Austrian business cycle theory and price expectations of entrepreneurs

Working paper

Tomáš Frömmel

Abstract

Common critique of the Austrian business cycle theory states that the Austrian cycle could not be initiated under the rational expectations hypothesis. This thesis therefore investigates the role of price expectations of entrepreneurs in the Austrian cycle theory. We conclude that this theory might be compatible with rational expectations only under several assumptions. The rational expectations hypothesis is, however, evaluated rather critically concluding it is quite strong and unrealistic assumption.

Keywords: business cycle, Austrian business cycle theory, producer's decision-making, uncertainty, price expectations, rational expectations

JEL Classification: D21, D80, E32, E58

2. Theory of production: An intertemporal approach

This chapter focuses on microeconomic theory of producer's decision-making. Basic "textbook" model of the profit maximization will be modified by separating the process of production and the process of sale of the product, as both processes occurs in different periods of time. This implies the necessity of implementing expectations of entrepreneurs in the model of producer's decision-making.

2.1 Textbook version of profit maximization problem

In textbook microeconomics (e.g. Varian 2006), producer's decision-making is expressed by the problem of profit maximization. For simplicity, let us make the assumption of perfectly competitive markets which implies producer possesses no market power, thus, producer acts as a price-taker. Producer will choose such a quantity of inputs that maximizes its profit defined as a difference between its total revenues and total costs.

It is assumed that the production takes no time. As stated by Tullock (1988, p. 74), "most manufacturing processes take relatively little time. (…) Mostly what takes the time is building the factory, not the actual production once the factory is completed." Therefore, time dimension of the production process may be neglected. This statement is, however, inacceptable for Austrian economists and will be subject of critique in following chapters.

Mathematically, "textbook" producer solves the following problem:

$$\underset{\{m_1,\dots m_n\}}{\mathrm{MAX}}\ \pi = p\cdot q(m_1,\dots m_n) - \sum_{i=1}^{n} w_i m_i ,$$

where π denotes producer's profit, p the price of the product, m_1 up to m_n quantities of inputs hired and w_1 up to w_n rental prices of inputs. The term $q(m_1,\dots m_n)$ represents producer's production function. Let us further assume marginal product of each of inputs is positive and declining, thus:

$$\frac{\partial q(\cdot)}{\partial m_i} > 0,\ \frac{\partial^2 q(\cdot)}{\partial^2 m_i} < 0 .$$

Producer's choice variables are the quantities of inputs m_1 up to m_n, therefore, the first-order conditions for the profit maximization states that the first derivatives of the

profit function with respect to quantities of all the inputs are equal to zero. Mathematically, the first-order conditions can be written as

$$p \cdot \frac{\partial q(\cdot)}{\partial m_i} - w_i = 0$$

for each of the inputs m_1 up to m_n, which can be modified to

$$MP_i = \frac{w_i}{p},$$

where MP_i stands for marginal product of input m_i.

Thus, in order to maximize its profit, the producer equalizes marginal product of each input with real rental price of this input. As marginal products are assumed to be declining, the higher the rental price, the lower the quantity of input hired, and, contrarily, the higher the price of the product, the higher the quantity of input hired.

2.2 Modification of the profit maximization problem

The textbook version of the profit maximization problem presented above assumes that production and sale of the product take place in the same time. Nevertheless, this assumption does not seem highly realistic. As Hayek (1928, p. 186) suggests, "the main difficulty of the traditional approach is its complete abstraction from time". Thus, this abstraction away from time dimension of the problem would be, from an Austrian point of view, fallacious.

Assuming (for simplicity) discrete time and that every production process takes one period of time, we can express the intertemporal structure of producer's decision-making process by the diagram based on Mises' concept of the evenly rotating economy presented in first chapter of this thesis and inspired by the idea of overlapping generations in Diamond model of economic growth (Diamond 1965). The diagram in Figure 11 presents the intertemporal structure of producer's decision-making process based on overlapping stages of production.

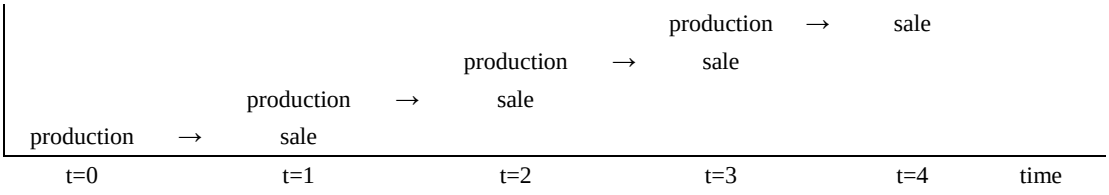

Figure 11 Intertemporal structure of producer's decision-making process
Source: own processing

In each period of time, one new production process is launched and will be finished in next time period. Simultaneously in each period of time, one production process that has been launched in the previous period is finished and the product sold. As one process is launched and one finished, it may seem we could neglect the time dimension of production (as textbook approach does). Nonetheless, this would be the over-simplification of the problem.

Let us, therefore, modify the problem of the profit maximization by separating the *ex ante* maximization which is related to the production process and the *ex post* maximization connected with the sale of the product.

2.2.1 *Ex ante* profit maximization

When deciding about quantities of inputs hired, producer takes rental prices of inputs and its production function which is assumed to be constant over time as given, but he does not know the exact future price of its product. Thus, when maximizing its *ex ante* profit, producer must make expectations about future prices and his decisions are based on his future price expectations.[1] Moreover, as revenues and costs of one production process do not occur in the same period of time, we need to discount the value of future revenues to the present value.

Hence, the *ex ante* profit maximization can be expressed mathematically as

$$\underset{\{m_{1,t},\dots m_{n,t}\}}{MAX}\, E_t(\pi_{t+1}) = \frac{E_t(p_{t+1})\cdot q_t(m_{1,t},\dots m_{n,t})}{1+r_{t+1}} - \sum_{i=1}^{n} w_{i,t} m_{i,t} \,,$$

where the objective function $E(\pi)$ is the expected future profit and $E(p)$ stands for the expected product price. Parameters t and $t+1$ express different time periods. Future revenues are discounted to present value by discount factor $1/(1+r)$, where r is the real

[1] Let us now take producer's price expectations as given. The process of price expectations making will be the subject of Chapter 3.

rate of interest. Let us now, for simplicity, assume real interest rate and thus discount factor are constant over time.

As in the textbook version of the problem, producer's choice variables are the quantities of inputs m_1 up to m_n. Thus, the first-order conditions can be written as

$$\frac{E_t(p_{t+1})}{1+r} \cdot \frac{\partial q(\cdot)}{\partial m_{i,t}} - w_{i,t} = 0$$

for each of the inputs m_1 up to m_n, which can be modified as

$$\frac{MP_{i,t}}{1+r} = \frac{w_{i,t}}{E_t(p_{t+1})},$$

which states that in order to maximize its expected profit, producer equalizes present value of marginal product of each input with its expected real rental price.

Note that the real rental price is defined as a ratio of currently paid nominal rental price and expected future price of the product, while usually real rental price is given as a ratio of nominal rental price and price of the product in the same period. Nevertheless, this modified definition of real rental price is necessary consequence of above presented intertemporal dimension of production process.

The formula just derived suggests that producer expecting rising price of its product will expand its production compared to its current level. On the other hand, if producer expected price of his product to fall, he would reduce the volume of its production in order to maximize his *ex ante* profit. Producer expecting its product price not to change would change the volume of its production only if prices of factors of production changed, otherwise he would hold its production constant.

2.2.2 *Ex post* profit maximization

Let us now focus on *ex post* profit maximization which is related to the second period of time. In such a situation, product has been produced, thus its quantity is fixed and all the costs are currently sunk costs. Let us once again recall that we cannot compare revenues and costs in the same period of time, because these are related to different production processes.

Mathematically, *ex post* profit maximization problem can be written as

$$\underset{\{p_t\}}{MAX}\, \pi_t = p_t \overline{q_{t-1}} - \overline{TC_{t-1}},$$

where π stands for maximized profit, p for the price of the product, q represents quantity of output and TC costs of production. Horizontal line under parameters q and TC expresses these parameters are already fixed. Different time periods are expressed by indexes t and $t–1$. As discount factor is assumed to be constant over time, future revenues are not, for simplicity, discounted to present value.

The only variable parameter is the price of the product; thus, in order to maximize its profit, producer maximizes price of his product being constrained by the demand for his product.

Let us now focus on the relation between expected (*ex ante* maximized) and actually accomplished (*ex post* maximized) profit. Neglecting discounting of future revenues, the difference is given by the difference between expected and actually attained price of the product. If market price is equal to the price expected by the producer, then the profit is exactly equal to the expected profit.

Producer expecting higher price than actually accomplished realizes lower profit than expected. This producer had better hire fewer inputs and produce lower volume of product, but as all the costs are actually sunk and the production has been already finished, this producer cannot change his previous decision which *ex post* seems to be incorrect.

Similarly, producer who expected market price to be lower than actually is realizes higher than expected profit. Producer's previous expectations seem to be *ex post* incorrect, as this producer had better realize higher volume of production. However, the quantity of product is currently fixed and new products can be available only in following periods of time, so this producer cannot immediately increase the volume of its production.

Our analysis presented above seems to validate Knight's (1964) theory of economic profit explaining the existence of economic profit by the existence of the uncertainty. As entrepreneur launches production process in a period of time different from that of the sale of the product, he does not know exact future price of his product which depends on many unknown factors. The entrepreneur, therefore, needs, to predict future price. If this prediction was correct, he would attain zero economic profit as his revenues would exactly cover his costs. If his prediction was incorrect and the price was higher than expected, entrepreneur would realize positive economic profit as his revenues would be higher than costs. This unanticipated profit cannot be eliminated

even on a perfectly competitive market. Our mathematical model of intertemporal producer's decision-making explained Knight's theory of economic profit algebraically.

2.3 Theory of price determination

The intertemporal approach to the theory of producer's decision-making described above seems to be inconsistent with the neoclassical theory of price determination presented by Marshall (1920). On the contrary, our mathematical model might support the Austrian view of price determination (e.g. Mises 1998 or Rothbard 2004). Let us, therefore, examine this issue in detail.

Neoclassical economics represented by Marshall (1920) states that the price is determined both by utility expressed by the demand function and by costs expressed by the supply function. The equilibrium price and equilibrium quantity are determined simultaneously. Graphically, the market equilibrium can be found in the intersection of the demand and supply curve, as shows Figure 12.

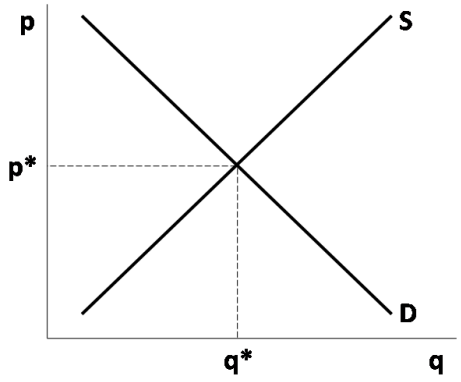

Figure 12 Neoclassical theory of price determination
Source: own processing

Rothbard (2004) criticizes Marshall's conclusion and states that the price is determined solely by the demand curve; costs might have no impact on equilibrium price. This view assumes the quantity of the product is fixed and can be changed only in the long term.

In our mathematical example presented above, the representative entrepreneur predicts future price of his product and based on this prediction he chooses the extent of his production. This prediction is apparently based on prediction of future demand

curve. Thus, using the terminology and graphical apparatus of neoclassical economics, the extent of production is given by the intersection of supply curve and expected future demand curve. This quantity determination is shown graphically in panel (a) in Figure 13 below.

In subsequent period of time, this extent of production represents total supply of product. As quantity is fixed, the only determinant of the price is the demand curve. This equilibrium price can be found graphically as the intersection of vertical supply curve and downward sloping demand curve, as shown in panel (b) in Figure 13 below.

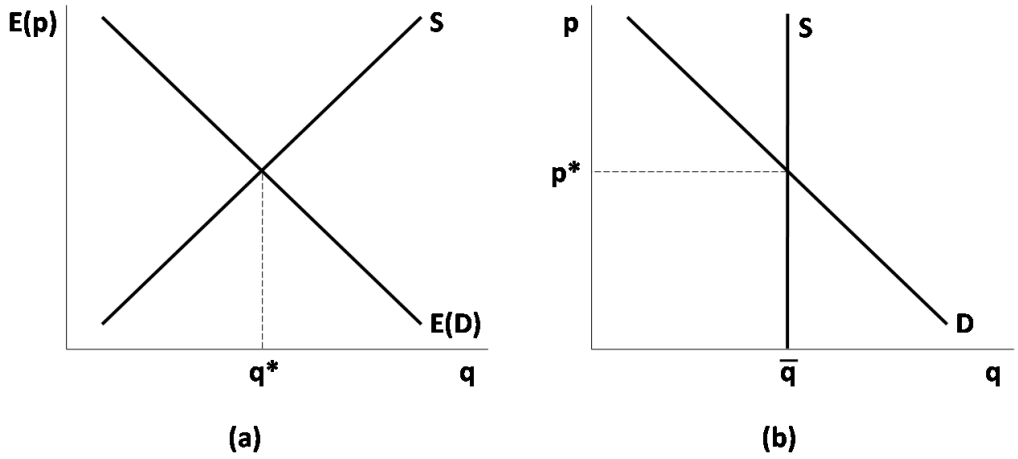

Figure 13 Austrian theory of price determination
Source: own processing

To sum up our analysis, we can conclude that the process of price determination is actually a two-stage process. First of all, producer maximizing its *ex ante* profit determines the quantity of product. In subsequent period of time, producer maximizing its *ex post* profit sets up the price.

Thus, our analysis supports Mises' (1998) and Rothbard's (2004) view of the price determination process. Contrarily, Marshall's (1920) theory is inconsistent with our intertemporal approach to the theory of production.

2.4 Input markets

Up to this point, we distinguished final product q and factors of production m_1 up to m_n and considered prices of inputs w_1 up to w_n be fixed. Let us now extend our analysis by taking in account the intertemporal structure of production presented in Chapter 1.

Let us recall that, according to the Austrian economics, factors of production are higher-order goods which are utilized in the production of lower-order goods. The intertemporal structure of production is such that the product of each stage of production is used as input in later stages, except of the product of the ultimate stage which is consumed by consumers. Each entrepreneur represents the demand on market for higher-order good and simultaneously the supply on market for lower-order good. His product than becomes an input for another entrepreneur.

Nonetheless, it is impossible to distinguish which good is first-order good and which is the higher-order one. Schmitz (2004, p. 89) explains that "any particular good can be employed in more than one stage of production and, in many cases, serve as a consumption good as well. (…) There is no objective criterion on which this distinction can be based." Therefore, we will no more distinguish between product and factors of production; all the goods will be denoted as q_i and all the prices as p_i.

In previous analysis, we assumed prices of inputs to be fixed, while price of the product was considered as flexible. Nevertheless, this assumption does not seem to be realistic and rightful as inputs are products as well. Let us now, therefore, extend our previous model of producer's decision-making by considering flexible prices of all the goods.

Let us examine the behavior of the first-order good producer who expects future rise of the price of his product. According to our previous analysis, this producer should increase his extent of his production in order to maximize his *ex ante* profit. Nevertheless, in order to increase the extent of the production, producer needs to hire more second-order goods which are used as inputs in production of first-order goods. Nonetheless, supply of second-order good is fixed in the short term and might be increases only in subsequent time periods. Thus, the only effect of expecting higher price of the first-order good is an increase in prices of second-order good, as shown in panel (a) in Figure 14 below summarizing effects on the market for the second-order good.

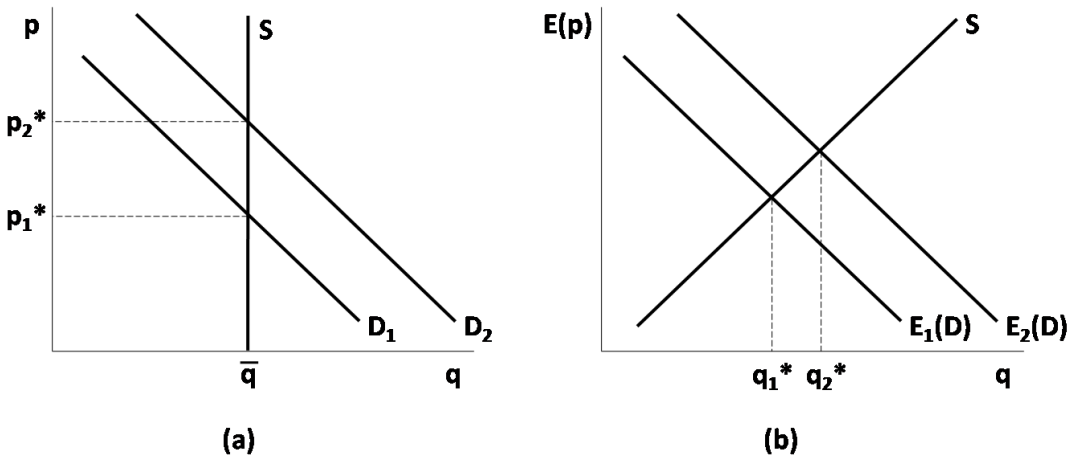

Figure 14 Effects of increased demand for first-order good
Source: own processing

As demand for second-order good increases, one could assume that this increase is perceived as permanent, thus second-order good producer might increase the extent of its production so as to maximize its *ex ante* profit. This is shown in panel (b) in Figure 14.

Nonetheless, increasing the production of second-order goods stands for increased demand for third-order goods. As supply of third-order goods is fixed in the short term, the only short-term effect is an increase of its price; the extent of second-order goods production remains unchanged in current period. Increased price motivates fourth-order goods producers to increase the production, but, while the quantity of fifth-order goods is fixed, the production of fourth-order goods remains unaffected and the only effect is an increase of prices of fifth-order goods.

To sum up above discussed effects of an increase of demand for first-order good, it should be obvious from our analysis that the only effect in the short term is an increase in prices of higher-order goods. As "all economic activity takes place over time" and "every individual economic process occupies a certain interval of time" (Hayek 1928, p. 186), the quantity of first-order good can be increased only in subsequent periods of production, after finishing the production of all the higher-order goods.

2.5 The role of entrepreneurs in the economy

Let us conclude the chapter analyzing the microeconomics of producer's decision-making by the discussion about the role of entrepreneurs in the economy. We begin with simple example of the evenly rotating economy[2] that might express a "steady-state" of the Austrian business cycle theory. No changes in consumers' preferences occur in the evenly rotating economy, thus identical production processes are continually repeated.

The fact that equal processes are continually repeated simplifies significantly the entrepreneurs' expectations-making. Obviously, in such an economy there will be no changes in prices, therefore, evolution of price *p* in time can be described as

$$p_{t+1} = p_t = p_{t-1}.$$

Thus, in an equilibrium situation expressed by the model of the evenly rotating economy, there is no indispensability of implementing price expectations into the decision-making problem of entrepreneurs and this economy might be described by the model of "textbook" microeconomics as well. Moreover, in such a "steady-state" economy, there is no scope for entrepreneurial discovery described by Kirzner (1997); all the decisions of entrepreneurs are simply "technical" ones which cannot be treated as economic decision-making.

After describing the role of price expectations in the evenly rotating economy, we can proceed to the study of more realistic case of the changing economy. Constant preferences of consumers will be no more assumed, all the prices might, hence, change over the time. Thus, it seems we need to consider uncertainty and entrepreneur's price expectations.

Changes in preferences constitute an opportunity for entrepreneurs to realize positive economic profit by expecting correctly future evolution of prices. As Schmitz (2004, p. 68) suggests, "the purpose of entrepreneurial activity is to adapt the existing structure of production (…) to expected changes in the economic conditions, and to exploit subjective profit opportunities, which arise from differences between the expected future prices of lower order goods and their production costs". Hence, in the changing economy, there is considerable scope for Kirzner's (1997) entrepreneurial discovery. Boettke (1997, p. 26) shares this idea and states that "price information is

[2] The concept of the evenly rotating economy is described in detail in the first chapter of this thesis.

also motivation for profitable real-world adjustment, over time, to the profit opportunities of a particular place".

The role of entrepreneurs in the economy is, therefore, connected with non-equilibrium states. Entrepreneurs finding profitable opportunities by expecting correctly future prices lead the economy to the equilibrium state. Nonetheless, after achieving the situation of equilibrium, there is no more scope for entrepreneurial activities as there are no profitable opportunities.

3. Price expectations of entrepreneurs

Previous chapter extended "textbook" approach to the theory of production by integrating price expectations of entrepreneurs into the model. Nevertheless, up to this point we considered expectations as given and we did not study how these expectations were constituted. Thus, this chapter focuses on the problem of expectations-making. Our task is to determine on which variables entrepreneurs' expectations are based and how their expectations are made.

3.1 Static and adaptive expectations

At first, let us present an Austrian view. Hayek's theory of business cycle theory presented in the first chapter of this thesis does not solve the problem of entrepreneurs' expectations. Hayek (1933b, pp. 139-140) assumes that "everybody foresees the future correctly and that this foresight includes not only the changes in the objective data but also the behaviour of all the other people with whom he expects to perform economic transactions". This assumption is, however, quite strong and unrealistic.

Later, Hayek in his letter to Hicks writes his theory of the business cycle is based on assumption that "at each stage of the process everybody acts in the expectation that future prices will be the same as present prices" (Hayek 1967, p. 102). These "static" expectations might be expressed formally as

$$E_t(p_{t+1}) = p_t .$$

Hayek's static expectation could be treated as a special case of adaptive expectations claiming that economic agents form their expectations based on past development of variables. As suggested by Schmitz (2004, p. 68), "current and past prices can (…) serve as starting points to forecast future prices". Hence, adaptive expectations are backward-looking.

Formally, adaptive expectations might be expressed by the equation

$$E_t(p_{t+1}) = E_{t-1}(p_t) + \alpha \cdot (p_t - E_{t-1}(p_t)),$$

where the first term expresses previous expectations of current price and the second term stands for correction of previous expectations. The parameter α ($0 < \alpha < 1$) denotes the degree of previous expectations correction; the lower the parameter α, the lower the correction.

After recurrent substitution and several algebraic operations, previous equation can be rewritten as

$$E_t(p_{t+1}) = \alpha \cdot p_t + \alpha(1-\alpha) \cdot p_{t-1} + \alpha(1-\alpha)^2 \cdot p_{t-2} + \ldots,$$

which expresses the idea that adaptive price expectations are formed as weighted average of previous development of price.

Assuming complete correction of previous expectations ($\alpha = 1$), we come to static expectations suggested by Hayek (1967). Thus, static expectations might be treated as a special case of adaptive expectations and we will, therefore, no more distinguish between static and adaptive expectations.

3.2 Rational expectations

The other approach to expectations is expressed by the rational expectations hypothesis. Muth (1961, p. 316) criticizes that „dynamic economic models do not assume enough rationality“ and further states that “it is rather surprising that expectations have not previously been regarded as rational dynamic models, since rationality is assumed in all other aspects of entrepreneurial behavior” (Muth 1961, p. 330).

Hence, he suggests the rational expectations hypothesis proposing that “expectations (…) are essentially the same as the predictions of the relevant economic theory” (Muth 1961, p. 316). For purposes of this thesis we will define the rational expectations hypothesis according to Mankiw (2009, p. 582) as “an approach that assumes that people optimally use all available information – including information about current and prospective policies – to forecast the future”.

However, this definition does not at all mean that every individual agent foresees the future correctly. The rational expectations hypothesis assumes that individual’s estimates are normally distributed around the mean value of expected variable as Figure 15 below shows. This idea is expressed also by Hayek (1933a, p. 69) stating that “there is no reason to assume that deviations will take place only in one direction“. Therefore, on average, expectations are correct.

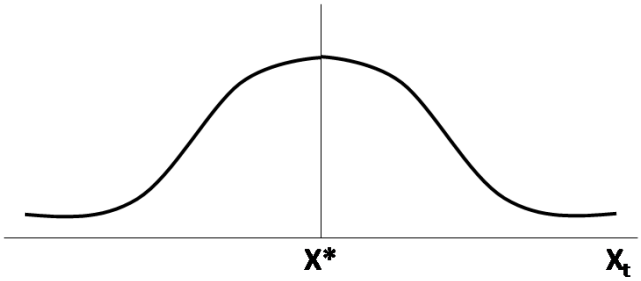

Figure 15 Normal distribution of individual's expectations
Source: own processing

As expected variable may be described by some statistical distribution with constant mean value, it might be expressed by the equation

$$X_t = X^* + \varepsilon_t,$$

where X_t denotes the variable X in time t, X^* is mean value of that variable and ε_t denotes random (stochastic) variable with zero mean and non-zero variance. As the mean of random variable is zero, its expected value is zero as well and, hence, expectation in time t of the variable X is given by

$$E_t(X_{t+1}) = X^*,$$

thus, expected value is determined by the mean value of the variable and deviations of actual variable from its expected value are only stochastic.

Lucas (1971) as first applies the rational expectations hypothesis in a macroeconomic model. In his view, rational expectations mean that "expectations are formed optimally" (Lucas 1971, p. 103) and the consequence of accepting the rational expectations hypothesis is that there is no short-run trade-off between the inflation and real output, thus money is neutral even in short run. Lucas (1976) criticizes econometric evaluation of public policy based on adaptive expectations and further suggests that policy evaluation have to be based on microeconomic models with agents forming rational expectations.

The rational expectations hypothesis was gradually accepted by the real business cycle school as well as by new Keynesians and became one of key elements of modern macroeconomic theory.

3.3 Critique of rational expectations hypothesis

The rational expectations hypothesis is, however, usually criticized by the Austrian economists. This subchapter summarizes the most frequent arguments against rational expectations and explains why entrepreneurs' expectations might be rather adaptive than rational.

3.3.1 Costs of gathering the information

One common argument states that information necessary for making expectations is not a public good available for free. Basse (2006, p. 20) sharing this idea states that "one further important argument against the rational expectations hypothesis seems to be that gathering information is costly". As the information is a scarce good, some costs, at least opportunity costs of time, need to be spend in order to obtain the information. Stigler (1961) further argues that since gathering the information is costly, it is not optimal for economic agents to search for all the information. Rational agent compares marginal costs of the information and its marginal benefit and demands the information only if marginal benefit of that piece of information exceeds its marginal cost.

Thus, it does not make much sense to assume agents use all the available information (as the rational expectations hypothesis does), since the information is never "available" or "given", but may be obtained only after spending some costs. The extent of information used when making expectations depends, therefore, on costs of gathering the information and on preferences of agents in the economy.

Hence, agents might prefer rational ignorance and their decision-making might be based on "imperfect" knowledge. One may assume that costs of gathering the information necessary for backward-looking expectations are lower than costs of gathering the information necessary for forward-looking expectations. Especially public policy monitoring is apparently considerably costly. Thus, it could be assumed that since the information is never available for free, agents form rather adaptive than rational expectations.

3.3.2 Dispersion of the information

Above presented argument is criticized by Boettke (1997) claiming that the irrelevance of rational expectations hypothesis is caused by the nature of the information itself. Boettke hereby confirms Hayek's idea that the information is dispersed among all the economic actors.

As Hayek (1945, p. 519) argues, "the peculiar character of the problem of a rational economic order is determined precisely by the fact that the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess". Thus, according to this argument, even if gathering the information was completely costless, agents could not form rational expectations as the information is never given in its totality, but is rather dispersed between all the actors in the economy. For that reason, Boettke (1997, p. 25) criticized that "formal neoclassical theory, instead of discerning how diffuse information is processed and used by imperfect economic actors, falls back on the assumption that everybody knows everything".

To sum up two arguments against the rational expectations hypothesis presented so far, we might conclude that, even if Boettke (1997) criticizes Stigler's (1961) view, these theories are not contradictory. They both actually share the idea that the information is never "given" or "available", either because of costs of gathering the information or because of the character of the information itself. Both theories unanimously imply that rational expectations hypothesis is quite strong assumption and thus, these theories might be treated as complementary theories.

3.3.3 Other arguments

Another argument disproving the rational expectations hypothesis is presented by Hoppe (1997). As our world does not represent the situation of complete certainty, it is impossible to predict all the future actions and their consequences. The rational expectations hypothesis is then disproved using proof by contradiction – "if we could indeed predict our future actions, either perfectly or subject only to random errors, then it would have to be implicitly assumed as well that every actor must possess the same

(identical) knowledge as everyone else" (Hoppe 1997, p. 57). Nonetheless, in such a world, "nothing could be learned, and accordingly, nothing would be worth knowing" (Hoppe 1997, p. 48). Thus, knowledge would become completely useless and no information would be demanded. This is, however, not what we actually observe in our world. Hence, we cannot predict all the future actions as proponents of the rational expectations hypothesis assume. The rational expectations hypothesis might be hereby disproved.

Hoppe (1997) also rejects the idea that human action could be described by any some statistical distribution as all the acts are singular, independent and non-repeatable events. This argument might be supported by the fact that statistical distribution of individual's expectations is not stable in time. This might be explained by the fact that economic profit of entrepreneur making incorrect expectations is lower than profit of those anticipating the future correctly. Entrepreneurs with low or even negative profit leave the market which should increase accuracy of expectations; nonetheless, on the other hand, new entrants on the market are not possessed of the ability of accurate prediction and, thus, their expectations might not be accurate. Both flows of entrepreneurs may change statistical distribution of individual estimates. This argument is supported by Block (1999) claiming that even if recently observed values of the variable could be characterized by some statistical distribution, this does not warrant that the distribution will remain same in the future. Hence, the problem of rational expectations hypothesis is how to determine and expect correctly mean value of distribution of future values of the variable.

Mises (1998, p. 7) simply says that "here is no such thing as perfection in human knowledge", therefore, expectations cannot be rational[3]. Robbins (1932, p. 80) further states „no one will really question the universal applicability of such assumptions as (…) different degrees of uncertainty regarding the future, even though there may be room for dispute as to the best mode of describing their exact logical status." Assuming perfect knowledge, Robbins states, is quite strong and subsidiary assumption.

When defending the rational expectations hypothesis, Muth (1961, p. 330) suggests that "if expectations were not moderately rational there would be opportunities for economists to make profits in commodity speculation, running a firm, or selling the

[3] The term „rational" is here used in sense intended by the rational expectations hypothesis proponents. Chapter 3.4 deals in detail with the problem of double meaning of this term.

information to present owners". This argument is, however, incorrect. One could assume that the extent of information used by economists is higher than the extent of information used by non-economists, which implies economists' expectations might be "more rational". Nevertheless, Muth (1961) neglects the problem of dispersion of the information and the problem of non-stable statistical distribution. Due to this reason, even economists' expectations might be treated as rather adaptive.

After discussing main arguments against the rational expectations hypothesis, we might conclude that the expectations of entrepreneurs are rather adaptive than rational and thus, the rational expectations hypothesis is quite strong assumption. Evans and Baxendale (2008, p. 85) even state that "rational expectations are an inapplicable behavioral assumption and ABC [Austrian business cycle theory] should be applauded for contradicting it". It might, therefore, seem we do not need to study the Austrian business cycle theory with entrepreneurs making rational expectations. Nevertheless, as the rational expectations hypothesis is commonly accepted by current economists, chapter 4 of this thesis will solve the puzzle of the Austrian business cycle with rational expectations.

3.4 Rationality of entrepreneurs' expectations

We have concluded that there are several serious objections against the rational expectations hypothesis, hence, entrepreneurs' expectations are rather adaptive than rational. Proponents of the rational expectations hypothesis unfortunately misused the term "rational" and hereby created linguistic problem.

The term "rational" may be used in two different senses. Firstly, "rational expectations" are the opposite of adaptive expectations and secondly, "rational expectations" might stand for the opposite of "irrational expectations". Rational expectations hypothesis seems to imply that rational expectations are rational while adaptive expectations are irrational, nevertheless, this statement would be fallacious.

Mises (1998, p. 18) argues that „human action is necessarily always rational", hence, "the terms rational and irrational are inappropriate and meaningless" (ibid). One cannot evaluate the rationality of anyone else's behavior since no one can recognize anyone else's preferences. There is only one manner of manifestation of a man's will – „what counts is a man's total behavior, and not his talk about planned but not realized

acts“ (Mises 1998, p. 13). Hence, one cannot evaluate anyone else’s behavior and any behaviour is, therefore, rational *per se*.

Hence, both adaptive and rational expectations must be treated as rational behavior. Basse (2006, p. 20) states that “it is not always rational for economic agents to form rational expectations”. Making rational expectations requires expending some costs; nonetheless, benefit of rational expectations need not be worth these costs and agents might, therefore, prefer adaptive expectations. Hence, entrepreneurs making adaptive expectations behave rationally as well.

4. Price expectations and business cycle

In this chapter we will accept the rational expectations hypothesis presented in previous chapter. Our objective is to prove that, despite the arguments of critics, the Austrian business cycle can be launched even in the economy with rational-expectations entrepreneurs. Austrian business cycle with adaptive-expectations agents will be analyzed as well.

4.1 Critique of the Austrian business cycle theory

The idea that the Austrian business cycle cannot be launched in the economy whose entrepreneurs form rational expectations is common argument of the critique of the Austrian economics. Let us first of all examine this critique in detail.

Tullock (1988, p. 73) criticizes the "apparent belief that business people never learn". He further states that "one would think that business people might be misled in the first couple of runs of the Rothbard cycle and not anticipate that the low interest rate will later be raised." According to Tullock, entrepreneurs cannot be fooled systematically by the central bank's expansionary policy, as rational entrepreneurs learn from its previous mistakes. This idea is shared by Cowen (1997, p. 77) who argues that "the postulated entrepreneurial mistakes in the traditional Austrian theory, which are systematic, violate the rational expectations hypothesis. Entrepreneurs with rational expectations will sometimes choose unprofitable term-lengths for investment, but they will not err systematically."

This argumentation is developed by Wagner (1999). He agrees that the Austrian business cycle theory could describe the economy when this theory was originally formulated, as that time there were no published statistics on inflation and monetary policy. But nowadays, "statistics, observers, and pundits are everywhere. A cycle theory that depends on the inability of people to distinguish, in the aggregate, between an increase in personal saving and an increase in central bank holdings of government debt must rightfully be dismissed on the grounds that it fails to incorporate any reasonable requirement of individual rationality in economic action," states Wagner (1999, p. 71).

Additional argument against the Austrian business cycle theory introduced by Tullock (1988, p. 73) states that "one would assume that a well-informed business

person interested in important matters concerned with the business would read Mises and Rothbard and, hence, anticipate the government's action." As Tullock further argues, after reading Mises and Rothbard, entrepreneurs would not react to the monetary expansion of the central bank and thus, business cycle would be smoothed.

We can sum up the arguments of critique of the Austrian business cycle theory by stating that as entrepreneurs are rational and form rational expectations, they are able to predict the central bank policy and learn from its previous faults, therefore, the Austrian business cycle cannot persist in the long term. Our task is now to show that these arguments are incorrect and that the Austrian business cycle theory can describe contemporary business fluctuations.

4.2 Response to Tullock's critique: Game theory approach

Let us now, despite the critique presented in third chapter of this thesis, assume the hypothesis that entrepreneurs form rational expectations and let us further accept Tullock's (1988) idea that after reading Mises and Rothbard, entrepreneurs could anticipate government's action and, hence, there would be no cyclical fluctuations of the economy. We will develop a simple model explaining why rational entrepreneurs actually do not read Mises and Rothbard and hereby partly disprove Tullock's critique.

The behavior of the representative entrepreneur deciding whether or not to read Mises and Rothbard will be examined. Nevertheless, as there are many entrepreneurs in the economy, each of them posses only very limited influence on the course of the business cycle. Thus, when studying the behavior of representative entrepreneur, we need to take into account the behavior of all the other entrepreneurs as well and we might use the apparatus of the game theory. The method of following analysis is similar to that of Carilli and Dempster (2001) using the game theory when studying the behavior of representative firm and representative bank during the course of the business cycle and concluding that it is optimal for any firm to increase production after monetary expansion.

Studying the Austrian economics is related both with benefits and costs. The acquired ability to predict government's action leading to the business cycle smoothing might be treated as a benefit of studying. On the other hand, studying the Austrian

economics is, as all the other activities, costly – it takes some time and effort that could be devoted to other activities.

4.2.1 One-round game

At first, let us formulate and solve one-round simultaneous game. All the entrepreneurs decide simultaneously whether or not to read Mises and Rothbard. Thus, each entrepreneur has two possible actions – "to read" and "not to read". Pay-offs for all the possible actions combinations are summarized in following Figure 16. Both benefits (B) and costs (C) of the representative entrepreneur are summed up below.

		Other entrepreneurs	
		To read	**Not to read**
Representative entrepreneur	**To read**	**Square 1** B > 0 C > 0	**Square 2** B → 0 C > 0
	Not to read	**Square 3** B > 0 C = 0	**Square 4** B = 0 C = 0

Figure 16 Representative entrepreneur's pay-off table
Source: own processing

Costs of representative agent are positive when he studies the Austrian economics; otherwise costs are equal to zero. Representative entrepreneur's benefits depend on decision of the other agents. If the other entrepreneurs read Mises and Rothbard, benefits would be positive as the business cycle would be smoothed, regardless whether the representative agent read or not, as his ability to smooth the course of the business cycle is very limited. If other entrepreneurs did not study the Austrian economics, benefits would be equal to zero or only slightly above zero, depending on decision of representative agent.

In the above presented game, "benefits" means private benefits. Studying the Austrian economics and subsequent business cycle smoothing is the source of the positive externality, nevertheless, social benefits are not considered as the representative entrepreneur does not take them into account during his decision-making.

Let us now set up the preferences of the representative entrepreneur. Square 3 is strictly preferred to all other squares as this square leads to highest difference between

benefits and costs. Contrarily, squares 1, 3 and 4 are strictly preferred to square 2 leading to the lowest difference between benefits and costs.

Now we can finally solve the whole game. If the other entrepreneurs read Mises and Rothbard, representative entrepreneurs' optimal action is "not to read", as square 3 $\succ$ square 1. If the other entrepreneurs do not read Mises and Rothbard, representative entrepreneur does not read as well, as square 4 $\succ$ square 2. Thus, "not to read" is the dominant strategy of the representative entrepreneur.

As this game is solved by all the entrepreneurs in the economy deciding whether or not to read Mises and Rothbard, we can state that "not to read" is the dominant strategy of all the entrepreneurs. Nash equilibrium is, therefore, represented by square 4 in Figure 16. In this situation of equilibrium, no entrepreneur has any motivation to study the Austrian business cycle theory as he cannot unilaterally increase his utility.

Note that the behavior of all the entrepreneurs in the economy is fully rational – each of them maximizes its expected utility and cannot be better off. Socially optimal outcome represented by square 1 cannot be achieved because of coordination failures such as in "prisoner's dilemma" game.

4.2.2 Multiple-round game

As Potužák (2007) states, this coordination failure can be simply overcome by formulating the game as the dynamic one consisting of many rounds. Let us, therefore, extend our previous analysis by repeating this game in infinite number of rounds. The question we solve is, as before, whether the entrepreneurs are motivated to read Mises and Rothbard or not. Obviously, entrepreneurs will read Mises and Rothbard only if the present value of net benefits of reading will be higher than the present value of net benefits of not reading.

In subsequent analysis, "net benefit", denoted π_i in each of squares 1 to 4, means the difference between benefits and costs. We can now express present value of net benefits for infinite number of rounds of the game for both possible actions of representative entrepreneur – "to read" (thus, to cooperate with the other entrepreneurs) and "not to read" (thus, not to cooperate). Present value is given by discounting future values by discount factor *1/(1+r)*, where *r* denotes real interest rate which is assumed to be constant over time.

Situation of cooperative strategy is represented by square 1 in Figure 1. Thus, for the present value of net benefits we obtain

$$\pi_1 + \frac{\pi_1}{(1+r)} + \frac{\pi_1}{(1+r)^2} + \ldots = \pi_1 \cdot \frac{1+r}{r}.$$

Situation of non-cooperation is slightly more complicated. In the first round of the game the outcome is represented by square 3 in Figure 16. However, as one representative entrepreneur does not cooperate, the others are motivated not to cooperate as well in subsequent rounds of the game. Thus, the outcome in next rounds will be represented by square 4. Present value of net benefits of non-cooperative strategy is, therefore, given by

$$\pi_3 + \frac{\pi_4}{(1+r)} + \frac{\pi_4}{(1+r)^2} + \ldots = \pi_3 + \pi_4 \cdot \frac{1}{r},$$

which can be simplified using the fact that in square 4, both benefits and costs are equal to zero, thus net profit is equal to zero as well ($\pi_4 = 0$).

Cooperation of entrepreneurs can be sustainable only if net benefits of cooperation are higher than net benefits of non-cooperation. Mathematically, we obtain following condition:

$$\pi_1 \cdot \frac{1+r}{r} > \pi_3,$$

which can be rewritten as

$$r < \frac{\pi_1}{\pi_3 - \pi_1}.$$

The real interest rate on the left side of this inequality condition is always positive. Thus, there will certainly be no cooperation of entrepreneurs in case of negative π_1. As $\pi_3 > \pi_1$, inequality condition might be satisfied in case of positive π_1, nevertheless this outcome is not warranted. Studying the Austrian business cycle theory is likely to occur only in case of sufficiently low real rate of interest, otherwise entrepreneurs do not cooperate. Thus, Tullock's (1988) argumentation seems to be justified in some particular cases.

However, when solving the dynamic infinite-round game, we assumed that as one entrepreneur chooses uncooperative strategy, the other entrepreneurs do not cooperate in subsequent rounds as well. Nonetheless, this assumption seems to be feasible only in the economy with sufficiently low number of entrepreneurs having the possibility to observe the behavior of all the other entrepreneurs. In reality, this is not the case.

Entrepreneurs actually cannot observe one another and, therefore, their reaction to the non-cooperation of the other entrepreneurs might be delayed.

This delay of adjustment raises future value of net profits for non-cooperative strategy. Using the letter *m* for number of rounds when one entrepreneur does not cooperate while the others do, we can generalize the condition for cooperative strategy sustainability. This generalized condition takes form

$$\pi_1 \cdot \frac{1+r}{r} > m \cdot \pi_3,$$

which can be rewritten as

$$r < \frac{\pi_1}{m \cdot \pi_3 - \pi_1}.$$

This generalized version of the model predicts that the higher the delay of reaction is, the lower rate of interest is necessary in order to the cooperation of entrepreneurs can be sustained. One could assume that the *m* parameter is the increasing function of the number of entrepreneurs in the economy. Thus, in the economy consisting of high number of entrepreneurs, lower interest rate is necessary so as to maintain the cooperative strategy of entrepreneurs and thus, the probability of reading Mises and Rothbard is lower than in the economy with only few entrepreneurs. Tullock's (1988) critique of the Austrian business cycle theory might be hereby disproved.

To conclude this chapter, let us recall that the whole game theory analysis was based on the assumption that after reading Mises and Rothbard, entrepreneurs obtain the ability to predict the central bank policy and the business cycle will be thus smoothed. In following chapters we will discuss whether this idea is accurate or not.

4.3 Representative entrepreneur with adaptive expectations

Previous sub-chapter showed that rational entrepreneurs need not always study the Austrian economics as Tullock (1988) suggested. Nonetheless, as this outcome is not warranted and Tullock's argument might be justified in some cases, we will now focus on exploration and prediction of the behavior of the representative entrepreneur during the course of the business cycle induced by expansionary policy of the central bank. We will, first of all, analyze simple case of entrepreneur whose expectations are adaptive

and in next sub-chapter, we may proceed to behaviour of rational-expectations entrepreneur.

The microeconomics apparatus presented in second chapter will be used. Let us briefly recall that the producer maximizing its *ex ante* profit hires such a quantity of each input that equalizes present value of its marginal product with its expected real rental price defined as a ratio of currently paid nominal rental price and expected future price of the product.

Third chapter of this thesis further explained that adaptive expectations are backward-looking and formed as weighted average of previous development of the variable. Expected future price is simply given by extrapolation of foregone prices, assuming there will be no change in trend in its development.

Let us now assume central bank increases an amount of money in circulation which, according to the first chapter of this thesis, lowers monetary rate of interest and changes demand for goods in different stages of production. Entrepreneurs with adaptive expectations treat these changes as permanent and assume these will persist in the future.

Profitability of investment projects in far distant stages of production rises after monetary expansion. As entrepreneurs do not expect any future change in increased profitability, they may launch new investment projects. The same effect holds for stages close to first-order goods; due to increased demand for consumption goods, profitability of investment in these stages rises as well and scarce sources are, therefore, shifted to these stages as well.

Nonetheless, monetary expansion is non-permanent phenomenon while it was treated as permanent change by entrepreneurs. Thus, after monetary expansion, as monetary rate of interest increases, profitability of newly launched investment projects falls back and these projects become unprofitable. This reversal was not, however, expected by entrepreneurs with adaptive expectations; previous expectations are, therefore, not fulfilled. While an increase in investments was *ex ante* appropriate, it seems to be *ex post* erroneous. Entrepreneurs committed mistakes and their expectations appear to be *ex post* false.

Entrepreneurs again expect no change in market data; hence, decreased profitability of their investment projects is expected to be unchanged as well. Thus, entrepreneurs

might cancel their unprofitable investments. This leads to recession; economic slowdown is, however, possibility for future recovery.

To conclude this sub-chapter, incorporation of adaptive expectations into the Austrian business cycle theory is problem-free. Business cycle may be initiated and passed in the manner described by Mises (1953) and Hayek (1935) and this mechanism is supported by adaptive expectations.

4.4 Representative entrepreneur with rational expectations

After examining the case of adaptive expectations, we may proceed to the other, more complicated, case of entrepreneur whose expectations are rational.

Nonetheless, let us recall that third chapter of this thesis presented several arguments against the rational expectations hypothesis and that our conclusion was such that entrepreneurs' expectations are rather adaptive. Nevertheless, Hayek (1933b, pp. 139-140) assumed that "everybody foresees the future correctly and that this foresight includes not only the changes in the objective data but also the behaviour of all the other people with whom he expects to perform economic transactions". This statement seems to imply Hayek assumed rational expectations of entrepreneurs, his later work (Hayek 1967), however, states entrepreneurs' expectations might be static.

When explaining behavior of adaptive-expectations entrepreneur, our conclusion was such that during an artificial boom, entrepreneurs made incorrect decisions about their investments. This conclusion might hold generally, "every explanation of economic crises must include the assumption that entrepreneurs have committed errors" (Hayek 1933b, p. 141) and some expectations need to be disappointed.

The question is whether the Austrian business cycle could be initiated even in the economy with entrepreneurs whose expectations are rational, not adaptive. "The mere fact that entrepreneurs do make errors can hardly be regarded as a sufficient explanation of crises" (ibid), we may, therefore, explain why all the entrepreneurs should simultaneously make mistakes in the same direction.

There are several contradictory answers to the question whether the Austrian business cycle may run under the rational expectations hypothesis. Murphy (2005, p. 3) believes that "entrepreneurs really can be "fooled" by the central bank's machinations, even if their expectations are perfectly rational in the neoclassical sense" and concludes

that “if entrepreneurs could perfectly anticipate all future economic conditions, then there couldn’t possibly be a recession” (Murphy 2005, p. 7). Contrarily, Garrison (1989, p. 14) suggests “the assumption of rational expectations (…) implies that a monetary disturbance should not have any systematic real effects beyond the period in which the disturbance occurs”. Hence, we might try to solve this puzzle.

4.4.1 Price level and relative prices

First problem we need to consider is whether and how rational entrepreneur is able to recognize that central bank increases the amount of money in circulation, thus, whether the Austrian business cycle is expected to be induced.

In theory, one may distinguish two different reasons for an increase in individual prices – changes in the money supply and changes in consumers’ preferences. Are entrepreneurs actually able to distinguish these two phenomena?

Wagner (1999, p. 71) argues entrepreneurs are able to recognize these two sources of price changes. “Statistics, observers, and pundits are everywhere. (…) The aggregate data are widely and readily available.” Nonetheless, Wagner admits justification of the Austrian business cycle theory when the theory was initially formulated: “The collection of economic statistics was primitive. (…) There was no developed community of financial observers and Fed watchers” (ibid).

Other suggestion is expressed by Lucas (1971, p. 103) explaining that “information on the current state of (…) disturbances is transmitted to agents only through prices in the market where each agent happens to be. (…) Prices convey this information only imperfectly, forcing agents to hedge on whether a particular price movement results from a relative demand shift or a nominal (monetary) one.“ Thus, Lucas proposes entrepreneur need not be able to distinguish between these two sources of price change.

Moreover, Lucas business cycle theory[4] suggests that while monetary expansion leads to uniform rise in all the prices in the economy, relative demand shift increases only one single price. Nevertheless, entrepreneur may erroneously regard an increase in price of his product due to monetary expansion as an increase of his relative price and, hence, may increase the extent of his production. This increase is, however, erroneous as relative price of his product is not affected by monetary expansion.

[4] „Textbook“ version of Lucas model is presented by Romer (2006).

Nevertheless, Lucas' idea is incorrect for two reasons. Firstly, according to the model derived in Chapter 2, no entrepreneur actually cares about the price level. Extended model of entrepreneur's decision-making presented in Chapter 2 implies entrepreneurs need not care about all the prices in the economy; only knowledge of prices of inputs and product is sufficient for his decision-making. Murphy (2005, p. 9) confirms this idea: "the individual entrepreneur is concerned only with a very small set of market prices, namely, the prices of the inputs she will need for her projects, and the prices for which these products will sell"[5].

Even if all the prices in the economy rose uniformly after monetary expansion, both prices of inputs and output would increase equally and there would be no reason to increase the amount of production. Hence, no business cycle could be induced by policy of the central bank.

Second argument disclaiming Lucas business cycle model criticizes the term "price level". As first chapter of this thesis explained, price level is false aggregate whose utilization leads to over-simplification of studied problem. Monetary expansion never leads to uniform rise in all the prices; hence, relative prices do not remain unchanged after monetary expansion. Money is, therefore, never neutral in terms of their impact on relative prices which completely disclaims Lucas business cycle theory.

Moreover, even if monetary expansion led to uniform rise in prices, another problem would arise. How may rational entrepreneur distinguish between two sources of price change? Entrepreneur possesses the knowledge of only very limited set of prices. He might improve his knowledge by recognizing more prices in the economy; nonetheless, this would take some time which is costly. Moreover, "during the wait for the (…) information, which will clarify the meaning of the local price change, economic agents must react in some way" (Garrison 1991, p. 97). Hence, decision-making of rational entrepreneurs is necessarily based on imperfect knowledge; entrepreneur simply cannot analyze the set of all the prices in the economy and needs to decide using the knowledge of limited set of prices.

Another argument asks how entrepreneurs may recognize artificial monetary expansion in situation of permanent use of monetary policy instruments. Murphy (2005, p. 10) suggests that "in reality the government (in each major country) has implemented

[5] Murphy (2005) considers prices of product as known, while our analysis assumes these prices are not known exactly and have to be foreseen.

a permanent intervention in the credit market by the creation of a central bank (or a centralized system of banks)". According to this suggestion, entrepreneurs might have no idea what the free market set of relative prices would be without any intervention of the central bank. Murphy (2005, p. 16) concludes that "the entrepreneur (…) perfectly rational in the neoclassical sense will make more mistakes when the most important intertemporal prices (…) are influenced not only by "fundamentals" but also by the changing whims of central bankers".

To sum up previous discussion, producer actually cannot distinguish between two sources of changes in price suggested by Lucas. Hence, even entrepreneurs with rational expectations might be fooled by the central bank policy. Nonetheless, our model of producer's decision-making is based on expected prices, we may, therefore, continue our analysis of monetary expansion consequences by taking price expectations of entrepreneurs into account.

4.4.2 Course of the business cycle

Another problem associated with the course of the Austrian business cycle under the rational expectations hypothesis is whether rational entrepreneurs possessing the knowledge of economic theory should launch new investment projects in far stages of production after monetary expansion.

Increased profitability of investing in these production stages should motivate entrepreneurs to invest more, thus, to launch more processes of production. Nonetheless, an increase in the profitability has only temporary character which is an argument for the investment to remain unchanged.

One possible answer to this question uses the apparatus of game theory. Carilli and Dempster (2001) study the behavior of representative entrepreneur deciding whether or not increase an investment after expansive monetary policy. Change in representative entrepreneur's profit depends not only on his action, but on the other entrepreneurs' actions as well; application of the game theory apparatus is hereby justified.

The pay-off matrix of game suggested by Carilli and Dempster (2001, p. 327) showing change in relative profits is depicted in Figure 17 below. Each player has two possible actions – increase investment or maintain the current level of investment. Sign

$\Delta\pi_R$ stands for change in relative profit of representative entrepreneurs, while $\Delta\pi_O$ denotes change in relative profits of all the other entrepreneurs.

		Other entrepreneurs	
		Increase	**Maintain**
Representative entrepreneur	**Increase**	**Square 1** $\Delta\pi_R = 0$ $\Delta\pi_O = 0$	**Square 2** $\Delta\pi_R > 0$ $\Delta\pi_O < 0$
	Maintain	**Square 3** $\Delta\pi_R < 0$ $\Delta\pi_O > 0$	**Square 4** $\Delta\pi_R = 0$ $\Delta\pi_O = 0$

Figure 17 Representative entrepreneur's pay-off table
Source: Carilli and Dempster (2001) (modified)

Change in relative profits is zero in cases when action of representative entrepreneur is the same as actions of all the others, hence, change in relative profits is zero in Square 1 and in Square 4. Square 2 represents state when only one representative entrepreneur increases investment while all the others do not; in such a situation, relative profit of representative entrepreneur increases while profit of all the others decreases. Contrarily, Square 3 depicts situation when all the entrepreneurs increase investment while only one representative entrepreneur does not; his relative profit, therefore, decreases while all the others' profit increases.

Since each entrepreneur prefers positive change in its profit to negative change, its preferences are Square 1 $\succ$ Square 3 and Square 2 $\succ$ Square 4. Increasing investment is, therefore, a dominant strategy of each entrepreneur, hence, Nash equilibrium of this game is represented by Square 1 when all the entrepreneurs increase amount of its investments. While such an outcome is individually favorable, it is not favorable for the whole economy; hence, this outcome is of "prisoners' dilemma" type. Garrison (1989, p. 9) states that "macroeconomic irrationality does not imply individual irrationality". This is exactly that case.

Carilli and Dempster (2001) hereby argue that during the business cycle induced by expansive monetary policy, entrepreneurs are actually not fooled by the central bank; on the contrary, their behavior is fully rational and profit maximizing: "profit maximizing behavior on the part of individual entrepreneurs rather than their foolishness can explain the start of the boom" (Carilli and Dempster 2001, p. 326). According to this argument,

the Austrian business cycle could be initiated under the rational expectations hypothesis as well.

Presented argument may be, however, criticized for several reasons. Potužák (2007) suggests prisoner's dilemma may be overcome in multiple-round game. In such a case, maintaining the current level of investment may become dominant strategy and equilibrium of the game is shifted to Square 4 where no entrepreneur increases investments and, therefore, no artificial boom is initiated. Other argument criticizing Carilli's and Dempster's approach is based on maximizing relative profit. The question is whether entrepreneurs actually maximize profit *per se* instead of relative profit. If so, design of the game would be different and its outcome might be different as well.

Murphy (2005) rejects above presented argument as well asking "why does a firm increase its profits by making bad investments" (Murphy 2005, p. 6). One may assume entrepreneur's decision-making is based on long-term forecasts and long-term planning, hence, the fact that an increase in profitability of investments has only temporary character should be included in entrepreneur's expectations. Thus, entrepreneur should not launch any investment projects whose profitability has only temporary nature. Murphy (2005), therefore, concludes that Austrian business cycle theory is not compatible with the rational expectations hypothesis.

This argument may be, however, slightly extended and modified. Whether new investment projects are likely to be launched depends on length of each individual stage of the production process (time between beginning of production of any good and its sale to lower stage of production) and on length of time period when profitability of investment is increased.

If each stage of production was sufficiently short, Austrian business cycle could be initiated. In such a situation, entrepreneur could increase its investment and so benefit from its higher profitability; nonetheless, newly launched production process needs to be finished during the period of higher profitability. Otherwise entrepreneur's profit would be lower than expected. On the contrary, if each stage of production was sufficiently long, Austrian business cycle might not be started since period of increased profitability would be overly short compared to the length of the stage of production. Hence, no entrepreneur could benefit from increased profitability of investment since his products would be sold after backward shift of investment profitability, thus, no entrepreneur would launch new investments.

The Austrian business cycle theory might be, therefore, compatible with the rational expectations hypothesis if an increase in profitability of investment in early stages of production had long-term character and if length of each stage of production was short enough. In such a case, entrepreneurs could increase their profits by benefiting from temporary increase in profitability of investment; such a behavior is individually rational, nevertheless, it is not optimal for the economy as whole since this leads to cyclical fluctuation. Such a mechanism of business cycle does not support Murphy's (2005) view; entrepreneurs are actually not fooled by the central bank.

The question whether above suggested conditions for compatibility of the Austrian business cycle theory with the rational expectations hypothesis are fulfilled in reality is an empirical one and hence, this question will not be answered in this thesis. In theory, we hereby proved a possibility of the Austrian business cycle initiation under the rational expectations hypothesis.

Nonetheless, above suggested idea may be disproved by asking whether entrepreneurs know the length of period of increased profitability of investment projects. The answer should be probably negative. As stated by Hoppe (1997, p. 51), learning is the "learning by experience, from previous mistakes". However, monetary expansions are never completely identical, thus, the period of artificially increased profitability of investments is never equally long. Rational entrepreneurs cannot learn whether increase of maintain their investments from past experience since their current situation may be completely different. Past experience may possibly be useful when learning direction of changes after monetary expansion; nevertheless, intensity of the change cannot be learned from past experience. Hence, proposed possibility of initiation the Austrian business cycle under the rational expectations hypothesis is rather theoretical exercise without any practical relevance.

4.4.3 Summary

To sum up the discussion whether the Austrian business cycle theory is compatible with the rational expectations hypothesis, Garrison (1989, p. 8-9) states "employing the assumption of so-called rational expectations along with other essential assumptions, such as instantaneous market clearing and costless information, the New Classicists are able to transform the impermanence of money-induced distortions as seen by the

Austrians into the nonexistence of such distortions". Moreover, theories of new classicists and of new Keynesians as well are labor-based; economic fluctuations are mostly due to fluctuations of labor supply and demand. On the contrary, Austrian economics is capital-based; economic fluctuations are caused by artificial changes in intertemporal structure of capital goods which is the element not considered by current economic mainstream. Contrarily, Hayek (1967) claims that the Austrian business cycle is initiated since neoclassical assumptions are not fulfilled.

Hayek (1933b) further explains that during the course of the business cycle, some price expectations needs to be disappointed; some prices are different from expected prices. In other words, entrepreneurs' expectations were, at least partially, erroneous. Thus, it seems the Austrian business cycle theory cannot be compatible with the rational expectations hypothesis proponents' assumption that expectations are on average correct.

Neoclassical assumption, however, seem to be highly unrealistic[6]. Above suggested assumption of short stages in production process along with long period of increased profitability may be treated as unrealistic as well. Hence, we may state the Austrian business cycle could not be initiated under neoclassical assumptions; nonetheless, these assumptions are never fulfilled in reality.

We need not, therefore, study in detail the compatibility of the Austrian business cycle with the rational expectations hypothesis. Garrison (1989, p. 11) hence concludes "expectations, rational or otherwise, are in this context a subsidiary issue"; the Austrian business cycle theory does not need to incorporate the element of entrepreneurs' expectations.

[6] The rational expectations hypothesis was criticized in third chapter of this thesis as well as the assumption of costless information.

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