

# Rethinking Multipliers in a Globalized World

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## Abstract

This paper uses the central tool of an investment-savings and monetary-policy model with an augmented Philips curve and presents a few extensions of that model to analyze the multiplier effects of macroeconomic policies in the United States. In doing so, the authors incorporate realistic assumptions in the model related to the recent financial characteristics of the global economy. The monetary policy reaction function embeds a new augmented Taylor-rule incorporating housing and stock prices and the credit lending rate. And the household consumption and firm investment decisions incorporate housing and stock assets and the credit market frictions.

The equilibrium income is derived and compared with the actual nominal gross domestic product of the United States for the period 1990 to 2009. More importantly, fiscal and trade multipliers are derived and discussed. The main finding is that government spending, tax cut, and trade multipliers are relatively smaller in size when more realistic features are incorporated in the model. The model simulation shows that the model can track actual gross domestic product reasonably well. The model should be further improved before it could be used for policy exercises.

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# **Rethinking Multipliers in a Globalized World**

by

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## 1. Introduction

The aim of this paper is to analyze the fiscal-monetary-trade-and international financial multipliers to better understand the pathways to global economic recovery. For this purpose, we develop an open macroeconomic model which incorporates some realistic features. First, the fiscal multipliers are derived after solving for the equilibrium income using the combination of the good-markets, the Augmented Taylor Rule, and the Philips curve with expectations. This model has the novelty of including housing and financial/stock assets in household's wealth function and firm's investment decision while taking into account financial market imperfections through the inclusion of the credit or lending rates in firms' decisions to invest and central bank formulation of the monetary policy rule. Such a realistic structural model can be used by developed and developing countries to assess the efficacy of their policies.

The global economic crisis has brought about renewed interest among academics and policymakers, particularly on fiscal multipliers. The Keynesian multiplier is the impact of traditional macroeconomic policies, such as an increase in government spending, that is "multiplied" by boosting private consumption by households and capital investment by firms as they receive income from the initial round of fiscal stimulus. The multiplier effects are important to assess the strength and speed of economic recovery in a country. Therefore, the arguments are about the 'size' of the multipliers, which itself will depend upon the structure, methodology and assumptions underlying the models.<sup>2</sup> This paper presents a simple but more realistic model to discuss the recent US financial and economic problems, and the transmission of the crisis to other countries, argues that the sum of all the multipliers on the global economy is likely to be quite small.

The challenge of raising aggregate demand is now a global phenomenon. To get an understanding of the underlying processes, take the case of the US. Here, the fall in the stock market and owner occupied real estate led to an erosion of household wealth by \$10 trillion. This led to an estimated decrease in aggregate demand by about \$600 billion

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<sup>2</sup> Examples of policy modeling include the IMF's Global Economy Model (Bayoumi 2004), the Swedish Riksbank's RAMSES (Adolfson et al., 2007), the European Central Bank's New Area-wide Model (Kai Christoffel et al., 2007) and a few others who developed dynamic stochastic general equilibrium (DSGE) models.

annually, or about 3 percent of GDP, due to a fall in household spending by about \$400 billion and production by \$200 billion. Automatic stabilizers like a decrease in personal and corporate taxes cushion the fall in aggregate demand by about a third, but still leaving a net GDP gap of about \$400 billion annually<sup>3</sup>. So the present challenge in the US alone lies in policies that could potentially raise aggregate demand by about \$400 billion annually.

In many advanced countries, including the United States, the scope of monetary policy to forcefully affect demand is limited to interest rates. However, interest rates in many of these countries are already at historically very low levels leaving little leverage for further use of this instrument. In many emerging and developing economies, though central banks have lowered interest rates, they have done so cautiously so as to maintain incentives for capital inflows and external stability. Given the extent of the downturn and the limits to monetary policy action, fiscal policy is regarded as being crucial in providing short and medium term support to the global economy. However, while a fiscal response across many countries may be needed, not all countries have sufficient fiscal space to implement it since expansionary fiscal actions may threaten the sustainability of fiscal finances.

Despite many shortcomings, the IS-LM model has been one of the main tools for macroeconomic teaching and policy analysis. The IS-LM model describes the aggregate demand of the economy using the relationship between output and interest rate. In a closed economy version, in the goods market, a hike in interest rate reduces aggregate demand, usually investment demand and/or demand for consumer durables. This lowers the level of output and results in equating the quantity demanded with the quantity produced. This condition is equal to the condition that planned investment equals saving. The negative relationship between interest rate and output is known as the IS curve.

The second relationship deals with the money market, where the quantity of money demanded increases with aggregate income and decreases with the interest rate. As to realistically capture the working of the monetary policies following the 1990s, the Keynesian IS-LM model has been reviewed and opened road to the IS-MP model. Indeed, while the IS curve is still incorporated, the Monetary Policy (MP) curve has replaced the LM curve (Romer, 2000). Indeed while the monetary policy is captured by the level of the money

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<sup>3</sup> Feldstein (2009).

supply and price level in the IS-LM, the IS-MP is more precise and pragmatic by expressing the monetary policy in terms of the central bank interest rate reacting to the inflation rate. That is, rather than focusing on the nominal interest rate as in the IS-LM, the real interest rate is what matters the most in the IS-MP. The aggregate demand in this model is determined by the equilibrium IS-MP.

This paper builds on a more realistic aggregate demand as we add several features - including housing, stock and credit market frictions - in the formulation of the Fed monetary policy and households and firms decisions to consume and to invest their assets. That enables us to discuss the propagation of the global economic crisis and the effect of fiscal, monetary, trade and other policies and US and global economic recovery. The equilibrium income analytically derived and empirically simulated is a combination of the IS-MP (aggregate demand) and an aggregate supply defined as the augmented Philips with rational expectations. The main conclusion is that traditional government spending, tax cut, and trade multipliers are relatively smaller in size when more realistic features are incorporated.

The rest of this paper is as follows. We begin by setting up an extension of the work-horse model of IS-MP-IA which is detailed in Section 2. The discussion in this section focuses on the new Keynesian-Neoclassical synthesis version that includes private consumption and investment as dependent on income and asset values (wealth in the form of housing and stocks). It also replaces the 'money supply' function of a Central Bank with augmented-Taylor rule that targets policy interest rates while incorporating assets in the policy function. In a simple, closed-economy model, fiscal multipliers are theoretically large but in an open economy model the fiscal multipliers are theoretically and empirically smaller due to leakages on account of imports (Section 3). Section 4 discusses the international trade multiplier while Section 5 discusses the international finance multiplier. The simulation results are briefly discussed in Section 6, and the paper concludes by emphasizing that in a realistic depiction of a complex open economy, the multipliers are relatively smaller than in the traditional Keynesian models and therefore expansionary policies are less effective than originally thought.

## 2. Extended IS-MP Model

**Goods-market.** The goods-market is in equilibrium when the income,  $Y$ , is equal to the sum of consumption by households  $C$ , investment by private firms  $I$ , government outlays  $G$ , and net exports  $NX$  (which is the difference between exports and imports of goods and services)

$$Y = C + I + G + NX \quad (1) \quad (\text{Goods-Market Equilibrium})$$

Households' consumption depends on disposable income and wealth. As mentioned before, wealth comprises of the market value of stocks and housing. Government bonds, real monetary holdings, and other financial assets.

$$C = C(Y - T, W) \quad (2) \quad (\text{Consumption Function})$$

Households' tax payments depends on personal income

$$T = T(Y) \quad (3) \quad (\text{Tax function})$$

Consumption and tax payments of households depend on personal income, and personal income in turn depends on the interest paid on domestic bonds  $B$ . The previous equations can be re-written as

$$C = C(Y + B - T, W) \quad (2') \quad (\text{Consumption function})$$

$$T = T(Y + B) \quad (3') \quad (\text{Tax function})$$

Households' wealth consists of stocks and other financial assets  $S_H$ , housing assets  $H_H$ , capital assets ( $K$ ), monetary assets or real balances  $M$ , and government bonds ( $B(r)$ ).

$$W = [K_H + M + \left(\frac{B}{r}\right) + H_H + S_H] \quad (4) \quad (\text{Wealth definition})$$

The government budget constraint is given by the following identity where the nominal government deficit defined as government outlays minus tax receipts and denoted by  $P[G - T(Y)]$  is financed by new bonds  $\dot{B}$  and new money  $\dot{M}$ .

$$P[G - T(Y)] = \dot{B} + \dot{M} \quad (5) \text{ (Government budget constraint)}$$

The central government pays the interest on bonds to its holders. For simplicity, we assume that each bond is in perpetuity paying one dollar per year, then the total interest payments will be  $B$  and the value of the stock of bonds will be  $B/r$ . While the change in the number of bonds at the current market price is  $\dot{B}$ , the change in the market value of the entire stock of the bonds, including capital gains or losses on the pre-existing bonds, is  $\dot{B}/r$ . Therefore, the government constraint can be re-written as:

$$P[G + B - T(Y + B)] = \dot{B}/r + \dot{M} \quad (5')$$

The investment function depends negatively on the real interest or the fed fund rate  $R$ , in the case of the United States of America, the economic activity or income level  $Y$ , the credit or loan rate  $L$ , and the assets in the firms' balance sheets ( $A$ ).

$$I = I(R, Y, L, A) \quad (6) \text{ (Investment function)}$$

The balance sheets of the firms, for simplicity, consist of housing and stock assets held by firms. Those assets are also used as collateral and play an essential role in firms' investment decisions.<sup>4</sup>

$$A = A(H_F + S_F) \quad (7) \text{ (Corporate Balance sheet)}$$

The credit or loan rate  $L$  depends on firm behavior, the structure of the banking sector, the monetary policies implemented and the economic environment. For instance, Stiglitz and Greenwald (2003) see the lending rate as depending on the availability of credit or funds to

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<sup>4</sup> That is an essential point in understanding the triggers of the current financial turmoil; particularly the new securitization investment vehicle and CDOs that triggered in part the current global economic crisis.

loan  $L$ , firms net worth  $q$ , credit inter-linkages with other financial firms, or the probability of bankruptcy or default of the banks. So one could ask: Are credits available to all the firms or are they constrained to some firms for which the policy interest rate  $R$  will no longer reflect the cost of the credits? Are firms net worth reflected in their market values or are they risk takers? Are banks holding enough initial capital or are they holding important toxic assets in their balance sheets? What is the probability of the default of the banks or are banks' credit inter-linkages such that the probability of the bankruptcy is significant? All or some of these factors could well be considered while assessing credit or lending rates  $L$  as determinants of firm's investment. For instance, Stiglitz and Greenwald (2003, p 107) assesses that a bank probability of default is related to the interest rate it pays to the central bank  $\rho$ , the interest rates it charges from its loans,  $r$ , the size of its loans  $s$ , the number of its loans  $n$ , the size of its deposits  $D$ , its initial capital/asset  $K_B$ , the evolution of the economy  $z$ . The latter could be really important in the context of financial distress, interconnected economies, and boom-bust cycles, etc.<sup>5</sup>

While a detailed analysis of the credit frictions or financial market imperfections is beyond the scope of this paper, we do incorporate the asymmetrical information in considering the loan rate  $L$ . Therefore, the straightforward equation of firm's investment could be written as

$$I = I(R, Y, L, (H_F + S_F)) \quad (6') \text{ (Investment Function)}$$

Net exports depend on the exchange rate  $\epsilon$ , the domestic income  $Y$ , and the foreign income  $Y^*$ .

$$NX = NX(\epsilon, Y, Y^*) \quad (8) \text{ (Corporate Balance sheet)}$$

In this equation, the sensitivity of net exports to the exchange rate,  $\frac{\partial NX}{\partial \epsilon}$ , is positive because undervalued exchange rates improve trade balances.<sup>6</sup> The marginal propensity to import,

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<sup>5</sup> While the interest rates will be relevant for the demand of fund of non-credit constrained firms, the availability of fund will be a more effective determinant for constrained firms.

<sup>6</sup> Assuming the Marshall-Lerner conditions holds. That is, under the assumption that the trade account is initially balanced and the supply elasticity is infinite, a depreciation of the exchange rate in case of a flexible exchange rate regime or a devaluation of exchange rate under a fixed regime improves the trade balance as long

$nx_Y$ , is negatively related to net exports. And the sensitivity of foreign income to domestic net export,  $nx_{Y^*}$ , is positive.

After substitution, the identity representing the equilibrium income in the good markets can be written as:

$$Y = C \left( Y + B - T(Y + B), [K_H + M + \left(\frac{B}{r}\right) + H_H + S_H] \right) + I(R, L, A(H_F + S_F)) + G + NX(\epsilon, Y, Y^*) \quad (9) \text{ (IS Goods-Market equilibrium)}$$

Its explicit form will be:

$$Y = C_0 + c_Y(Y) + c_B(B) - c_Y T_0 - c_Y t_Y(Y) - c_Y t_B(B) + [c_K(K_H) + c_M(M) + c_B \left(\frac{B}{r}\right) + c_H(H_H) + c_S(S_H) + I_0 + i_R(R) + i_Y(Y) + i_L(L) + i_H(H_F) + i_S(S_F) + G + NX_0 + nx_\epsilon(\epsilon) + nx_Y(Y) + nx_{Y^*}(Y^*)] \quad (10) \text{ (Goods-Market)}$$

Where

$$c_Y > 0; c_B > 0; t_Y > 0; t_B > 0; c_M > 0; c_B > 0; c_H > 0; c_H > 0; c_S > 0; i_Y > 0; i_Y > 0; i_R < 0; i_L < 0; i_H > 0; i_S > 0; nx_\epsilon > 0; nx_Y < 0; nx_{Y^*} > 0$$

We can rearrange this equation by bringing together common variables related to Y, R and  $\pi$  as:

$$Y[1 - c_Y(1 - t_Y) - i_Y - nx_Y] - R(i_R) = C_0 + c_B(B) - c_Y t_B(B) + [c_K(K_H) + c_M(M) + c_B \left(\frac{B}{r}\right) + c_H(H_H) + c_S(S_H) + I_0 + i_L(L) + i_H(H_F) + i_S(S_F) + G + NX_0 + nx_\epsilon(\epsilon) + nx_{Y^*}(Y^*)] \quad (10') \text{ (Goods-Market)}$$

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as the sum of price elasticity of exports and imports (in absolute value) are greater than one. Nevertheless, empirical studies, such as Hooper et al. (2000), find the demand for exports and imports, while elastic in the long term, are almost inelastic in the short term. Hence, a depreciation of the exchange rate is likely to deteriorate the current account in the short run, thereafter improve it in the long run. This situation is well illustrated by the observable J curves in some studies.

The right hand-side or the exogenous part of this equation can be termed  $IS_0$ .

$$IS_0 = C_0 + c_B(B) - c_Y t_B(B) + [c_K(K_H) + c_M(M) + c_B\left(\frac{B}{r}\right) + c_H(H_H) + c_S(S_H) + I_0 \\ + i_L(L) + i_H(H_F) + i_S(S_F) + G + NX_0 + nx_\epsilon(\epsilon) + nx_{Y^*}(Y^*)]$$

The equilibrium output level in this model is definitively smaller than it would be in other models that do not introduce the marginal propensity to import because a fraction of national income is now devoted to the purchase of foreign rather domestic goods, and therefore reduces the national income.<sup>7</sup>

We now focus on the MP side of the model

**The Augmented Taylor Rule.** Allow us to now introduce the central bank's monetary policy using an augmented Taylor rule, which is used not only by the US Federal Reserve but over 35 emerging country central banks. Our contribution here is to implicitly include the idea that the central bank fund-rates should adjust to the deviation of economic agents' expectations from the market lending or credit rates, the housing prices and the stock-prices. Therefore, the monetary policy rule (MP) can be written as:

$$R = R[(\pi - \pi^e), (Y - Y^e), \epsilon, R^*, (L - L^e), (S - S^e), (H - H^e)] \quad (11) \text{ (Monetary Policy)}$$

and

$$R = r_\pi(\pi - \pi^e) + r_Y(Y - Y^e) + r_\epsilon\epsilon + r_{R^*}R^* + r_L(L - L^e) + r_S(S - S^e) \\ + r_H(H - H^e)]$$

where the parameters or the weights put on each deviation of the expectations from the current targets are respectively:

$$r_\pi > 0; r_Y > 0; r_\epsilon > 0; r_{R^*} > 0; r_L > 0; r_S > 0; r_H > 0$$

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<sup>7</sup> In other words, the slope of this IS curve will be steeper than those in the models without marginal propensity to import foreign goods (source of leakage).

This is an augmented Taylor rule which includes the deviation of the actual inflation from its expectations, the output gap (deviation of the current output from its natural or potential level), the exchange rate, and the foreign interest rates. The novelty in this paper is the introduction of the expectations in the values of the housing and the stock markets, and the credit rate spreads. Most importantly, our model incorporates the central bank reaction function to the housing prices, stock prices and credit frictions. The idea behind credit friction is that the optimal monetary policy rule should be designed in such a manner where the Fed funds rate should be lowered when credit spreads increase. This avoids the potential increase in credit spreads from “effectively tightening monetary conditions” which are not justified by the deviation of the inflation expectations, the output gap, and the other variables included in the monetary policy rule.

We think this idea is probably very relevant for smaller open economies, where the policy makers cannot follow a fully independent monetary rule vis-à-vis the world international financial markets.<sup>8</sup>

The equation (11) can be rearranged with respect to  $Y$ ,  $R$ , and  $\pi$ :

$$R - Y(r_Y) - r_\pi(\pi) = r_\pi\pi^e + r_Y Y^e + r_\epsilon\epsilon + r_{R^*}R^* + r_L(L - L^e) + r_S(S - S^e) + r_H(H - H^e) \quad (11')$$

Let us denote the right hand-side or the exogenous part of this equation by  $MP_0$ .

Here  $MP_0 = r_\pi\pi^e + r_Y Y^e + r_\epsilon\epsilon + r_{R^*}R^* + r_L(L - L^e) + r_S(S - S^e) + r_H(H - H^e)$

**The aggregate supply curve – Augmented Phillips Curve.** Taking into consideration Lucas critique on the importance of expectations, particularly expected prices or inflation, and relying on the augmented Philips Curve equation, we define the inflation rate as function of the expected inflation rate, the output gap, and the nominal exchange rate. We write the aggregate supply curve as:

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<sup>8</sup> This assumption might be irrelevant for the US.

$$\pi = \pi^e + \beta(Y - Y^e) + \gamma\epsilon \quad (12) \text{ (The augmented Phillips curve)}$$

Where  $\pi^e$  is the expected inflation. The parameter  $\beta$  represents the weight allowed to the output gap, and  $\gamma$  is the degree of exchange rate pass-through to domestic inflation. We rearrange this equation as

$$\pi - \beta Y = AP_0$$

The right hand-side of this equation is denoted by  $AP_0 = \pi^e + \beta(Y^e) + \gamma\epsilon$

**The equilibrium output.** We can rewrite the equation (10'), (11') and (12') as a system in which  $Y$ ,  $R$ , and  $\pi$  are the endogenous variables.

$$\begin{bmatrix} (1 - c_Y(1 - t_Y) - i_Y - nx_Y) & (-i_R) & 0 \\ (-r_Y) & 1 & (-r_\pi) \\ -\beta & 0 & 1 \end{bmatrix} \begin{bmatrix} Y \\ R \\ \pi \end{bmatrix} = \begin{bmatrix} IS_0 \\ MP_0 \\ AP_0 \end{bmatrix} \quad (13)$$

The Jacobean determinant  $J$  is computed as:

$$|J| = (1 - c_Y(1 - t_Y) - i_Y - nx_Y) - (i_R)[r_Y + \beta r_\pi] > 0$$

The equilibrium revenue is therefore obtained by solving

$$\bar{Y} = \begin{bmatrix} IS_0 & (-i_R) & 0 \\ MP_0 & 1 & (-r_\pi) \\ AP_0 & 0 & 1 \end{bmatrix} / |J|$$

That is

$$\bar{Y} = [IS_0 + i_R (MP_0) + (i_R)(r_\pi) (AP_0)] / |J|$$

The explicit expression of the equilibrium income is therefore:

$$\begin{aligned}
\bar{Y} = & \left[ [C_0 + c_B(B) - c_Y T_0 - c_Y t_B(B) + [c_K(K_H) + c_M(M) + c_B\left(\frac{B}{r}\right) + c_H(H_H) \right. \right. \\
& + c_S(S_H) + I_0 + i_L(L) + i_H(H_F) + i_S(S_F) + G + NX_0 + nx_\epsilon(\epsilon) \\
& + nx_{Y^*}(Y^*)] \\
& + i_R [(r_\pi \pi^e + r_Y Y^e + r_\epsilon \epsilon + r_{R^*} R^* + r_L(L - L^e) + r_S(S - S^e) \\
& \left. \left. + r_H(H - H^e)] + (i_R)(r_\pi)[(\pi^e + \beta(Y^e) + \gamma\epsilon)] \right] / |J|
\end{aligned}
\tag{13'}$$

Equilibrium income is affected by a whole gamut of initial values of economic variables, as well as on policy variables which is more a reflection of a modern economy found in both advanced and emerging countries. At this equilibrium income level, all the markets clear and the interest rate and the inflation are also at their equilibrium level.

### 3. The Fiscal Multipliers

Having set up a modern day complex economy with policy response functions, we are now in a position to derive and discuss the multipliers. The multipliers are derived as follows:

$$\frac{\bar{dY}}{dG} = \frac{1}{|J|} \tag{14} \text{ Public spending multiplier}$$

$$\frac{\bar{dY}}{dT_0} = \frac{-c_Y}{|J|} \tag{15} \text{ Tax cut multiplier}$$

$$\frac{\bar{dY}}{dY^*} = \frac{nx_{Y^*}}{|J|} \tag{16} \text{ Trade multiplier}$$

Expansion in government outlays, tax-cut and increase in world income (via feed-back loops) all have a positive impact on domestic aggregate income; therefore these multipliers are all positive. No matter what is the magnitude of the Jacobean determinant J, which embeds many structural aspects of the economy, public spending multiplier is larger than the tax cut multiplier and the foreign demand for domestic goods as the marginal propensity to consume and the impact of the foreign income on domestic products are both smaller

than one. Yet tax-cut multiplier will be bigger than foreign trade multiplier if and only if the marginal propensity of domestic households to consume domestic products is larger than the appetite of foreign country's income to purchase domestic goods (that is if  $c_Y > nx_Y^*$ ).

What about the size of the fiscal multipliers? With  $\frac{1}{|J|} = m$ , the fiscal multipliers are derived as  $dY/dT = -c_Y m$ , for raising tax, and  $dY/dG = m$ , for increasing government outlays. Since the marginal propensity to consume,  $c_Y$ , is positive and less than one; the bigger it is, the larger the fiscal multipliers will be. Government spending multiplier is bigger than the tax multiplier as the marginal propensity to consume is less than one. The full effect of the fiscal policy multipliers in the first round is smaller in models that incorporate a sensitivity of the private investment to the interest rate. Public investment might crowd-out private investment in implementation of fiscal stimulus packages. The crowding-out is the result of an expansionary fiscal policy causing the interest rates to increase and thereby reducing the private investment as financing becomes expensive.

The main challenges in estimating the size of multipliers relate to identification and attribution problems as well as the structure of the model used in the estimation process. Fiscal policy is usually deployed with other policies and many factors come into play at the same time. Moreover, the impact of fiscal policy can be felt over many years by which time other policies and factors may have changed as well.

There is a long literature on the empirics of multipliers, particularly for advanced economies. Focusing on recent studies, one could summarize that:

- (i) in recessions, government spending rather than tax-cuts has to do “the heavy lifting”<sup>9</sup> as historically, multipliers on government spending are estimated to be in the range of 1.5 to 2, while multipliers for tax cuts can be much smaller, say 0.5 to 1. However, Taylor (2008) points out that the 2008 May tax rebates of \$300-600 per person by the Bush administration did not avert an economic recession in the third and fourth quarters of 2008. The small and insignificant effect of tax

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<sup>9</sup> Feldstein, Martin (January 2009) estimates that the marginal propensity to consume out of disposable income is 0.7, while the marginal propensity to consume out of reduction in taxes and tax rebates is only 0.13.

rebates in 2001 and 2008 conforms to the permanent income and life-cycle theories of consumption in which temporary increases in income are predicted to lead to small increases in consumption.

- (ii) In contrast, Moody's Economy.com model indicated that multiplier for low-income and liquidity-constrained consumers is 1.73 for unemployment benefits, and 1.64 for food stamps, and 1.36 when money is transferred to the states.
- (iii) Fiscal multipliers vary widely across countries and decreased over time and spending multipliers are estimated to be in the range of zero to two (Bryant and others 1988). In Vegh et al. (2009) fiscal multipliers tend to be lower for advanced or high income countries than emerging or developing ones; they are bigger for countries following fixed exchange rate regimes than for those adopting flexible regimes and they tend to be bigger for closed economies than open-economies. The main reason is that the more open an economy the higher likelihood of leakages from the domestic economy in the form of spending on imports (see details in Appendix Table A1).
- (iv) When credit markets are impaired, tax cuts as well as income earned from government spending on goods and services, will not be leveraged by the financial system to nearly the same extent, resulting in (much) smaller multipliers. The conventional IS-MP model fails to deal with 'dysfunctional financial markets' or the liquidity trap, a condition that is currently prevalent in many advanced and emerging economies, in which banks are willing to lend only to the 'safest' of the borrowers.
- (v) Conventional Keynesian multipliers are meant for closed economies (no leakages from demand through imports and the effect of the fiscal expansion on the exchange rate further reduced multiplier) and do not consider the total debt position of the country. More generally, the fiscal multipliers of an expansionary fiscal policy will be bigger if the leakages are minimized, an accommodative monetary policy is implemented, and the fiscal position of the country is sustainable after the initial change in fiscal policy.

As a matter of fact, while the structure of the economy and dynamics behind the multiplier is more complicated than the standard text books indicate, it is crucial to really understand important factors such as the role of housing and stock in households' wealth and in firms'

balance sheets. Also, understanding credit frictions or lending rates is very important as those rates affect not only firms' investments but also the optimal monetary policy of any central bank.

We can now determine the effect of housing prices, stock prices, and lending rate (credit frictions) on the income. For simplicity we assume that housing prices are the same across households and firms  $H_H = H_F = H$ . Similarly stock prices are the same across firms and households:  $S_H = S_F = S$ . So we can compute the effect of housing and stock prices and lending rates on the income as :

$$\frac{\overline{dY}}{dH} = \frac{c_H + i_H + r_H}{|J|} \quad (17)$$

$$\frac{\overline{dY}}{dS} = \frac{c_S + i_S + r_S}{|J|} \quad (18)$$

$$\frac{\overline{dY}}{dL} = \frac{i_L + r_L}{|J|} \quad (19)$$

Their magnitude will depend on their sensibilities to households' consumption through wealth, to firms' investment through balance sheet and the funds interest rates.

The above analysis of the multiplier has been essentially comparative static and did not distinguish the magnitude of the spending multiplier when the government deficit is financed by creating money or issuing bonds. If we ignore the dynamics of the model and focus only (for simplicity) on the economy at the steady state, the equation (5'), which describes the balanced budget, provides the theoretical solutions. Indeed at the steady-state, there is no more additional change in money creation and public bond holdings. That is  $\dot{B}/r = \dot{B} = \dot{M} = 0$ . Such that the equation (5') is written as

$$P[G + B - T(Y + B)] = \dot{B}/r + \dot{M} = 0 \quad (5')$$

It is another way to say that in the long-run, the government budget has to be balanced.

$$G + B - T(Y + B) = 0 \quad (5'')$$

The total derivative of this equation is therefore

$$dG + dB - T'dY - T'dB = 0$$

Using simple algebra, we get the multiplier at the steady state as:

$$\frac{dG + dB(1-T')}{T'} = \left(\frac{dY}{dG}\right)$$

$$\frac{dY}{dG} = \frac{1}{T'} + \frac{(1-T')}{T'} \frac{dB}{dG}$$

This long run multiplier of government spending has different magnitudes depending upon the way the deficit is financed. If the government deficit is financed by money-creation only, and not by bond finance ( $\frac{dB}{dG} = 0$ ), the fiscal multiplier is smaller ( $\frac{dY}{dG} = \frac{1}{T'} + 0$ ). However if the deficit is financed by bond purchases, ( $\frac{dB}{dG} > 0$ ), the spending multiplier is bigger ( $\frac{dY}{dG} > \frac{1}{T'}$ ).

#### 4. Trade Multiplier

Theoretically with the economy becoming more globalized, domestic policy changes affect other countries. A rise in the domestic (home) income is good news for foreigners as the demand for their goods is likely to increase along with world income. Hence, any increase in the global demand and income is theoretically expansionary for each individual economy involved. The effect of the US financial crisis as well as a decline in GDP growth had a very large effect on world trade because US accounts for about 8% of total world imports and about 20% of world GDP. Trade has fallen faster than income around the world during late 2008 and early 2009 as a result of falling commodity prices; the decline in cross border finance and production stages for many goods is spread out among many different countries. A negative demand shock in US (home) would induce a series of reactions that would

boomerang and reduce both home and foreign GDP. During downturns most governments tend to adopt policies to expand their exports in world markets while protecting their production and employment from foreign competition. If all countries increase tariffs at each others' expense they will end up shrinking trade even more.

$$\frac{\overline{dY}}{dY^*} = \frac{nx_{Y^*}}{|J|} \quad (16) \text{ Trade multiplier}$$

## 5. International Financial Multiplier

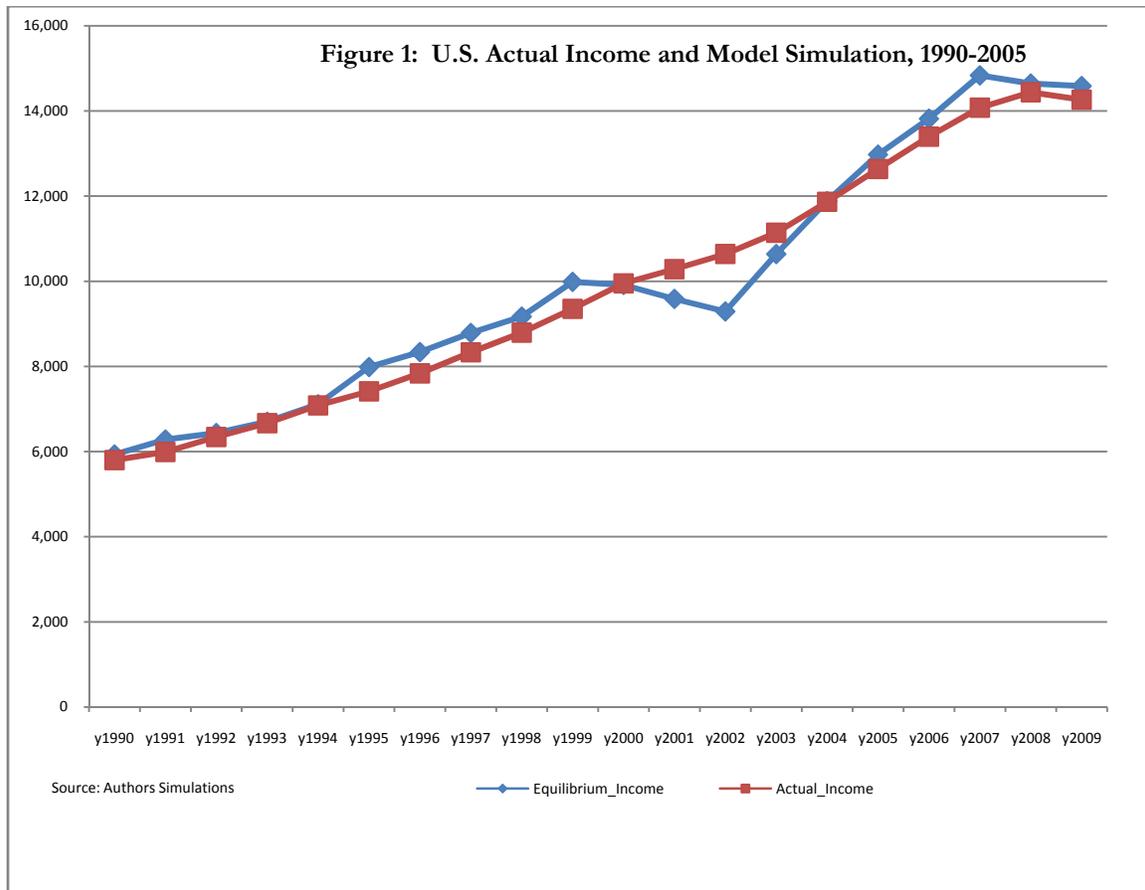
Krugman (2008) explains the current financial crisis using the approach of Calvo (1998) and Kaminsky et.al (2003) where contagion spreads through balance sheet effects on financial intermediaries. Several episodes of financial crisis during recent decades involve a ‘leveraged common creditor’ where different countries are connected financially. The issue is not one of liquidity but one of under-capitalization. For example, when Russian crisis hit in 1998, hedge funds that had large exposure in Russia plugged massive amounts out of Brazil as well, thereby creating financial problems in Brazil. During the current crisis, highly toxic assets such as mortgage-backed securities were held by several highly leveraged financial institutions in US, Europe, Brazil, China and a few other countries. A large decline in housing prices reduced the general public’s demand for mortgage-backed securities (assets) and leveraged institutions had to cut back sharply on the supply of mortgage-backed securities (assets). This initial effect is magnified as the falling asset prices force the leveraged institutions to further contract their balance sheets leading to further fall in asset values and so on. When housing prices declined not only in US, but a large number of countries in Western and Eastern Europe, and several emerging economies, the global financial multiplier is further magnified in a vicious spiral downward. The same multiplier can also work in a virtuous circle, say when the next great financial innovation occurs using say life-insurance policies or pension funds or some other assets that could replace the mortgage backed securities.

Let us assume that housing and stock assets are all backed by mortgage-securities which have suddenly become toxic. In other words, private investment now comprising of financial and

non-financial firms are holding these toxic assets. We do not extend our model to include international financial multiplier because we are not assessing the impact of US actions on the global economy. Moreover, it is not clear if the international financial multiplier is needed to track the turning points in the US economy.

## **6. Simulation Results**

A modern complex economy can be depicted using an extended IS-MP-IA framework. Using such a structural model, we derive and find that equilibrium income of such an economy is dependent on several factors and parameters (see Table A1). Historically, multipliers on government spending are estimated to be in the range of 1.5 to 2, while multipliers for tax cuts can be much smaller, say 0.5 to 1. But the world is a drastically changed place, particularly during this global crisis, and the various multipliers are likely to be much smaller because of leakages in a globalized world in the form of higher imports from rest of the world. Also, the various multipliers may work at cross purposes and the cumulative effect may be much smaller as shown in Vegh et al. (2009). The calibration and simulation exercise we embarked upon with the structural model derived in this paper tracks the US national income reasonably well (See figure1). Our estimates are respectively 0.4, 0.3, and 0.2 for the government spending, tax cut and trade multipliers (Table 1 and Table A2). The results of our model are almost similar to the estimates of Vegh et al. (2009) and confirm the relatively smaller size of each of the multipliers. The estimates explain the so far weak impact of the large US fiscal stimulus package of over \$757 billion during 2009, and also explain why the tax-refunds of \$150 billion in mid-2008 by the Bush administration did not prevent a US recession in later half of 2008.



<b>Table 1: Simulated Multipliers</b>		
Government Expenditure	$\frac{dY}{dG} = \frac{1}{ J }$	0.39
Tax	$\frac{dY}{dT_0} = \frac{-c_Y}{ J }$	-0.27
Trade	$\frac{dY}{dY^*} = \frac{nx_{Y^*}}{ J }$	0.19
<i>Source: Authors Simulations</i>		

## 7. Conclusions

We extended an IS-MP model to incorporate a few realistic features and derived and discussed fiscal and trade multipliers. The main finding is that government spending, tax cut, and trade multipliers are relatively smaller in magnitudes when more realistic features are incorporated in a model. The model simulation shows that the model can track the actual US nominal GDP reasonably well. However, further work is needed to improve the model

specification to bring about more realism in small models. The dynamic stochastic general equilibrium (DSGE) model of Smets and Wouters (2007) that was used for some of the fiscal stimulus policy exercises needs to be improved to capture more realism. The current global crisis came about because of speculative bubbles in global oil and food grains markets during 2007-08, which coincided with bubbles in the US and European housing markets, and the stock markets in several countries. Rising prices in these sectors encouraged optimism, which led to more buying and more speculation in a feedback loop that was only stopped by an unexpected crash. To capture such phenomenon, we need to include in the model a role for banks and financial firms in financial intermediation, while relaxing the assumption of rational expectations with one of ‘animal spirits’ or ‘herding’ in investment and financial decisions, and at the same time introducing a two-country situation to capture the ‘international contagion’ effects through trade, finance and labor flows across. This will also help us to analyze the international financial multiplier which appears to have played an important role in the global crisis of 2008-09.

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Appendix

<b>Table A1: Variables in the simulation of the Augmented IS-MP-AS with Stocks, Housing, and Credit market frictions</b>	
<b>1. IS-Good Markets</b>	
	GDP, current Price
$C$	Household consumption
$c_Y$	Households Marginal propensity to consume the income
$\left(\frac{B}{r}\right)$	The value of the stock of bonds
$B$	Bond/treasury
$c_B$	Marginal propensity to consume wealth (Government bond)
$t_B$	Tax rate on Bond
$T_0$	Tax Revenue on personal income
$t_Y$	Tax rate on personal income
$K_H$	capital assets part of the household wealth
$c_K$	Marginal propensity to consume wealth in terms of capital assets
$M$	Monetary assets
$c_M$	Marginal propensity to consume wealth in terms monetary assets
$H_H$	Housing Assets detained by Households
$c_H$	Marginal propensity to consume wealth from housing assets
$S_H$	Stock Prices (detained by Households)
$c_S$	Marginal propensity to consume wealth in the form of stocks and other financial ) assets $S_H$
$I_0$	Investment
$i_R$	Investment Elasticity to the interest rates
$L$	Fed Fund Rate
$i_Y$	Investment elasticity to income
$L$	Loan/lending rates
$i_L$	Investment elasticity to Loan/credit/lending rate
$H_F$	Housing Assets (Those held by firms)
$i_H$	Investment elasticity to Housing (prices)
$S_F$	Stock Assets (Those held by firms)
$i_S$	Investment elasticity to Stocks (prices)
$G$	Government outlays $G$
$NX_0$	Net exports
$nx_\epsilon$	Elasticity of net exports to the exchange rate
$\epsilon$	The exchange rate
$nx_Y$	Elasticity of net exports to the domestic income (marginal propensity to import)
$nx_{Y^*}$	Elasticity of net exports to the foreign income (Global demand)
$Y^*$	Foreign income $Y^*$ (Difference between the world and the US income)
<b>2. MP: The Augmented Taylor Rule with Housing, Stock Prices, and Credit market frictions</b>	
$R$	Fed Fund Rate ( See Taylor Rule)
$r_\pi$	Weight put on the Inflation deviation from its Expected level
$\pi$	Inflation rate
$\pi^e$	Expected inflation rate
$r_Y$	Weight put to the output deviation (output gap)
$Y^e$	Expected Output
$r_\epsilon$	Sensitivity of R (fed fund Rates) to the exchange rate
$\epsilon$	Dollar Exchange Rate (REER)

	$r_{R^*}$	Sensitivity of the fed funds Rates to the foreign interest rate (LIBOR)
	$R^*$	LIBOR / Foreign interest rate
	$r_L$	Weight placed by the Fed on the deviation of the loan rate from the expected rate
	$L$	credit or lending rates
	$L^e$	Expected credit or lending rates
	$r_S$	Weight placed by the Fed on the deviation of the stock price from the equilibrium or expected level
	$S$	Stock Prices
	$S^e$	Expected Stock Prices
	$r_H$	Weight placed by the Fed on the deviation of the Housing price from the equilibrium or expected level
	$H$	Housing Prices
	$H^e$	Expected Housing Prices
<b>3. The aggregate supply curve – Augmented Phillips Curve</b>		
	$\pi$	Inflation rate
	$\pi^e$	Expected Inflation Rate
	$\beta$	Weight placed by the Fed on the output gap
	$Y^e$	Expected output
	$\gamma$	The degree of the exchange rate pass-through to domestic inflation
	$\epsilon$	Dollar REER
Source: Authors		

**Table A2: Spending multipliers of the US and other country groups**

Impact Multiplier	$\frac{\Delta Y(t)}{\Delta G(t)}$
<b>United States (Nallari &amp; Engozogo, 2010)</b>	<b>0.39</b>
G7*	0.4
High Income*	0.36
Emerging Countries*	0.6
Developing Countries*	0.7
Pre-Determined (Fix)*	1.06
Flexible Regime*	0.11
Open-Economy (More leakages)*	0.73
Closed Economy*	0.43
(*) Estimates obtained from Veg. Carlos et al. (2009)	
Source: Authors	