A Non-Walrasian Analysis of Asset Price Movements under the Tobin-Blanchard-Samuelson Model: A System Dynamics Approach

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Abstract

The purpose of this paper is to analyze the dynamics of stock price movements as an example of asset prices, under the conditions of different expectation formations and to show the effects of an expansionary monetary policy on these movements. This analysis applies the model established by Blanchard (1981) based on the standard IS-LM Model and expanded with *Tobin's q Theory*. Although Blanchard set his model as a differential equation system with two dynamic variables (real income Y and real stock market value q), he probably did so due to difficulty of visual expression of more variables. System dynamics approach provides an opportunity to add the real interest rate r as a third variable and to use time lag values of some variables, as Samuelson (1939) did in his study. Moreover, with this dynamic approach, we modeled the asset price expectations and wealth accumulation in the form of differential equations. The main distinguishing factor of this paper is a non-Walrasian analysis method that allows trade under uncertain market conditions in which demand-supply equality is not satisfied. Furthermore, this analysis differentiates between the desired and realized demands and supplies of equities and bonds of firms and households. Thus, we can consider buying and selling actions under the possibility of excess demand or excess supply for assets. Under the framework of the expanded Blanchard (1981) model, we analyzed the influence of the expansionary monetary policy on stock price with a different type of expectation formations like naive (static), adaptive, and trend following.

Keywords: Non-Walrasian, Tobin-Blanchard-Samuelson Model, System Dynamics

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1 Introduction and Literature

As mentioned above, Blanchard (1981) constructed two-dynamic-variable, nonlinear differential equation systems to plot a phase diagram into the two-dimensional plane, and he applied money

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market clearing interest rate as a static equation regarding real money supply and real income. He claimed to explain the interaction between output and asset price and also to show the effects of announced and unannounced fiscal and monetary policy changes on the equilibrium values of these variables. According to Blanchard (1981), the value of shares in the stock market affects consumption as a part of wealth and also affects investments, because it determines the ratio of the market value of capital to its replacement cost, which is known as Tobin's q Theory[1].

Shone (2002) and Zhang (2005) linearized and solved the Blanchard's nonlinear differential equation system in the neighborhood of its equilibrium point. Since these studies were performed, the Blanchard (1981) model has become known as the Tobin?Blanchard model and is accepted as the most popular example of the application of nonlinear equation systems in economics. While under the constraints of analyzing such methods, these studies focused on the movements from old to new equilibrium points, and the system dynamics method permits simulation of the process. The property of stability condition of the Tobin?Blanchard model, which is called the saddle path solution, statistically gives very small chance to find a new equilibrium point once it departs from the old equilibrium. Thus, the saddle path condition requires the assumption of rational expectations to help find the direction of a stable arm of the system. Because of this assumption, Blanchard (1981) supposed that the agents in his model could perfectly foresee the future values of shares. Conversely, and fortunately, the system dynamics approach frees us to loosen rational expectation assumption.

Another loosened assumption relates to the substitution conditions of bonds and stock markets. Although Blanchard supposed that these two assets are perfect substitutes, in this article we assumed that savers would be indifferent between the stocks and bonds if the share pays more than bonds' interest rates proportionally with a risk premium of the stock market, which is calculated from standard deviation. For this reason, bond and stock markets are taken as close substitutes instead of perfect substitutes.

The rest of the paper is organized as follows. Section two presents the detailed model of an artificial economy based on Blanchard (1981) article. Section three analyzes the effects of expansionary monetary policy on stock price under the different expectation formations, with simulations. The fourth and last section assesses the consequences of the simulations.

2 Model

It is assumed that there are two types of assets in the economy: bonds and stocks. Even if money does not pay any returns, it is included in the definition of wealth, as defined by Tobin (1969) and improved by Sargent (1987). According to the definition of Blanchard (1981), q refers to real stock market value and it can be considered as an average real price level of the stock market in this study. Also Q denotes the total quantity of stocks at any given period. Then, total wealth can be written as in Equation (1).

$$W_t = q_t Q_t + \frac{(M_t + B_t)}{P_t} \tag{1}$$

Here, $q_t Q_t$ represents the equity-based total wealth in this economy. P_t refers to the general commodity price level and is used to convert nominal terms into real values. In order to simplify

[1]As (Mishkin, 2011a, p. 536) asserted, the Tobin's q value is positively related to stock market price.

the model, as in Blanchard (1981), it is assumed that P_t is constant and additionally it equals one[2]. Furthermore at the beginning of each time period[3] bond price equals one, as well. This last assumption about bonds price allows us to represent the total quantity of bonds with B_t. With these simplifications, wealth can be rewritten as in Equation (2).

$$W_t = q_t Q_t + B_t + M_t \tag{2}$$

Stock shares can be held by firms $Q_{F,t}$ or households $Q_{H,t}$.

$$Q_t = Q_{F,t} + Q_{H,t} \tag{3}$$

If firms observe an annual increase in real income, they would decide to expand their capital stock. That's why the total amount of stock shares proportionally increases with real income, but it does not decrease in an economic slump-down without any severe recession. The annual growth rate of the economy is represented in Equation (4).

$$g_{Y,t+12} = \frac{Y_t - Y_{t-12}}{Y_{t-12}} \tag{4}$$

Change in total quantity of stocks can be defined as in Equation (5).

$$\begin{cases} g_{Y,t+12} > 0 \Rightarrow Q_{t+12} = (1 + \eta g_{Y+12})Q_t \wedge \Delta Q_t = g_{Y+12}Q_t \\ g_{Y+12} \leq 0 \Rightarrow Q_{t+12} = Q_t \wedge \Delta Q_t = 0 \end{cases} \tag{5}$$

Like the standard macroeconomics textbooks, it is supposed that money can be used for transactions and it does not pay interest, and it is constituted by currency CU_t and demand for checkable deposits D_t (Blanchard and Johnson, 2013).

$$M1_t = CU_t + D_t \tag{6}$$

Since time deposits and bank loans do not take place in the model, the only interest-bearing asset in the model is bonds. We assume that nominal and real rates for bonds are equal and they constitute the opportunity cost of holding money (Mishkin, 2011b). Hence, while money demand is positively correlated with real income Y through the transactions, it negatively relates to the real r interets rate (Shone, 2002). In Equation (7), real money demand $\frac{M^D}{P}$ is expressed as a function of real income and real interest rates, where L denotes liquidity.

$$\frac{M^D}{P} = L(Y, r) \tag{7}$$

In this study, besides the interest rate, the expected return of stock market is also regarded as the opportunity cost of holding money. Thus, money demand is defined as a negative function of the expected return of stock shares, like interest rate.

$$\frac{M^D}{P} = L(Y, r, r_q^e) \tag{8}$$

[2]Because the study focuses on asset price movements like Blanchard (1981), it is assumed that the price level is fixed and there is neither actual nor expected inflation rate, hence nominal and real interest rate are equal.

[3]Although distance of time periods is determined in months, continious notations like time derivatives imply approximate daily changes. This means that dynamic variables are adjusted daily by the VENSIM simulation software.

If q^e_{t+1} refers to the expected return of stock market belonging to the next period,

$$r^e_{q,t+1} = \frac{q^e_{t+1} - q_t + \pi_t}{q_t} \tag{9}$$

Here π_t denotes the dividends of shareholders. Dividend per unit equity is the ratio of total profit of firms to total stock shares.

$$\pi_t = \Pi_t / Q_t \tag{10}$$

Total profit is driven by firms through the sales described as a positive function of real income, as Blanchard (1981) assumed.

$$\Pi_t = a_0 + a_1 Y_t \tag{11}$$

Davidson (1965) defined money demand as a function of planned consumption and investment expenditures instead of income, and called this relation the finance motive of money demand. In this study, money is assumed to be demanded for financing consumption expenditures. To simplify the model, we assume that consumption expenditures are paid by households with currency, and deposits play a role in the redistribution of households' wealth.

$$\frac{M^D}{P} = L(C, r, r^e_q) \tag{12}$$

We follow Palley (2013, 2015), Flood and Marion (2004), and Crespo-Cuaresma *et al.* (2004) to design the final form of money demand function, which is constituted by the summation of currency and deposits.

$$\frac{M^D}{P} = \frac{CU(C)}{P} + \frac{D(r, r^e_q)}{P} \tag{13}$$

According to dynamic IS-LM models, a change in the bond market interest rate is determined by the excess demand for money.

$$\frac{dr}{dt} = \beta \left[\frac{M^D}{P} - \frac{M^S}{P} \right] \quad \text{for} \quad 0 < \beta < 1 \tag{14}$$

It is also supposed that the monetary authority can determine the money supply through open market operations and can influence the interest rates. If we denote the money multiplier for $M1$ with μ, then money supply is equal to multiplier times monetary base:

$$M^S = \mu MB \tag{15}$$

Monetary base includes the assets of the central bank, which is constituted of the credits given to commercial banks L_{CB}, and bonds held by the central bank B_{CB}:

To make the model simple, it is accepted that the government budget is financed by tax revenues paid by households.

$$G = T \tag{16}$$

Hence the government does not need to issue new bonds, and the total quantity of bonds held respectively by the central bank, banking sector, and households are fixed and do not change over time.

$$B_t = B_{CB,t} + B_{B,t} + B_{H,t} \tag{17}$$

It is assumed that, instead of firms, firm owners hold bonds as households. According to the model, commercial banks play a regulatory role when the central bank intends to intervene in the money market or households decide to buy or sell bonds at the second-hand bonds market. Commercial banks would accompany them and provide the required amount of demand or supply. On the other hand, because the total stock of bonds is constant, there is a limit for this role. The total demand of the central bank and households cannot exceed the amount of bonds held by the commercial banks, and its priority is to respond to the demand of the central bank, as explained in Equations (18, 19, 20).

$$\Delta B_{CB,t} + \Delta B_{H,t} \leq B_{B,t} \Rightarrow \Delta B_{B,t} = -(\Delta B_{CB,t} + \Delta B_{H,t}) \tag{18}$$

$$\Delta B_{CB,t} < B_{B,t} \wedge \Delta B_{H,t} > (B_{B,t} - \Delta B_{CB,t}) \Rightarrow \Delta B_{B,t} = -B_{B,t} \wedge \Delta B_{H,t} = B_{B,t} - \Delta B_{CB,t} \tag{19}$$

$$\Delta B_{CB,t} \geq B_{B,t} \Rightarrow \Delta B_{B,t} = -B_{B,t} \wedge \Delta B_{H,t} = 0 \tag{20}$$

Shone (2002) claimed that investment should be a positive function of q. Sorenson and Jacobsen (2010) improved this assertion and showed the higher value of q than one could support in the investment expenditures. A greater q value than one would mean that the market value of the firm exceeds its replacement cost, and thus the firm can easily finance its investment by selling shares.

$$I(q - 1) \tag{21}$$

Notwithstanding Equation (21) emphasizes the positive relationship between investment and Tobin's q through the financing side, it does not explain the reason for investing. The main incentive of making a new investment is probably related to expectations about future profits. Changes in consumption expenditures might be taken as a proper indicator for profit, which is why we prefer to use the investment function of Samuelson (1939). To simplify the model, depreciation cost of the capital stock is accepted as constant during the analysis.

$$I_t = \varphi_0 + \varphi_1(C_t - C_{t-1}) \tag{22}$$

The system dynamics method allows for adaptation of lag variables in the model, like in Equation (22). Moreover, the investment function should include changes in the total stock share ΔQ_t.

$$I_t = \varphi_0 + \varphi_1(C_t - C_{t-1}) + \Delta Q_t \tag{23}$$

Like the investment, consumption function was described as depending on the one-period previous value of income by Samuelson (1939). We adjusted it as a lag value of disposable income.

$$C_t = \delta_0 + \delta_1 (Y - T)_{t-1} \tag{24}$$

The second differential equation of this model defines the dynamics of changes in income. Aggregate demand AD, is the sum of consumption, investment, and government expenditures. Equation (25) indicates that aggregate demand in excess of output triggers greater production.

$$\frac{dY}{dt} = \alpha[AD - Y] \quad \text{for} \quad 0 < \alpha < 1 \tag{25}$$

Firms distribute their profits to households proportionally to the equities they hold. The allocation of equities is assumed to be driven by some factors like changes in total equity stock and changes in the amount of total stock that firms and households would like to hold.

$$\begin{cases} t = 0 \Rightarrow \Pi_{F,0} = \frac{Q_{F,0}}{Q_{t_0}} \Pi_0 \wedge \Pi_{H,0} = \frac{Q_{H,0}}{Q_{t_0}} \Pi_{t_0} \\ 0 < t < 12 \Rightarrow \Pi_{F,t} = \frac{Q_{F,t}}{Q_t} \Pi_t \wedge \Pi_{H,t} = \frac{Q_{H,t}}{Q_t} \Pi_t \\ t \geq 12 \Rightarrow \Pi_{F,t} = \frac{Q_{F,t} + \Delta Q_t}{Q_t + \Delta Q_t} \Pi_t \wedge \Pi_{H,t} = \frac{Q_{H,t}}{Q_t + \Delta Q_t} \Pi_t \end{cases} \tag{26}$$

If firms' profits are enough for financing their investment expenditures, they will use their profits. If their profits exceed their investment expenditures, they will prefer to buy equities to support the equity price. Otherwise, to finance investment expenditures, they will sell equities.

$$\begin{cases} \Pi_{F,t} > I_t \Rightarrow Q^{PD}_{F,t} = \frac{\Pi_{F,t} - I_t}{q_t} \\ \Pi_{F,t} = I_t \Rightarrow Q^{PD}_{F,t} = 0 \\ \Pi_{F,t} < I_t \Rightarrow Q^{PS}_{F,t} = \frac{I_t - \Pi_{F,t}}{q_t} \end{cases} \tag{27}$$

According to Equation (27), firms determine their demand for and supply of stock shares as planned values. Although the return of bonds is predetermined for savers, the return of stock market is uncertain. Thus households, to be indifferent, demand higher return than the bond interest rates, proportionally with the standard deviation of past returns, which denote the risk premium of stock market σ_q.

$$r^e_{q,t+1} = r_t + \sigma_q \tag{28}$$

If households expect that the future value of stock market would be equal to today's value q^e_{t+1}, then the expected return of equity would be determined by dividends $r^e_{q,t+1} = \frac{\pi_t}{q_t}$.

Since the balance of the budget is provided by the government, its savings equal zero, and therefore, total savings in the economy are constituted by private savings.

$$S = Y - C - G = \underbrace{Y - T - C}_{S^P} + \underbrace{T - G}_{S^G = 0} \tag{29}$$

Hence, savings, as defined by Equation (29), belong to households and combine their actual savings and dividends with their wealth $W_{H,t-1}$ coming from the previous period with returns to obtain their re-distributable potential wealth. After that, they compare the expected returns of stocks and bonds and decide how many units they want to hold from each of them.

$$W_{H,RPW,t} = W_{H,t-1} + S_t + \Pi_{H,t} \tag{30}$$

A logistic probability function is used to determine households' willingness to hold assets. This function allows distribution of the total wealth according to the returns of stocks and bonds by keeping a varied portfolio.

$$Q_{H,t} = \left[\frac{1}{1+e^{-\alpha(r^e_{q,t+1}-r-\sigma_q)}}\right]\left(\frac{S_t + W_{H,t-1}}{q_t}\right) \tag{31}$$

$$B_{H,t} = \left[\frac{1}{1+e^{\alpha(r^e_{q,t+1}-r-\sigma_q)}}\right](S_t + W_{H,t-1}) \tag{32}$$

Desired or planned demand or supply of households for stocks and bonds $Q^{PD}_{H,t}$, $Q^{PS}_{H,t}$, $B^{PD}_{H,t}$, and $B^{PS}_{H,t}$, would be determined by a difference if they prefer to hold $Q_{H,t}$ and $B_{H,t}$ and they already have.

$$Q_{H,t} > Q_{H,t-1} \Rightarrow Q^{PD}_{H,t} = Q_{H,t} - Q_{H,t-1} \qquad Q_{H,t} < Q_{H,t-1} \Rightarrow Q^{PS}_{H,t} = Q_{H,t-1} - Q_{H,t} \tag{33}$$

$$B_{H,t} > B_{H,t-1} \Rightarrow B^{PD}_{H,t} = B_{H,t} - B_{H,t-1} \qquad B_{H,t} < B_{H,t-1} \Rightarrow B^{PS}_{H,t} = B_{H,t-1} - B_{H,t} \tag{34}$$

Although firms' and households' planned demands are defined by Equations (**??**) and (**??**) respectively, the realization of demand for each of them requires the supply of the other. The minimum of them determines the realized amount of trade. Thus, the desired (planned) $Q^{PS}_{F,t}$, $Q^{PS}_{H,t}$, $Q^{PD}_{F,t}$, $Q^{PS}_{H,t}$ and realized $Q^{RS}_{F,t}$, $Q^{RS}_{H,t}$, $Q^{PD}_{F,t}$, $Q^{PD}_{H,t}$, values of demand and supply might be different from each other.

$$Q^{RD}_{F,t} = \min[Q^{PD}_{F,t}, Q^{PS}_{H,t}] \tag{35}$$

$$Q^{RD}_{H,t} = \min[Q^{PD}_{H,t}, Q^{PS}_{F,t}] \tag{36}$$

$$Q^{RS}_{F,t} = \min[Q^{PD}_{H,t}, Q^{PS}_{F,t}] \tag{37}$$

$$Q^{RS}_{H,t} = \min[Q^{PD}_{F,t}, Q^{PS}_{H,t}] \tag{38}$$

The commonly used Walrasian models assume that the trade action in the market necessitates the occurrence of the equilibrium price. Nonetheless, in this study, it is assumed that excess demand drives price changes and that trade can be continued at a wrong price during the price adjustment process. Without the existence of a Walrasian *tatonnement*, prices cannot automatically reach to the market clearing level. The adjustment process goes on with the buying and selling actions.

Change in equity price is managed by excess demand, which is determined by households and firms. Equation (39) describes equity price movements as a third differential equation of the model.

$$\frac{dq}{dt} = \vartheta(Q^D_{F+H,t} - Q^S_{F+H,t}) \tag{39}$$

As long as at least one of the stock or bonds earns positive returns, households do not prefer to hold money. They plan to allocate their redistributional wealth between stocks and bonds. On the other hand, if the redistributional wealth of households exceeds the sum of the values of their stocks and bonds due to a restriction on the total amount of bonds or possibility of inconsistency between desired demand and desired supply, they have to keep money as deposits. For this reason, we prefer to use Tobin's definition of wealth, which also includes money.

Thereby, at each period, redistributional wealth is allocated between bonds and stocks, and its surplus part is kept as deposits by households. The planned composition of stocks and bonds is described in Equation (40).

$$W_{H,RPW,t} = q_t Q^P_{H,t} + B^P_{H,t} \tag{40}$$

However, non-Walrasian dynamics and restrictions on the total amount of bonds can potentially cause an appearance of their different combinations with deposits. Depending on the conditions ex post allocations can differ from plans. Even if the plans do not contain deposits, realized allocation can contain them.

$$W_{H,RPW,t} = \underbrace{q_t Q^P_{H,t} + B^P_{H,t}}_{planned} = \underbrace{q_t Q^R_{H,t} + B^R_{H,t} + D_{H,t}}_{realized} \tag{41}$$

At the end of the period, while bonds get their returns, changes in stock price make the shares more or less desirable. At the beginning of the next period, with the savings and dividends that belong to the new period, redistributional wealth is reconsidered.

$$W_{H,RPW,t+1} = \underbrace{(q_t + \Delta q_t)Q^R_{H,t} + (1 + r_t)B^r_{H,t} + D_{H,t}}_{W_{H,t}} + S_{t+1} + \Pi_{H,t+1} \tag{42}$$

The next period's value of redistributional wealth, based on the realized part of Equation (41), can be described in Equation (42).

$$W_{H,t} = (q_t + \Delta q_t)Q^R_{H,t} + (1 + r_t)B^r_{H,t} + D_{H,t} \tag{43}$$

The term $W_{H,t-1}$, given in Equation (30) without its defination, can be expressed as a preivous value of $W_{H,t}$ described in Equation (43) to obtain a clear definition of redistributional wealth as in Equation (44).

$$W_{H,RPW,t} = \underbrace{(q_{t-1} + \Delta q_{t-1})Q^R_{H,t-1} + (1 + r_{t-1})B^r_{H,t-1} + D_{H,t-1}}_{W_{H,t-1}} + S_t + \Pi_{H,t} \tag{44}$$

This term expresses the expected value of equity included in Equation (9), which might be formed in different ways. As is mentioned above, naïve households may think that the asset price does not systematically change and fluctuate around a zero mean error term ε.

$$q^e_{t+1} = q_t + \varepsilon_t \tag{45}$$

Another expectation formation approach, which is called adaptive, allows households to revise their expectations according to the mistakes they made in the previous periods.

$$q^e_{t+1} = q^e_t + \psi(q_t - q^e_t) \tag{46}$$

The last type is referred to as trend following expectations and supposes that trend followers reflect recent changes on asset price in their expectations. They expect that the recent trends would continue.

$$q^e_{t+1} = q_t + \phi(q_t - q_t) \tag{47}$$

3 Scenarios and Simulations

The model explained in the previous section is simulated by *Vensim Simulation Software*. Before conducting the simulation, the model expressed through the equations above is visualized using stock and flow variables as in Figure (1).

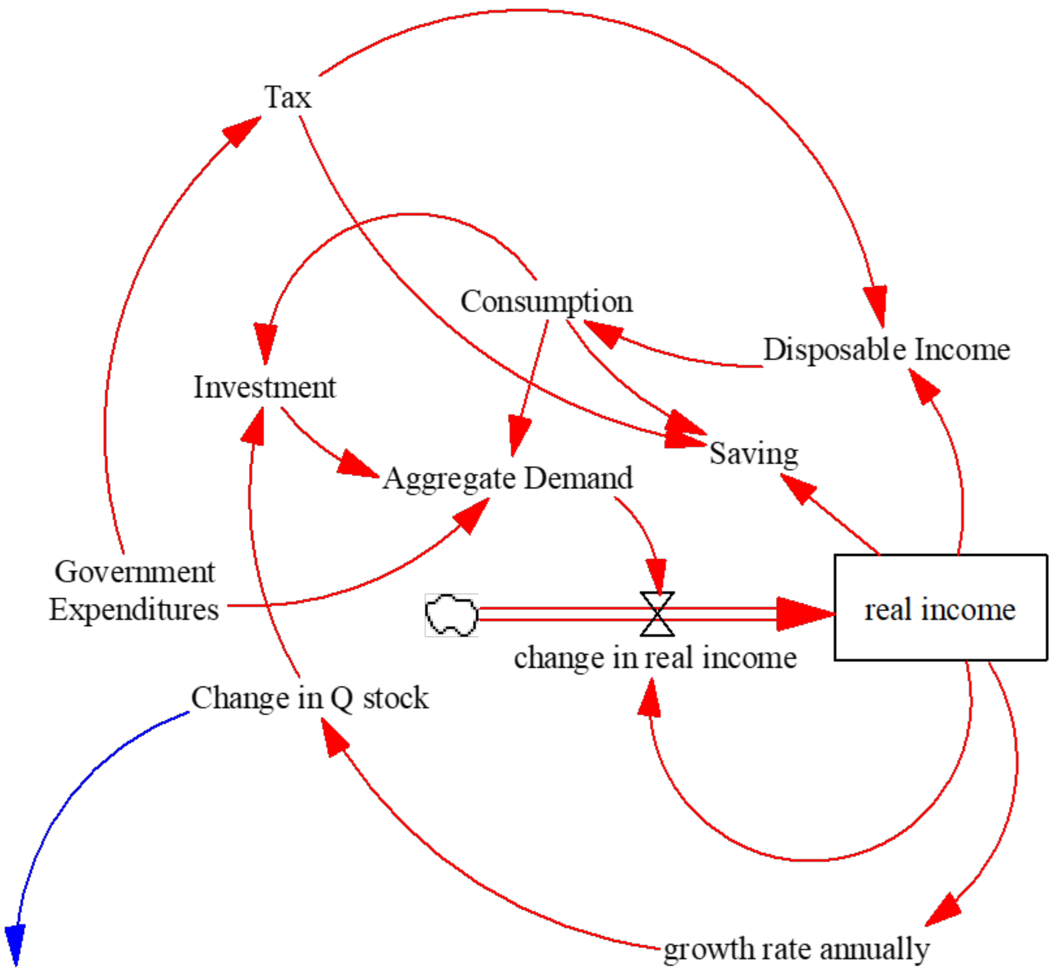


Figure 1: National Income Dynamics

Like the given component of the visualized model in Figure (1), there are two more sectors that represent the interest rates dynamics and wealth dynamics. All interactions and also positive and negative feedback loops between the sectors and between the variables are plotted by arrows. The time unit representing one period is selected as a month, and initially, the dynamics of income and interest rates with savings, investment, and some additional variables related to wealth acquisition are run over 72 months.

Simulations indicate that income follows dampened fluctuations and converges a stable pattern with its internal dynamics, as Samuelson (1939) showed.

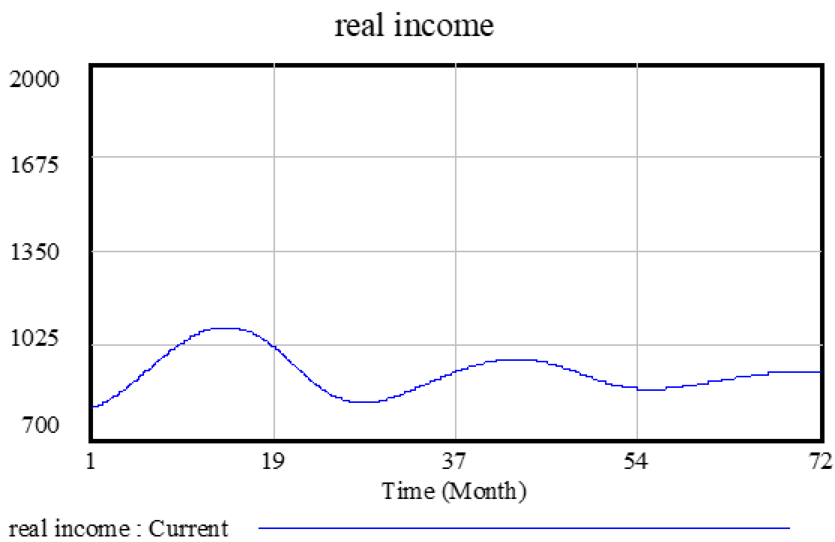
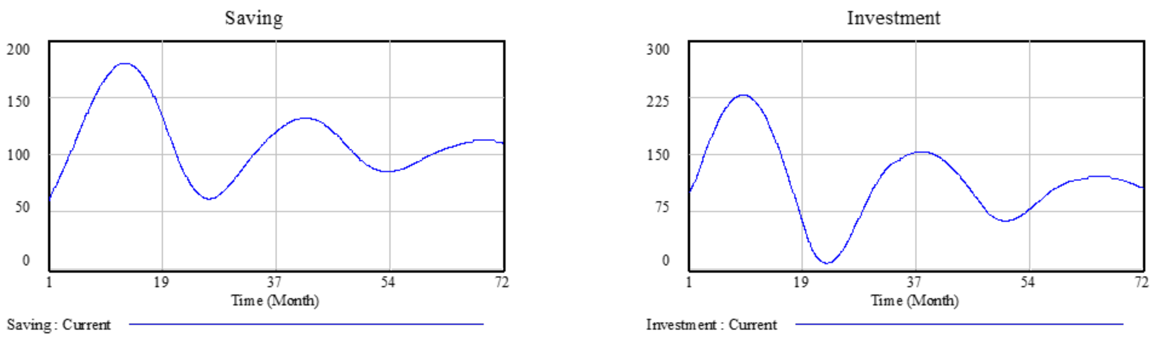


Figure 2: Real Income Dynamics

Since the model analyzes a closed economy, savings and investments seem to converge in the long run, as expected.



(a) Savings (b) Investment Expenditures

Figure 3: Savings & Investments

Because the stock and bond market returns represent the opportunity cost of holding money, there is an interaction between wealth acquisition and interest rates through the components of money demand, which are deposit and currency. As mentioned before, currency is determined by consumption expenditures, and deposits are related to excess wealth. Hence, the currency ratio, which includes currencies and deposits, and the money multiplier which consists of the currency ratio, change over time together. Thus, although the monetary base determined by the monetary authority is fixed during the analysis, money supply accompanies the money multiplier.

Thus, the interest rate is driven by the interaction between the money demand and money supply functions.

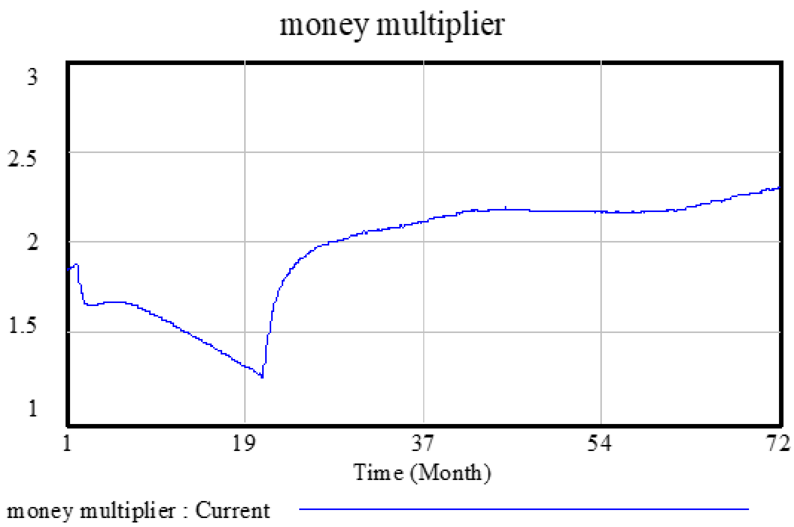
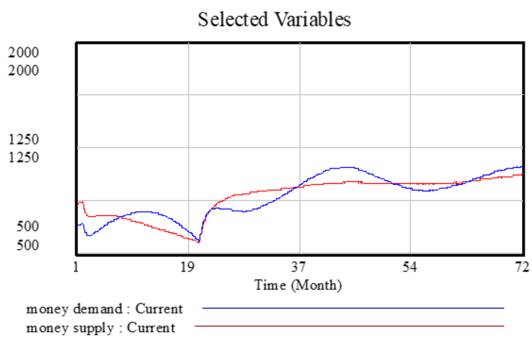
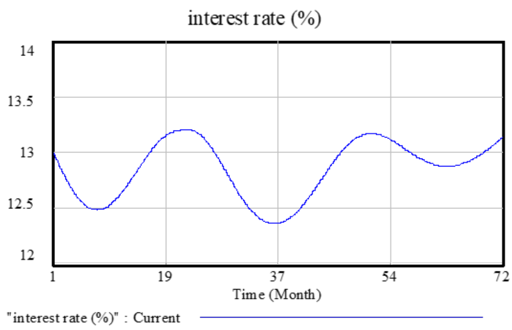


Figure 4: Money Multiplier

Initially, we assume that the expected return of the stock market is proportional to dividends, and the expectation formation of households is naïve. While the risk premium of the stock market moves around a half of a percent, the simulation exhibits that the expected return tends to fall during the first two years and, after that, begins to rise slightly.



(a) Dynamics of Money Demand and Money Supply



(b) Interest Rate Dynamics

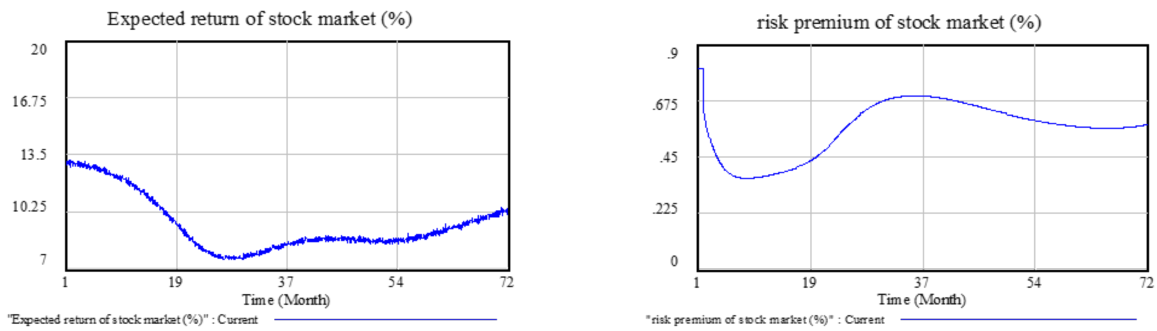
Figure 5: Dynamics

At the beginning of the analysis, households intend to distribute their wealth equally between stocks and bonds, but in time, returns push the probability of holding stock shares to 40 percent and holding bonds to 60 percent.

To observe the influence of an expansionary monetary policy on equity price, we prefer to narrow the time interval of our analysis and focus on the first 36 months.

In a given period, equity price starts at 1 unit, steadily increases, and seems to converge on a stable path around the 1.3 unit.

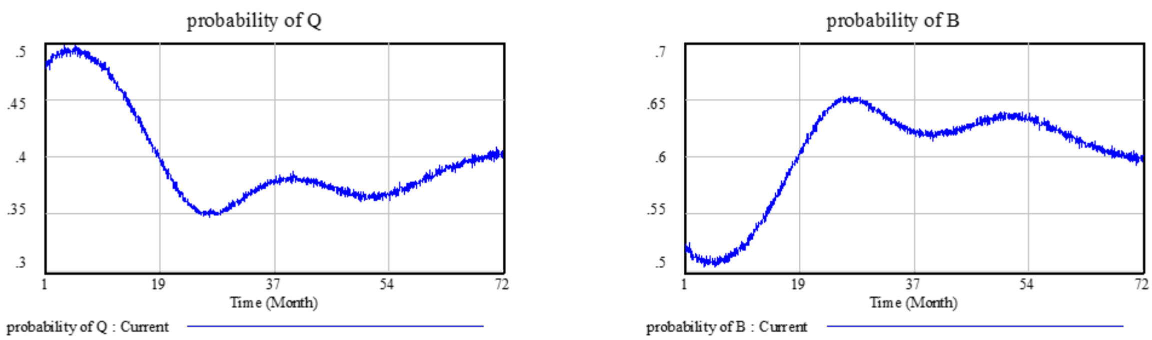
Although the expected return of the stock market decreases, redistributable wealth, which is fed by savings and dividends, helps households to sustain their demand for stocks and supports the equity price.



(a) Expected Return of Stock Market (b) Risk Premium of Stock Market

Figure 6: Expected Return & [Risk Premium

When the central bank increases the money supply through open market operations, interest rate decreases and results in a differentiation between the returns of the two assets. In contrast to the fluctuated movement, interest rate begins to display a declining path which encourages households to hold more equity instead of bonds. Holding more equity pushes the stock price up.



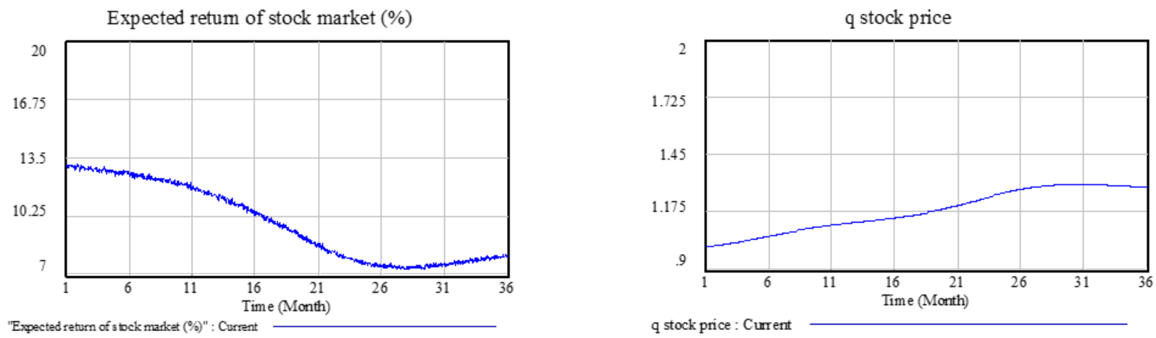
(a) Probability of Holding Equities (b) Probability of Holding Bonds

Figure 7: Probabilities

To explain the effects of the expectation formation of households on equity price, we replace the adaptive expectation formation instead of the naïve expectation. Replicating the analysis above, we observe that expected returns and the price of the stock market follow similar patterns as before. It should be reiterated that the naïve expectations are assumed to be a type of adaptive expectations.

On the other hand, when the expectations are formed by trends, the initial increase in stock prices creates a positive feedback loop on itself and expected returns tend to increase, even without the implementation of the expansionary monetary policy condition.

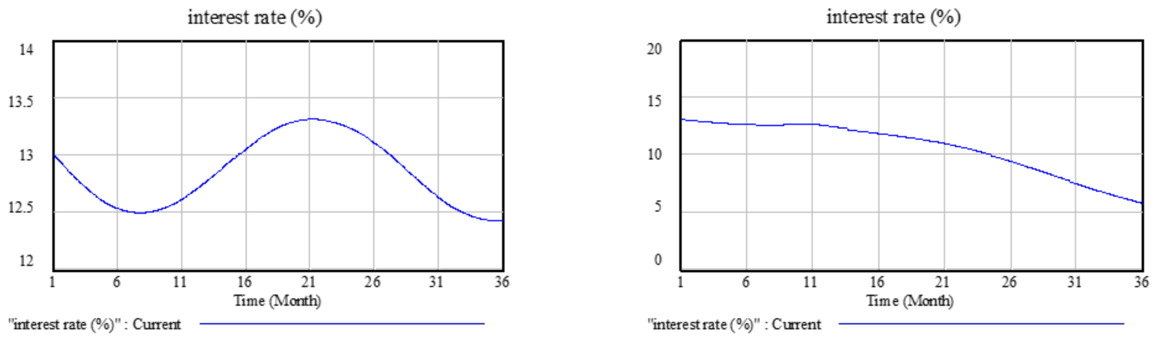
Higher expected returns bring the price close to 1.6 unit. Nonetheless, the expansionary monetary policy does not cause any significant effect on the equity price.



(a) Expected Return of Stock Market

(b) Stock Market Price

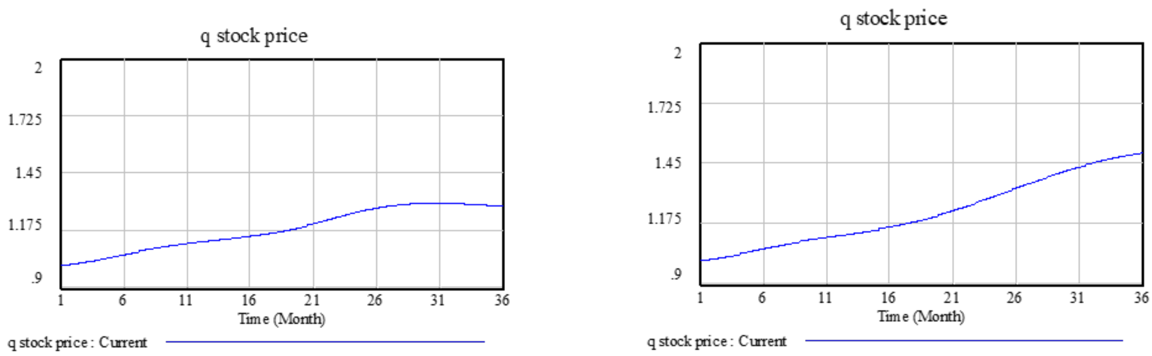
Figure 8: Expected Return & Prices



(a) Interest Rates Before Expansionary Monetary Policy

(b) Interest Rates After Expansionary Monetary Policy

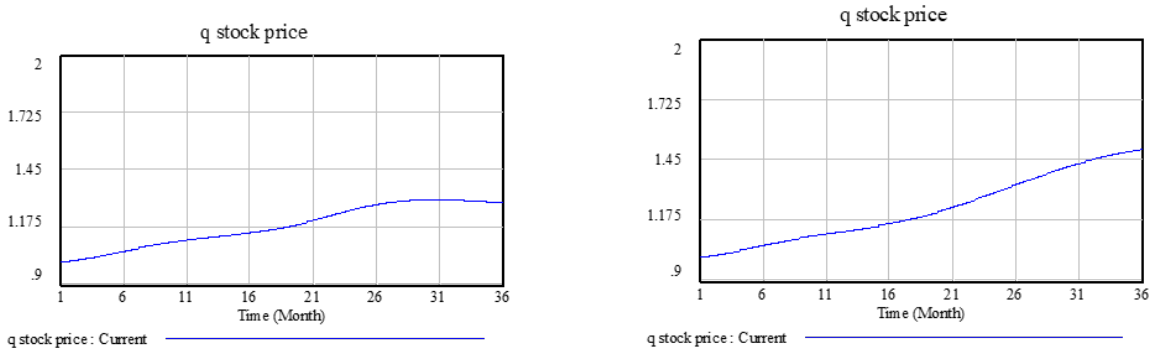
Figure 9: Interest Rates



(a) Stock Price Before Expansionary Monetary Policy with Naïve Expectations

(b) Stock Price After Expansionary Monetary Policy with Naïve Expectations

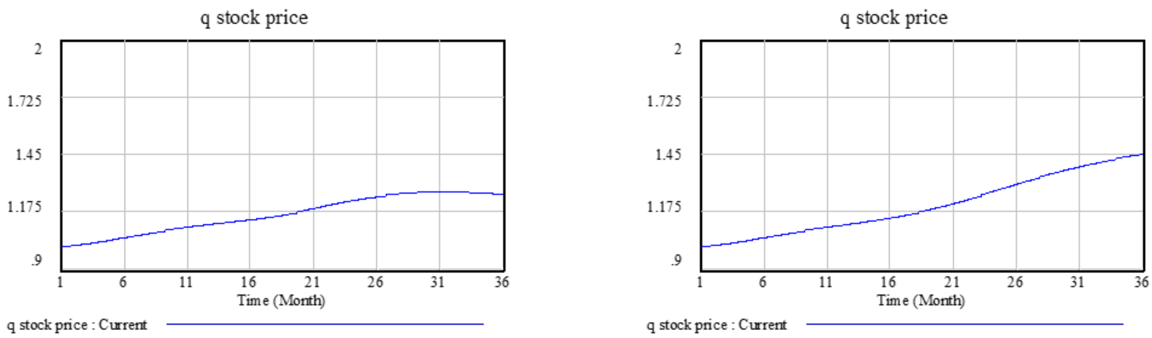
Figure 10: Stock Prices



(a) Stock Price Before Expansionary Monetary Policy with Naïve Expectations

(b) Stock Price After Expansionary Monetary Policy with Naïve Expectations

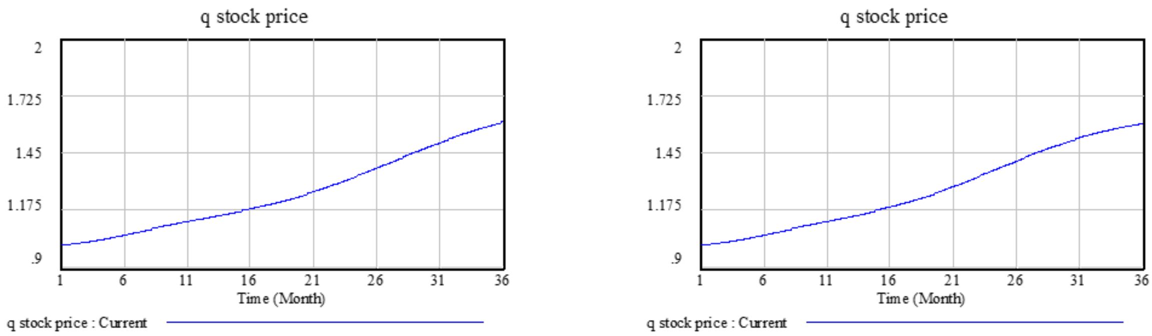
Figure 11: Naïve Expectations



(a) Stock Price Before Expansionary Monetary Policy with Adaptive Expectations

(b) Stock Price After Expansionary Monetary Policy with Adaptive Expectations

Figure 12: Adaptive Expectations



(a) Stock Price Before Expansionary Monetary Policy with Trend Following Expectations

(b) Stock Price After Expansionary Monetary Policy with Trend Following Expectations

Figure 13: Trend Following Expectations

4 Conclusion

When the bonds and stocks are close substitutes, the expected consequence of an expansionary monetary policy on equity price would be a clear increase. Our artificial economy could display

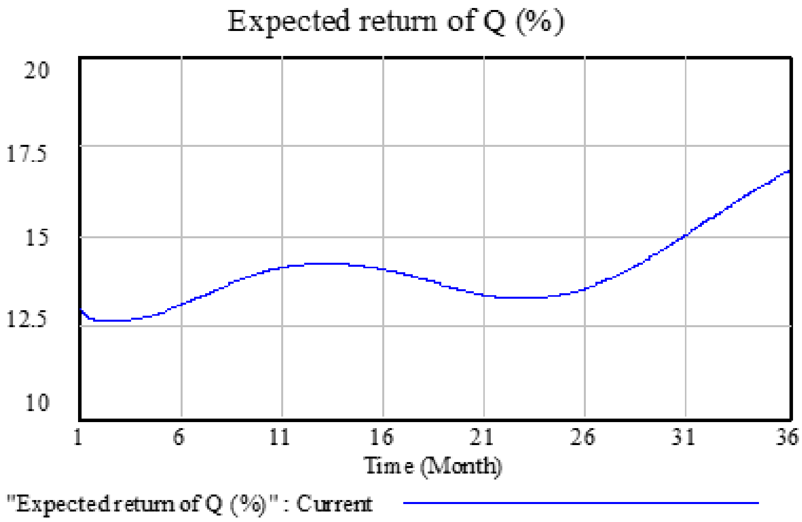


Figure 14: Expected Return of Stock Market with Trend Following Expectations

this influence on equity price as a simple example of expansionary monetary policies which is prevalent throughout the world. Moreover, the expectation formation of agents can also dampen or stimulate this effect. In this study, it is shown that, unlike the naive or adaptive expectations, the trend-following type of expectations create a positive feedback loop and stimulates itself. Higher expected returns affect the allocation of redistributional wealth of households and push their equity demand up. Thus, equity price rises more.

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