

# The Stock Market: A Steady View in Volatile Times

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## Abstract

This paper presents a “GDP demand-side” model that treats changes in GDP, the price level, money supply, and many other parameters, as comparative static exercises. The major conclusions are that (1) changes in stock prices may substitute for changes in GDP when the economy experiences shocks, (2) many “Monday morning quarterback” analyses of stock prices are flawed, and (3) normally stock prices increase because GDP increases.

Keywords: Asset Prices, GDP, economic shocks



## Introduction

As this paper is being written in the fall of 2008 it seems that asset prices are affected by everything including the housing bubble, energy prices, incipient recession, monetary policy, the Asian savings glut, distrust of financial institutions, and pure old fashioned panic. The present paper argues that the only one of these that matters in the intermediate and long run is changes in GDP. The message is not very jazzy; if it was posted on you-tube it would not get a single download. But sometimes steady-as-she-goes is the right message, and panic is rarely useful.

It is certainly the case that the other factors matter in the short run, although there is considerably more agreement in the literature on some than others. Almost no one doubts the existence of an Asian savings glut (Feldstein, 2008) and the moral hazard problems of financial markets (Chen, Chiang, and Wang (2008). Although the evidence for a housing bubble in at least parts of the country seems compelling, it is difficult to find a forthright statement of this in the literature, perhaps because of data issues (Wheaton and Nechayev, 2008). But the bottom line we would argue is GDP. The 2008 Nobel Prize winner in Economics, the widely respected Paul Krugman, is forecasting recession (Krugman, 2008). The most important determinant for asset prices is whether this prediction is true, and if it is, how long and deep the recession is.

The present paper suggests that to the extent that GDP falls then asset prices will also fall. The converse is also true, that a rising GDP implies asset prices will rise. And the current moment notwithstanding, for the U.S. it is much more common for GDP to grow rather than decline. And if the recession is short (however sharp) it may well be the case that GDP will rise next year overall and that by the end of next year asset prices will have recovered somewhat.

The paper proceeds by first outlining the theoretical model, doing some comparative statics, and finally using a simulation to illustrate the major results. Although the present paper is certainly not the place for investment advice, the paper concludes with some comments on possible future developments. The first appendix gives the formal details of the simulation. And although this paper is not primarily pedagogical, the second appendix reviews the coverage of asset markets in principles textbooks in case that information might be useful to those choosing a textbook.

### I. The Market for the Financial Asset

Although we have motivated the model by referring to the stock market, and use the S & P 500 index to provide some parameters for the example which concludes the paper, formally our model considers all assets aggregated into a single asset. All financial assets (other than money) are aggregated into a single asset—firms sell the asset to finance investment and the government sells it to finance its deficit. Demand for the asset comes from households and perhaps the foreign sector. In other words, the paper rearranges the familiar leakages and injections equation,

$$S + T + M = I + G + X \quad (1)$$

in terms of the market for the financial asset:

$$Supply = I + (G - T) = S - (X - M) = Demand .$$

Rather than using something like equation (1) to determine GDP or National Income in a Keynesian fashion, or using it to determine the real interest rate in a Classical approach,<sup>1</sup> the premise of this paper is that “leakages equal injections” determines the asset price. Since the goal of the present paper is to examine how changes in the real economy affect asset prices (rather than the converse), the method of the paper uses a “GDP demand-side” model to predict stock prices, treating changes in GDP, the price level, money supply, and many other parameters, as comparative static exercises. The theoretical foundations for the model are found in Wojcikewych, Scott, and Highfill (2005).

Consider first the supply side. In general firms are investing in real capital so that they are suppliers of the financial asset. Investment depends on GDP and the real interest rate, and the real interest rate in turn depends on GDP, the price level, and the money supply. Suppose also that the government budget is in deficit so that it sells the financial asset to meet its financial obligations. Thus

$$P_s N_s = I(I_0^+, \bar{P}, M_s^+, Y) + GB(G_0^+, t, \bar{Y}) . \quad (2)$$

The notation is meant to reflect standard usage, except that  $P_s$  is the asset price,  $N_s$  is the number of “shares” supplied, and  $GB(\cdot)$  is the government budget. The sign of the derivatives is indicated above the parameter. (The Appendix gives one set of functional forms that satisfy these assumptions.)

In Figure 1, The Market for the Financial Asset, the supply curve is shown by the dashed line. As is apparent there or from equation (2) the supply curve is a rectangular hyperbola. A well-known attribute of the hyperbola is that any point yields the same dollar amount of funds. (To buy a fifty dollar machine a firm can sell 5 shares for \$10 each or 10 shares for \$5 each.)

The financial asset is demanded by households—it is the form in which they hold their wealth. Define a consumption function

$$C = \alpha_o + \alpha(Y - T) + c_w W \quad (3)$$

where

$$T = tY \quad (4)$$

$$W = P_s(N_o + N_H^D) . \quad (5)$$

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<sup>1</sup> In this model the interest rate is determined endogenously, but in the money market rather than in a savings equal investment equation.

The mpc,  $\alpha$ , is between zero and one; autonomous consumption,  $\alpha_o$ , is non-negative. Consumption is also a linear function of wealth; the “marginal propensity to consume from wealth,”  $c_w$ , is between zero and one, and, usually quite small. A wealth coefficient of 1 to 5 cents per dollar of wealth is consistent with Maki and Palumbo (2001), Mehra (2001), Poterba (2000), Shirvani and Wilbratte (2002), and Boone and Girouard (2002).

Households hold an (exogenous) amount  $N_o$  of the financial asset before any savings in the present period. The (endogenous) quantity of the financial asset purchased is  $N_H^D$ . Since the (endogenous) price of the financial asset is  $P_S$ , the dollar amount of wealth is as shown in (5).

Savings are, from  $S = (Y - T) - C$  and (3)-(5)

$$S = (Y - T) - (\alpha_o + \alpha(Y - T) + c_w W). \quad (6)$$

or

$$S = -(\alpha_o + t_o(1 - \alpha)) + (1 - \alpha)(1 - t)Y - c_w P_S (N_o + N_H^D). \quad (7)$$

Savings are held in the financial asset (rather than money); thus savings are also  $S = P_S N_H^D$ . Substituting this into the left-hand side of (7) and simplifying yields

$$P_S N_H^D = \frac{-\alpha_o}{1 + c_w} + \frac{(1 - \alpha)(1 - t)}{1 + c_w} Y - \frac{c_w}{1 + c_w} P_S N_o = S_o + sY - wP_S \quad (8)$$

where

$$S_o = \frac{-\alpha_o}{1 + c_w}, \quad s = \frac{(1 - \alpha)(1 - t)}{1 + c_w} \text{ and } w = \frac{c_w}{1 + c_w} N_o.$$

It will be useful to note how household wealth changes for movements along the household demand function. From (5) and (8)

$$W = P_S (N_o + N_H^D) = P_S \left( N_o + \frac{S_o + sY - wP_S}{P_S} \right) = P_S N_o + S_o + sY - \frac{c_w}{1 + c_w} N_o P_S$$

so that  $\frac{\partial W}{\partial P_S} = \frac{N_o}{1 + c_w} > 0$ .

There may also be a net demand from the rest of the world; assuming the current account deficit is the capital account surplus, demand from abroad is the capital account balance. Thus

$$FD = (INFLWS - OUTFLOWS) = FD(P, Y, M_S^+, E(\bar{XR}))$$

where  $FD$  denotes the foreign demand for the asset. (The appendix again gives one possible set of functional form that satisfy these assumptions. Denote the expected value of the foreign exchange unit by  $E(XR)$ . An expected appreciation of the dollar (i.e., a decrease in  $E(XR)$ ) will cause the expected return on dollar assets for foreigners to increase thus increasing demand for the asset. Notice that if foreigners expect the value of the dollar to appreciate, they will sell their currency now, causing it to depreciate now.

Total demand for the asset is

$$P_S N_D = S_o + sY - wP_S + FD(P, Y, M_S, E(\bar{X}R))$$

Solving for the asset price (to graph the demand function in Figure 1)

$$P_S = \frac{S_o + sY + FD(P, Y, M_S, E(\bar{X}R))}{(N_D - w)}$$

or solving for quantity demanded

$$N_D = \frac{S_o + sY + FD(P, Y, M_S, E(\bar{X}R))}{P_S} - w. \quad (9)$$

As shown in Figure 1 the demand curve is downward sloping, somewhat flatter than the supply curve (thus insuring that the equilibrium is stable) with a positive intercept.

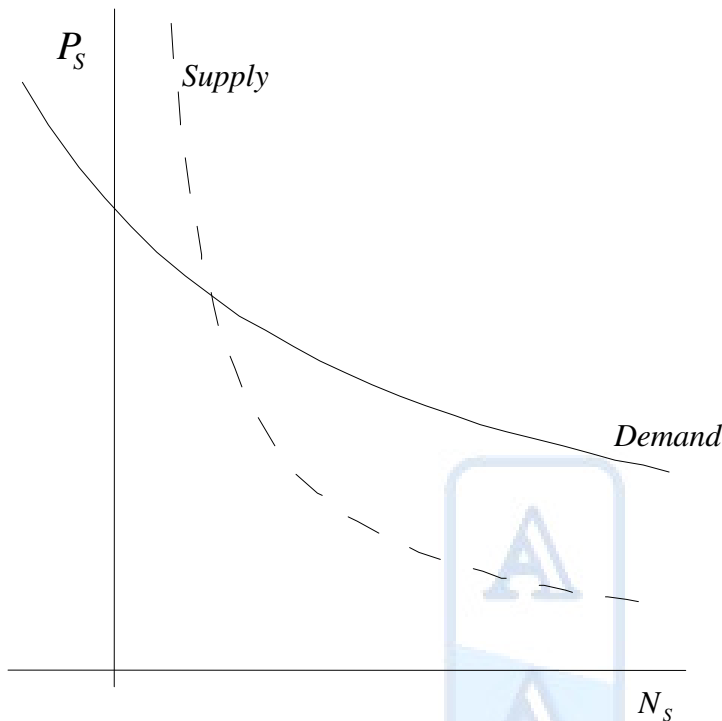


Figure 1: The Market for the Financial Asset

Equilibrium is found by equating the quantity demanded for and supplied of the asset from (2) and (9).

$$\frac{I(I_0^+, P^-, M_s^+, Y^+) + GB(G_0^+, t^-, Y^-)}{P_s} = N_s = N_D = \frac{S_o + sY + FD(P^+, Y^+, M_s^-, E(\bar{X}R))}{P_s} - w \quad (10)$$

or

$$wP_s = S_o + sY - I(I_0^+, P^-, M_s^+, Y^+) - GB(G_0^+, t^-, Y^-) + FD(P^+, Y^+, M_s^-, E(\bar{X}R)). \quad (11)$$

The equilibrium asset price is determined by (11). We now turn our attention to economic factors that will change the asset price.

## II. Comparative Statics

### A. Government Deficit Spending

Suppose the government increases its spending,  $G_0$ , without increasing taxes (and none of the other parameters in the model change). Clearly the supply of the financial asset increases. This will cause the asset price to fall as shown in Figure 2. For the intuition notice first that the increase in  $G_0$  does not imply an increase in either

GDP or disposable income, and both are unchanged.<sup>2</sup> This implies that investment and net exports are unchanged. Notice that there is no crowding out of investment via changes in the interest rate, since the interest rate is determined by GDP, the price level, and the money supply, and they are all unchanged. (See the Appendix for details). Since it remains the case that  $Y = C + I + G + (X - M)$ , when  $G$  increases  $C$  must decrease by exactly the same amount. With income unchanged, the only way to get a decrease in consumption is for the wealth of households to fall. As shown earlier, a decline in wealth is associated with a movement down and to the right of the demand curve in Figure 2.

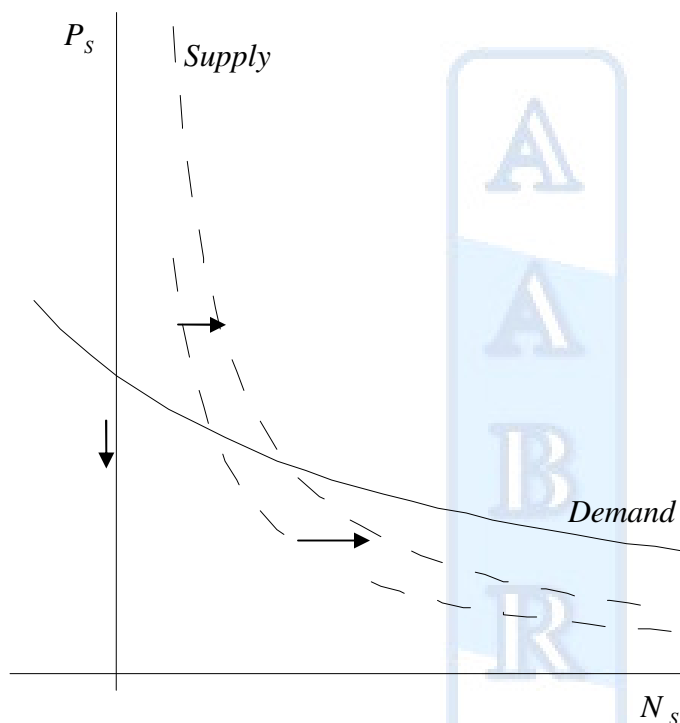


Figure 2: Increase in Government Expenditure

Since disposable income is also unchanged, savings increase by exactly the amount that consumption fell when government expenditure increased.

<sup>2</sup> Certainly it is possible to do a comparative static exercise where both  $G_0$  and  $Y$  increase. But the present model cannot be used to show that an increase in  $G_0$  necessarily increases GDP. This is where the logic of Hall and Lieberman (2005, 518) falters. Their model is explicitly a Keynesian Cross model, formally similar to ours. An increase in  $G_0$  in equation (11) causes the asset price to increase when GDP is held constant; just as an increase in  $G_0$  causes GDP to increase when the asset price is held constant. A single equation model like (11) can be used to investigate the effect of changes in parameters on the asset price, or on GDP, but not both simultaneously. In brief, the standard Keynesian multiplier assumes a constant asset price and thus cannot be used to draw any inferences about changes the asset price.

## B. Consumers Expect Asset Price to Increase

Suppose consumers expect the price of the asset to increase next year. Therefore they want to buy more of the asset in the current period. This can be modeled as a decrease in autonomous consumption,  $\alpha_0$ , and thus an increase in autonomous savings  $S_0$ . The demand for assets curve shifts out (to the right), and the asset price rises. In this sense, consumer expectations are a self fulfilling prophecy.

## C. Business Firms Expect Higher Future Profits

Now suppose business are optimistic about profit opportunities in future periods, and therefore undertake more investment spending to position them to take advantage of future opportunities. Therefore, current investment increases, which can be modeled as an increase in  $I_0$ . Firms will supply more of the asset causing its price to decrease. (The analysis is similar to that for increases in government expenditure as shown in Figure 2.)

## D. Increase in $Y$

Consider the effect of an increase in GDP on both the demand and supply of the financial asset. From the right-hand side of equation (10), increasing  $Y$  increases both saving and the foreign demand for the financial asset, so the demand for the asset curve shifts to the right. From the left-hand side of (10), increasing  $Y$  increases

investment but it decreases the government's budget. However, noting  $\frac{\partial GB}{\partial Y} = -t$  and

defining  $mpi \equiv \frac{\partial I}{\partial Y}$ , we would argue that for the U.S. economy it is reasonable to

assume that the tax rate is greater than the marginal propensity to invest. In this case increasing  $Y$  decreases the supply of the asset, shifting the supply of the asset curve to the left. Thus we find that an increase in GDP increases the asset price

## III. Simulation

An interesting application of our model simulates and compares the impact on the asset price generated by the model with the dramatic increase in stock prices during the latter half of the 1990's, specifically, 1994-99. The intent is to replicate in our model the changes in GDP, the price level, and the money supply that occurred during this period, and then, to see how well the model mimics the impact on the price of the asset (as measured by the S & P 500 index).

The latter half of the 1990's witnessed one of the strongest bull markets in U.S. history. From 1994 to 1999, stock prices (S & P 500) increased by 320%, while real GDP, the price level (CPI) and the money supply (M2) increased by 32%, 12%, and 33% respectively. When these changes were incorporated into our model (see Table 1,



Case 1) the impact on the price of the asset ( $P_S$ ) was very similar, i.e., the model simulates a 310% increase (from a value of 1 to a value of 4.10).

Table 1. Simulation Results

Parameters	Baseline	Case 1	Case 2
<b>Y</b>	12,000	15,840 (32% increase)	<b>15,840</b> <b>(32% increase)</b>
<b>P</b>	1	1.12 (12% increase)	<b>0.80</b> <b>(20% decrease)</b>
<b>M<sub>S</sub></b>	1,300	1,729 (33% increase)	<b>1,729</b> <b>(33% increase)</b>
<b>P<sub>S</sub></b>	1	4.10	<b>1.03</b>
<b>r</b>	2.03	2.02	<b>2.02</b>
<b>π</b>	0%	12%	<b>-20%</b>
<b>C</b>	7,866	11,086	<b>10,470</b>
<b>I</b>	1,757	2,425	<b>3,1046</b>
<b>G</b>	2,400	2,400	<b>2,400</b>
<b>X – M</b>	-23	-96	<b>-95</b>
<b>S</b>	534	2	<b>618</b>
<b>Wealth</b>	<b>9,313</b>	<b>36,011</b>	<b>9,709</b>

In our model, an increase in money supply would decrease the asset price. This happens because the increase in  $M_S$  decreases the interest rate ( $r$ ) which causes the foreign demand for less attractive U.S. assets to fall, and, increases domestic business investment spending which increases the supply of the asset. However, in our model, this decrease in asset price due to the increase in the  $M_S$  is apparently swamped by the increase in asset price resulting from the increase in both GDP and the price level. The effect on the asset price due to the increase in GDP is particularly noteworthy because it increases demand for the asset while decreasing its supply. Each of these changes contributes to a definite increase in the price of the asset. Specifically, the increase in GDP increases demand for the asset from both households (increased saving) and foreigners (financing our expanded trade deficit,  $X-M$ ). Simultaneously, the increase in GDP decreases the supply of the asset (and thus contributes to the increase in  $P_S$ ). While the supply increases as a result of more business borrowing due to induced investment spending, the overall supply decreases owing to a smaller budget deficit that has to be financed by the government. This conclusion derives again from the realistic assumption that the marginal propensity to invest (out of increased GDP) is smaller than the marginal tax rate.

Our simulation results above suggest real GDP plays an important role in explaining asset prices. Therefore, an additional simulation was performed to determine the strength of the relationship. Specifically, we assumed, for the same increase in GDP (32%) and money supply (33%), a decrease in the price level along with autonomous increases in both consumption and investment spending. Each of these changes alone has the effect of decreasing the price of the asset in our model. The results of this

simulation (Table 1, Case 2) confirms that it would take a large deflation (20%) coupled with very large increases in both autonomous C and I to undo the positive effect that an increase in GDP has on the price of the asset.

## Conclusion

Scholars may be doomed to always be studying the past, but presumably the past informs our views of the present and future. The results of this paper suggest that in the long run changes in GDP drive asset prices. Predictions, and for that matter, advice about the stock market we would argue devolve into predictions about the real economy—the growth rate in GDP. We would argue that if GDP grows at its historical average for the next ten years, then asset prices will follow. On the other hand, we would argue that if GDP declines for any substantial period of time, then the pain felt in the real economy will be of much more importance than the value of asset prices per se.

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## Appendix 1: Simulation

The baseline parameters are  $\alpha_0 = 26.5$ ,  $\alpha = 0.9$ ,  $N_0 = 8780$ ,  $M_S = 1300$ ,  $I_0 = -320$ ,  $G_0 = 2400$ ,  $\beta_0 = 0.19$ ,  $\beta_1 = 100$ ,  $z = 0.22$ ,  $m_0 = 24$ ,  $m_1 = 0.125$ ,  $A = 150$ ,  $M^* = 1500$ ,  $a_0 = 0$ ,  $a_1 = 96$ ,  $a_2 = 100$ ,  $E(X) = 1$ ,  $P = 1$ ,  $t = 0.3$ ,  $c_w = 0.03$ ,  $Y = 12,000$ .

The calculations are done in the following order. A brief explanation of the assumptions for equations not found above is given after the equation. Fuller explanations are found in Wojcikewych, Scott, and Highfill (2005).

I. Preliminary Calculations towards finding the equilibrium Asset Price

$$(1) \quad S_o = \frac{-\alpha_o}{1 + c_w}$$

$$(2) \quad s = \frac{(1 - \alpha)(1 - t)}{1 + c_w}$$

$$(3) \quad r = z \frac{Y}{M_S}$$

Assume money demand is isoelastic  $r(M_D / P) = z(Y / P)$ , and equilibrium in the money market .

$$(4) \quad I = I_o P + \beta_o Y - \beta_1 r P$$

Assume real investment is a function of real income and the interest rate:

$$\frac{I}{P} = I_o + \beta_o \frac{Y}{P} - \beta_1 r$$

$$(5) \quad XR \equiv \frac{\$}{FE} = \frac{m_o P + m_1 Y + A + a_2 E(XR)}{M^* + a_o + a_2 + a_1 r}$$

Notation,  $m_oP + m_1Y$  is imports,  $M^*$  is exports (denominated in the foreign exchange FE units),  $A$  is capital outflows and  $a_0 + a_2 + a_1r$  are capital inflows (denominated in the foreign exchange FE units) and  $a_2E(XR)$  captures the effect of the expected exchange rate. Equilibrium in the foreign exchange market implies that demand for dollars is equal to supply of dollars:

$$\frac{\$}{FE}(a_0 + a_2 + a_1r) - a_2E(XR) = m_oP + m_1Y + A.$$

$$(6) \quad w = \frac{c_w}{1 + c_w} N_o$$

$$(7) \quad wP_S = (S_o - I_oP - G + m_oP) + (s - \beta_0 + t + m_1)Y + \beta_1r + XR(a_0 + a_2 + a_1r) - a_2E(XR) - A$$

using Appendix (3) and Appendix (5).

II. Find Savings, Wealth, and Taxes

$$(8) \quad S = S_o + sY - wP_S$$

$$(9) \quad N_H^D = \frac{S}{P_S}$$

$$(10) \quad W = P_S(N_o + N_H^D)$$

$$(11) \quad T = tY.$$

III. Compute the components of Aggregate Demand

$$(12) \quad C = \alpha_o + \alpha(Y - T) + c_w W$$

$$(13) \quad I = I_oP + mpiY$$

$$(14) \quad GB = G_o - tY$$

$$(15) \quad (X - M) = \frac{\$}{FE}M^* - m_oP - m_1Y$$

## Appendix 2: Survey of Macropinciples Textbooks

Prior to the 1990s, analysis of the stock market in macropinciples textbooks was limited primarily to an institutional treatment of how stocks (and bonds) enable business firms to raise cash and finance capital expansion. Beyond this, the importance of the stock market to the over-all economy, however, was typically relegated to a brief historical footnote of how the crash of 1929 precipitated (caused?) the Great Depression. There was no serious attempt to integrate the stock market and stock prices into a formal model of the macroeconomy.

A survey of current principles textbooks suggests the bull market of the 1990's may have altered the discussion of the stock market and its relationship to the economy. At a minimum, most texts continue to briefly note the role of stocks and the stock market as sources of funds for capital expenditures.<sup>31</sup> Frank and Bernanke (2004) use the asset market approach to explain the determination of stock prices from a micro point of view, i.e., the role of risk, interest rate, and expectations in explaining the price of a specific stock. Most textbooks surveyed made some attempt at incorporating the

<sup>3</sup> See for example Colander (2004) and Stiglitz and Walsh (2002).

stock market and stock prices into a macroeconomic explanation of output determination via the wealth effect.<sup>4</sup> In these analyses, changes in stock prices affect consumer spending through the wealth effect. The resulting change in aggregate demand then causes output to change in the same direction. The current paper does not investigate this question—although the model of this paper could be used as a theoretical foundation for the demand side of such an analysis.

A typical policy implication of the above analysis mentioned in the texts is that the Fed therefore needs to pay some attention to the stock market because fluctuations in stock prices can indirectly cause changes in nominal output.<sup>5</sup> Thus, while a number of principles textbooks analyze how the stock market and fluctuations in stock prices can affect the economy, only one text, Hall and Lieberman (2005), examined the relationship the other way around, i.e., how the macroeconomy affects the stock market. While we agree with their result that increases in real GDP cause increases in stock prices (Hall and Lieberman, 2005, 517), we arrive at the conclusion through different reasoning, and, we have serious reservations about their “multiplier effects” as will be explained below.



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<sup>4</sup> These textbooks include Baumol and Blinder (2005), Case and Fair (2005), Frank and Bernanke (2004), Hall and Lieberman (2005), Lipsey, Courant, and Ragan (1999), Mankiw (2004), McConnell and Brue (2005), and Schiller (2003).

<sup>5</sup> See for example Frank and Bernanke (2004), Lipsey, Courant, and Ragan (1999), and Mankiw (2004).