 'fiscal space', and other forces*

that cause variations in multipliers…. Fourth and finally, the existing empirical literature has not typically accounted for the fact that many fiscal actions are known prior to their implementation, and the work of Leper, Walker and Yang (2009) shoes that econometric analyses that fail to take this into account can produce distorted results about the effects of fiscal stimulus" (IMF 2010, p. 9)

Despite these problems, I have gone ahead and used an empirical econometric model for my analysis in this paper. The results do need to be viewed with caution, given the potential distortions enumerated above.

The IMF study focused much of its attention on structural models, such as DSGE models, which attempt to predict the rational choices of households, and then sum up the resulting impacts of all of their actions. For the purposes of evaluating fiscal stimulus, the IMF analysis favors the structural models. However, they too have problems, and there is a good bit of disagreement about how exactly they should be calibrated. (IMF 2010)

In comparing different model's measures of the impact of stimulus money sent towards direct government spending versus transfer payments to households, the IMF study noticed that the models that assumed a higher percentage of poor households produced larger multipliers for transfer payments than did the models that assumed a larger middle and upper class population. This finding, which is a direct result of the

higher marginal propensity to consume of lower income people, is very relevant to my analysis using Fair's model. The IMF uses this to emphasize the importance of transfer payments being targeted to low income households, where it will have the largest effect on the economy.

Chapter 3

ESTIMATING THE IMPACT OF STIMULUS GEARED TOWARDS LOW, MEDIUM AND HIGH INCOME COHORTS

3.1. The Base Model

Of the large econometrically estimated macro-models, the Fair Model is by far the most accessible, because it is posted online and the underlying equations are available to be downloaded in E-Views. Unlike most commercial models, the Fair model is not add-factored[1]; thus the forecasts depend entirely on the estimated equations. While this means that the model will not factor in current events that have not yet shown up in the data, it also makes the process creating forecasts transparent. This makes the model particularly well suited for academic style experiments.

The Fair Model consists of 30 simultaneous equations, estimated using two-stage least squares, and 161 identities. Two-stage least squares is used because in the simultaneous equations, some of the right hand side variables are actually endogenous in other equations. This creates a number of problematic-variables that need to be worked around by using instrumental variables – hence the two-stage least squares estimation technique.

[1] A common practice where economists over-write the econometrically estimated forecast, in order to factor in economic events that are not reflected in the data, or simply to make the forecast line up with their own personal hunches

3.2. The Dataset.

Fair's model is estimated using quarterly data, from publically available, federal government sources. All of the time series in the model, from 1952 up through the second quarter of 2010, are actual reported data. The forecast period begins in the third quarter of 2010, and continues through the fourth quarter of 2020.

3.3 The Experiment.

For this project, I modified Fair's basic model in order to compare stimulus geared towards low, medium, and high income cohorts. Rather than specifically evaluating the impact of the recent federal fiscal stimulus bill, I created a model structured to evaluate how the differing marginal propensities to consume of low, medium and high income cohorts impact how economic stimulus programs impact the macro economy, specifically GDP and unemployment.

This paper focuses specifically on government transfers to households. This includes tax cuts, as well as direct payments to households, in the form of programs like food stamps, unemployment insurance, and social security. I am making the assumption that households will react to an additional dollar of disposable income in the same way, regardless of the specific program that the increased income came from.

I am not, however, looking at the impact of direct government investment in infrastructure, research grants, or the expansion of federal agencies. While other studies have concluded that economic stimulus in the form of direct investment is

more effective than transfer payments, Fair's model already includes a broad variable for government investment that can be easily adjusted. Breaking the direct investment variable down further into different categories of investment spending would be very difficult.

Fair's existing model does not distinguish between income cohorts. He does not include any variables that measure income distribution. In his current model, any government transfer payment is included in the same variable; thus a tax cut given to the wealthy would have the exact same economic impact as a tax cut given to poor households, provided that both tax cuts amounted to the same total dollar amount. This is clearly an unrealistic simplification, since low income households are much more likely to increase their consumption when they receive any additional disposable income. High income households are more likely to save any new disposable income they receive.

3.4. Model Modifications

In Fair's model, transfer payments to households (the form of stimulus that I am measuring) are added to government spending and disposable income. The impact of an increase in the transfer payments filters through the model through the disposable income regressor in the consumption equations.

In order to measure the impact of transfer payments that are targeted to low income households versus high income households, I needed to break up disposable

income into different income cohorts, create a variable for economic stimulus that gets added into the new disposable income categories, assign different marginal propensities to consume to each income group, and finally modify the consumption equations to include the new disposable income groups and marginal propensities to consume.

For the purposes of this experiment, the low income cohort is arbitrarily assumed to possess 10% of all disposable income. 30% of disposable income goes to the middle income cohort, and the remaining 60% is allocated toward the high income group. Based on 2009 data from the CPS Annual Social and Economic Supplement, the low income group comprises approximately one third of households, and consists of households making $30,000 and under. The high income group is roughly one quarter of all U.S. households, and consists of households where income is $90,000 and above.

Since econometrically estimating the marginal propensity to consume for each income cohort is beyond the scope of this thesis, for illustration I have assumed that the MPC for middle income people matches Fair's estimate[2]. I am also assuming that the MPC for high income people is half that of middle income people. Given these assumptions, the MPC for low income people is necessarily four times the MPC for middle income people.

[2] Econometrically estimating the marginal propensity to consume for different income groups would require a panel data set that included the income and consumption patterns of individual households.

Specifically, the overall spending by the low income group is their MPC multiplied by 0.1 (the low income cohort share of the nation's disposable income) multiplied by the total national disposable income. Spending by the middle income group will be MPC_{med} *0.3 (middle income share of disposable income) * national disposable income. Finally, the high income group's spending will be MPC_{high} * 0.6 (high income share of disposable income) *national disposable income.

Given that YD_{low}[3] = (.1)(YD), YD_{med} = (.3)(YD), and YD_{high} = (.6)(YD), my assumptions that the MPC for the middle income group will match Fair's original estimates, and that the MPC for the high income group will be half of the middle income group, a MPC for the low income group needs to be chosen that will satisfy the criteria that with no stimulus added, the equation for spending by all combined income groups will match Fair's original estimates. If we call Fair's MPC "β", and call the low income MPC "Lβ", then

$$(3.1) \quad \beta = L\beta(0.1) + (1)\beta(0.3) + (0.5)\beta(0.6)$$

Solving this equation for L yields L=4, so the low income MPC = 4β. Thus, the completed consumption equations take the general form:

$$(3.2) \quad Consumption = (FairB)\left(4 * YD_{low} + YD_{med} + .5 * YD_{high}\right) + \sum_{i=1}^{i}(B_i * X_i)$$

[3] YD = disposable income

While my estimated income distributions and marginal propensities to consume are clearly an oversimplification, they are not unreasonable. Analysis of the Fair model by Seidman and Lewis shows that the one-quarter marginal propensity to consume in Fair's model is roughly 0.2. (Seidman & Lewis, 2009) Thus, using my estimated MPC's, if disposable income increases by $100, in the first quarter, a low income person would spend $80, a middle income person would spend $20, and a high income person would spend $10.

3.4.1 Changed Variables.

The following are the variables I modified:

STIM. This is a new variable that I created. It refers to economic stimulus, and is added on to disposable income and total government spending. The variable, STIM is the sum of stimulus geared to the low, medium and high income groups. Each income group also has its own stimulus variable. (STIM_LOW, STIM_MED, and STIM_HIGH). STIM is assumed to be zero in the base version of the model, and the impact of economic stimulus targeted to different income groups can be measured by manually adjusting the relevant STIM variables and solving the model.

YD: This is the disposable income variable, which feeds into the consumption equations.

In order to create disposable income cohorts based on income groups, I first renamed the original disposable income YD_ORIG from YD.

Then, YD cohorts were created, as follows:

$$YD\_LOW = .1(YD\_ORIG) + STIM\_LOW$$

$$YD\_MED = .3(YD\_ORIG) + STIM\_MED$$

$$YD\_HIGH = .6(YD\_ORIG) + STIM\_HIGH$$

$$YD = YD\_HIGH + YD\_MED + YD\_LOW$$

Since the YD_ORIG identity remains in the model file, as do the formulas for the income cohorts, changes in other variables that result from the stimulus can filter back into YD cohorts, although not the added stimulus dollars themselves.

TRGH. This refers to government transfers to households. This variable was not altered, because it would be difficult to break down all government transfers to households into the income cohorts used in this model. However, the stimulus variable I am using is taking the form of a government to household transfer, so STIM must be added on to every equation in which TRGH appears. TRGH is not directly in any econometrically estimated equations, but it is a component in some identities that are then placed into the estimated equations. Thus, in every identity where TRGH appears as a dependant variable (with the exception of YD, which is treated separately), STIM was added to the identity as well. This is because STIM is a form of a government transfer to households, and so needs to be counted as part of

government expenditures. STIM was not added to TRGH itself because I needed to isolate STIM's impact on different income cohorts separately.

Thus, the additional equations with STIM added in are:

EXPG(total government expenditures, SH (household saving), YNL – after tax nonlabor income

STIM is subtracted from:

SG (government saving)

3.4.2 Data Transformations

Since Fair includes a number of data transformations in his model, I had to make the appropriate transformations to all of my modifications as well. Specifically, Fair created two transformations of his disposable income variables that he then used in his consumption equations: per capita disposable income (YDZ) and the log of per capita disposable income (LYDZ). I created transformed versions of the disposable income by income cohort variables to match Fair's transformations.

3.4.3 The Consumption Equations

The Fair model breaks consumption into three equations: services, durables, and nondurables. In Fair's model, disposable income is a regressor in each of the three consumption equations (durable, non-durable, and services).

I have modified each of these equations, by taking the disposable income component and replacing it with the low, medium, and high cohorts. I am also making the assumption that the marginal propensity to consume is for low income people is four times what it is for middle income people, and that the MPC for high income people is half the MPS for middle income people.

I copied the coefficients for FAIR's equations, inserted my assumptions, and then ran the model. To hold the coefficients constant when other factors were added, I transformed the each of the consumption equations into identities[i].

Thus, the equation for the log of services consumption is:

(3.3) $lcsz = -0.03085649691494439 + ag1 * -0.09865898178217036 + ag2 * -0.5035962701613533 + ag3 * 0.4294856100043902 + lcsz(-1) * 0.8100732376396253 + log((4 * ydz\_low) + ydz\_med + (0.5 * ydz\_high)) * 0.06479584315824281 + rsa * -0.001016986503266006 + laaz(-1) * 0.03056792781302758 + t * 0.0004727144088155788$

For the log of nondurables:

(3.4) $lcnz = -0.2068271638256963 + ag1 * -0.05917064424408762 + ag2 * 0.100888740879963 + ag3 * -0.06907185820192914 + lcnz(-1) * 0.7966056625914876 + lcnz1(-1) * 0.1621851270869534 + laaz(-1) * 0.04304664607395797 + log((4 * ydz\_low) + ydz\_med + (0.5 * ydz\_high)) * 0.07778876496133894 + rma * -0.002002793652584495$

And durable goods:

(3.5) $cdz1 = -0.3807122431409585 + ag1 * 0.36752133100371 + ag2 * 2.01369958661219 + ag3 * -2.036761072690907 + dkdzcdl1 * 0.265758334424237 + kdz(-1) * -0.02534848144788553 + (4 * ydz\_low + ydz\_med + 0.5 * ydz\_high) * 0.08436136449325158 + rmacdz * -0.004908084326545916 + aaz(-1) * 0.00035942625258723080$

Where (in order of appearance):

Lcsz = log of services consumption

Ag1 = Percent of 16+ population 26-55 minus percent 16-25

Ag2 = Percent of 16+ population 56-65 minus percent 16-25.

Ag3 = Percent of 16+ population 66+ minus percent 16-25

Lcsz(-1) = Log of services consumption, lagged one period

Ydz_low = Disposable income, low income cohort

Ydz_med = Disposable income, medium income cohort

Ydz_high = Disposable income, high income cohort

Rsa = After tax bill rate, percentage points.

Laaz(-1) = Log of household net wealth divided by population

T= Time; 1 in 1952:1, 2 in 1952:2, etc.

Lcnz = Log of nundurable consumption

Lcnz1 = Log of consumer expenditures for nondurable goods divided by population

Rma = After tax mortgage rate, percentage points.

Cdz1 = Consumer expenditures for durable goods divided by population

Dkdzcdl1 = Depreciated value of stock of durable goods divided by population

Kdz = Stock of durable goods divided by population

Rmacdz =After tax mortgage rate multiplied by the peak to peak interpolation of per capita durable goods expenditure

Aaz = Total net wealth divided by population

Chapter 4

THE RESULTS

The program solves, and gives results showing that stimulus geared towards low income people increases consumption more than stimulus geared towards high income people, when $250 billion is added to the economy as a one-time stimulus in the second quarter of 2010. This departs from Fair's original model, which assumes that all transfer payments to households have the same impact, regardless of where the transfer payments are directed. This increased consumption caused by directing stimulus at the low income cohort then factors into increased GDP and lowered unemployment.

The forecasts produced by my modification of the Fair model can be seen in Tables 1-12. Tables 1-3 show the impact of $250 billion in stimulus targeted at different income groups on GDP. Tables 4-6 show show the impact of the stimulus on the unemployment rate. Tables 7-9 look at private sector jobs, and tables 10-12 look at the impact on the deficit.

According to my model, the $250 billion economic stimulus added in 2010Q2 reaches it's maximum impact in the third quarter of 2010, regardless of what income group the stimulus goes to. As seen in Table 1, if no stimulus is added, 2010Q3 GDP is forecasted at $3756.255 billion. $250 billion of stimulus geared towards low income people results in a GDP of $3949.033 billion, and $250 billion of stimulus

geared towards high income people results in a lower GDP forecast of $3815.258 billion.

The stimulus has positive short term effects, and negative long term effects. In the model, adding stimulus to the high income group increases GDP from the no-stimulus baseline for six quarters after the stimulus, after which the forecasted GDP is slightly lower than the pre-stimulus GDP.

As seen in Table 2, giving stimulus in the form of transfer payments to lower income households results in a consistently higher GDP, than when stimulus is given to middle or high income households. The impact is most pronounced soon after the stimulus is received, and then it gradually levels out. If $250 billion of stimulus is put into the economy in the second quarter of 2010, directing it at the low income group will result in a third quarter GDP $113 billion higher than if it were directed at the middle income group. Directing the stimulus at the high income group would result in the third quarter GDP being $30 billion lower than if the stimulus were directed at the middle income group.

The unemployment rate forecast follows a similar pattern, although with a slight lag. Table 4 shows that economic stimulus leads to a forecasted lower unemployment rate, especially when stimulus is applied to the low income group. With no stimulus, the unemployment rate is forecasted to get below 7% only in the first quarter of 2012. If $250 billion of economic stimulus is given in the second

quarter of 2010, my modification of the Fair model forecasts that unemployment will fall below 7% in the fourth quarter of 2010 if the stimulus is directed at the low income cohort, but if the stimulus is directed at the medium or high income cohorts, it will not fall below 7% until the first quarter of 2010 – the same time as it would have if no stimulus were applied.

Table 9 shows that he impact of stimulus on private sector jobs peaks two quarters after the stimulus is added to the economy. When $250 billion of stimulus is added in the second quarter of 2010, by the fourth quarter of 2010 private sector jobs will increase by 3.698 million jobs if stimulus is directed towards the low income cohort, 1.5132 million jobs if the stimulus is directed at the middle income cohort, and 1.1255 million jobs if the stimulus is directed at the high income cohort. As with GDP, the difference between the medium and low, and medium and high stimulus groups on the unemployment rate is largest soon after the stimulus is administered. This can be seen in Table 8.

Table 8 shows that private sector jobs follow the expected pattern of being the most impacted by stimulus geared towards the low income group. If the stimulus is given to the low income group, there will be 2.2056 million more jobs in the first quarter of 2011 than if the stimulus were spread throughout the economy. If the stimulus is directed at the high income group, there would be 0.3918 million fewer jobs in the first quarter of 2011 than if the stimulus were spread out throughout the economy or directed at the middle income group.

Table 9 shows that the lag is similar to that of the unemployment rate, with the biggest impact on jobs coming two quarters after the stimulus is applied, regardless of the income cohort to which the stimulus money is directed.

In my modification of Fair's model, the deficit level is reduced by focusing stimulus on the low income group. Of course, any economic stimulus will cost money and so increase the deficit, but since the stimulus geared towards lower income people stimulates the economy more, it has a larger impact on tax revenues, thus reducing the negative impact on the budget. Thus, even though the $250 billion of stimulus in the second quarter of 2010 increases government expenditures by $250 billion, the deficit grows by less than $250 billion, since increased consumption and incomes will lead to an increase in tax revenues. Thus, Table 12 shows that the deficit in the second quarter of 2010 increases by $221.202 billion if the stimulus is directed at the low income cohort, $238.818 billon if the stimulus is directed at the middle income cohort, and $241.922 billion if the stimulus is directed at the high income cohort. We can see that regardless of the income group that the stimulus is directed at, the deficit will increase by less than $250 billion, and stimulus directed at the low income cohort results in the smallest deficit increase.

In theory, the results of my model should match up exactly to the results of Fair's online model when 1) there is no stimulus added, and 2) stimulus is added only to the medium income cohort, and the same amount is added to TRGH in the online

version. This is because the marginal propensity to consume for the middle income cohort is the same as what is estimated in Fair's model.

Since the medium-income stimulus category was designed to equal the marginal consumption estimate in Fair's original model, giving stimulus to the medium income group is equivalent to spreading stimulus out throughout all income groups. This is because the assumption was made that the higher marginal propensity to consume for the low income group would cancel out the lower marginal propensity to consume for the high income group.

However, there are some slight differences between the forecasts produced by Fair's online model and the EViews version of the model. This is because the FP program, which is used for the model on Fair's website, and EViews, handle the TSLS instruments a bit differently. EViews sometimes adds instruments that are not directly specified into the estimation, while the FP program does not. (Fair, The US Model in Eviews, 2010). Thus the generated forecasts are not an exact match.

Chapter 5

SUMMARY

Given the widely accepted assumption that an individual's marginal propensity to consume increases with additional income, it is clear that a low income person's marginal propensity to consume is higher than that of a high income person. It follows that since a low income person will spend more of an additional dollar of income, targeting transfer payments toward low income households will have a greater impact on economic growth than will targeting transfer payments to the general population.

My modifications of the Fair model allow us to quantitatively forecast the impact of specific economic stimulus programs targeted at different segments of the population. While my assumed marginal propensity to consume ratios and income breakdowns are too arbitrary to be taken at face value, the overall concept will hold even with different income and consumption ratios.

REFERENCES

Auerbach, A., Gale, W., & Harris, B. (2010). Activist Fiscal Policy. *Journal of Economic Perspectives* , 141-164.

Coenen, G., Erceg, C., Freedman, C., Furceri, D., Kumhof, M., Lalonde, R., et al. (2010). *Effects of Fiscal Stimulus in Structural Models.* IMF Working Paper.

Elmendorf, D. (2010). *Policies for Increasing Economic Growth and Employment in the Short Term.* Congressional Budget Office.

Fair, R. (2010). *Changes to the US Model since 2004*. Retrieved August 5, 2010, from FairModel: http://fairmodel.econ.yale.edu/memo/changes.htm

Fair, R. (2010). Estimated Macroeconomic Effects of the U.S. Stimulus Bill. *Contemporary Economic Policy* .

Fair, R. (2004). *Estimating how the Macroeconomy Works.* Boston: Harvard University Press.

Fair, R. (2010). *The US Model Appendix A.* Retrieved September 9, 2010, from FairModel: http://fairmodel.econ.yale.edu/wrkbook/xaqapa.pdf

Fair, R. (2010, July 30). *The US Model in Eviews.* Retrieved October 9, 2010, from FairModel: http://fairmodel.econ.yale.edu/eviews/eviews.htm

Gordon, R. J. (2006). *Macroeconomics.* Boston, MA: Pearson Education.

Romer, C., & Bernstein, J. (2009). *The Job Impact of the American Recovery and Reinvestment Plan.*

Seidman, L. S., & Lewis, K. A. (2009). Does Fiscal Stimulus Casue Too Much Debt? *Business Economics* , 201-205.

Zandi, M. (2009). *The Economic Impact of a $750 Billion Fiscal Stimulus Package.* Retrieved August 2, 2010, from Moody's Economy.com: http://www.economy.com/mark-zandi/documents/the_economic_impact_of_a_750_billion_fiscal_stimulus_package

GDP

Table 1 GDP with $250 Billion of Stimulus

	Stimulus Income Cohort			
	None	Low	Middle	High
2010.2	3696.945	3846.448	3760.359	3745.105
2010.3	3756.146	3949.033	3835.264	3815.258
2010.4	3807.606	3971.871	3872.764	3855.243
2011.1	3862.367	3983.253	3907.98	3894.585
2011.2	3926.73	4011.517	3956.284	3946.428
2011.3	4000.341	4056.532	4017.419	4010.434
2011.4	4072.815	4107.33	4080.754	4076.001
2012.1	4149.232	4168.603	4151.097	4147.957

GDP is nominal, quarterly, and measured in billions of dollars. To convert to annual numbers, multiply by 4.

Table 2 Difference in GDP when $250 billion of Stimulus is Directed at Low or High income Cohorts, when Compared to the Stimulus Directed at the Middle Income Cohort.

	Low vs. Middle Stimulus	High vs. Middle Stimulus
2010.2	86.089	-15.254
2010.3	113.769	-20.006
2010.4	99.107	-17.521
2011.1	75.273	-13.395
2011.2	55.233	-9.856
2011.3	39.113	-6.985
2011.4	26.576	-4.753
2012.1	17.506	-3.14

GDP is nominal,quarterly, and measured in billions of dollars. To convert to annual numbers, multiply by 4.

Table 3 Difference in GDP from No Stimulus when $250 Billion of Stimulus is Directed at Each Cohort.

	Low	Middle	High
2010.2	149.503	63.414	48.16
2010.3	192.887	79.118	59.112
2010.4	164.265	65.158	47.637
2011.1	120.886	45.613	32.218
2011.2	84.787	29.554	19.698
2011.3	56.191	17.078	10.093
2011.4	34.515	7.939	3.186
2012.1	19.371	1.865	-1.275

GDP is nominal,quarterly, and measured in billions of dollars. To convert to annual numbers, multiply by 4.

Unemployment Rate

Table 4 Unemployment Rate, %, with $250 Billion of Stimulus

	Stimulus Income Cohort			
	None	Low	Middle	High
2010.2	9.3942	8.5001	9.0119	9.1032
2010.3	8.9607	7.2911	8.2588	8.431
2010.4	8.5495	6.631	7.7591	7.9601
2011.1	8.1839	6.4609	7.4928	7.6774
2011.2	7.8356	6.5396	7.3381	7.4817
2011.3	7.4846	6.6887	7.2064	7.3002
2011.4	7.1733	6.849	7.0967	7.1421
2012.1	6.8965	6.9562	6.9789	6.9836

Table 5 Difference in the Unemployment Rate when $250 billion of Stimulus is Directed at Low or High income Cohorts, when Compared to the Stimulus Directed at the Middle Income Cohort.

	Low vs. Middle Stimulus	High vs. Middle Stimulus
2010.2	-0.512	0.0913
2010.3	-0.968	0.1722
2010.4	-1.128	0.201
2011.1	-1.032	0.1846
2011.2	-0.799	0.1436
2011.3	-0.518	0.0937
2011.4	-0.248	0.0453
2012.1	-0.023	4.73E-03

Table 6 Difference in the Unemployment Rate from No Stimulus when $250 Billion of Stimulus is Directed at Each Cohort.

	Low	Middle	High
2010.2	-0.894	-0.382	-0.291
2010.3	-1.67	-0.702	-0.53
2010.4	-1.919	-0.79	-0.589
2011.1	-1.723	-0.691	-0.506
2011.2	-1.296	-0.497	-0.354
2011.3	-0.796	-0.278	-0.184
2011.4	-0.324	-0.077	-0.031
2012.1	0.0597	0.0824	0.0871

Private Sector Jobs

Table 7 Private Sector Jobs with $250 Billion of Stimulus

	Stimulus Income Cohort			
	None	Low	Middle	High
2010.2	123.2467	124.7907	123.9071	123.7494
2010.3	124.0648	127.0719	125.3234	125.0129
2010.4	124.9302	128.6282	126.4434	126.0557
2011.1	125.7975	129.462	127.2564	126.8646
2011.2	126.7023	129.8891	127.924	127.5744
2011.3	127.6719	130.1642	128.5734	128.2901
2011.4	128.6289	130.3748	129.1986	128.989
2012.1	129.5748	130.6347	129.8486	129.7084

Jobs are measured in millions.

Table 8 Difference in Private Sector Jobs when $250 billion of Stimulus is Directed at Low or High income Cohorts, when Compared to the Stimulus Directed at the Middle Income Cohort.

	Low vs. Middle Stimulus	High vs. Middle Stimulus
2010.2	0.8836	-0.1577
2010.3	1.7485	-0.3105
2010.4	2.1848	-0.3877
2011.1	2.2056	-0.3918
2011.2	1.9651	-0.3496
2011.3	1.5908	-0.2833
2011.4	1.1762	-0.2096
2012.1	0.7861	-0.1402

Jobs are measured in millions.

Table 9 Difference in Private Sector Jobs from No Stimulus when $250 Billion of Stimulus is Directed at Each Cohort.

	Low	Middle	High
2010.2	1.544	0.6604	0.5027
2010.3	3.0071	1.2586	0.9481
2010.4	3.698	1.5132	1.1255
2011.1	3.6645	1.4589	1.0671
2011.2	3.1868	1.2217	0.8721
2011.3	2.4923	0.9015	0.6182
2011.4	1.7459	0.5697	0.3601
2012.1	1.0599	0.2738	0.1336

Jobs are measured in millions

Deficit

Table 10 The Deficit with $250 Billion of Stimulus

	Stimulus Income Cohort			
	None	Low	Middle	High
2010.2	-330.001	-551.202	-568.818	-571.923
2010.3	-331.467	-295.181	-317.789	-321.739
2010.4	-268.4	-239.601	-258.396	-261.685
2011.1	-272.412	-255.091	-267.589	-269.78
2011.2	-274.635	-267.541	-274.33	-275.513
2011.3	-274.816	-275.988	-278.081	-278.43
2011.4	-250.19	-257.196	-255.894	-255.641
2012.1	-250.935	-261.983	-258.24	-257.554

Deficit is measured in billions of dollars.

Table 11 Difference in the Deficit when $250 billion of Stimulus is Directed at Low or High income Cohorts, when Compared to the Stimulus Directed at the Middle Income Cohort.

	Low vs. Middle Stimulus	High vs. Middle Stimulus
2010.2	17.6166	-3.1041
2010.3	22.6083	-3.9502
2010.4	18.7955	-3.2887
2011.1	12.4979	-2.1905
2011.2	6.7898	-1.1828
2011.3	2.0935	-0.349
2011.4	-1.3019	0.2534
2012.1	-3.7423	0.6863

Deficit is measured in billions of dollars.

Table 12 Difference in the Deficit from No Stimulus when $250 Billion of Stimulus is Directed at Each Cohort.

	Low	Middle	High
2010.2	-221.201	-238.818	-241.922
2010.3	36.2863	13.678	9.7278
2010.4	28.7987	10.0032	6.7145
2011.1	17.321	4.8231	2.6326
2011.2	7.0943	0.3045	-0.8783
2011.3	-1.1714	-3.2649	-3.6139
2011.4	-7.0062	-5.7043	-5.4509
2012.1	-11.0482	-7.3059	-6.6196

Deficit is measured in billions of dollars.