Rational Choice and Market Behavior

Truong Hong Trinh

Abstract This chapter explores the value concept that is much important to define market equilibrium and explain market behaviors in the economy. Marginal principle is used to determine supply functions in the market structure that provide rational choices in production and consumption. However, rational behaviors are criticized on its being of the underlying assumptions, in which the neoclassical theoretical models cannot justify and describe actual market behaviors. For that reason, endogeneity and exogeneity are considered in the market equilibrium model that provides a better explanation on market behaviors in reality. The chapter contributes to the theory of market equilibrium and provides a testable theoretical framework on market behaviors.

Keywords Value concept · Market equilibrium · Marginal principle · Rational choice · Market behavior

1 Introduction

The value concept is the base in the formulation of value theories. Classical economists argued that value comes from production process, price is determined upon input factors and production conditions (Smith 1776; Ricardo 1821). Neoclassical economists argued that value comes from its utility in consumption process (Bentham 1789; Dupuit 1844), price is determined upon demand and supply (Marshall 1890). The utility concept (Bentham 1789) and marginalist revolution (Jevons 1871; Menger 1871; Walras 1874) had transformed classical economics into neoclassical economics from the 1870s on.

In literature, there are many debates on the utility concept and marginal principles in explaining market behaviors. Most critics on the utility concept are mainly its

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utility measurement and its explanation on market demand. Since value is better than utility to explain value creation and value distribution in today's economy, the value concept needs to redefined and value theory should construct upon a law of diminishing marginal value. The concepts of value and price is essential to explain value creation and value distribution in the market, in which value is created in the consumption process and price plays as a role of value distribution in the exchange process (Trinh 2018). The theory of value explains the value concept and equilibrium mechanism that should originate from the facts of reality. Market equilibrium presents behaviors of both producers and consumers, in which value and price are determined upon market equilibrium. Rational choice theory has been applied in many disciplines of the social science to model and understand market behaviors (Sugden 1991), in which marginal principle is a cornerstone of neoclassical economics.

The main critics of the rational choice theory are that the discipline is built on untestable assumption foundation (Simon 1955, 1979; Plott 1986). The individual choices often appear to be highly situational or context-dependent (Levin and Milgrom 2004). While the rational choice theory provides a very useful set of general principles with underlying assumptions, the behavioral researches provide insightful explanations in actual situations with disparate empirical observations (Mathis and Steffen 2015). The big challenge is the extension of the rational choice model with incorporation of these realistic features that provides a better understanding on market behaviors. In this chapter, the supply functions are determined upon the logic of maximizing behaviors, the market supply depends on both market demand and marginal cost. Market equilibrium model is extended with rational decisions in production and consumption. Moreover, the market equilibrium model considers endogeneity and exogeneity that provide a testable theoretical framework for empirical researches on market behaviors.

2 Market Equilibrium

The value concept has been debated in a long history, Aristotle (4th century BC) stated the value is driven by certain needs that create the basis of exchange (Aristotle 1959). Classical economists argued that value is created in the production process, where production input factors and production conditions have influence on the value of a commodity and bring it to market for exchange (Smith 1776; Ricardo 1821). Neoclassical economists argued that the value depends on its utility that comes from exchange and consumption (Bentham 1789; Dupuit 1844). The utility concept and marginal analysis are cornerstones of neoclassical economics to explain customer choice and market demand (Jevons 1871; Menger 1871). Later, Marshall (1890) explains price mechanism in terms of both supply (cost of production) and demand (utility). However, market equilibrium in neoclassical economics explains market price of a commodity determined by supply and demand, the explanation on value of a commodity is still a big challenge.

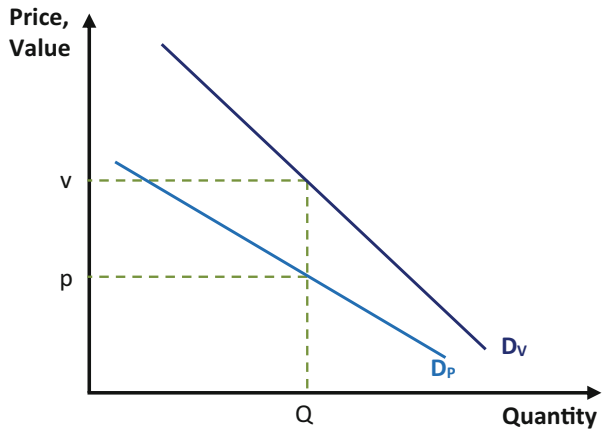

Fig. 1 Market demand for a commodity. Source: Based on Trinh (2014, 2018)

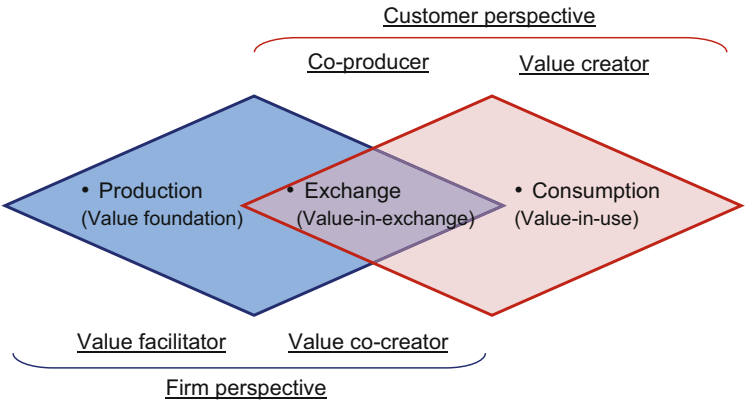

Fig. 2 Value creation system. Source: Based on Grönroos and Voima (2012) and Trinh (2018)

In fact, there is a common understanding that value of a commodity is evaluated and created in the consumption process (Wikström 1996; Vargo and Lusch 2004; Grönroos 2011; Grönroos and Voima 2012; Trinh 2014, 2018). Since the value of a commodity (v) is created in the consumption process, and the price of commodity (p) is determined in the exchange process, the theory of value should construct upon a law of marginal diminishing value, in which the utility of commodity (u) is defined as the difference between value (v) and price (p). The law of demand states that marginal value and marginal utility declines as quantity consumed increases. Trinh (2014) defines demand for a commodity includes not only the existing relationship between price and quantity demanded, but also the existing relationship between value and quantity demanded in a given time period, *ceteris paribus*. Figure 1 illustrates demand for a commodity that includes both price demand (D_P) and value demand (D_V).

Figure 2 illustrates a value creation system in which a firm uses production factors to create value foundation for a commodity in the production process. Then, the

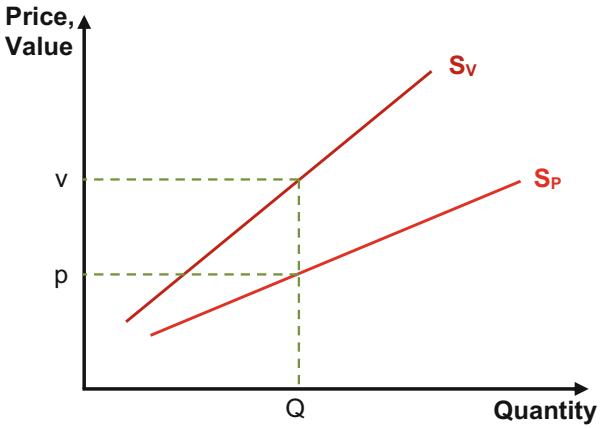

Fig. 3 Market supply for a commodity. Source: Based on Trinh (2014, 2018)

commodity is exchanged at the price (value-in-exchange) in the market. Customers will add consumption factors and creates value (value-in-use) during the consumption process.

Since the market, a place for exchange of a commodity, determines production surplus, and consumption surplus, market supply for a commodity includes both price supply (S_P) and value supply (S_V) as illustrated in Fig. 3. The price supply presents for the relationship between price and quantity supplied in production, the value supply presents for the relationship between value and quantity supplied in consumption.

In the value creation system, firm, and customer make their choices in production and consumption to achieve their goals (firm profit and customer utility). Trinh (2014) defines the utility function in the consumption that incorporates both the value (v) and the price (p) of a commodity. In addition, the value balance between firm profit and customer utility in the value creation system is a necessary condition for market equilibrium in which it also exists the balance between production surplus and consumption surplus in the market (Trinh 2019). Figure 4 illustrates the market equilibrium (E_P and E_V) that includes both price equilibrium (E_P) and value equilibrium (E_V).

Price equilibrium (E_P) occurs at the price that the price's quantity demanded equals the price's quantity supplied, *ceteris paribus* (Trinh 2014). Utility equilibrium (E_U) occurs at the utility that the utility's quantity demanded equals the utility's quantity supplied, *ceteris paribus*. While price equilibrium presents for production choice in the market, utility equilibrium presents for consumption choice in the market. Value equilibrium (E_V) occurs at the value that the value's quantity demanded equals the value's quantity supplied, *ceteris paribus* (Trinh 2014). Value equilibrium presents for both production and consumption choices in the market.

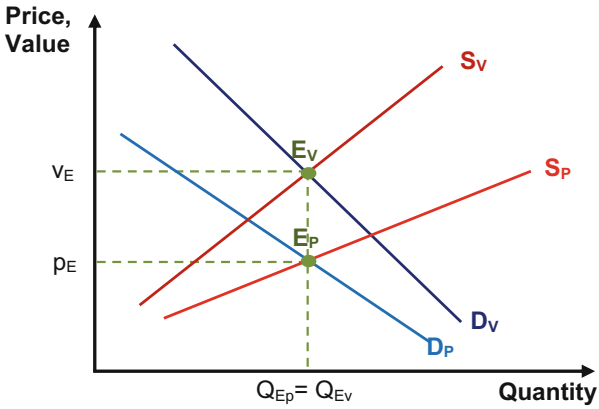

Fig. 4 Market equilibrium for a commodity. Source: Based on Trinh (2014, 2018)

3 Logic of Maximizing Behaviors

The rational choice approach is discussed by many economists (Plott 1986; Sugden 1991; Becker 2013). Rational choice is defined as the process of determining the most preferred option according to some consistent criterion (Levin and Milgrom 2004). The logic of maximizing behaviors relies on rational choice theory, in which individuals always make logical decisions with the greatest benefit or satisfaction under marginal decision rules. The marginal decision rule is a powerful tool for the analysis of choice in production and consumption in the market. Marginal analysis is used to determine if any activities (production or consumption) maximizing its net benefit (firm profit or customer utility) at the point where marginal benefit (marginal revenue or marginal utility) equals marginal cost.

The firm's marginal revenue (MR) is the first derivative of the firm's total revenue (TR) as follows:

$$\mathrm{MR} = \mathrm{TR}'(Q) = p'(Q_D) \times Q + p(Q_D) \tag{1}$$

From Eq. (1), the relationship between the price's demand function ($p(Q_D)$) and marginal revenue (MR) is expressed as follows:

$$p(Q_D) = \mathrm{MR} - p'(Q_D) \times Q \tag{2}$$

Firm will produce at the quantity where $\mathrm{MR} = \mathrm{MC}_1$ to maximize firm profit in production. The price's supply function $p(Q_S)$ intersects the price's demand function ($p(Q_D)$). By replacing $p(Q_S) = p(Q_D)$ and $\mathrm{MR} = \mathrm{MC}_1$ into Eq. (2), the price's supply function is determined as follows:

$$p(Q_S) = \mathrm{MC}_1 - p'(Q_D) \times Q \tag{3}$$

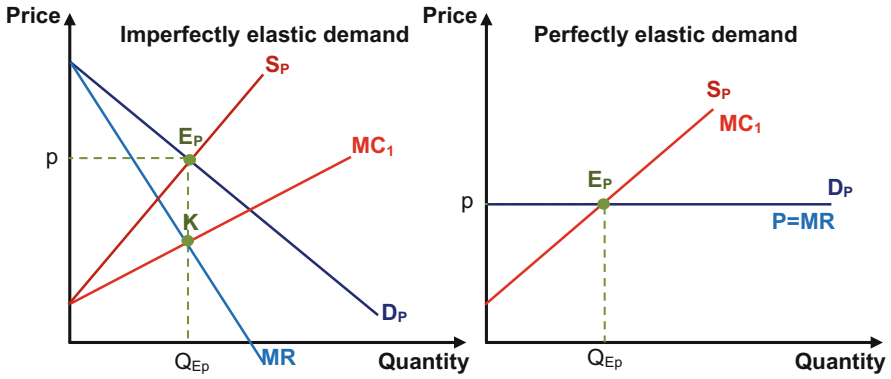

Fig. 5 Logic of profit maximizing behavior. Source: Author's own study

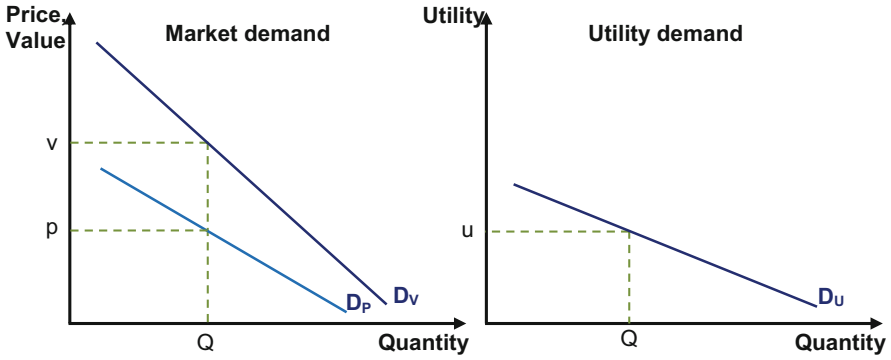

Fig. 6 Derivative of utility demand. Source: Author's own study

The price's supply function relies on both firm's marginal cost function and the price's demand function. Whenever there are changes in the price's demand function or firm's marginal cost function, the price's supply function will changes in responding to Eq. (3).

When the price's demand function is perfectly elastic, marginal revenue (MR) is identity to the price's demand function ($p(Q_D)$), and the price's supply function ($p(Q_S)$) will be identity to the firm's marginal cost (MC_1). From the logic of profit maximizing behavior, the price's supply function ($p(Q_S)$) under imperfectly and perfectly elastic demands are illustrated in Fig. 5.

Market demand for a commodity includes price demand (D_P) and value demand (D_V). Utility demand (D_U) is derivative from value demand (D_V) and price demand (D_P) as illustrated in Fig. 6.

The customer's total utility (TU) is defined with incorporation of value (v) and price (p) as follows:

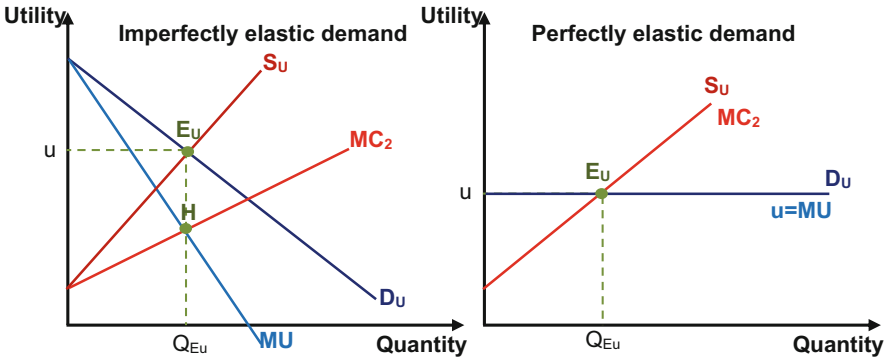

Fig. 7 Logic of utility maximizing behavior. Source: Author's own study

$$\mathrm{TU} = (v - p) \times Q = u \times Q \tag{4}$$

The customer's marginal utility (MU) is the first derivative of the customer's total utility (TU) as follows:

$$\mathrm{MU} = \mathrm{TU}'(Q) = u'(Q_D) \times Q + u(Q_D) \tag{5}$$

From Eq. (5), the relationship between the utility's demand function ($u(Q_D)$) and marginal utility (MU) is presented in the following formula:

$$u(Q_D) = \mathrm{MU} - u'(Q_D) \times Q \tag{6}$$

Customer will consume at the quantity where $\mathrm{MU} = \mathrm{MC}_2$ to maximize customer utility in consumption. The utility's supply function ($u(Q_S)$) intersects the utility's demand function ($u(Q_D)$). By replacing $u(Q_S) = u(Q_D)$ and $\mathrm{MU} = \mathrm{MC}_2$ into Eq. (6), the utility's supply function is determined as follows:

$$u(Q_S) = \mathrm{MC}_2 - u'(Q_D) \times Q \tag{7}$$

When the utility's demand function is perfectly elastic, marginal utility (MU) is equal to the utility's demand function ($u(Q_D)$), and the utility's supply function ($u(Q_S)$) is equal to the customer's marginal cost (MC_2). From the logic of utility maximizing behavior, the utility's supply function ($u(Q_S)$) under imperfectly and perfectly elastic demands are illustrated in Fig. 7.

The supply functions are determined upon maximizing behaviors of the firm and the customer that provide a theoretical model of rational decisions in production and consumption in market structure. Moreover, market supply relies on both marginal cost and market demand that explains behaviors between rational choices and market equilibrium.

4 Endogeneity and Exogeneity

Neoclassical market equilibrium presents endogenous variables in models of supply and demand. In the model of price demand, price (p) and quantity demanded (Q_D) are endogenous variables, in which values of the endogenous variables are determined in the model. Determinants of price demand are exogenous variables, in which values of the exogenous variables are determined outside the model. When exogenous variables are considered in the market equilibrium model, it will provide a better explanation on market behaviors.

$$p = f(Q_D); \;\; Q_D = g(p) \tag{8}$$

In the above model of price demand, price (p) and quantity demanded (Q_D) are endogenous variables. When exogenous variable of consumer's disposable income is considered in the model of price demand, and effect of the income on price demand assumes to be linear, the price demand under changes of income variable is as follows:

$$p = \alpha_I + \beta_I \times f(Q_D) \tag{9}$$

The price demand would be parallel upward shift when $\alpha_I > 0$, the price demand would stretched upward vertically when $\beta_I > 1$ as illustrated in Fig. 8. When $\alpha_I = 0$ and $\beta_I = 1$, there is no influence of the income on the price demand in a given time period, *ceteris paribus*.

It assumes that the price demand is given under the following form:

$$p = f(Q_D) = a + b \times Q_D \tag{10}$$

The exogenous effect of income variable (I) on the price's demand function assumes to be linear as follows:

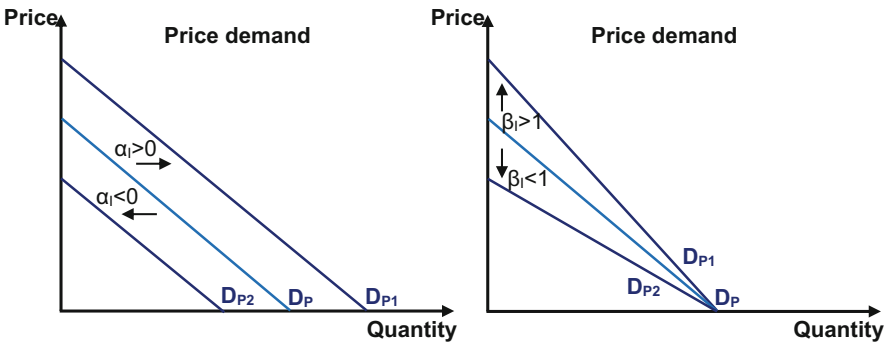

Fig. 8 Income effects on price demand. Source: Author's own study

$$p = c_1 + d_1 \times I \tag{11}$$

$$Q_D = c_2 + d_2 \times I \tag{12}$$

From Eqs. (11) and (12), the price's demand function is reformulated under the changes of income variable (I).

$$p = \frac{c_1 \times d_2 - c_2 \times d_1}{d_2} + \frac{d_1}{d_2} \times Q_D \tag{13}$$

From Eqs. (9) and (10), the price's demand function is rewritten as follows:

$$p = \alpha_I + \beta_I \times (a + b \times Q_D) = \alpha_I + \beta_I \times a + \beta_I \times b \times Q_D \tag{14}$$

From Eqs. (13) and (14), the effect of the income variable on the price's demand function in a given time period is determined as follows:

$$\beta_I = \frac{d_1}{d_2} \times \frac{1}{b} \tag{15}$$

$$\alpha_I = \frac{c_1 \times d_2 - c_2 \times d_1}{d_2} - \frac{a}{b} \times \frac{d_1}{d_2} \tag{16}$$

When exogenous variables are considered in the model of the price's demand function, the price's demand function in a given time period under the effect of exogenous variables is given as follows:

$$p = \sum_{i=1}^{m} \alpha_i + \prod_{i=1}^{m} \beta_i \times f(Q_D) = A + B \times f(Q_D) \tag{17}$$

where $A = \sum_{i=1}^{m} \alpha_i$ and $B = \prod_{i=1}^{m} \beta_i$.

m: the number of exogenous variables.

α_i, β_i: are parameters that indicate the effect of exogenous variable i on the price's demand function.

A, B: are parameters that indicate the aggressive effect of all exogenous variables on the price's demand function.

In the model of price supply, the price's supply function relies on firm's marginal cost (MC_1) and the price's demand function ($p(Q_D)$) as in the following formula.

$$p = f(Q_S) = \mathrm{MC}_1 - p'(Q_D) \times Q_S \tag{18}$$

Price (p) and quantity supplied (Q_S) are endogenous variables, in which values of the endogenous variables are determined in the model. Determinants of the firm's marginal cost and price demand are exogenous variables, in which values of the exogenous variables are determined outside the model.

When exogenous variables are considered in the model of the firm's marginal cost ($\mathrm{MC}_1 = h(Q)$), the effects of exogenous variables on the firm's marginal cost function in a given time period is given as follows:

$$\mathrm{MC}_1 = \sum_{i=1}^{m} \lambda_i + \prod_{i=1}^{m} \gamma_i \times h(Q) = C + D \times h(Q) \tag{19}$$

where $C = \sum_{i=1}^{m} \lambda_i$ and $D = \prod_{i=1}^{m} \gamma_i$.

m: the number of exogenous variables.

λ_i, γ_i: are parameters that indicate the effect of exogenous variable i on the firm's marginal cost function.

C, D: are parameters that indicate the aggressive effect of all exogenous variables on the firm's marginal cost function.

From the logic of profit maximizing behavior, the price's supply function relies on changes in the price's demand function and the firm's marginal cost function. As a result, the price's supply function depends on determinants of both the price's demand function and firm's marginal cost function. From the logic of utility maximizing behavior, the utility's supply function relies on changes in the utility's demand function and the customer's marginal cost function. From the logic of value maximizing behavior, the value's supply function relies on changes in the value's demand function and the total marginal cost function.

A numerical example assumes the price's demand function in the following form:

$$p = a + b \times Q_D = 28 - 0.2 \times Q_D \tag{20}$$

The price's supply function is determined by the following formula:

$$p = \mathrm{MC}_1 - p'(Q_D) \times Q_S \tag{21}$$

where $p'(Q_D)$ is the first derivative of the price's demand function, and MC_1 is the firm's marginal cost.

The firm's marginal cost is assumed as $\mathrm{MC}_1 = 8$. Since $p = 28 - 0.2 \times Q_D$, so $p'(Q_D) = -0.2$. The price's supply function is determined as follows:

$$p = \mathrm{MC}_1 - p'(Q_D) \times Q_S = 8 + 0.2 \times Q_S \tag{22}$$

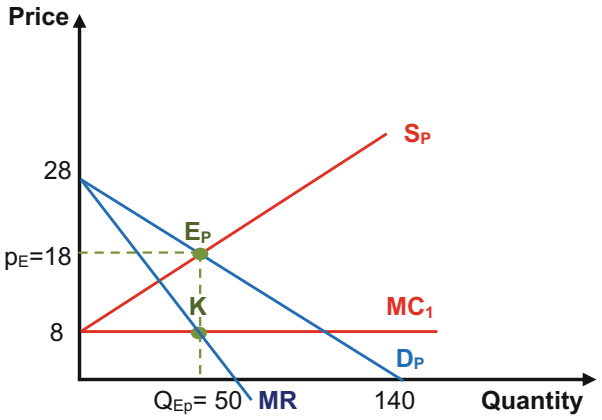

Fig. 9 Price's supply function and price equilibrium. Source: Author's own study

Figure 9 presents the price's supply function and price equilibrium for the above example.

In order to conduct the effects of exogenous variables on the market equilibrium, it assumes there is only exogenous variable of income (I) being consideration in the market equilibrium model. The effect of income variable (I) on the price's demand function in a given time period assumes to be linear as follows:

$$p = c_1 + d_1 \times I = 30 - 5 \times I \tag{23}$$

$$Q_D = c_2 + d_2 \times I = 40 + 20 \times I \tag{24}$$

The effect of the income variable on the price's demand function is determined as follows:

$$\beta_I = \frac{d_1}{d_2} \times \frac{1}{b} = \frac{-5}{20} \times \frac{1}{-0.2} = 1.25 \tag{25}$$

$$\alpha_I = \frac{c_1 \times d_2 - c_2 \times d_1}{d_2} - \frac{a}{b} \times \frac{d_1}{d_2} = \frac{30 \times 20 - 40 \times (-5)}{20} - \frac{28}{-0.2} \times \frac{-5}{20}$$
$$= 5 \tag{26}$$

The new price's demand function under income effect is determined as follows:

$$p = \alpha_I + \beta_I \times f(Q_D) = 5 + 1.25 \times (28 - 0.2 \times Q_D) = 40 - 0.25 \times Q_D \tag{27}$$

The price's new supply function relies on the price's new demand function and firm's marginal cost (MC_1), the new price equilibrium is illustrated in Fig. 10.

When market equilibrium model is to be evaluated, all endogenous and exogenous variables need to be observed and sometimes controlled. If a variable cannot be

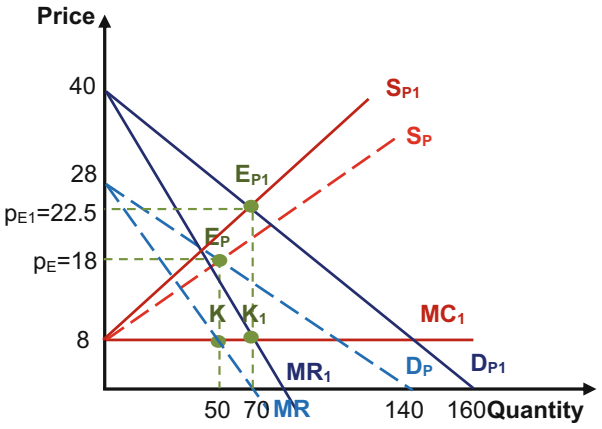

Fig. 10 Income effect on price equilibrium. Source: Author's own study

observed directly, the model itself does not fit the data. While variables of price and quantity present endogenous relationship in demand and supply functions, exogenous variables have influence on the demand function and supply function, so the market equilibrium has been changed under the exogenous effects that provide a better explanation on market behaviors in real world.

5 Conclusions

The value concept is the base to form the theories of value that explain where the value comes from and how price is determined in the market. By exploring the value concept, this paper extends the theory of market equilibrium that explains how price and value of a commodity are determined in the market. In addition, the marginal principle under the logic of maximizing behavior is used to determine the supply functions that rely on marginal cost and market demand. These findings are much important in understanding on what drives market behaviors that explain on the mechanism of market equilibrium.

The rational choice model is mostly criticized with questionable assumptions of rational choices in efficient market that cannot be testable in reality. Since endogeneity and exogeneity are considered in the market equilibrium model, the underlying assumptions are relaxed for testable empirical research that deals with the big challenge in the neoclassical theoretical models. The neoclassical equilibrium model presents endogenous variables, while exogenous variables hold being constant. When these exogenous variables are considered in the market equilibrium model, it allows understanding the role of endogeneity and exogeneity in such model. The extension of the rational choice model with incorporation of these inherent features provides a better understanding on market behaviors.

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