Macro Models: an APP for Macroeconomic Models. User Manual 1.0

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Macro Models
An App for Macroeconomic Models.
User Manual 1.0

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Abstract

Macro Models are a series of free Apps available in App Store, and they work with Ipads. Each App simulates a specific macroeconomic model and presents both the static and the dynamic results. The first five Apps developed and published are: the Income-Expenditure model in three versions (I, II and III), the IS-LM model and the Taylor's rule (IS-MP model). The economic model of each single App and several examples on how it works are outlined in this paper.

Keywords: Macroeconomics, Income-Expenditure model, IS-LM, Taylor's rule, APP.
Jel Codes: A20; E20

Acknowledgment

The Apps of Macro Models series have been developed by Gianluigi Coppola and Natalia Marsilia (nmarsilia@yahoo.it), the engineer who elaborated the software. A special thanks to her because these Apps and also this paper would not have been possible without her precious help. Thank you very much, Natalia!

Contents

Chapter 1

Introduction

This paper is a user manual for an APP that simulates the widely used Macroeconomic Models [1]. The first app developed concerns the Income- Expenditure Model. The first question to answer is: why an App? There are two reasons.

Firstly, tablets provide another learning opportunity. Tablets allow you to play, write e-mails, and connect to Internet, everywhere. But you can also read articles and books and listen to mp3. For these reasons these Apps are an opportunity to understand how the main macroeconomics models work. Secondly, only a few examples for each single model can be found in textbooks and they mainly concentrate on the static aspects. Apps allows you to simulate both the static and the dynamic results of the model. In fact it is possible to input the parameters of the model in order to obtain both the static and the dynamic results with each app. Another important issue exists. Both this app and paper can lead to another interpretation of the macroeconomic models. Schemes useful for studying the implication the instruments applied by the government in order to guarantee the social stability.

The logo of the app is a sphere over a picture of a flow of water. The sphere is not real while the photo is real. The sphere is stable and it represents the ”perfect” equilibrium: each infinite point of the sphere is an equilibrium and is identical

[1] This paper is not a Macroeconomics text book. We suggest Dornbush et al. (2004) or Blanchard (2009).

to all the others. The water is dynamic and it represents the unstable conditions of reality. The sphere may represent the being, the metaphysic, while the water is the becoming, the nature. For Talete water was also the origin of all things. Parmenides says that two things, being and becoming, sphere and water, are conflicting. The government has to rule dynamics, considering the sphere.

This App can be downloaded by the Apple Store. They are free. Each App may contain one or more models.
The screen of the single app is divided into two parts which can be scrolled. The first table of the upper side of the screen is the panel of inputs. It contains three columns, each of them represents a period. For example, the first one is the initial period, while in the second one there is a shock (i.e a decrease of the investment) and in the third period the Government reacts to that negative shock cutting the income tax rate.
The first panel of the lower part of the screen shows the results of the model in the equilibrium. You can obtain them by pressing the RESET button, while with SAVE you save them. In the lower part of the screen the are also some graphs. Some of them show the model's static results while others show the dynamics of the variables. It is possible to choose which variables to plot switching the cursors that are in ”Graphic”. The Legend, that is in the upper side of the screen, explains the meanings of the symbols, the results, and the graphs.

Chapter 2

The Income Expenditure model

1. Introduction

The Income Expenditure model is the first one that students find in the Macroeconomics textbooks. It is based on two assumptions. Firstly, prices are fixed. This implies that in the model the prices mechanism doesn't work. In order to reach the equilibrium the quantity of goods and services offered, must be changed. If demand is greater than supply, the production will fall, while on the contrary, if supply is greater than demand, the production and the supply will rise.

The second assumption is that there are infinite equilibria but not all of them can ensure the social stability, as the economic system may reach an equilibrium were there is no full employment. According to the Keynesian theory, a full employment situation or a condition of social stability, even in the short run can be reached with the Government's intervention. In other words, the economic system is unstable. It is mainly due to the Investments which are the unstable components of the aggregate demand. The Government can stabilize the business cycle through the fiscal policy. In order to stimulate the production growth, the government can increase economic expenditure, or reduce taxes. In the first case it substitutes the private sector, while in the second case, it stimulates the private sector through the disposable income and consumption.

However, in recent years with the Eurozone crisi (often referred as Euro crisis), many European countries, as Greece, Spain and Italy, have been obliged to reduce their debt. In these cases the social stability was linked to the reduction of public debts instead of the reduction of unemployment. For this reason in the software developed particular attention is given to the dynamic of the debt.

2. The Model I: Income-Expenditure Model

Be Y the income, t the Income tax rate, and TR the net Government Transfers. TR is positive if the amount of subsidies is greater than the lump-sum taxes, and it is negative otherwise. The after-tax income, or disposable income, YD, is equal to

$$YD = Y + TR - tY \tag{2.1}$$

The Aggregate Demand AD is equal to the sum of Consumption C, Investment I, Net Export NX, and the Government's expenditure G.

$$AD = C + I + NX + G \tag{2.2}$$

The Keynesian Consumption function is:

$$C = \overline{C} + cYD \tag{2.3}$$

where $\overline{C}$ is the autonomous consumption, and c is the marginal propensity to consume. $\overline{C} > 0$ and $0 < c < 1$. Substituting Yd into the equation (2.3), it obtains:

$$C = \overline{C} + cTR + c(1 - t)Y \tag{2.4}$$

$c(1-t)$ is the Net Marginal Propensity (NMP) to consume. The Investment function is:

$$I = \overline{I} + \theta Y \tag{2.5}$$

$\overline{I}$ is the autonomous investment and θ the marginal propensity to invest. $\theta \geq 0$.

The Net Exports NX are exogenous.
The Government can modify the expenditure G, the Net Transfer TR, and the income taxes rate t. They are the government's instruments.

The Income Expenditure Model is:

$$C = \overline{C} + cTR + c(1-t)Y$$

$$I = \overline{I} + \theta Y$$

$$G = \overline{G}$$

$$TR = \overline{TR}$$

$$NX = \overline{NX}$$

$$Y = AD \tag{2.6}$$

The equation (2.6) is the equilibrium where the supply Y is equal to the demand AD. It can also be rewritten as:

$$Y = \overline{C} + c\overline{TR} + \overline{I} + \overline{NX} + \overline{G} + C(1-t)Y + \theta Y \tag{2.7}$$

Solving for Y, we obtain the equilibrium income:

$$Y_e = \frac{1}{(1-c(1-t)-\theta)}[\overline{C} + c\overline{TR} + \overline{NX} + \overline{I} + \overline{G}] \tag{2.8}$$

$\frac{1}{(1-c(1-t)-\theta)}$ is the Keynesian Multiplier. It is possible to demonstrate that with $\theta = 0$ the Keynesian Multiplier is always greater than one. With $\theta > 0$ it can be assumed that $0 < 1 - c(1-t) - \theta < 1$. For this reason also in this case the Keynesian Multiplier is always positive and greater then 1.

Once the equilibrium income is obtained, it is possible to calculate the equilibrium consumption and the equilibrium investment. They are respectively:

$$C_e = \overline{C} + c\overline{TR} + c(1-t)Y_e \tag{2.9}$$

$$I_e = \overline{I} + \theta Y_e \tag{2.10}$$

The Balance Surplus BS of the government is equal to the difference between receipts and expenditure. The receipts are the amount of taxes tY and the expenditure are represented by the sum of the government's expenditure G and the Net Transfer TR [1] . In formula:

$$BS = tY - (\overline{G} + \overline{TR}) \tag{2.11}$$

The Balance Surplus in equilibrium is equal to:

$$BS_e = tY_e - (\overline{G} + \overline{TR}) \tag{2.12}$$

or

$$BS_e = t\frac{1}{(1-c(1-t)-\theta)}[[\overline{C} + c\overline{TR} + \overline{NX} + \overline{I} + \overline{G}] - (\overline{G} + \overline{TR}) \tag{2.13}$$

There is a deficit for $BS < 0$. The government's debt B at the time t is equal

[1] if $TR < O$ the net transfer are receipts.

to the algebraic sum of the previous surplus and deficits[2]:

$$B = \sum_{t=0}^{T} BS_t \tag{2.14}$$

2.1. The Comparative Static

$\overline{C}$, $\overline{I}$ and NX are the exogenous variables of the model. A shock of one of these variables causes a variation of income equals to the Keynesian multiplier

$$\frac{dY}{d\overline{I}} = \frac{dY}{d\overline{C}} = \frac{dY}{d\overline{NX}} = \frac{1}{(1 - c(1-t) - \theta)} \tag{2.15}$$

The government can change the government expenditure G, the Net Transfers TR and the income tax rate t. The multipliers are respectively:

$$\frac{dY}{d\overline{G}} = \frac{1}{(1 - c(1-t) - \theta)} \tag{2.16}$$

$$\frac{dY}{d\overline{TR}} = \frac{c}{(1 - c(1-t) - \theta)} \tag{2.17}$$

$$\frac{dY}{dt} = \frac{-c}{(1 - c(1-t) - \theta)^2}[\overline{C} + c\overline{TR} + \overline{NX} + \overline{I} + \overline{G}] \tag{2.18}$$

The impact on government budget is:

$$\frac{dBS}{d\overline{I}} = \frac{dY}{d\overline{C}} = \frac{dY}{d\overline{NX}} = \frac{t}{(1 - c(1-t) - \theta)} \tag{2.19}$$

$$\frac{dBS}{d\overline{G}} = \frac{t}{(1 - c(1-t) - \theta)} - 1 \tag{2.20}$$

$$\frac{dBS}{d\overline{TR}} = \frac{ct}{(1 - c(1-t) - \theta)} - 1 \tag{2.21}$$

[2]This is an optimistic assumption: to consider that the interest rate on the debt is equal to zero.

$$\frac{dBS}{dt} = \frac{(1-c-d)}{(1-c(1-t)-\theta)^2}[\overline{C} + c\overline{TR} + \overline{NX} + \overline{I} + \overline{G}] \tag{2.22}$$

The surplus is:

$$BS = tY - (\overline{G} + \overline{TR}) \tag{2.23}$$

The variation of surplus is equal to:

$$dBS = tdY - d\overline{G} - d\overline{TR} \tag{2.24}$$

For the sake of simplicity suppose that $\theta = 0$. The variation of Equilibrium income is equal to:

$$dY_e = \left(\frac{1}{(1-c(1-t))}\right)[cd\overline{TR} + d\overline{G}] \tag{2.25}$$

and the change in the government Budget Surplus BS is:

$$dBS = t\left(\frac{1}{(1-c(1-t))}\right)[cd\overline{TR} + d\overline{G}] - [d\overline{G} + d\overline{TR}] \tag{2.26}$$

$$dBS = \left(t\frac{1}{1-c(1-t)} - 1\right)[d\overline{G}] + \left(t\frac{c}{1-c(1-t)} - 1\right)[d\overline{TR}] \tag{2.27}$$

$$dBS = \left(\frac{(1-c)(t-1)}{(1-c(1-t))}\right)[d\overline{G}] + \left(\frac{(c-1)}{(1-c(1-t))} - 1\right)[d\overline{TR}] \tag{2.28}$$

$$dBS = \left(t\frac{1}{(1-c(1-t))} - 1\right)[d\overline{G}] \tag{2.29}$$

The change in Government expenditure $d\overline{G}$ has an impact on Budget Surplus less than its amount, being

$$0 \leq \left(t\frac{1}{(1-c(1-t))}\right) \leq 1 \tag{2.30}$$

In other words an increase (or a decrease) in G also causes an increase (or decrease) in the Tax revenue tY equal to $t\frac{1}{(1-c(1-t))}$. The algebraic sum is less than dG.

2.2. Balanced Budget Multiplier

A government can increase spending and taxes keeping the budget in balance. In this case the Government expenditure multiplier has a different value, in another words, the impact of a change in Government expenditure dG on income Y is different.

The variation of Budget Surplus BS is equal to:

$$dBS = tdY - d\overline{G} - d\overline{TR} \tag{2.31}$$

or

$$dBS = \left(\frac{(1-c)(t-1)}{(1-c(1-t))}\right)[d\overline{G}] + \left(\frac{(c-1)}{(1-c(1-t))} - 1\right) d\overline{TR}] \tag{2.32}$$

For $dBS = 0$

$$\left(\frac{(1-c)(t-1)}{(1-c(1-t))}\right)[d\overline{G}] + \left(\frac{(c-1)}{(1-c(1-t))} - 1\right) d\overline{TR} = 0 \tag{2.33}$$

$$d\overline{TR} = (t-1)d\overline{G} \tag{2.34}$$

The change in income can now be considered

$$dY_e = \frac{1}{(1-c(1-t))}[cd\overline{TR} + d\overline{G}] \tag{2.35}$$

and substituting $\overline{TR}$ with $(t-1)d\overline{G}$, the following is obtained

$$dY_e = \frac{1}{(1-c(1-t))}[c(t-1)d\overline{G} + d\overline{G}] \tag{2.36}$$

$$dY_e = \frac{1}{(1 - c(1-t))}[1 - c(1-t)]d\overline{G} = 1 \quad (2.37)$$

This result is known as Haavelmo Theorem (Haavelmo, 1945). When the Government increases spending and taxes keeping the budget in balance, the multiplier is equal to 1.

2.3. The reduction of Government Budget Deficit (keeping Income constant)

In this subsection the case in which the Government reduces its budget deficit, keeping the income constant is considered. Change in income is equal to:

$$dY = \frac{1}{(1 - c(1-t) - \theta)}[d\overline{G} + cdTR] \quad (2.38)$$

and the change in the Budget Surplus is:

$$dBS = tdY - (d\overline{G} + d\overline{TR}) \quad (2.39)$$

For dY=0, it it obtained:

$$d\overline{G} = -cd\overline{TR} \quad (2.40)$$

or

$$dTR = -\frac{1}{c}d\overline{G} \quad (2.41)$$

Substituting this result in the budget surplus equation, it becomes:

$$dBS = (d\overline{G} - \frac{1}{c}d\overline{G}) \quad (2.42)$$

$$dBS = \frac{s}{c}d\overline{G} \quad (2.43)$$

where s=$1-c$. This is the impact of a change in Government expenditure on the budget surplus when income is kept constant.

2.4. The Fiscal Policy Options

In the next scheme, a list of feasible fiscal policy measures as consequence of a negative Investment shock, is shown. As known, a decrease in investment (I↓) causes a reduction of income (Y↓) and of the Government Budget Surplus (BS↓).

It is useful to distinguish two scenarios. In the first one, the budget surplus remains positive, while, in the second scenario, it becomes negative.

In the first case the government can decide to increase income (Y↑) or to do nothing (0)[3]. In the second case the Government can pursue three aims (one more compared with the first one): 1) to increase income (Y↑), to do nothing (0), and to reduce Deficit (BS↑).

The first group includes the Keynesian fiscal Policies [1.], the second group is a "non-intervention" fiscal policy [2.], while the third one is directed to control the Government's Balance [3.].

The Scheme 1 shows this possible list of fiscal policy,

Scheme 2. List of Fiscal Policies

[3]to do nothing is always a political option.

$$I\downarrow\to(Y\downarrow;BS\downarrow)\begin{cases} Aim: Y\uparrow \begin{cases} \textit{single policy}\begin{cases} [1.1.1](G\uparrow)\to(Y\uparrow;C\uparrow;BS\downarrow) \\ [1.1.2](TR\uparrow)\to(YD\uparrow;C\uparrow;Y\uparrow;BS\downarrow) \\ [1.1.3](t\downarrow)\to(YD\uparrow;C\uparrow;Y\uparrow;BS\downarrow) \end{cases} \\ policy-mix\begin{cases} [1.2.1](G\uparrow TR\downarrow)\to(Y\uparrow;C=;BS=) \\ [1.2.2](G\downarrow TR\uparrow)\to(Y\uparrow;C=;BS=) \end{cases} \end{cases} \\ 0 \\ Aim: BS\uparrow \begin{cases} \textit{single policy}\begin{cases} [3.1.1](G\downarrow)\to(BS\uparrow;Y\downarrow;C\downarrow) \\ [3.1.2](TR\downarrow)\to(BS\uparrow;YD\downarrow;C\downarrow;Y\downarrow) \\ [3.1.3](t\uparrow)\to(BS\uparrow;YD\downarrow;C\downarrow;Y\downarrow) \end{cases} \\ policy-mix\begin{cases} [3.2.1](G\uparrow TR\downarrow)\to(BS\uparrow;YD\downarrow;C\downarrow;Y) \\ [3.2.2](G\downarrow TR\uparrow)\to(BS\uparrow;YD\downarrow;C\downarrow;Y) \end{cases} \end{cases} \end{cases}$$

2.5. Some Examples (I): A reduction of the Investment (*with a Government budget still positive*)

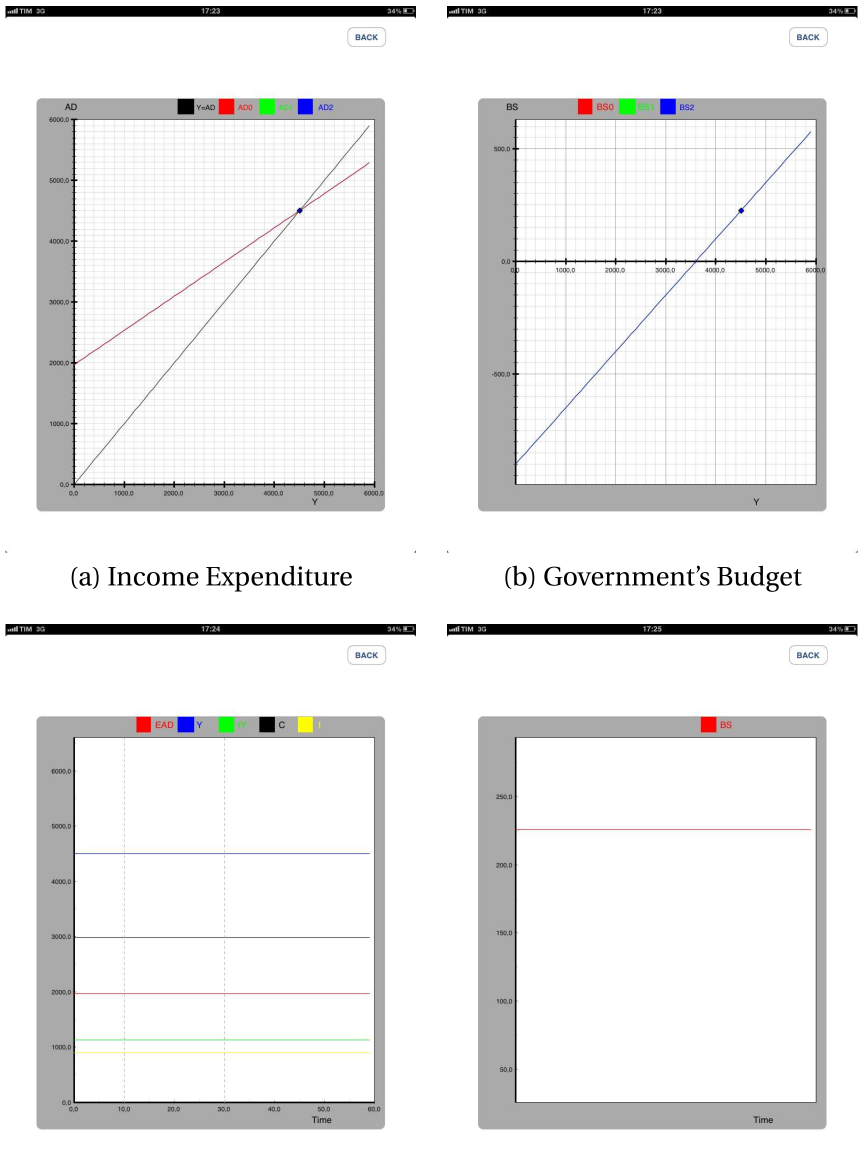
In this section some examples are presented. Each case is represented by a figure that includes 4 graphs: 1) Income - Expenditure Equilibrium, 2) The Government's Budget ($BS = f(Y)$), 3) The variables' dynamic, 4) the Government's budget's dynamic. There is a short comment for Each case. The Figures are taken from the Macro Models' APP.

The history begins from the Equilibrium: a negative shock of the investment causes a reduction of Income and of government budget.

In this first example

Table 2.1: Fiscal Policies

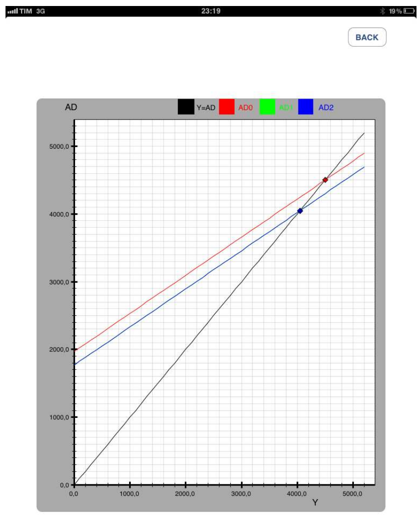
Symbol	t_0	t_1	t_2(I)	t_2 (II)	t_2 (III)	t_2 (IV)	t_2 (V)	t_2 (V)
I_0	900	**700**		700	700	700	700	700
	-	$I\downarrow$	-	$G\uparrow$	$G\uparrow; BS_{>0}$	$TR\uparrow$	$t\downarrow$	$G\uparrow; TR\downarrow$
$\overline{C}$	300	300		300	300	300	300	300
I_0	900	**700**		700	700	700	700	700
NX	-80	-80		-80	-80	-80	-80	-80
c	0.75	0.75		0.75	0.75	0.75	0.75	0.75
d	0	0		0	0	0	0	0
G	700	700		**900**	**811.43**	700	700	**1157.15**
TR	200	200		200	200	**466.6**	200	**-142.15**
t	0.25	0.25		0.25	0.25	0.25	**0.146**	0.25
NMP	0.56	0.56		0.56	0.56	0.56	**0.64**	0.56
K. M	2.29	2.29		2.29	2.29	2,29	**2.78**	**2.29 ; 1**
Y_e	4502.86	**4045.71**		4502.86	**4299.4**	4502.86	4502.91	4502.91
C_e	2982.86	**2725.71**		2982.86	2868.43	**3182.6**	**3182.91**	**2726.84**
I_e	900	700		700	700	700	700	700
BS_e	225.71	**111.43**		**25.71**	**63.86**	**-40.95**	**-40.97**	**111.43**
ΔY	-	**-457.14**		**457.14**	**253.71**	**457.15**	**457.15**	**457.15**



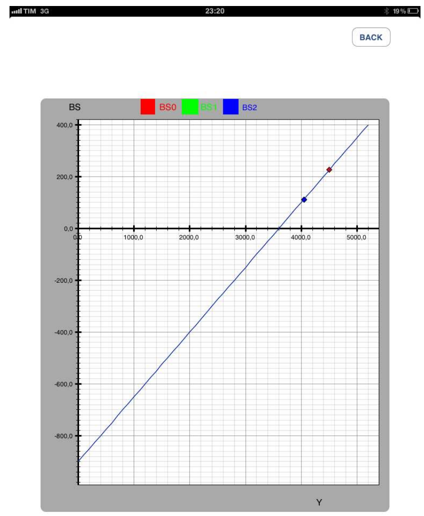
(a) Income Expenditure (b) Government's Budget

(c) Dynamic I (d) Dynamic II

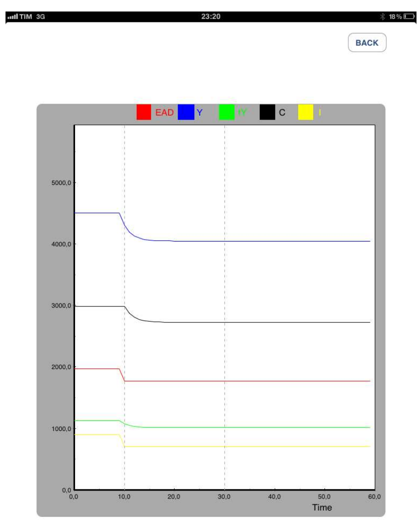
Figure 2.1: At the Beginning of the History



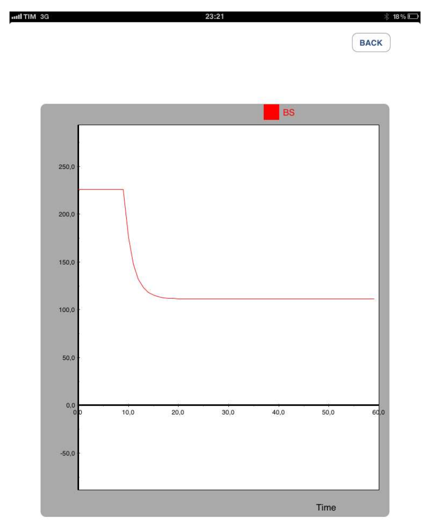
(a) Income Expenditure



(b) Government's Budget

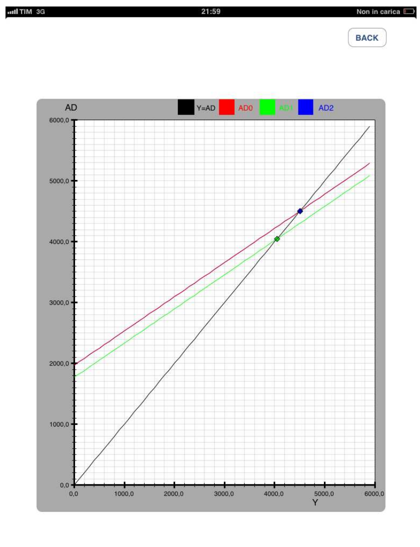


(c) Dynamic I

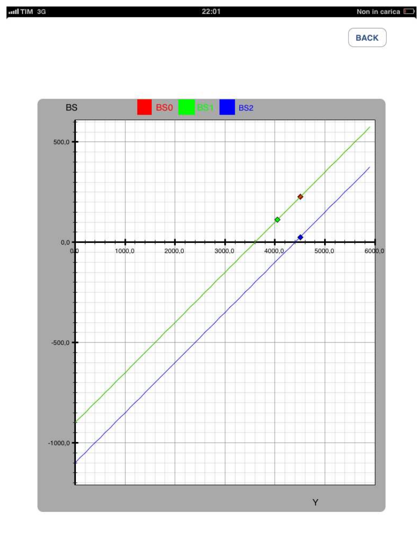


(d) Dynamic II

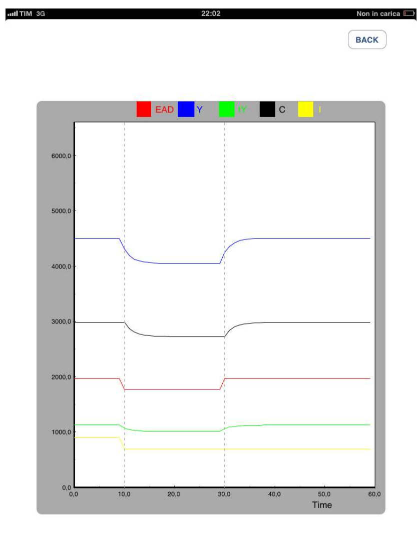
Figure 2.2: Case 1.I A negative shock: $I\downarrow$ and $BS > 0$



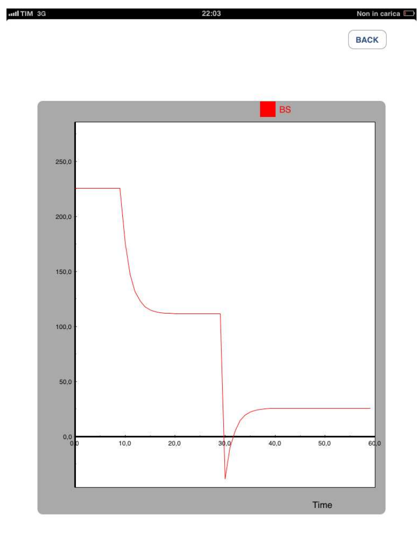
(a) Income Expenditure



(b) Government's Budget

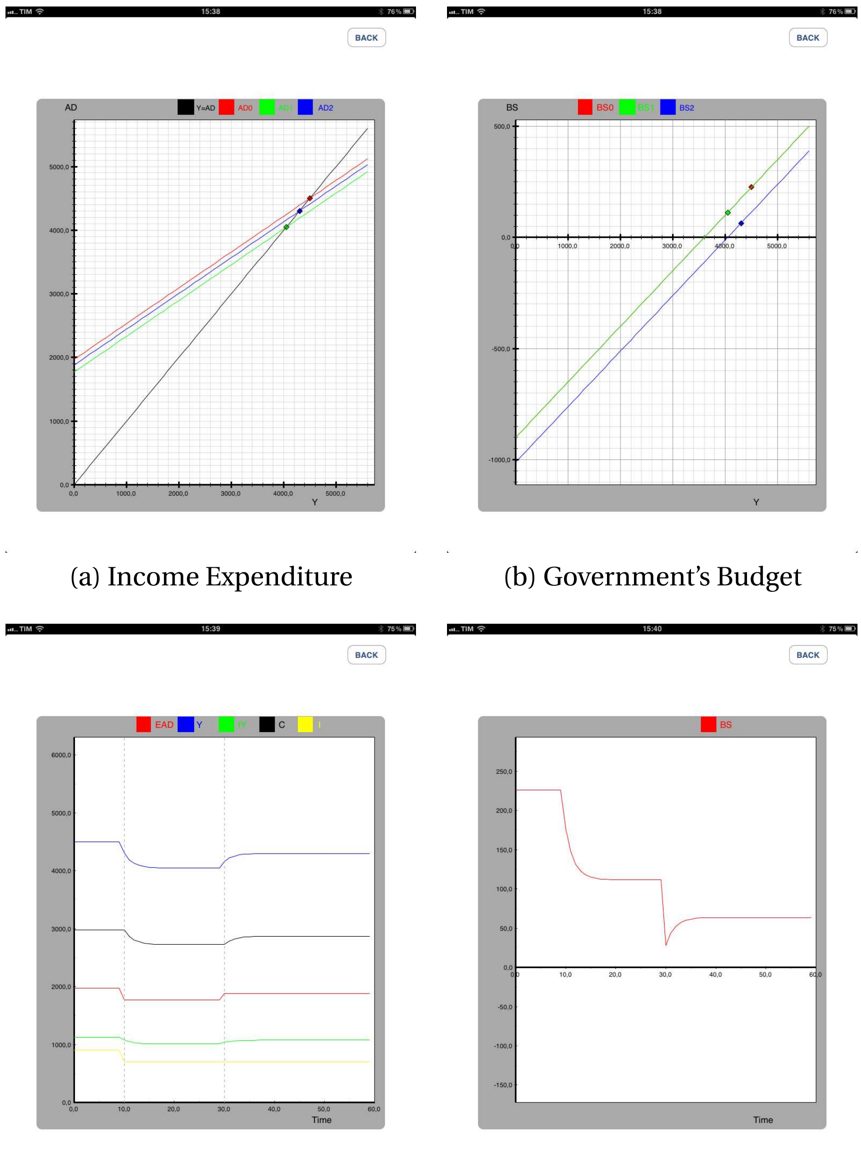


(c) dynamic I



(d) dynamic II

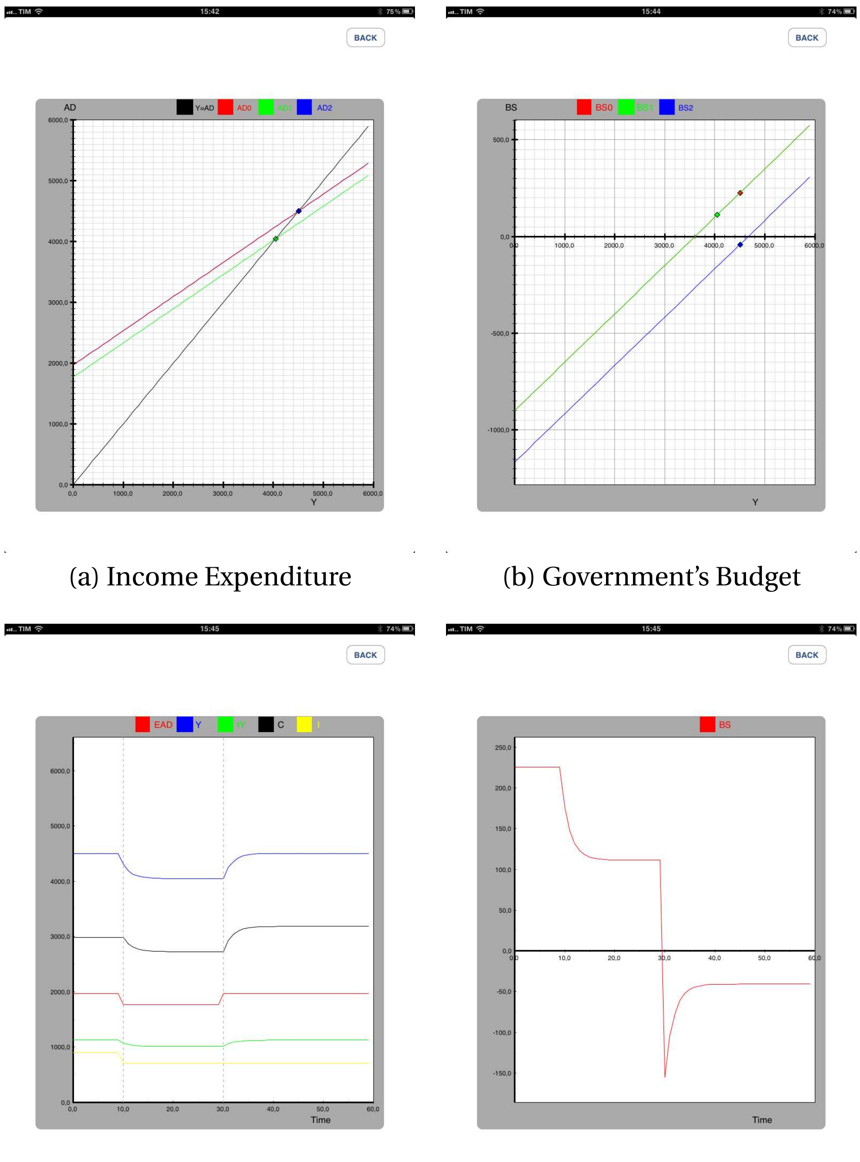
Figure 2.3: Case 1.II. the Keynesian scenarios: I ↓ and G ↑
BS becomes negative for "a while". Y returns at the initial level.



(a) Income Expenditure (b) Government's Budget

(c) dynamic I (d) dynamic II

Figure 2.4: Case 1.III. I ↓ and G ↑
BS is always positive but Y does not return at the initial level.



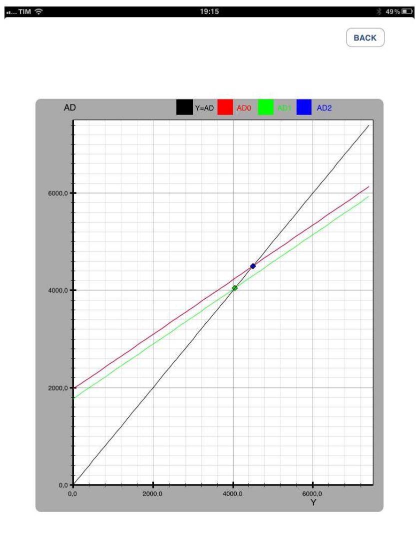
(a) Income Expenditure

(b) Government's Budget

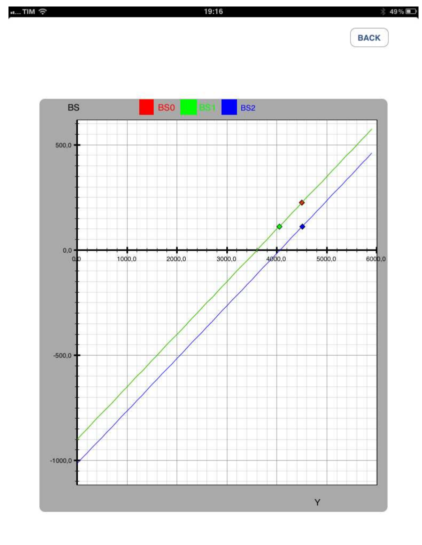
(c) dynamic I

(d) dynamic II

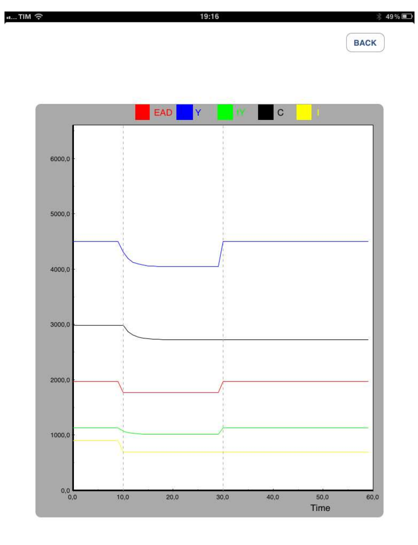
Figure 2.5: Case 1.IV $I\downarrow$ and $TR\uparrow$
$C\uparrow\uparrow$, BS is negative and higher.



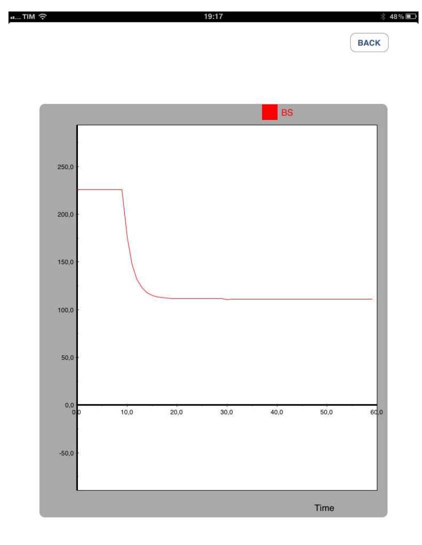
(a) Income Expenditure



(b) Government's Budget

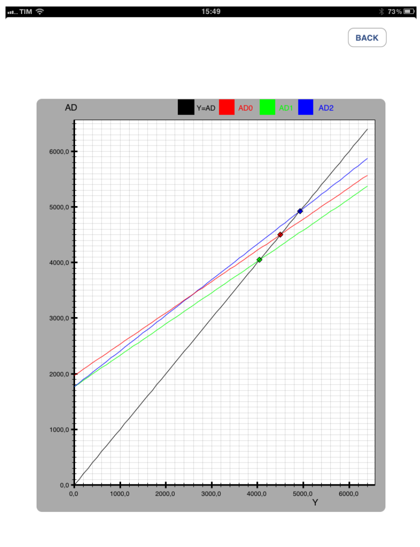


(c) dynamic I

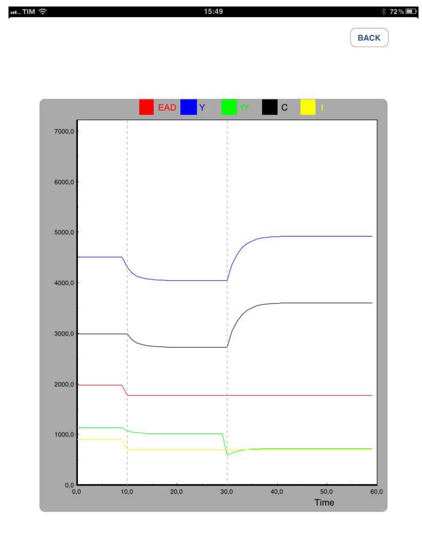


(d) dynamic II

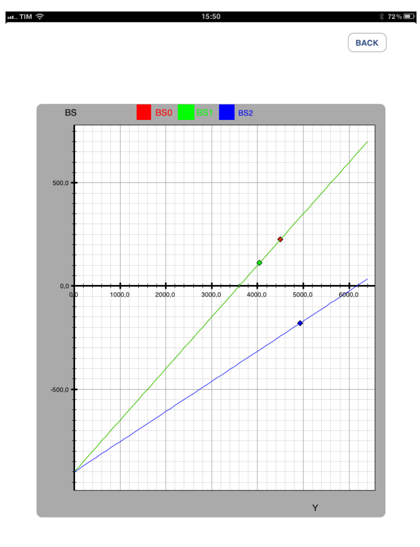
Figure 2.6: Case 1.V. $I\downarrow$. - Haavelmo Theorem - $G\uparrow, TR\downarrow$
BS is constant.



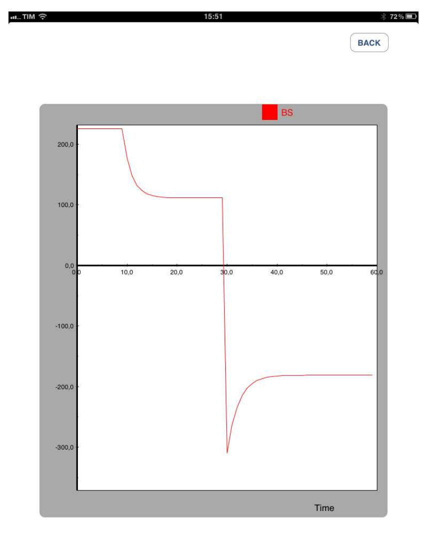
(a) Income Expenditure



(b) Government's Budget



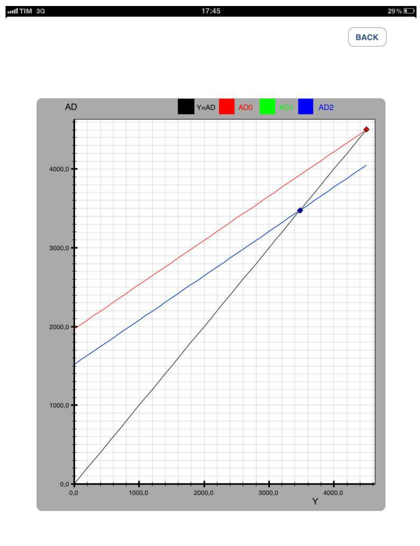
(c) dynamic I



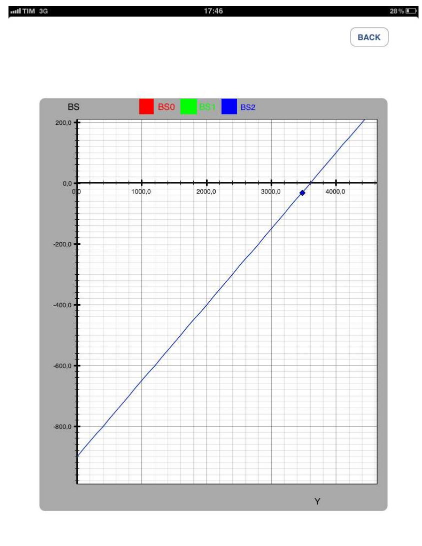
(d) dynamic II

Figure 2.7: Case 1.VI I $\downarrow$ and $TR \uparrow$
$C \uparrow\uparrow$, BS is negative and higher (as Case 1.IV.)

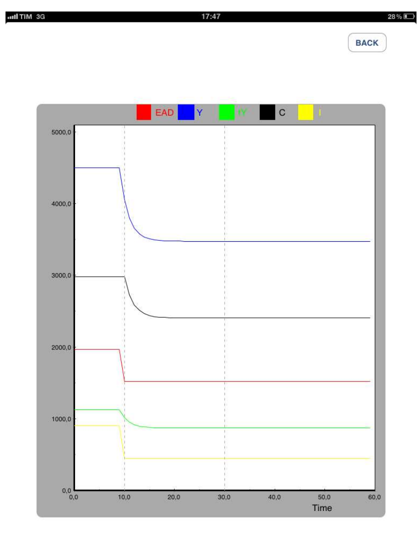
2.6. Some Examples (I): A reduction of the Investment (*with a Government budget that becomes negative*)



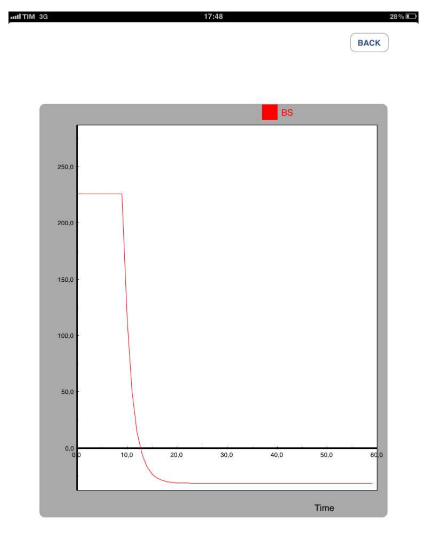
(a) Income Expenditure



(b) Government's Budget

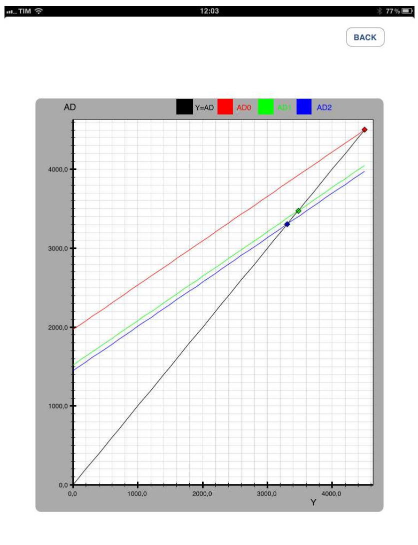


(c) dy

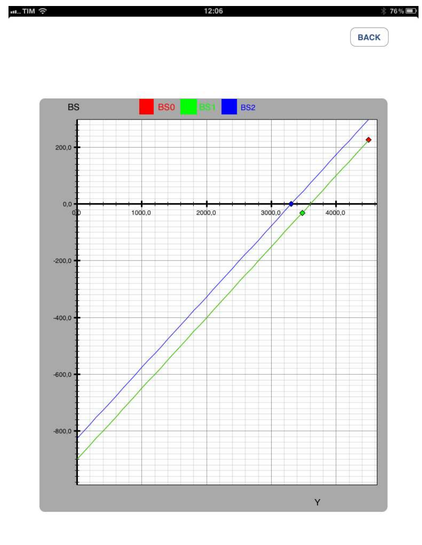


(d) BS

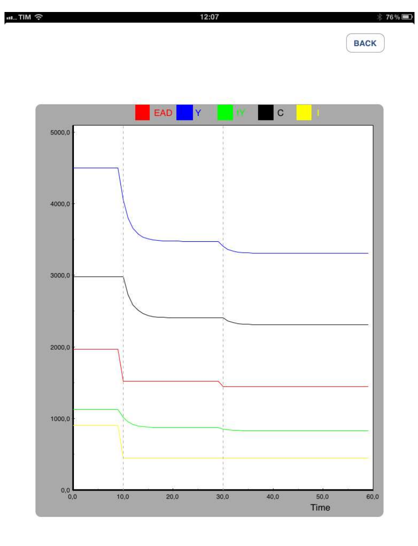
Figure 2.8: Case 2: A negative shock: $I{\downarrow}$ and $BS < 0$



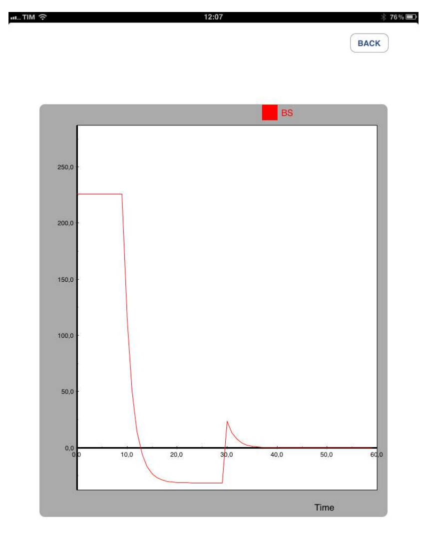
(a) Income Expenditure



(b) Government's Budget



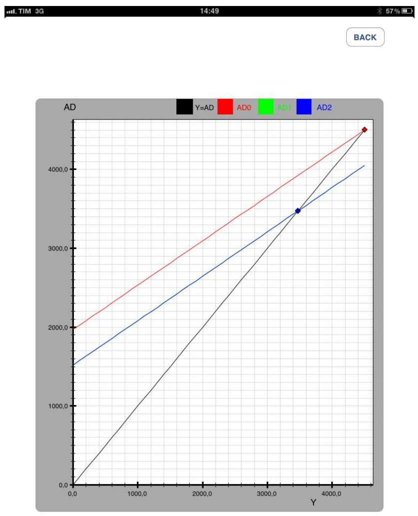
(c) dy



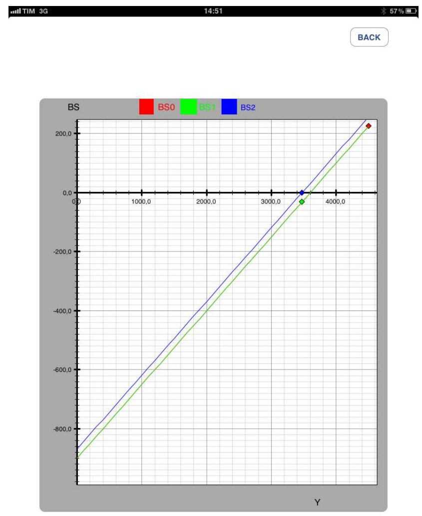
(d) BS

Figure 2.9: Case 2.1: A negative shock: $I \downarrow$ and $BS < 0$.
In order to reduce $BS \rightarrow$0. $G \downarrow$, and also $C \downarrow$ and $Y \downarrow$

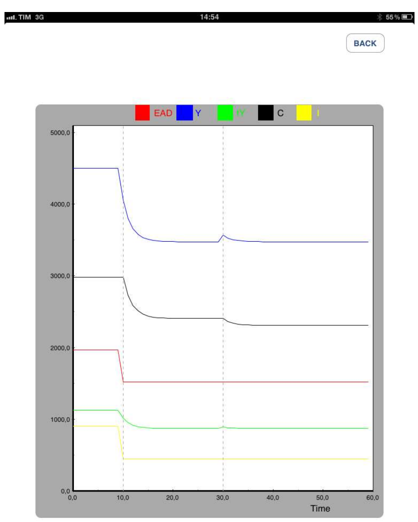
.



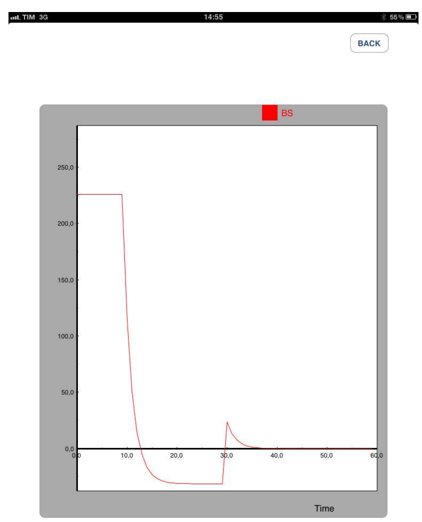
(a) Income Expenditure



(b) Government's Budget



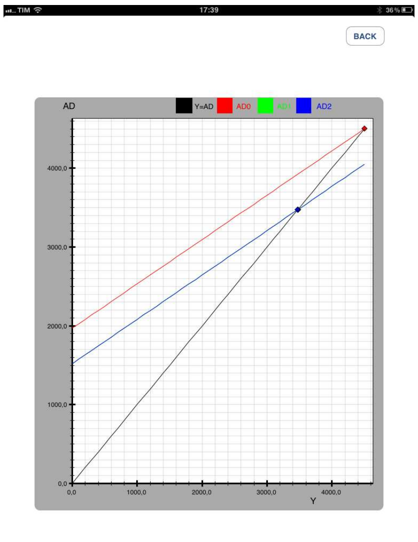
(c) dy



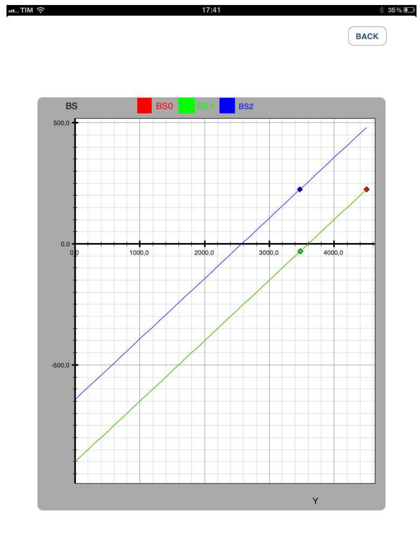
(d) BS

Figure 2.10: Case 2.2: A negative shock: $I\downarrow$ and $BS < 0$.
In order to reduce $BS \rightarrow$0. $G\uparrow$, $TR\downarrow$, $C\downarrow$ but Y remains constant

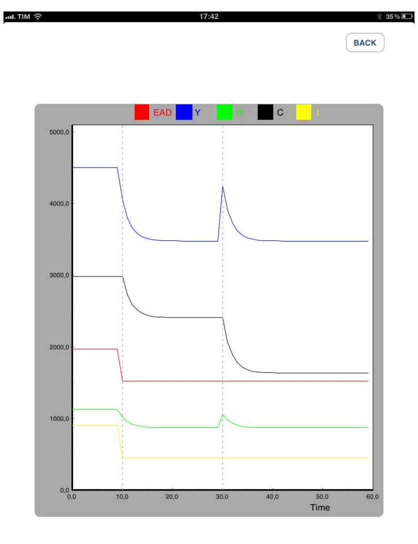
.



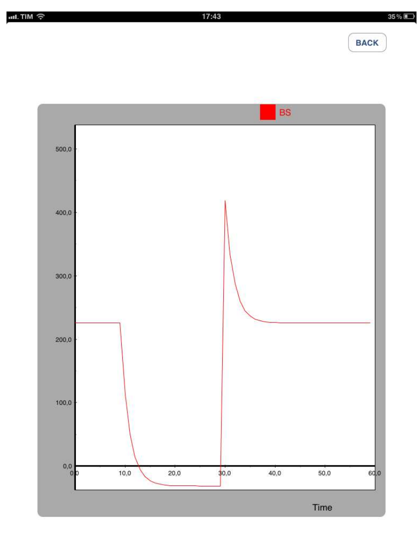
(a) Income Expenditure



(b) Government's Budget



(c) dy



(d) BS

Figure 2.11: Case 2.2: A negative shock: $I\downarrow$ and $BS < 0$.
In order to reduce $BS \to$ "initial value"=225.71, $G\uparrow$, $TR\downarrow$, $C\downarrow$ but Y remains constant

.

2.7. The Income-Expenditure Model I. Legenda

Legenda

Table 2.2: Input

Symbol	Variable / Parameter
$\overline{C}$	Autonomous (exogenous) Consumption
I_0	Net Investment
NX	Net Export
c	Marginal Propensity To Consume
d	Marginal Propensity to Invest
G	Government purchase of goods and services
TR	Net Government Transfers payments
t	Income tax rate

Table 2.3: Output

acronymous	Parameter/Variable	formula
NMP	Net Marginal Propensity to consume	$c(1-t)$
Multiplier	Keynesian Multiplier	$\frac{1}{(1-c(1-t)-d)}$
Eq. Income	Equilibrium Income	Y_e
Eq. Consumption	Equilibrium Consumption	C_e
Balance	Government Surplus	$tY_e - (G+TR)$
ΔIncome	Income Variation	$Y_{e,t} - Y_{e,t-1}$

Table 2.4: Graph

EAD	Autonomous Aggregate Demand
Y	Income
tY	income tax
C	Consumption
I	Investment
D	Government Surplus
B	Government Debt

3. Model II: the Samuelson's Multiplier Accelerator Model

In this version of the model "the Principle of Acceleration" as in Samuelson (1939) is considered. The model assumes that consumption depends on the previous income. In formulas:

$$C_t = \overline{C} + c\overline{TR} + c(1-t)Y_{t-1} \tag{2.44}$$

and the investment on the variation of consumption.

$$I_t = \overline{I} + n(C_t - C_{t-1}) \tag{2.45}$$

In this case it is possible to write:

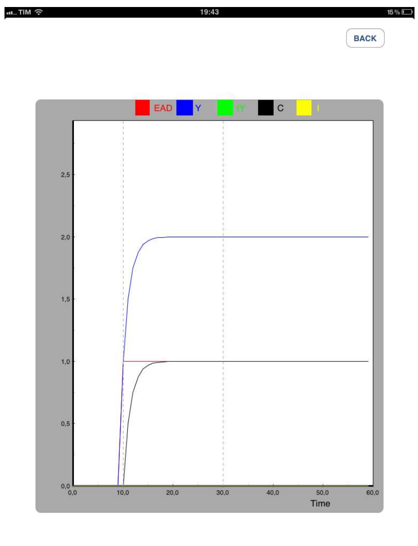
$$I_t = \overline{I} + nc(1-t)(Y_{t-1} - Y_{t-2}) \tag{2.46}$$

or

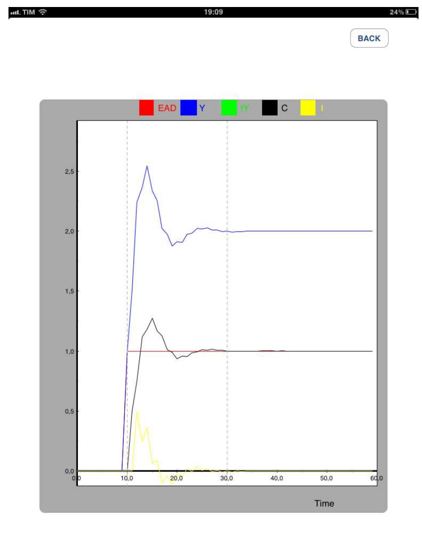
$$I_t = \overline{I} + \phi dY_{t-1} \tag{2.47}$$

where ϕ=$nc(1-t)$.

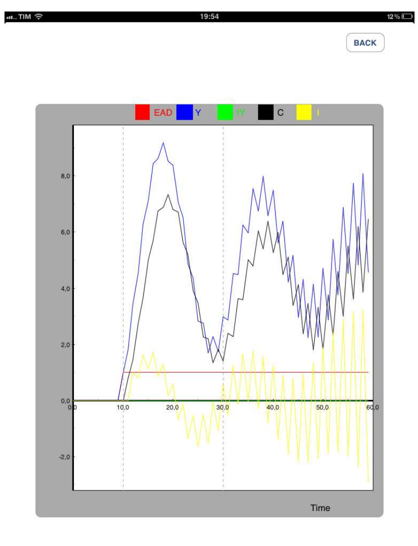
For $\phi > 0$ the APP shows only the dynamic results. Hereafter, some examples are reported.



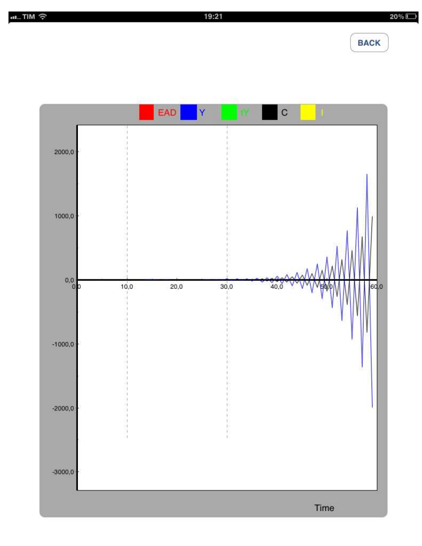
(a) c=0.5; n=0; ϕ=0, t=0



(b) c=0.5; n=0.98; ϕ=0.49, t=0



(c) c=0.8; n=1.25; ϕ=1, t=0



(d) c=0.6; n=2; ϕ=1.2, t=0

Figure 2.12: Case 3: Some Examples

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3.1. The Income-Expenditure Model II. Legenda

Legenda

Table 2.5: Input

Symbol	Variable / Parameter
$\overline{C}$	Autonomous (exogenous) Consumption
I_0	Net Investment
NX	Net Export
c	Marginal Propensity To Consume
ϕ	Accelerator parameter
G	Government purchase of goods and services
TR	Net Government Transfers payments
t	Income tax rate

..

Table 2.6: Output

acronymous	Parameter/Variable	formula
NMP	Net Marginal Propensity to consume	$c(1-t)$
Multiplier	Keynesian Multiplier	$\frac{1}{(1-c(1-t)-d)}$
Eq. Income	Equilibrium Income	Y_e
Eq. Consumption	Equilibrium Consumption	C_e
Balance	Government Surplus	$tY_e-(G+TR)$
∆Income	Income Variation	$Y_{e,t}-Y_{e,t-1}$

.

Table 2.7: Graph

EAD	Autonomous Aggregate Demand
Y	Income
tY	income tax
C	Consumption
I	Investment
D	Government Surplus
B	Government Debt

4. Model III: Income-Expenditure Model in an Open Economy

In this model Exports $(\overline{X})$ are assumed to be exogenous:

$$X = \overline{X} \tag{2.48}$$

while Imports are partly exogenous $\overline{M}$ and partly depend on Income Y.

$$M = \overline{M} + mY \tag{2.49}$$

where $m > 0$ is the marginal propensity to import.
Net exogenous Exports $(\overline{NX})$ are:

$$\overline{NX} = \overline{X} - \overline{M} \tag{2.50}$$

and Net exogenous Exports $(\overline{NX})$ are:

$$NX = \overline{NX} - mY \tag{2.51}$$

or

$$NX = \overline{X} - \overline{M} - mY \tag{2.52}$$

Now the system becomes:

$$Y = AD$$

$$AD = C + I + G + X - M$$

$$C = \overline{C} + cTR + c(1-t)Y$$

$$I = \overline{I}$$

$$G = \overline{G}$$

$$TR = \overline{TR}$$

$$X = \overline{X}$$

$$M = \overline{M} + mY$$

The equilibrium is given by:

$$Y = C + c\overline{TR} + I + G + \overline{X} - M \tag{2.53}$$

$$Y = \overline{C} + c\overline{TR} + c(1-t)Y + \overline{I} + \overline{G} + \overline{X} - \overline{M} - mY \tag{2.54}$$

Net Marginal Propensity to Consume in a open Economy is

$$NMP = c(1-t) + m \tag{2.55}$$

The Multiplier is equal to:

$$\frac{1}{1-c(1-t)+m} \tag{2.56}$$

It is smaller than the multiplier in a closed economy. This means that the stabilization policies in an open economy is more expensive because in order to reach the same level of income a higher level of public spending is needed.

The Equilibrium levels respectively are:

Income:

$$Y_e = \frac{1}{1-c(1-t)+m}[\overline{C} + c\overline{TR} + \overline{I} + G + \overline{X} - \overline{M}] \tag{2.57}$$

Consumption

$$C_e = \overline{C} + c\overline{TR} + c(1-t)Y_e$$

Budget Surplus:

$$BS = tY_e - (G + TR) \tag{2.58}$$

Net Exports:

$$NX = \overline{X} - \overline{M} - mY_e \tag{2.59}$$

4.1. The Income-Expenditure Model III. Legenda

Legenda

Table 2.8: Input

Symbol	Variable / Parameter
$\overline{C}$	Autonomous (exogenous) Consumption
I_0	Net Investment
NX	Net Export
c	Marginal Propensity To Consume
m	Marginal Propensity To import
G	Government purchase of goods and services
TR	Net Government Transfers payments
t	Income tax rate

Table 2.9: Output

acronymous	Parameter/Variable	formula
NMP	Net Marginal Propensity to consume	$c(1-t)$
Multiplier	Keynesian Multiplier	$\frac{1}{(1-c(1-t)-d)}$
Eq. Income	Equilibrium Income	Y_e
Eq. Consumption	Equilibrium Consumption	C_e
Eq. Investment	Equilibrium Investment	I_e
Net Export	Net Export	NX_e
Balance	Government Surplus	$tY_e - (G + TR)$
ΔIncome	Income Variation	$Y_{e,t} - Y_{e,t-1}$

Table 2.10: Graph

EAD	Autonomous Aggregate Demand
Y	Income
tY	income tax
C	Consumption
I	Investment
D	Government Surplus
B	Government Debt

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