Mass Balance Diagrams in Macroeconomics

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Abstract

This study proposes a material balance approach to teaching the IS-LM model. It introduces an easy to visualize box diagram approach for representing the goods market equilibrium, where all the income & expenditure components are simultaneously visible. Similarly, for the money market it introduces line-diagrams to visually represent the demand & exogenous supply of real liquidity. The material balance diagrams can be used to demonstrate shifts in IS and LM curves, as well as show the impact of monetary and fiscal policy on all components of the goods & money markets at the same time. The ability to simultaneously depict the interplay of many variables enables these diagrams to overcome the limitations of two-dimensional graphs which can tackle only two variables at a time.

Keywords: International Business, Macroeconomics, IS-LM, Teaching Pedagogy, Visual Diagrams

JEL classification: A22; A23;

1. INTRODUCTION

Macroeconomics is concerned with the structure, performance and behavior of the economy as a whole. In particular, macroeconomic analysis seeks to explain the cause and impact of short-run fluctuations in GDP (the business cycle) and the major determinants of the long-run path of GDP (economic growth) (Snowdon and Vane (2005)). The subject matter of economics is gaining more influence in understanding the dynamics of any country and its socio-political decisions. Therefore, it is essential to help the students think independently about real-world situations in terms of macroeconomic intuition and the underlying logic that forms its basis.

The nexus between the economy and industry is widely accepted, and it therefore generates the need for teaching economics even in fields like management education, with focus on developing the problem solving and critical thinking ability of the students in an industrial set up. Macroeconomics for managers by Evans (2003) states that none of the firms are out of the influence of business cycles and all the corporate strategies are prone to the impact of changing economic data, central bank policies and international market fluctuations. Shughart II et al. (1994) suggest that the wide range of decisions taken by managers must rely on economic theory. O'Rourke (1998) identifies six themes on the relevance and role of economics in business administration education and shows how economics improves or provides a perspective in understanding the international business problems. Empirical work by Grimes and Niss (1991) also emphasize the role of economics in the business education curriculum.

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However, several studies also state that economics is an unpopular subject among management students and even economics core students find it tough to follow. Healey (1993) through a questionnaire study among MBA students, suggests 'that they typically find economics courses abstract, excessively theoretical and mathematical'. This could probably be because economics as a subject needs continuous learning whereas management programs have very tight schedules. Gregory Mankiw (2019) observes that 'economics is a hard subject for many people, and they may need to hear the basic principles a few times before they internalize them all.'

Over the years, various teaching techniques were advocated by many scholars. These approaches vary from simplistic diagrammatic approaches to advanced technical analysis like simulated environment learning. Shapiro et al. (1999) observes that for making the student better decision maker, they need not be saddled with mathematics. Serious analysis can be established using simple logic and real world examples. To quote Irving Fischer: "say it in words, demonstrate it in graphs and tables, and if technical details are needed, place them in appendices or provide references". Visualization is established by several studies as a key to understanding and processing of information. Bamford and Greatbanks (2005) state that teaching through visualization practices can help highlight complex data in simple, visually powerful ways, and establish relationships between variables. Visual images can range from detailed graphical representations (such as pictures and photographs) to abstract schemes, diagrams, graphs and mind maps (Makarova et al. (2017))[3]. Diagrams and charts help the students in retaining the difficult concepts and in applying them as and when required.

In the learning process of macroeconomics, the IS-LM model remains the fundamental building block. Effective learning & teaching of the IS-LM model is therefore both important and critical. King (2000) gives a brief insight into the growth of the IS-LM model as a concept and its importance in the monetary policy framework over the years. The first variant of IS–LM model was developed by Hicks (1937) to explain the relationship between interest rate and output. Modigliani (1944) subsequently introduced the aggregate production function and the labor market. These models assumed constant prices, and later Phillips curve and its implications on inflation got incorporated[4].

Taylor (2000) notes that the two main objectives of any macroeconomic curriculum should be simplicity of concepts (understandable) and practicality in generating useful policy implications. Since the macro economy is a continuous interaction of multiple variables, two-dimensional graphs are not able to completely capture the interplay between all the variables. This calls for the need for a new visual approach to teach this complex interplay of a large set of variables. In this study, we propose a new teaching method for the IS-LM model using material balance

[3]Berinato (2016) in his Harvard Business Review article – 'Visualizations that really works' argues that visual communication is a must – have skill for all managers. Clarke III et.al. (2006) studies the relevance of visual summary as a teaching technique in marketing and observes that around 40 percent of the students belong to the category of visual learners

[4]The rational expectation approach due to Lucas Jr (1977) & a new macroeconomic framework developed by Sargent and Wallace (1975) led to the Phillips curve being replaced by a new version of the aggregate supply curve.

diagrams as is used in engineering. The main feature of this approach is its ability to visually capture the key fundamentals of the IS-LM model through material balance diagrams. This method has been successfully deployed by the authors in teaching Macroeconomics to MBA students for the past six years in a top business school in India.

To depict the goods market equilibrium (IS curve), this approach employs a box diagram to depict the production of goods/services in an economy due to value-adds by different factors of production and the allocation (demand) of those goods/services between the different expenditure components. The learners can therefore keep track of all income & expenditure components at the same time through this visual approach. Additionally, the box diagram can demonstrate shifts in IS curve due to changes in government expenditure or net exports by increasing/decreasing the areas under those heads. Along similar lines, the money market equilibrium (LM curve) is depicted using line diagrams which visually depict the transaction demand for real liquidity which must match the exogenous supply of real liquidity. The IS-LM equilibrium is shown by integrating the box & line diagrams. This study goes further in then demonstrating how this setup can be used to explain the impact of fiscal & monetary policy on all components of the goods & money markets at the same time. Finally, this framework is extended to an open economy setting with flexible exchange rate, to visually depict the impact of monetary policy on goods, money and dollar markets respectively.

Literature: Economics teaching

Becker (1997) provides a summary of the evidence on teaching economics to undergraduates. It points out that instructional methods do matter in the efficient understanding of the subject. Becker (2000) focuses on what to teach, how to teach and the analysis of educational performance. He identifies two types of pedagogy that suits the teaching of economics: active participation of students through engaging discussions/games/assignments; use of technology in the classroom. Erekson et al. (1996) cite challenges in the design of an intermediate macroeconomics curriculum, and in stimulating active participation of the students. Truscott et al. (2000) suggest an experiential learning pedagogy that encourages real-world activities with students as decision-makers. Wuthisatian and Thanetsunthorn (2019) propose a class project with a set of empirical exercises integrated with simple econometric methods for three levels of macroeconomics. Wheat Jr (2007) makes the dynamic feature of an economy more understandable using casual loop diagrams and computer simulation methods. Flow charts are a widely accepted teaching method in many disciplines. Reingewertz (2013) tries to include flow charts into the standard IS-LM, AD-AS models. Ray (2018) adopts the case-method mode for teaching economics while Zhang and Ramse (2021) point out the importance of incorporating economic events like toilet paper shortage, negative crude oil price, and unemployment hike etc into the classroom curriculum.

2. DIAGRAMMATIC LEARNING OF MACROECONOMICS

This paper explains how a different and simple diagrammatic method can be used to teach basic macroeconomic models. Step by step changes on a diagram are elaborated here to show the development of the IS-LM model for the closed economy as well as the open economy.

The diagrammatic method uses a rectangular box that represents the total size of an economy (Y) in period 't' (like Fig. 4). The right-hand side and the left-hand side of the box diagram represent the expenditure side and the income side respectively. On the left-hand side, the rectangular box can be partitioned into the components of income variables (households' income and government's income) and on the right-hand side it can be partitioned into components of expenditure variables (household consumption expenditure (C), private investment (I), government expenditure (G) and net exports (NX)). Changes in the equilibrium size of the economy (Y) is shown through the expansion or contraction of the rectangular box and the area of the corresponding subdivision of the variable that results in the movement of Y will also change accordingly. Arrows are used on either side of the box to represent the magnitudes of the variables. Additional or exogenous factors are shown in words or symbols outside the box. This paper progresses by showing how these diagrams can be used to teach the IS-LM model.

2.1 Circular Flow

The basic economic units of an economy are households and firms (ignoring the government for now). All individual decision-makers come under households while the production units of goods and services are known as firms. It is the continuous interaction of these units that makes the economy run. This interaction of households and firms is the circular flow of the economy. The households provide the firms with the inputs for production: land, labor, capital & organization; which in turn the firms use to create the final output in the form of goods and services. The households demand these goods & services from the firms in exchange for the incomes earned. Along with the flow of real inputs/output, there is a parallel-flow of incomes. Firms pay rent, wages, interest & profits, in return for the value adds provided by the households and households use these incomes to buy the final output. This circular flow is traditionally explained using a flow chart (Fig.1). The boxes represent the households and the firms in the economy and the arrowheads show the movement of goods and services and of nominal income. The real flow is shown through the inner circle and the outer circle represents the nominal flow of income. Understanding this circular flow is important as the next step of this teaching method takes into account these two aspects of the economy.

2.2. Income Side: Households & Government

Economic models are often far away from the real economy but they do help in drawing reasonable results and predictions. And economic models have a hierarchical structure. In this section, we depict the income side of an economy through a diagrammatic approach, first without the government and then by introducing the government. The rectangular box[5] in Fig. 2(a) represents the total amount of goods & services produced in the economy by the factors of production. We assume that all factors of production are domestically located and no foreign factors are present within the economy. We also ignore depreciation, and hence the total incomes earned by the factors of production are equal to the total value of goods/services produced in the economy. Fig. 2(b) introduces the government, where it collects TA amounts of lump-sum direct

[5] It is an alternate 90 degree counterclockwise rotated view of the income side of the diagram shown in Fig. 1

taxes[6] and returns TR amounts of transfers[7]. Therefore, the total income in the economy (Y) can now be broken up into households' disposable-income (Yd) and government's effective tax income (taxes minus transfers). We assume a broader definition of a household where it includes shareholders of firms & non-profits, and also assume that the firms' retained earnings can be considered as part of households' disposable income since they are the owners.

The households use the disposable income (Yd) either for consumption (C) or savings (S). On the other hand, government's earnings are in the form of lump-sum taxes (TA)[8]. Since the government returns some of its earnings in the form of transfers (TR), effectively it collects $T' = T\,A - T\,R$ amount of taxes. In the diagram depicting the income side (Fig. 2(b)), the effective taxes collected by the government is represented by T' which is the amount of taxes received by the government (TA) minus the government's transfer payments (TR). The components of the income side of the economy are shown on the left hand side of the diagrams in Fig. 2. So the total output & income (Y) of the economy is the sum of household disposable income (Yd) and effective taxes ($T' = T\,A - T\,R$) where the length of the rectangle is Y.

$$Y = Y\,d + T' \quad \text{where} \quad Y\,d = S + C \quad \& \quad T' = T\,A - T\,R \qquad (1)$$

2.3. Expenditure Side: Consumption, Investment, Net Exports & Government Purchases

While the income approach allocates the claims on the goods/services produced in the economy to the two entities (households & government), the expenditure approach shows the demand (end users) of the produced output[9]. Here, the right hand side of the box[10] in Fig. 3 represents the different components of the expenditure side: households' demand for consumption goods/services (C), firms' gross investment demand (I)[11], government's purchases[12] (G) and net exports which is exports minus imports[13] (NX). Therefore, when inventories are stable, for an economy in equilibrium, the total demand for goods & services is equal to the total production (and income) Y. Hence, the given identity is:

$$Y = C + I + G + NX \qquad (2)$$

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[6] includes personal income tax, corporate income tax, other direct taxes, non-tax payments & social security contributions. We ignore indirect-tax earnings of the government.

[7] includes subsidies, pension payments and interest payments on past borrowings

[8] In reality taxes are a distortion in the circular flow and may not accurately represent the value add of the government. Taxes also have a redistributive component to them. Here, for the sake of explanation we will assume that taxes are government's income in lieu of its value-add.

[9] we ignore labor market dynamics and assume that the economy has surplus labor & capital to meet the demand

[10] It is an alternate 90 degree counterclockwise rotated view of the expenditure side of the diagram shown in Fig. 1

[11] includes unsold inventory apart from fixed capital and residential structure. We assume zero depreciation so gross and net investments are the same

[12] of public goods from its legislators, judiciary, defense & administrative personnel apart from purchases of capital equipment

[13] In a closed economy setup, we will assume it to be zero. In Section 4, we will assume positive NX along with foreign exchange market.

Fig. 3 depicts that when inventories are stable and the economy is in equilibrium (identity 2), the total production (or output) of an economy (Y) is either bought by households as part of consumption expenditure C, or bought by firms as part of investment expenditure I, or purchased by government as part of government expenditure G, or bought by the foreign sector as net exports NX (=X-M). Fig. 3 also shows the extent of government borrowing to fund its expenditure G where its earnings post transfers is T' (=TA-TR) and expenditure is G, leading to a borrowing in that period of G-T'.

2.4. Using Expenditure & Income sides to derive the Private Savings Identity

The private savings identity presented below can be derived using Identities 1 & 2. Fig. 4 integrates the income and expenditure sides of an economy in equilibrium to depict the relation between private savings and the other terms. Private savings is households' disposable income (Yd) minus households' consumption expenditure (C). Private savings is the amount of goods and services which the households can potentially consume from their disposable incomes but do not consume. The left side of Fig. 4 presents the savings S of the households (LHS of identity 3). The right side of Fig. 4 shows that the goods & services not consumed by the households are borrowed by three entities: firms to incur investment expenditures (I), borrowed by foreign sector as depicted by NX, borrowed by the government because of its excess spending over and above its earning as depicted by G-T'. For an economy at equilibrium the terms on LHS & RHS are equal.

$$S = I + NX + (G - T') \qquad (3)$$

As part of their savings, the households hold financial assets in the form of government securities, corporate bonds/stocks & foreign currency/securities for their lending to the government, private businesses and the foreign sector respectively.

2.5. Representing the Goods Market Equilibrium: IS Curve

The IS curve is the combination of interest rates[14] (i) and output (Y) at which the goods market is in equilibrium (goods demanded is produced). This paper tries to explain this concept through the box diagram. To show the dynamics in the relationship between the interest rate[15] (i) and income (Y), blank space is left between the consumption (C) segment[16] and the rest of the segments in the box diagram presented in Fig. 5. Any increase in government purchases (ΔG) or

[14]We assume a static model with no dynamic variable of inflation. One or two price adjustments is different from continuous change in prices (therefore we assume zero inflation). Hence real & nominal interest rates are equal.

[15] . we assume zero inflation so nominal & real interest rates are same

[16] consumption is assumed to be a function of disposable income, Yd. Therefore, C =C0 +cYd where c is the marginal propensity to consume. Therefore, we assume household savings to not depend on interest rates. This can be justified based on the weak empirical evidence of savings depending on interest rates, given different income effects on net borrowers & savers in an economy.

net exports (ΔNX) or investment (ΔI) can be accommodated in this area. Any change in the consumption (ΔC) can be shown below box area for consumption C.

IS curve

The initial level of the economy is represented using the box outlined with black color. In Fig. 5, the black outlined boxes represent the initial economy with output Y and interest rate i. From the initial equilibrium, if there is a decrease in the interest rate in the economy from i to i', it generates additional investment demand ($\Delta I = I(i') - I(i)$), since borrowing costs for firms fall, which leads to increased investment demand. An additional chemical plant or car manufacturing unit installed by the economy will increase incomes for the firms which manufacture and install these plants, which means higher incomes for households through additional wages, profits, rent. This in turn will trigger additional consumption demand $\Delta C_1 = c\Delta I$ (c is marginal propensity to consume) since ΔI is additional disposable income (since we assume lump-sum taxes). This additional consumption demand of ΔC_1 for food, consumer durables, services etc will lead to additional incomes for other firms engaged in the provisioning of these goods & services. This will further trigger additional consumption demand of $c^2\Delta I$ through the multiplier effect. Therefore the total increase in consumption demand $\Delta C = c\Delta I + c^2\Delta I + c^3\Delta I + ...$ (infinite terms).

In Fig. 5 the increase in investment demand ΔI is represented by drawing an additional box outlined with red color in the space below I, and the additional consumption demand (ΔC) is shown in the same manner below the consumption segment. The ΔC is the sum of all the additional consumption demands which is illustrated in the diagram through different boxes. The resulting expansion in demand (and therefore production at equilibrium) in the economy increases to Y' which is visually demonstrated as the sum of ΔI & ΔC. In the graph in Fig. 5(b), the initial equilibrium is represented by point E (i,Y) and the new equilibrium is denoted by E' (lower i, higher Y). This is the downward sloping IS curve.

Shift in IS curve

The effect of an increase in government expenditure by ΔG from the initial equilibrium is demonstrated in Fig. 6. This expansion in government purchases in the form of commissioning of an additional highway or railway line will lead to additional ΔG as incomes for economic entities engaged in the construction of that highway or railway line. This will trigger additional consumption demands of $c\Delta G$, $c^2\Delta G$, $c^3\Delta G$ (through the multiplier channel) as depicted in Fig. 6. Therefore, the net expansion in demand (and output) will be $\Delta Y = \Delta G + \Delta C$. The new output $Y' = Y + \Delta Y$ happens without any change in interest rate (old interest rate i).

In the graph (Fig. 6(b)) the new point is depicted by E' which corresponds to the higher output (Y') and original interest rate (i). Similar shifts in IS curve can happen due to expansion of net exports by ΔNX. The mechanism of expansion will be similar, leading to a parallel outward shift of the IS curve.

2.6. Representation of Money Market: LM Curve

The next step is to develop the LM curve through a similar visual tool. LM curve is the combination of interest rates and sizes of the economy such that demand for real liquidity is

equal to the supply of real liquidity i.e. the money market clears. Instead of the box diagram, the real money demand and the real money supply are represented using line diagrams. Fig. 7 presents the demand for real money balances, Md/P (Md is nominal money demand & P is aggregate price level) for changes in interest rates and the size of the economy.

Money demand vs. interest rates: Fig. 7 (a) shows that the money demand falls as interest rates rise even when the size of the economy (Y) is unchanged. According to Baumol – Tobin analysis on transaction demand for money, the demand for real money balances fall as interest rates rise as economic entities are willing to hold fewer liquid assets (like bonds) which they can later convert to money by incurring a transaction cost (TC). Therefore, $\partial(Md/P)/\partial i < 0$. Fig. 7 (a) shows that as interest rates rise, Md/P falls and bond holdings increase, even when the total real transactions done by the economy (Y) is the same.

Money demand vs. size of economy: Fig. 7 (b) on the other hand shows that as the size of the economy doubles (from Y to 2Y), both real money demand as well as bond demand increase even when interest rates are unchanged. It is known that $\partial(Md/P)/\partial Y > 0$ as per the Baumol-Tobin equation, which is depicted diagrammatically in the figure. The red line in Fig. 7 (b) shows the additional real money demand ($\Delta Md/P$) as a result of increase in the size of the economy (from Y to 2Y).

LM curve: Fig. 8(a) left-panel shows the money market equilibrium where the real supply of money Ms/P (exogenously supplied by central bank) is equal to the real money demand for a given interest rate i1 & size of the economy Y.

The right panel of Fig. 8(a) shows two scenarios when the size of the economy doubles to 2Y:
1) when interest rates remain at previous level i1. Here, due to the increase in demand for transactions (bigger size of economy) the real money demand increases by $\Delta(Md/P)$ (which is depicted in red) and therefore becomes higher than the money supply (shown in left panel).
2) However, since money supply is constant at Ms/P the real money demand has to match it. As a result, interest rates increase to i2 which shrinks the money demand such that it matches supply.

The second figure (in right panel) shows the new interest rate i2, size of economy (2Y) combination at which real money demand is equal to the exogenous level of money supply. Fig. 8(b) shows the two equilibrium on the graph E (i1, Y) and E'(i2, 2Y) at which real money demand is equal to the exogenous level of money supply Ms/P. This is called the upward sloping LM curve, which is the combination of all (i,Y) such that real money demand matches the original externally determined real money supply.

Shift in LM: Fig. 9(a) left panel shows the initial money market equilibrium at interest rate i1 & size of the economy Y. The right panel in Fig. 9(a) shows the effect of central bank increasing the money supply by $\Delta Ms/P$ using Open Market Operations. The money demand also expands by $\Delta Md/P$ as the rest of the economy re-balances its financial portfolio by selling the bonds to the central bank which does an open market purchase. As a result the bond prices rise, and interest rates which are inversely proportional to bond prices, fall to i2. The same is depicted in the right panel of the figure where the new money demand at interest rate i2 equals the higher

money supply. As a result, the economy moves from the point (i1, Y) to (i2, Y) as also depicted through the down-shift of the LM curve in Fig. 9(b).

3. IS - LM EQUILIBRIUM

The equilibrium point of the IS and LM curves can be interpreted as the joint combination of the box diagram of the goods market and the line diagrams of the money market. Fig. 10(b) shows the intersection point of the IS-LM graphs at the level of economic activity Y1, and interest rate i1. Fig. 10(a) depicts the corresponding box & line diagram representations of the goods & money markets. The goods market clears at (Y1, i1) such that the demand for goods, including investment demand which is a function of interest rate i1, is equal to the production of goods by the firms in the economy. Similarly, the money market clears as the demand for liquidity (Md/P) which is a function of the level of economic activity Y1, and interest rate i1, is equal to the supply of exogenously controlled liquidity (Ms/P). Figs.10 (a) & (b) depict the same equilibrium point E (in the graph) in different forms.

The next sections elaborate the usage of this diagrammatic tool to teach the effect of fiscal and monetary policy through the IS – LM setup.

3.1. IS - LM Framework: Fiscal Policy in a Closed Economy[17]

For the understanding of fiscal policy in a closed economy, we use the box diagram to represent the goods market and the line diagrams for the money market. They collectively represent the equilibrium point at the initial level of output Y1, and interest rate i1. The black colored diagrams represent the initial level of economy, while any changes are depicted in red.

Fig. 11(b) shows the impact of an expansion in government spending ΔG on the IS curve which shifts right by $\Delta G+\Delta C$ to point C in the graph (from equilibrium point A). The same is depicted in Fig. 11(a)[18] by the box diagram where the additional demand for goods generated through government expenditure leads to an expansion in consumption demand by ΔC, leading to an expansion in output from the initial level Y1 to final level Y2[19].

The figure shows that at the initial equilibrium, the government was running a budget deficit of G-T'. Therefore, a further increase in spending by ΔG is financed through increased market borrowings. This increases the supply of bonds in the market leading to a price fall. The interest rates are inversely proportional to bond prices, which therefore rise to i2. Fig. 11(a)[20] depicts that the money supply is still constant while the level of economic activity has increased due to expansion in government & consumption demand (leading to higher transaction demand for

[17] for fiscal & monetary policy, even though the goods market diagrams (Figs. 11 & 12) show a positive NX, we assume it to be zero and therefore ignore the foreign exchange market

[18] left panel

[19] Y3 is the intermediate level at same interest rate i1, before crowding out.

[20] Right panel

money). It also shows that due to increase in bond supply (which is held by the economic agents) the interest rates rise to i2 from i1. As a result of this increase in interest rate to i2, investment gets crowded out which is depicted in the goods market box diagram through upward arrows (also shown for consumption). In the graphs, Fig. 11(b) shows point B as the final equilibrium point where output is higher at Y2 and interest rates have increased to i2. Instead of reaching point C in 11(b) the economy settles down at point B due to crowding out.

3.2. IS - LM Framework: Monetary Policy in a Closed Economy

For the understanding of monetary policy's effect in a closed economy, we again use the box diagram to represent the goods market and line diagrams for the money market (Fig. 12). They collectively represent the equilibrium point at the initial level of output Y1, and interest rate i1. The black colored diagrams represent the initial level of economy, and changes are depicted in red.

From the initial equilibrium depicted through point A (in graph), when the central bank conducts an open market operation i.e. buys bonds to inject money (ΔMs) into the economy[21], the bond prices immediately rise and interest rates fall. As a result, real money demand expands due to the fall in interest rate even when the size of the economy is unchanged. In the money market, Fig. 12(a)[22] shows the expansion in money supply as a result of OMO (red color changes), which leads to an expansion in money demand ΔMd/P (and reduced bond holding due to central bank's purchases). The figure also depicts the fall in interest rate from i1 to i2. In the graph this leads to a down-shift of the LM curve to LM' from point A to point B (Fig. 12(b)).

In the goods market, due to the fall in interest rate from i1 to i2, the cost of borrowing for investors has fallen which leads to additional ΔI amounts of investment demand. ΔI triggers additional consumption demand ΔC through the multiplier effect and therefore overall economy expands by ΔC + ΔI. The expansion of the goods demand by ΔI and ΔC is depicted in Fig. 12(a)[23]. The economy eventually settles at point C (Y2, i3) as shown in the graph in Fig. 12(b).

Due to ΔC + ΔI, additional transactions are needed in the economy and the money supply hasn't gone up any further. So interest rate has to go up to i3 (from i2) as a result of this increased money demand.

5. CONCLUSION

[21] A lowering of the repo rate will also have the same effect where banks borrow money from the central bank by depositing bonds as collateral. For ease of building the argument, we will discuss OMOs.

[22] Right panel

[23] Left panel

This paper attempts to use a material balance way of deriving and explaining the IS-LM set-up for classroom teaching to both, economics & MBA students, with packed time-tables and therefore restricted attention span. This method has been successfully employed by the authors for teaching international macroeconomics to the graduate MBA students at a top business school in India since 2014. Here, the goods market equilibrium (IS curve) is derived using a box diagram depicting the production of goods & services in an economy due to value-adds by different factors of production, and the final allocation (demand) of the produced output to the different expenditure constituents. The visual approach helps the participants of the course keep track of both production as well as final usage of goods/services at the same time. The box diagram setup is also capable of depicting any shifts in the IS curve due to changes in government purchases or net exports. Similarly, the money market equilibrium (LM curve) is depicted through line diagrams, which visually depict the transaction demand for real liquidity which matches the exogenous supply of real liquidity. The box and line diagrams are then integrated to depict the joint equilibrium of goods and money markets. The paper then shows how this setup can be used to demonstrate the effects of fiscal & monetary policy on all components of the goods & money markets at the same time. This setup can also be extended to an open economy setting with flexible exchange rate, to visually depict the impact of monetary policy on all key macroeconomic variables.

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FIGURES

FIGURE 1: CIRCULAR FLOW OF THE ECONOMY

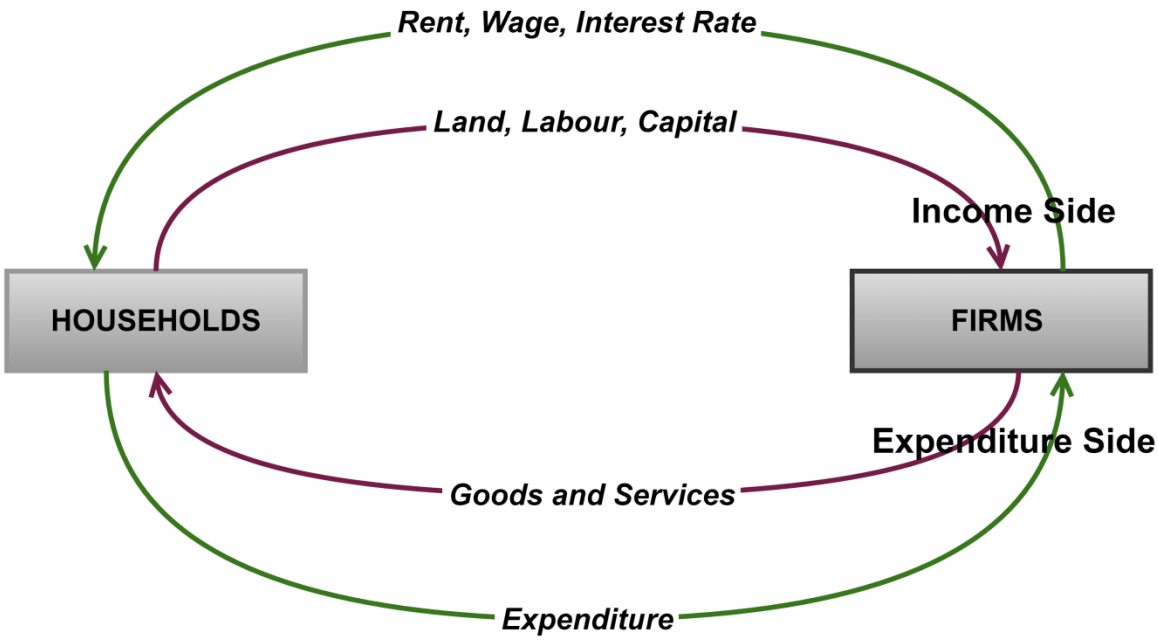
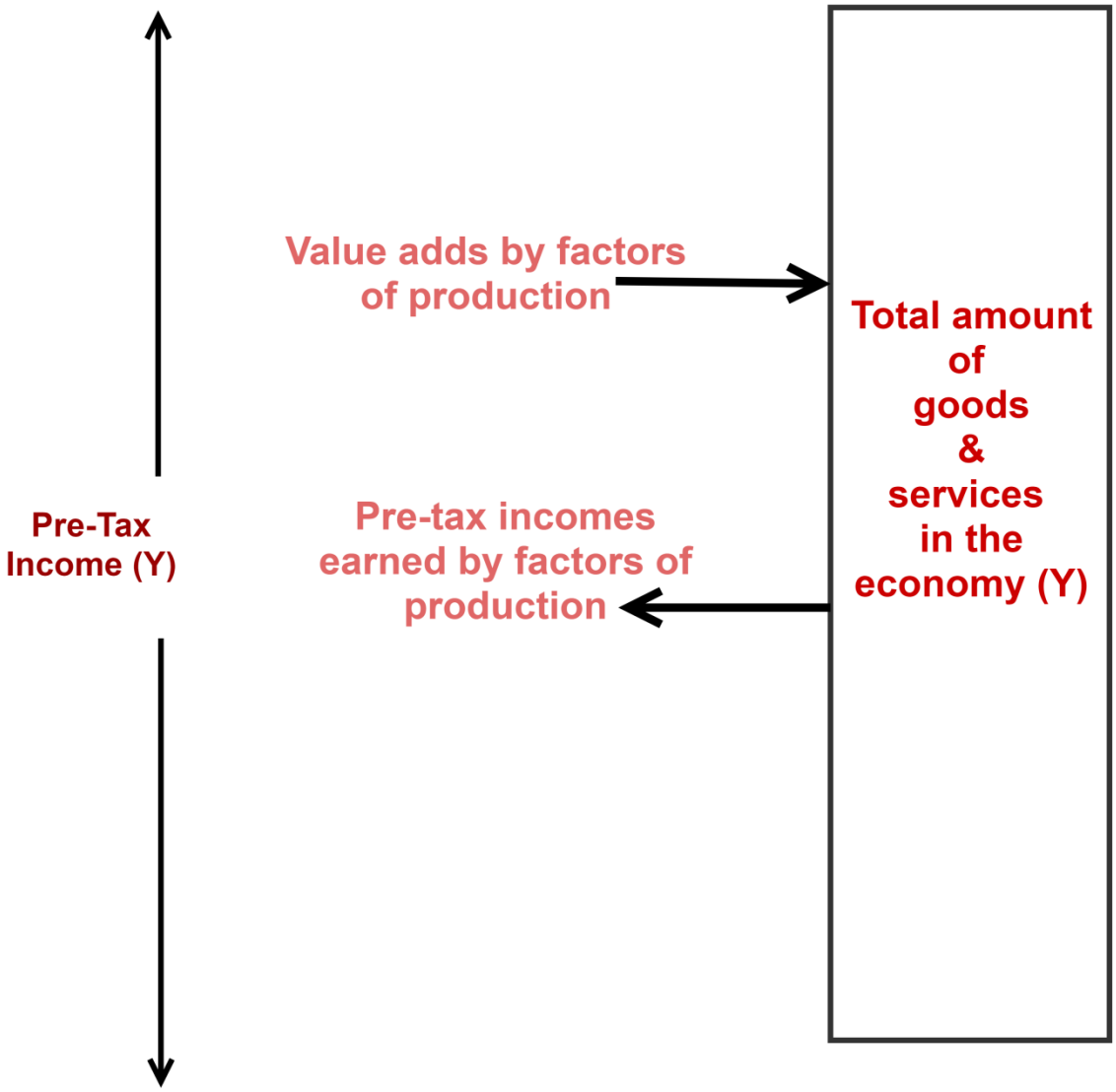


FIGURE 2: COMPONENTS OF THE INCOME SIDE

(a): VALUE -ADDS & INCOMES OF FACTORS OF PRODUCTION



(b): DISPOSABLE INCOME (YD) & LUMP-SUM DIRECT - TAXES COLLECTED BY GOVERNMENT LESS TRANSFERS

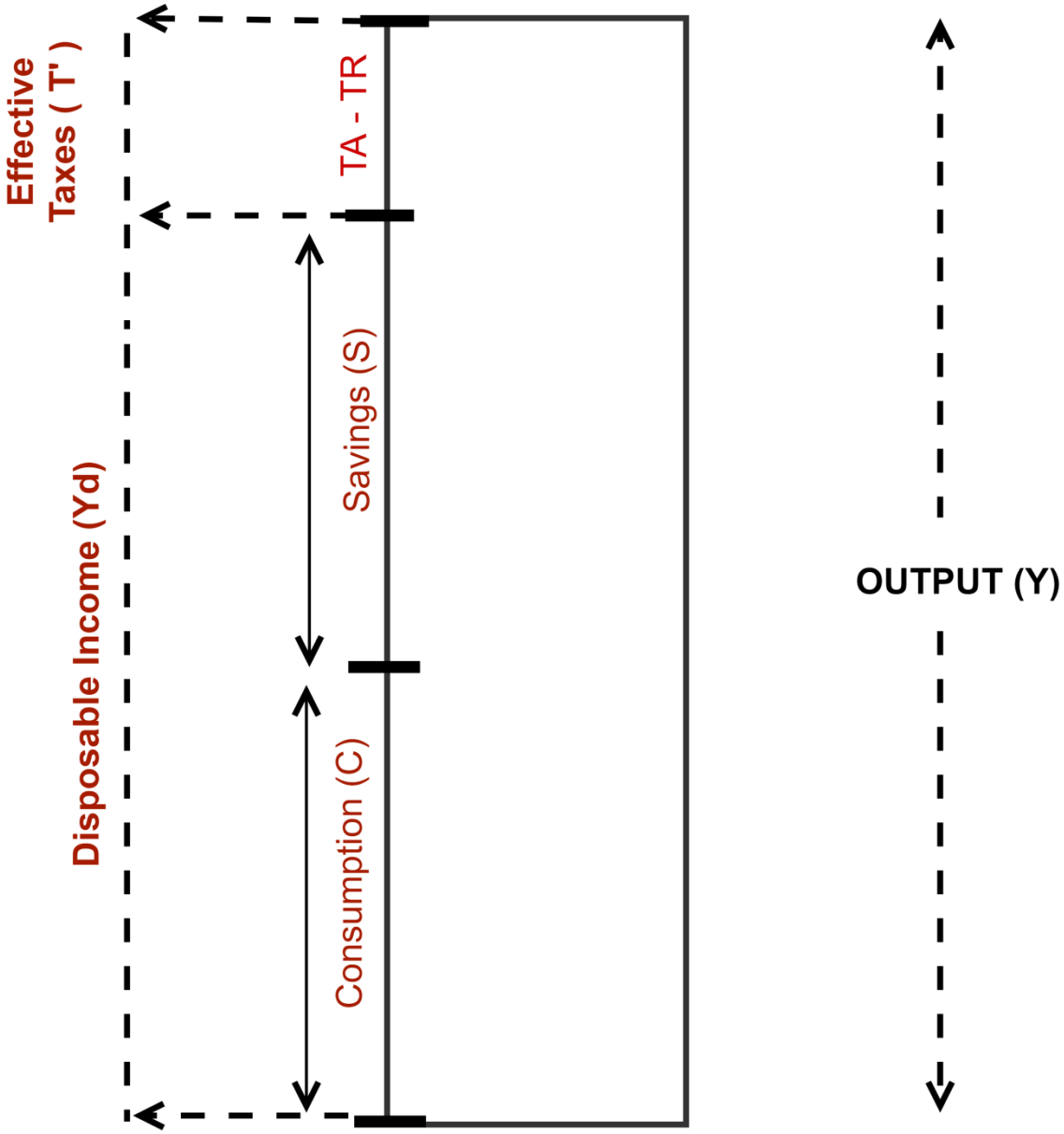


FIGURE 3: COMPONENTS OF THE EXPENDITURE SIDE

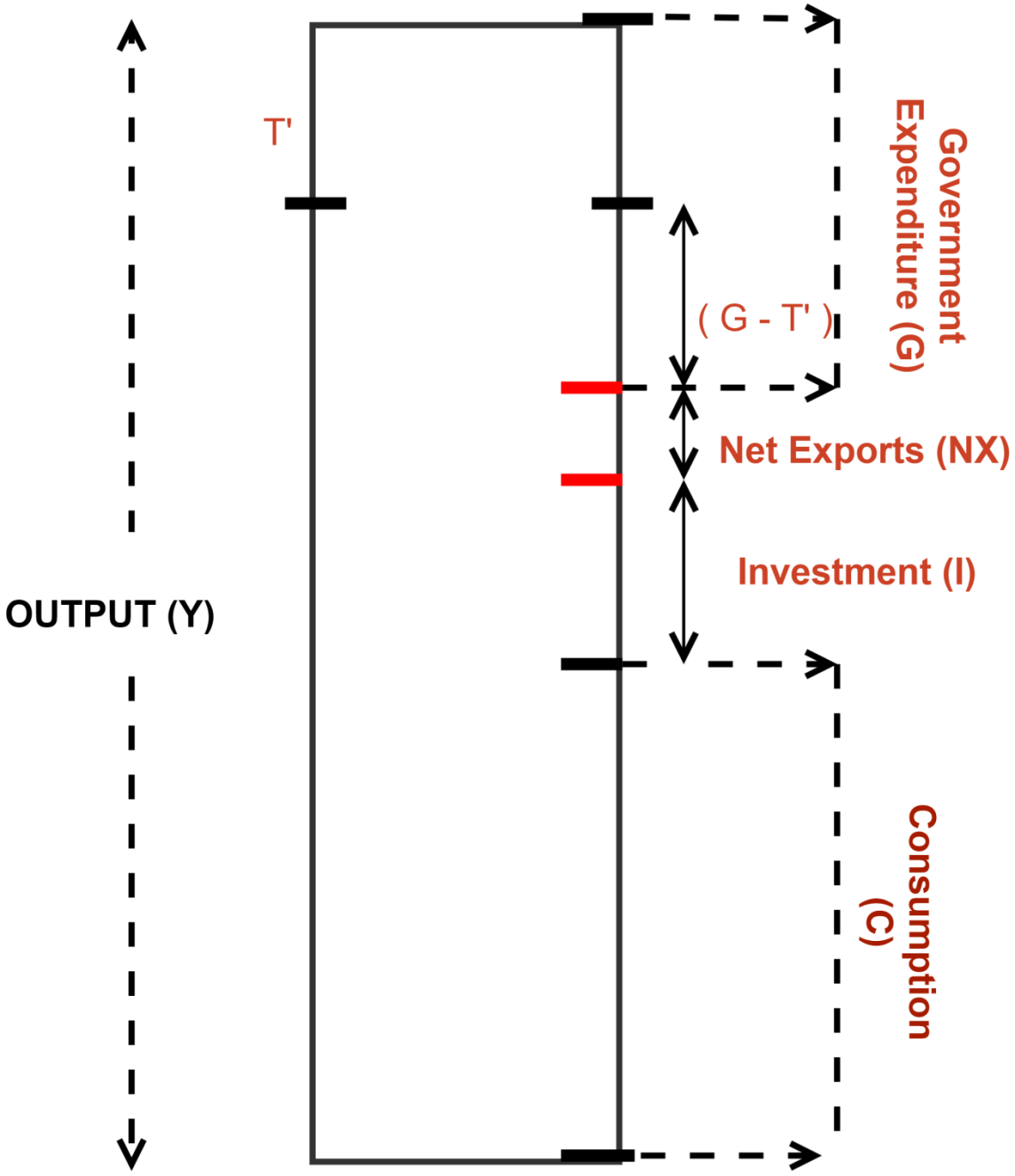


FIGURE 4: SAVINGS IDENTITY USING INCOME & EXPENDITURE COMPONENTS

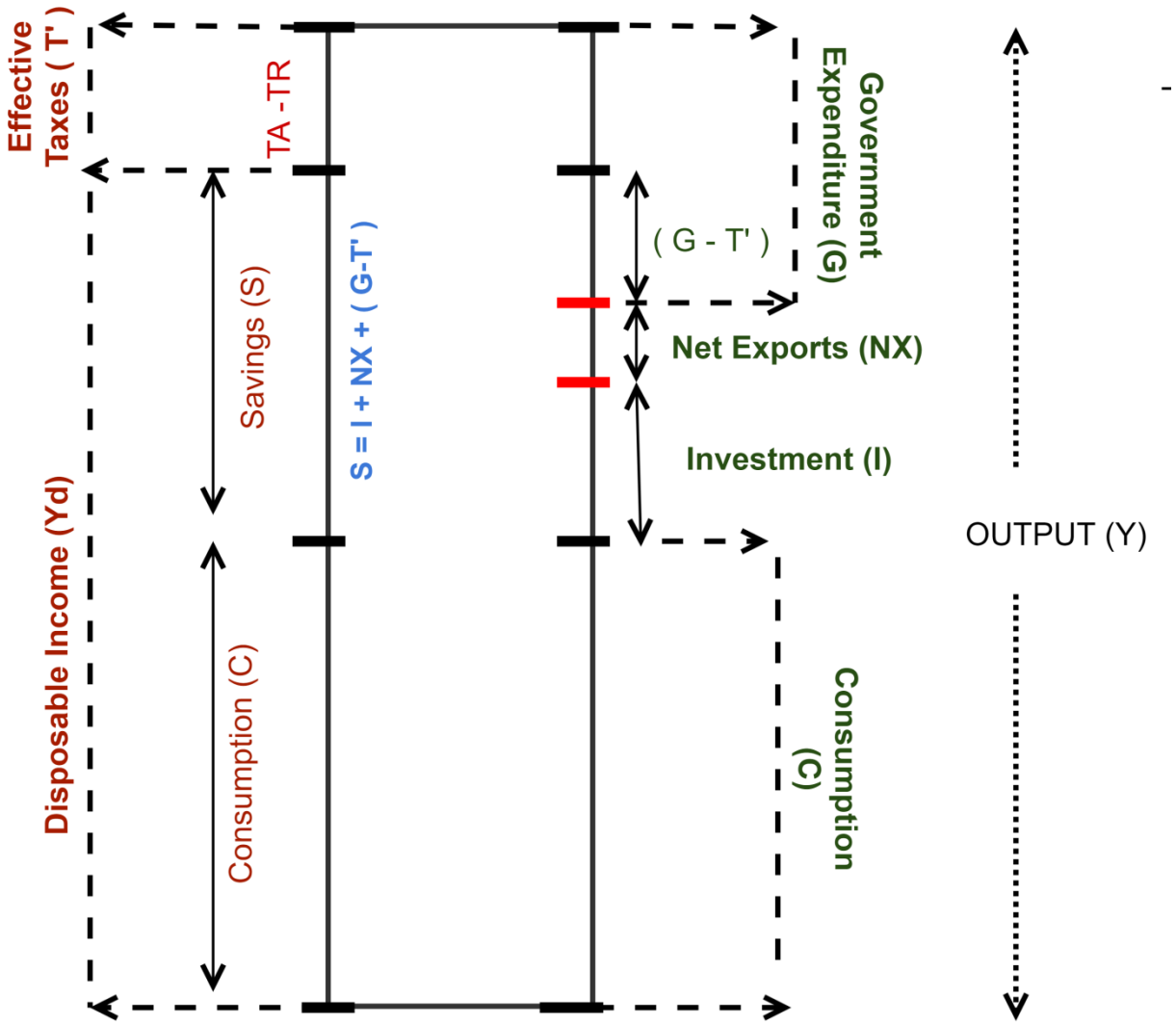
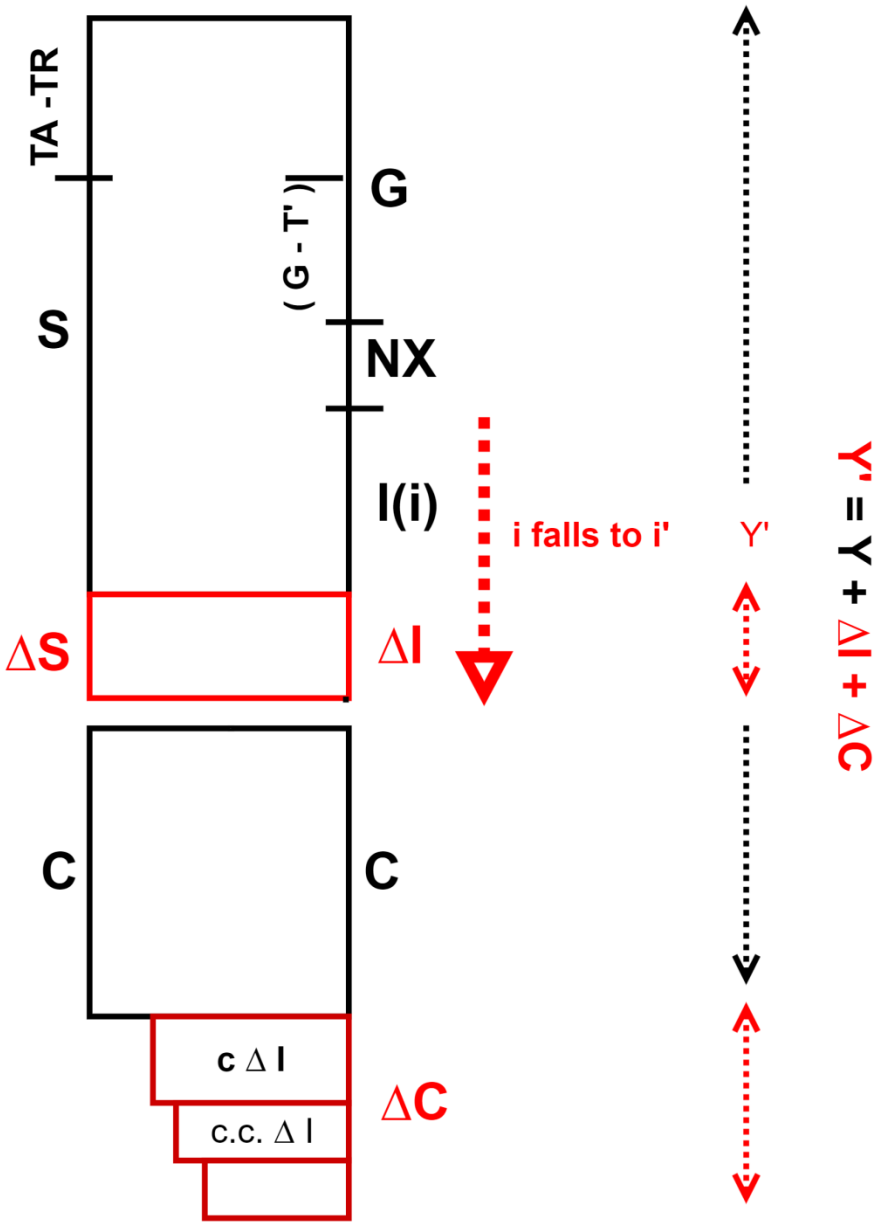


FIGURE 5: DIAGRAMMATIC & GRAPHICAL REPRESENTATIONS OF THE IS CURVE

a. DIAGRAMMATIC REPRESENTATION: IS CURVE



b. GRAPHICAL REPRESENTATION: IS CURVE

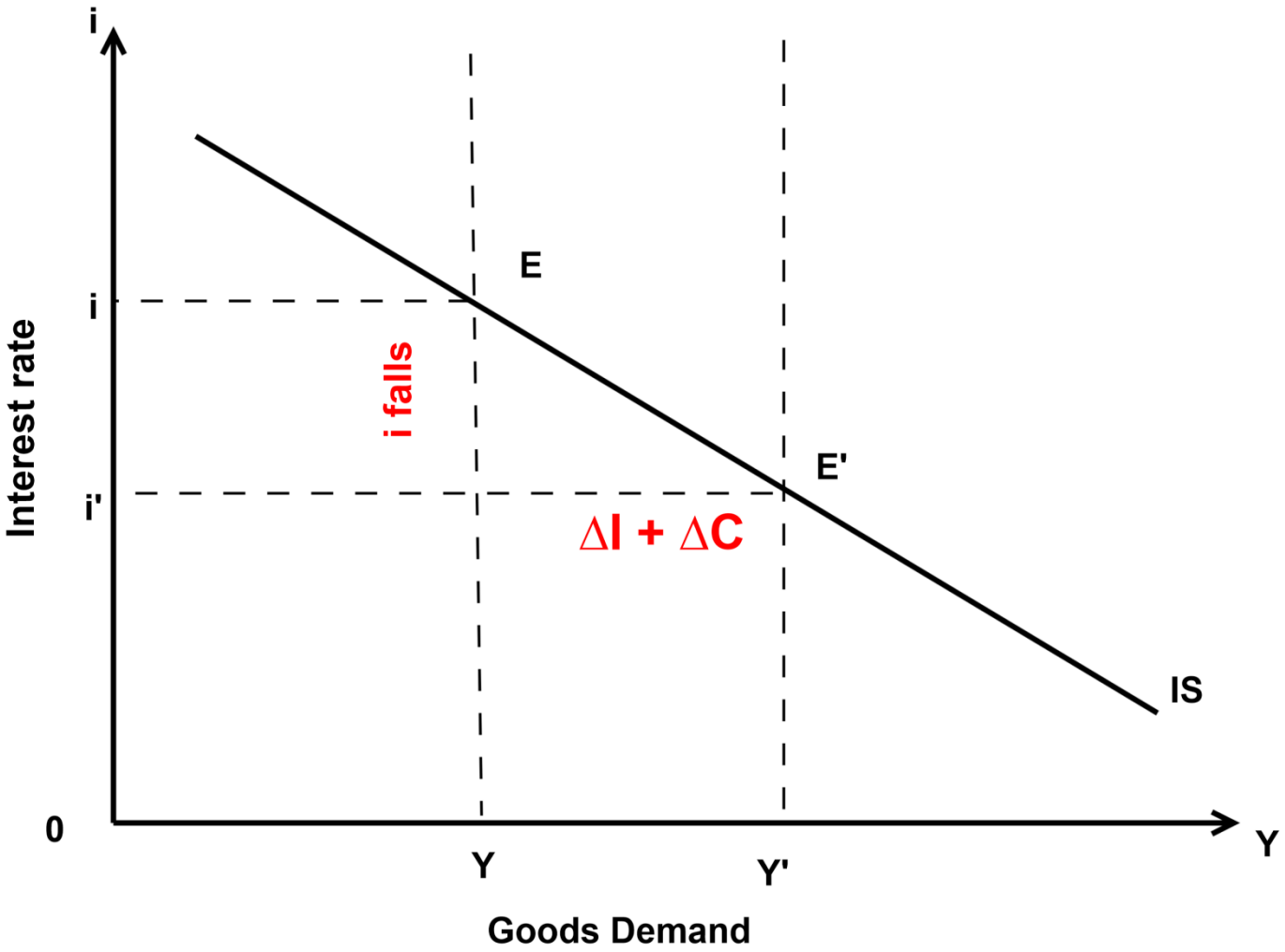
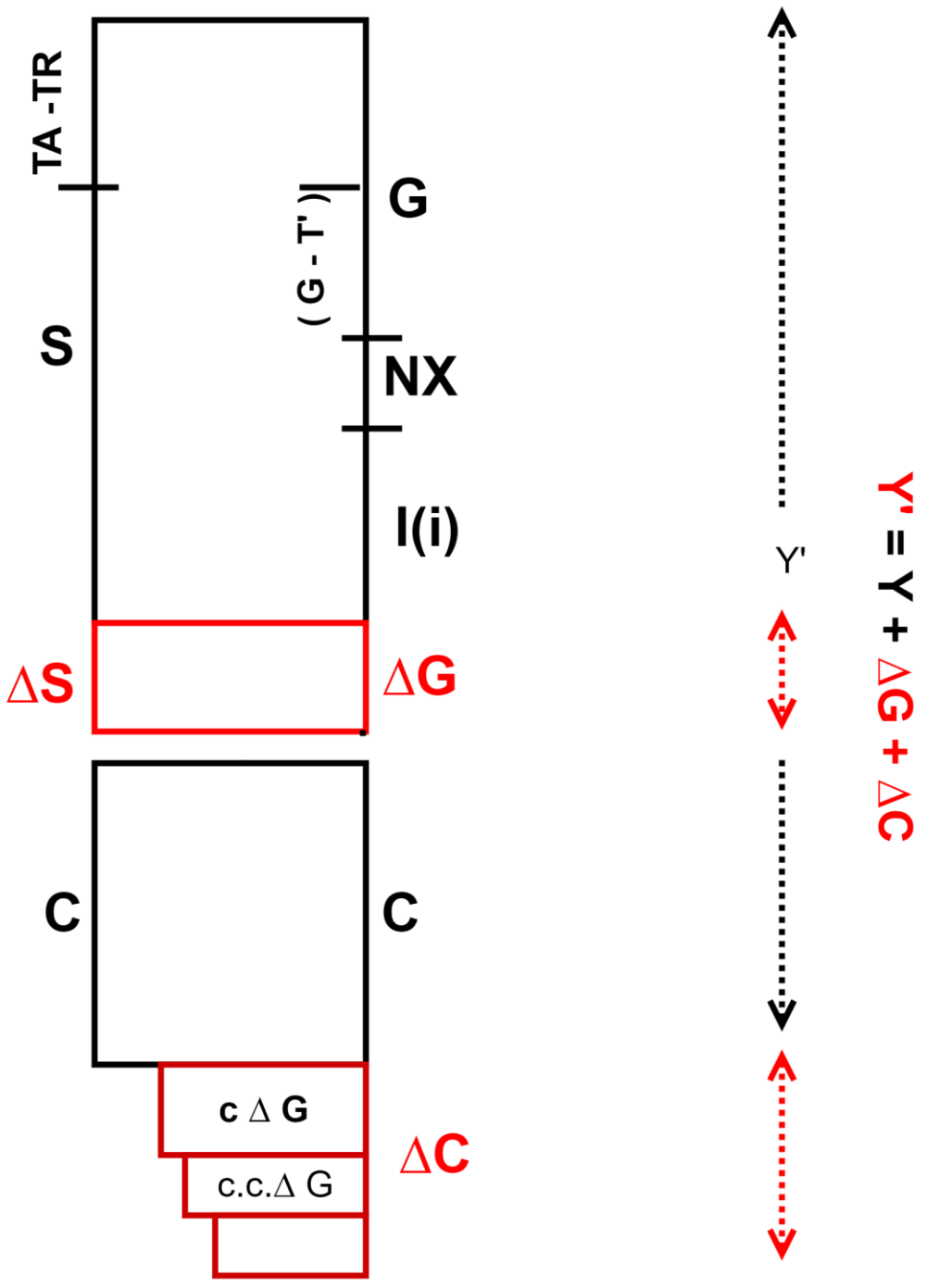


FIGURE 6: DIAGRAMMATIC & GRAPHICAL REPRESENTATION OF SHIFT OF IS CURVE DUE TO ΔG

a. EFFECT OF ΔG ON IS



b. SHIFT OF IS CURVE DUE TO ΔG

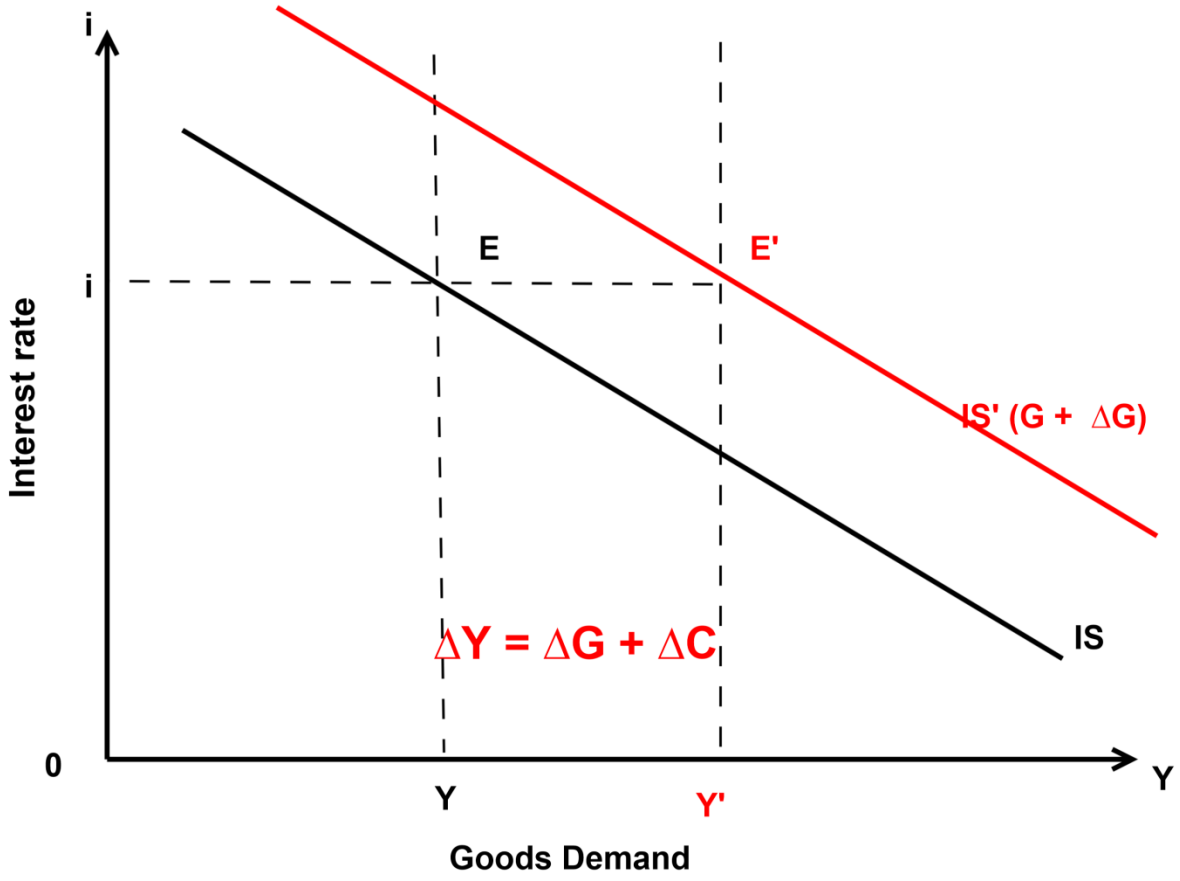
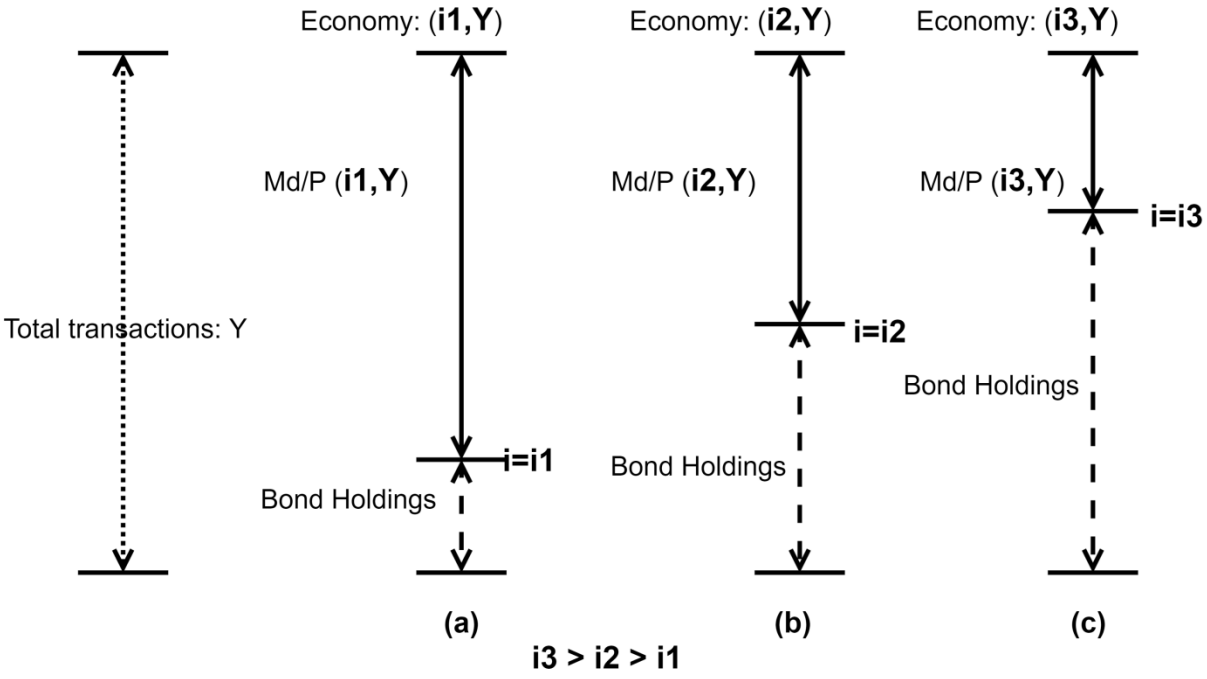


FIGURE 7: LINE REPRESENTATIONS OF REAL MONEY DEMAND AGAINST INTEREST RATE & SIZE OF ECONOMY

a. REAL MONEY DEMAND (*MD/P*) VS INTEREST RATES (I)



b. REAL MONEY DEMAND (*MD/P*) VS SIZE OF ECONOMY (Y)

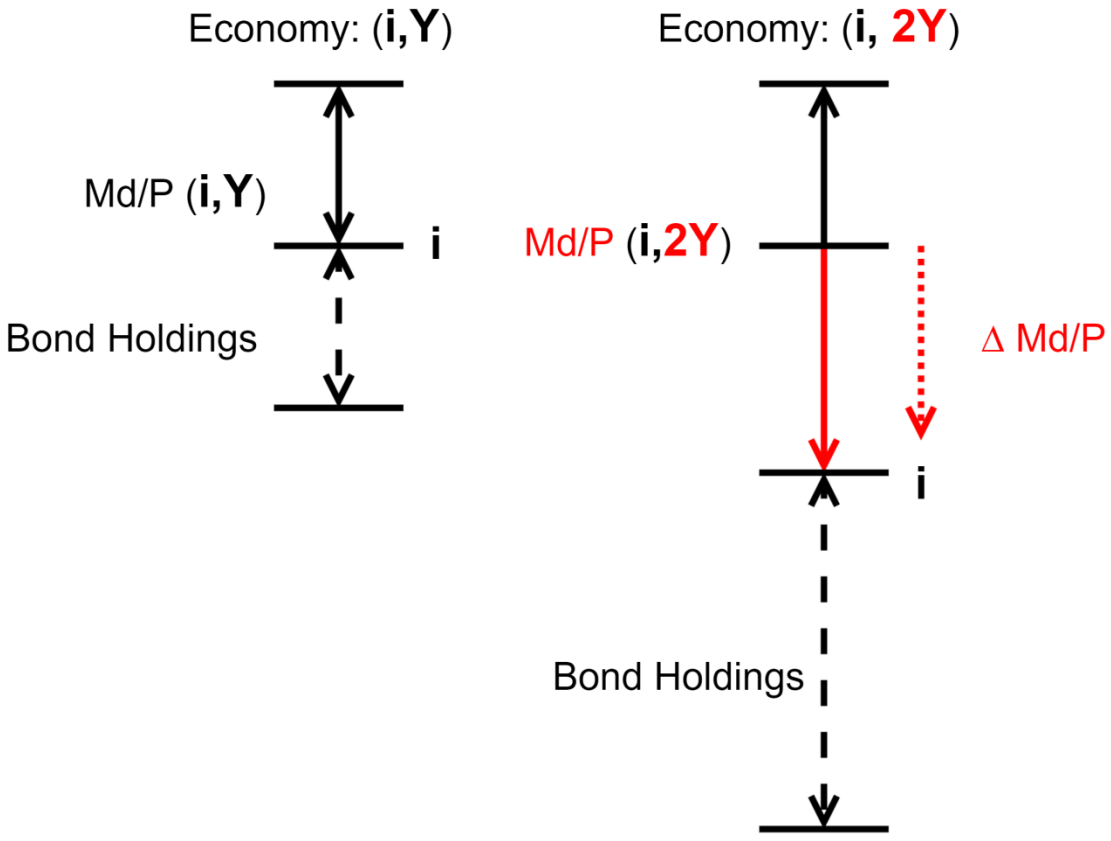
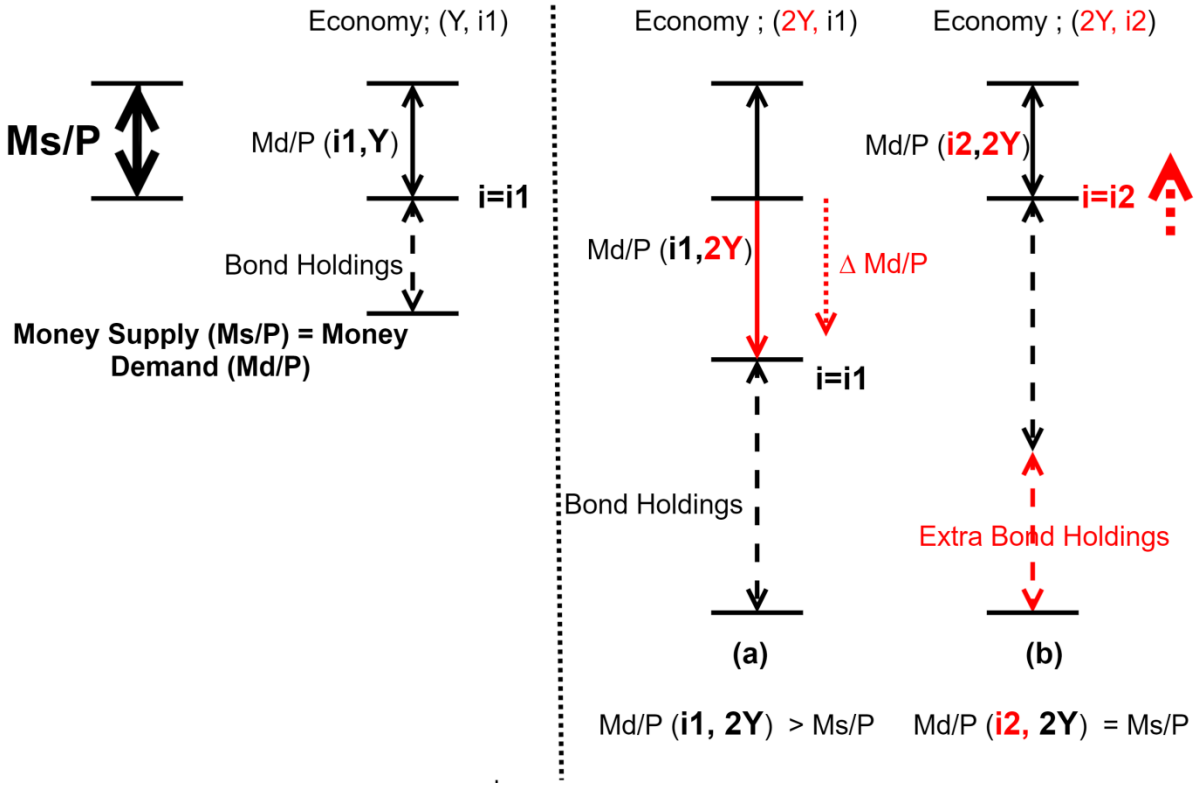


FIGURE 8: DERIVING THE LM CURVE BY CHANGING THE SIZE OF ECONOMY

a. IMPACT OF SIZE OF ECONOMY (Y) ON INTEREST RATES (I) FOR CONSTANT MONEY SUPPLY



b. GRAPHICAL REPRESENTATION: LM CURVE

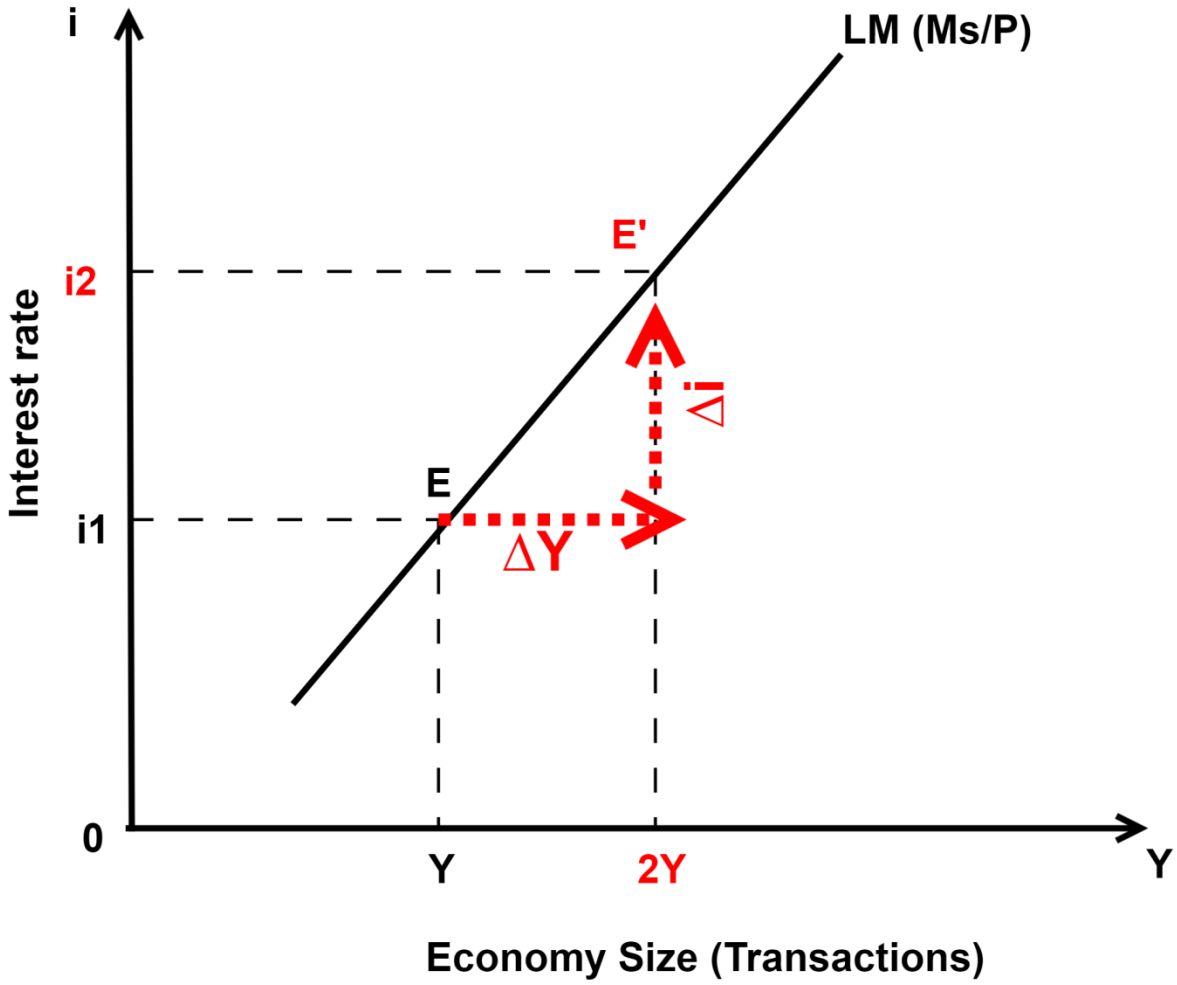
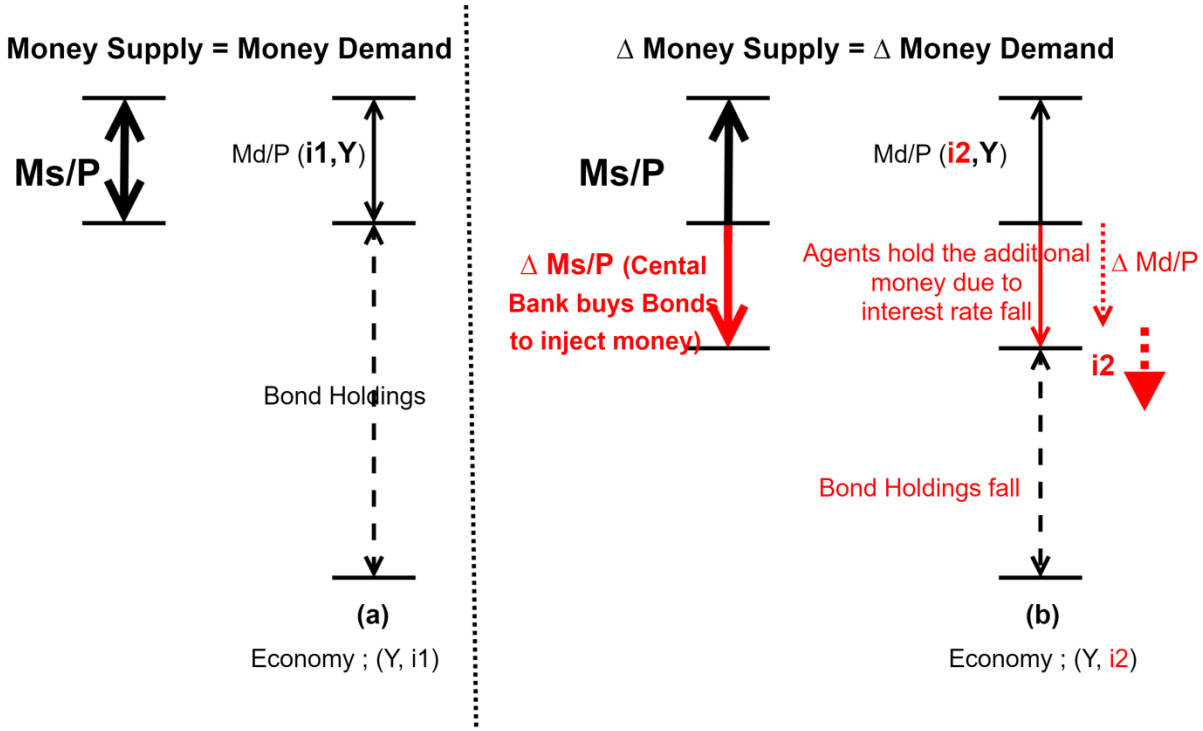

i
LM (Ms/P)
E'
i2
Interest rate
ΔI
E
i1
ΔY
0
Y
2Y
Y
Economy Size (Transactions)

FIGURE 9: LM CURVE DOWN - SHIFT DUE TO CENTRAL BANK'S BOND PURCHASE (OMO)

a. IMPACT OF CENTRAL BANK OPEN MARKET OPERATIONS TO INCREASE MONEY SUPPLY



b. GRAPHICAL REPRESENTATION: LM CURVE SHIFTS DOWN

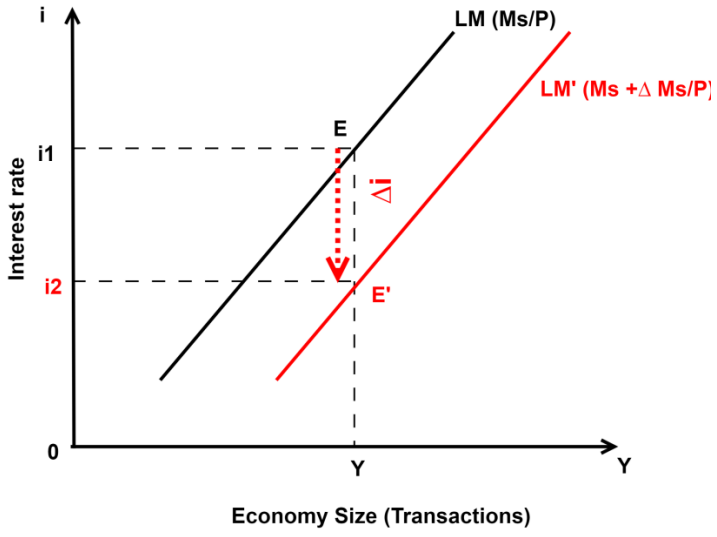
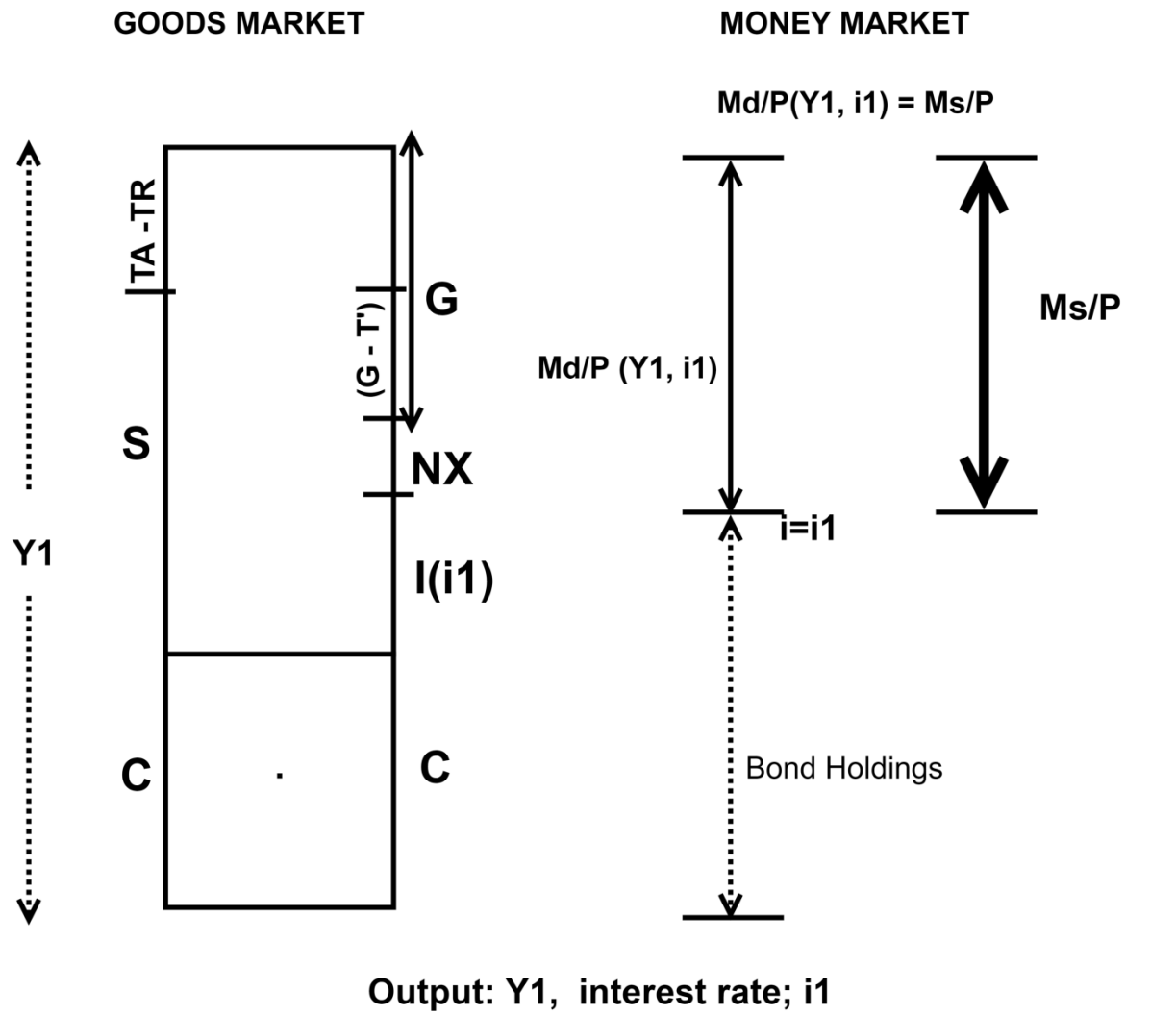


FIGURE 10: DIAGRAMMATIC AND GRAPHICAL REPRESENTATIONS OF IS - LM EQUILIBRIUM

a. DIAGRAMMATIC REPRESENTATION: IS - LM EQUILIBRIUM



b. GRAPHICAL REPRESENTATION: IS - LM EQUILIBRIUM

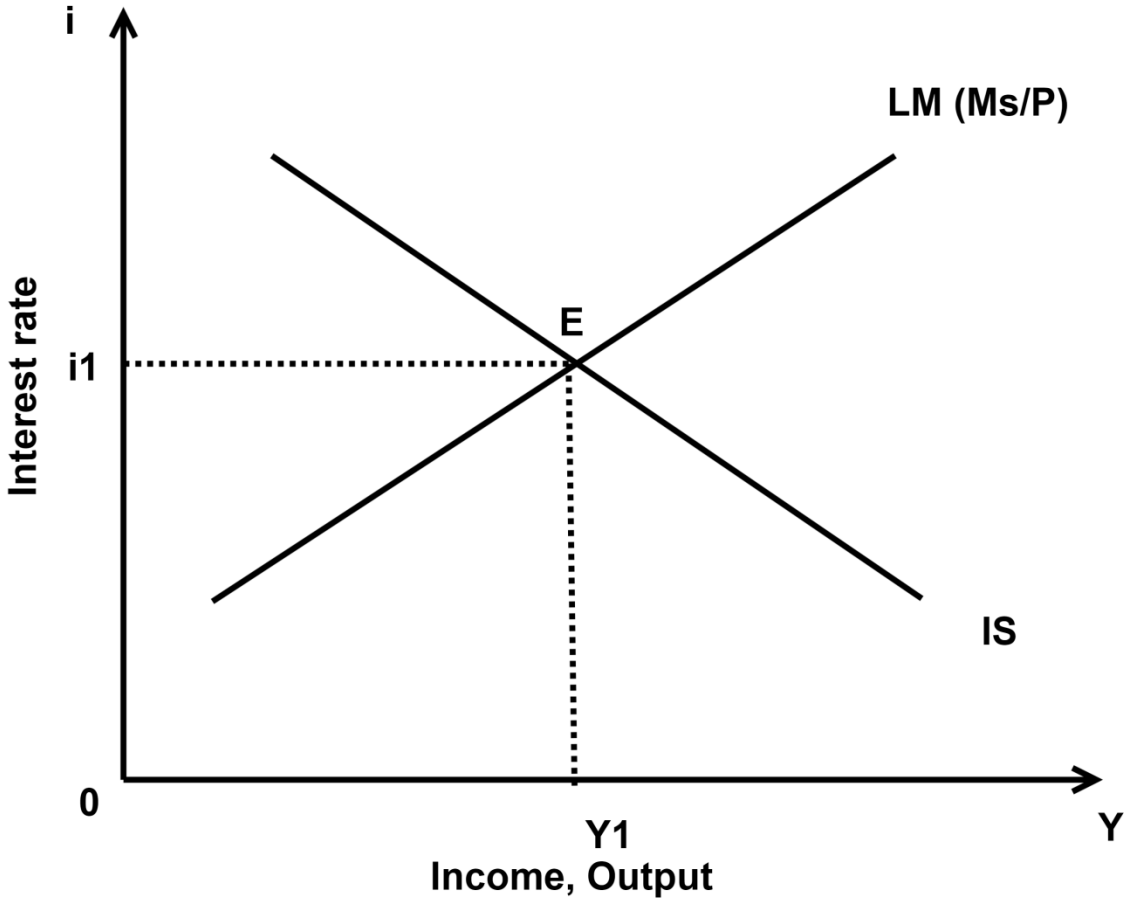
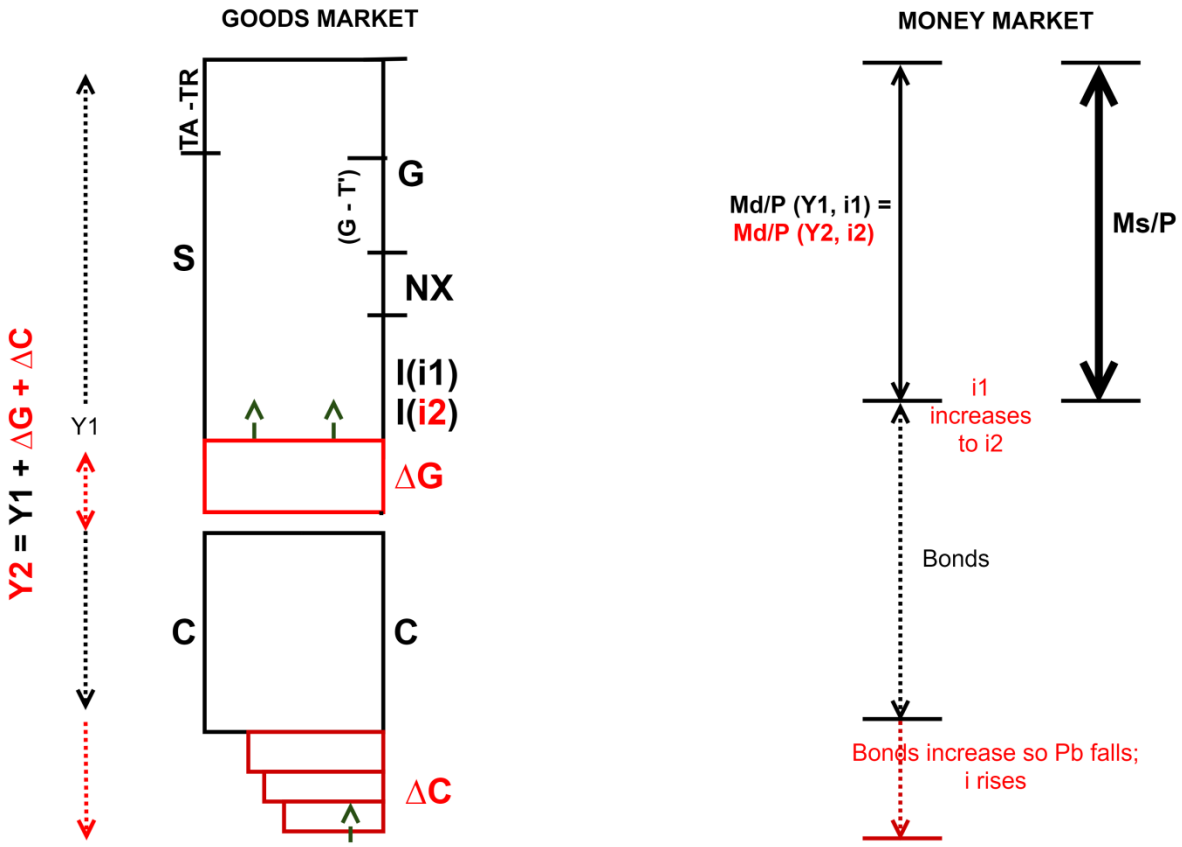


FIGURE 11: DIAGRAMMATIC AND GRAPHICAL REPRESENTATIONS OF FISCAL POLICY THROUGH ΔG

a. DIAGRAMMATIC REPRESENTATION: FISCAL POLICY THROUGH ΔG



b. GRAPHICAL REPRESENTATION: FISCAL POLICY

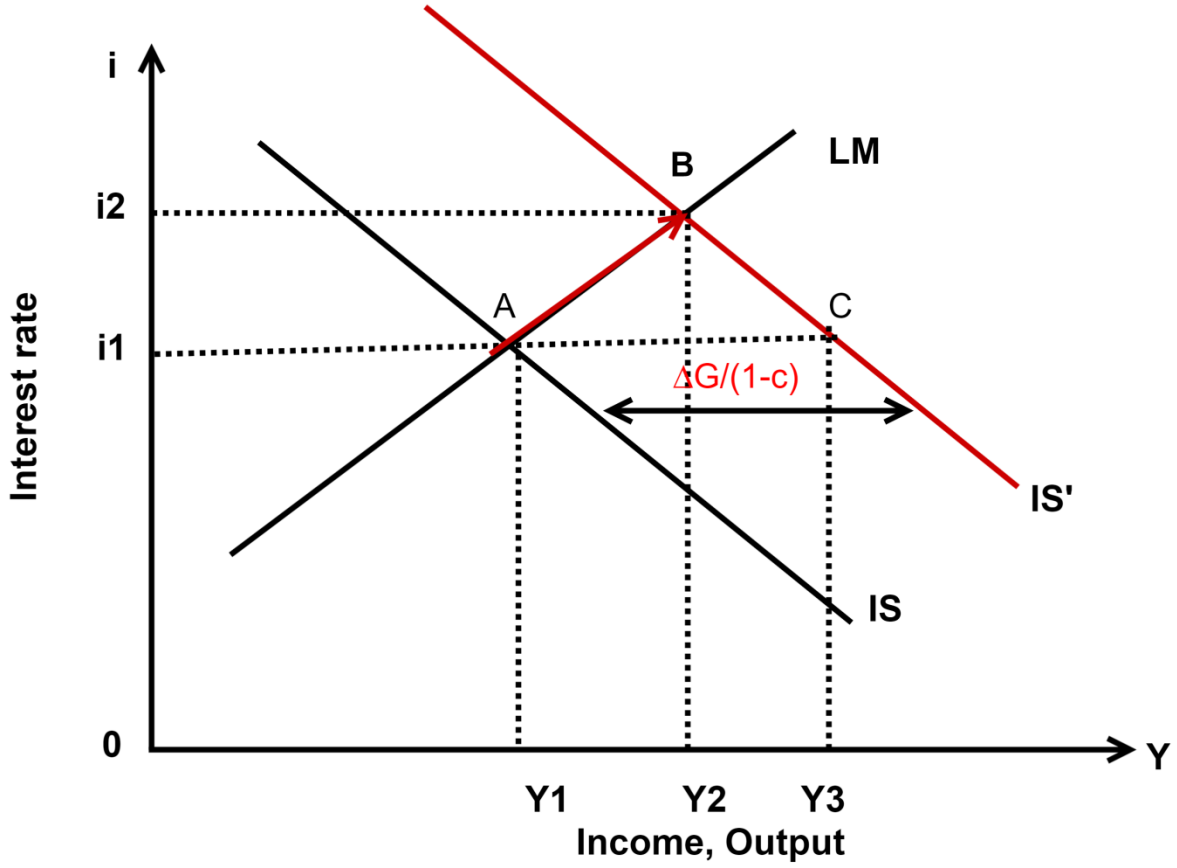
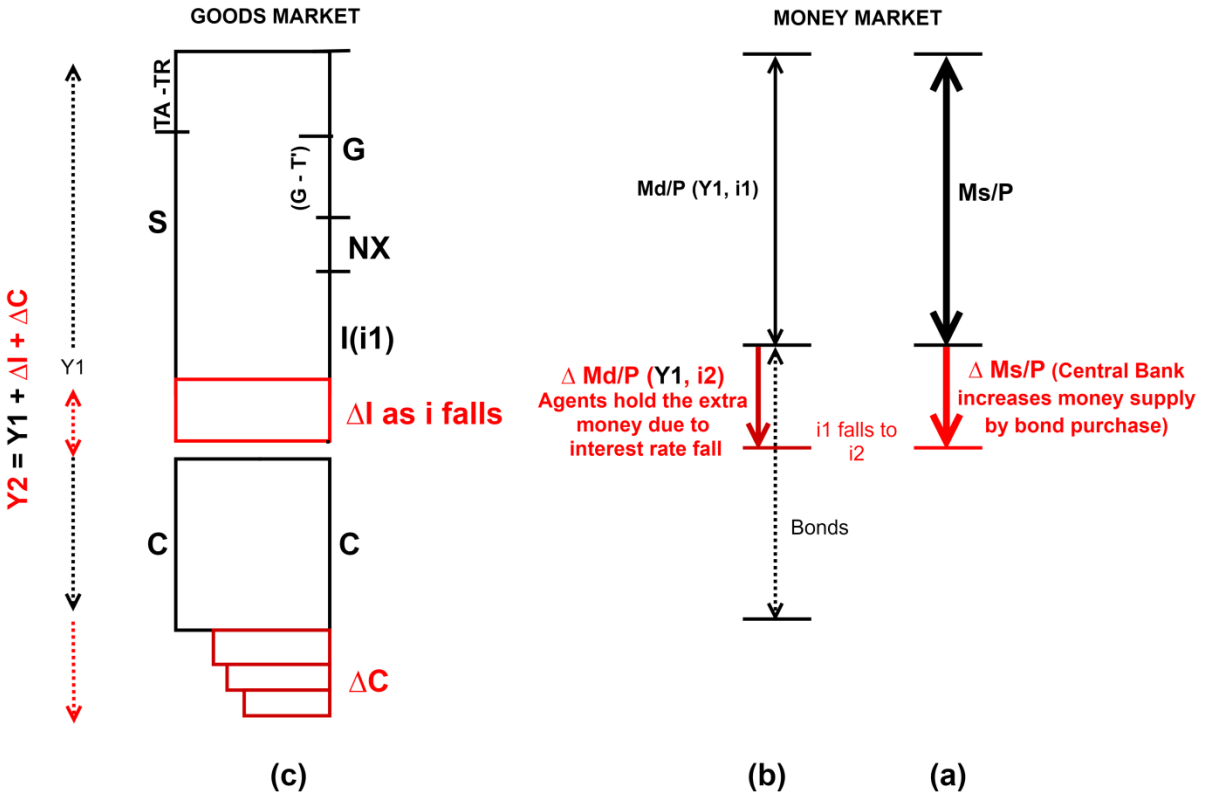


FIGURE 12: DIAGRAMMATIC AND GRAPHICAL REPRESENTATIONS OF MONETARY POLICY THROUGH ΔMS

a) DIAGRAMMATIC REPRESENTATION: MONETARY POLICY THROUGH ΔMS



b. GRAPHICAL REPRESENTATION: MONETARY POLICY