How Do the Search Costs and Uncertainty Affect the Incentives to Search for Maximum Wages and Minimum Prices?

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Abstract

We investigate a searcher's incentive to stop searching for a highest wage or a minimum commodity price in the framework of discrete-time lookback option. During the search period, the searcher decides whether to accept an offer or decline it and then to pay sunk costs to search for another period. Each of the wage offer and the commodity price evolves over time as a geometric Brownian motion such that the searcher holds a finite-time lookback option, given the assumption that the searcher can recall all previous offers. A job searcher who incurs larger search costs will ask for a higher wage and is thus less likely to stop searching. In contrast, a commodity searcher who incurs larger search costs is willing to accept a higher price and is thus more likely to stop searching. A more volatile return from the wage offer will not only decrease a searcher's reservation wage because he/she owns a more valuable recall option, but also touch a given reservation wage more often. Consequently, the searcher is more likely to stop searching. By contrast, a more volatile commodity price will not only decrease a searcher's reservation price, but also touch a given reservation price more often. Consequently, it is indeterminate whether the searcher is more likely to stop searching.

Keywords: job offer, lookback option, reservation price, reservation wage, search costs, uncertainty.

1. Introduction

The economics of search has become a heated topic ever since Stigler (1961; 1962) published his seminal works. This was evidenced by three labor economists, who made major contribution to the economics of search, were awarded the laureates of Nobel Prize in Economics in 2010. McCall (1970) extended the fixed-sample size search model of Stigler into the basic sequential search model (BSM) in which a job searcher faces the same probability distribution of wage during an infinite horizon of search. Accordingly, the searcher's decision can be characterized by a trigger policy: The searcher will accept a job offer if it exceeds a constant reservation wage. Furthermore, he predicts that the reservation wage will be lower if the search cost is higher because the marginal benefit from waiting another period declines with the wage offer.[1] Weitzman (1979) further shows that the reservation wage will be higher if there is a mean preserving spread on the distribution function of wage.

As stated in Lippman and McCall (1976c), the major drawback of the BSM is to use a static model to explain a dynamic phenomenon. They thus extend the BSM into a model in which the mean of the distribution of wage is increasing and the search cost is declining over time. While they are able to explain how a better economic environment affects a searcher's incentive to stop searching, yet they are unable to answer how a more volatile labor market affects the searcher's incentive to stop searching. This article intends to investigate this unexamined issue.

This article will apply the option pricing technique (e.g., Black and Scholes, 1973) to investigate the issue regarding searching both the highest wage in the labor market and the lowest price in the commodity market (see, e.g., Rothschild, 1974). We assume that initially a searcher is offered a fixed level of wage income or commodity price. Later on, the wage income and the commodity price will move stochastically over time as a geometric Brownian motion. At each date, the searcher has just an offer and can pay some costs to unveil the job or commodity offer. Assuming that the searcher is able to recall all previous offers during a finite period of time, then the searcher owns a finite-time lookback call option.

As is well known in the real options literature (e.g., Dixit and Pindyck, 1994), a searcher's strategy can be characterized by the following trigger policy: at each date, the searcher will not stop searching unless the wage offer exceeds the reservation wage willingly accepted by the searcher or the commodity price falls short of the reservation price willingly paid by the seracher. We will investigate how various exogenous forces affect these two triggers at the initial date. Each trigger is

[1] Lippman and McCall (1976a; 1976b) present an excellent survey on the early literature on the search theory, while McCall and McCall (2008) provide an excellent survey on the recent literature.

determined by equating the search cost with the marginal return from searching for another period, which is positively related to the wage offer or the commodity price as a result of the recall option. We can then investigate how these two triggers are affected by the search cost, and the other exogenous forces (which affect the marginal return of search) such as the searcher's discount rate, the expected appreciation rate of either the wage offer or the commodity price, and the volatility of that appreciation rate. Our results significantly differ from the predictions of the BSN for the case of job search because the recall option generates value to the searcher in our model, while it generates no value in the BSM.

This article is related to the real options literature that investigates the timing decision of sequential investment. The standard real options literature (e.g., McDonald and Siegel, 1986) assumes that a firm incurs a sunk cost to exercise a fixed scale of investment project once and for all. It shows that the firm will delay its investment timing decision if the firm incurs a larger investment cost or faces a more volatile return from the investment project. Dixit and Pindyck (1994, chapter 9) further show that if a firm needs to finish an investment project in two stages, and each stage can be finished instantly, then the firm will undertake these two stages simultaneously. A larger investment cost in either stage or a more volatile return from the investment project will still delay the firm's investment timing choice. This conclusion holds even if a firm undertakes sequential investment in which it takes time to finish the investment project in each stage (Bar-Ilan and Strange, 1998). By contrast, in our model a searcher can refuse or accept the offer at each period after paying a sunk cost. A larger sunk cost still delays the searcher's investment timing decision. However, a more volatile return from the wage offer will not only decrease a searcher's reservation wage because he/she owns a more valuable recall option, but also touch a given reservation wage more often. Consequently, the searcher is more likely to stop searching. By contrast, a more volatile commodity price will not only decrease a commodity searcher's reservation price, but will touch a given reservation price more often. Consequently, it is indeterminate whether the searcher is more likely to stop searching.

This article is related to the literature on the lookback option (see, e.g., Conze and Viswanathan, 1991; Kou, 2008). The job searcher in our framework owns a discrete-time monitored lookback option with a fixed strike price, the search cost. By contrast, the literature on the lookback option typically assumes that the option holder can exercise his/her option once and for all rather than sequentially.[2]

The remaining sections are organized as follows. Section 2 outlines the

[2] The literature on the lookback option has discussed the difference between a lookback option that can be exercised at any date in the continuous-time sense, and that can be only exercised at some certain discrete dates (see, Kou, 2008).

assumptions of the model. Section 3 presents the comparative-statics results of the trigger levels of the wage income (or the commodity price) with respect to the search cost, the job searcher's discount rate, the expected appreciation rate of the wage income (or the commodity price) and the volatility of that appreciation rate, assuming that a searcher is only able to search for one more period. Section 4 presents the simulation analysis so as to make the theoretical results in Section 3 more vivid. The last section concludes and offers suggestions for future search.

2. The Model

Our sequential model of search is as follows. An individual, referred to as the searcher, is seeking to find a highest wage in the labor market or a minimum price in the commodity market. Each day the searcher ventures out to find an offer, and generates exactly one offer. We will assume that the searcher is not allowed to vary the intensity of his/her search effort. The cost of generating each offer (which includes all out of pocket expenditures such as transportation that are incurred each time an offer is obtained) is a constant c, and the number of offers the searcher can obtain is limited by the period of search, denoted by T. We will focus on the case in which all previous offers are retained, which is referred to as sampling with recall. The non-recall scenario is not interesting for the case of job search because the searcher will then accept an offer now or never at the initial date. However, we will briefly discuss the non-recall scenario for the case of searching for a minimum commodity price because the searcher will then have incentives to search for another period after rejecting the initial offer.

Consider job search in the labor market. Whereas the searcher's skills are unvarying, prospective employers do not necessarily evaluate or value them equally; consequently, different employers tender different offers to the searcher. This "dispersion of offers" is incorporated into the model by assuming that there is a probability distribution of wage which governs the offer tendered. We assume that the distribution is stochastic over time and the job searcher knows the parameters of the stochastic wage distribution from which his/her offers are randomly generated. In this simple setting, the offer can be interpreted as the discounted present value of the lifetime earnings from the job.

All participants in job search are assumed to be risk-neutral and seek to maximize their expected net benefits. The only decision the searcher must make is when to stop searching and accept an offer. The amount of search (the period of unemployment) depends on the distribution of wages that the individual knows his services can command in the labor market and on c, the opportunity cost of the searching activity. If the searcher knows that his/her skills are highly valued, he/she will reject an offer that falls short of his/her expectations and remain unemployed. On the other hand, if the cost of search is high, the job searcher will wait longer before accepting an offer. Under the foregoing set of assumptions, we will demonstrate that at the initial date the optimal policy for the job searcher is to reject an offer below a single critical number, termed the reservation wage, and to accept the offer above this critical number. Furthermore, the reservation wage can be calculated so that the marginal cost of obtaining exactly one additional job offer is equal to the expected marginal return of one more offer.

Let us assume that the initial date is $t=0$ and that $W(t)$ denote as the wage offer and $F(t,W)$ as some function of the path followed by the wage offer between time zero and time t, which reflects the recall option. We will also define the value of a derivative security at time t as $v(W,F,t)$, and r as the riskless interest rate. The principle of risk-neutral valuation indicates that the value of the derivative security is independent of the risk preferences of investors. This means that we may assume that the world is risk-neutral. We suppose that the process followed by W in a risk-neutral world is a geometric Brownian motion:

$$dW(t) = \mu W(t)dt + \sigma W(t)dZ(t), \tag{1}$$

where $dZ(t)$ is an increment to the standard Wiener process, μ is the drift rate, and σ is the instantaneous volatility. Equation (1) indicates that $\ln W(t)$ is normally distributed with $\ln W(0) + (\mu - \frac{\sigma^2}{2})\, t$ and variance $\sigma^2 t$, thus departing from the BSM which assumes that the distribution function of wage offer is time invariant.

The search period can be represented in the form of steps of length, $\Delta t = T / N$, where N is the number of offers during the search period. Following the trinomial tree model of Boyle (1986), we assume that in time Δt the wage income either moves up by a proportional amount u with probability P_u, moves down by a proportional amount d with probability P_d, or remains unchanged with probability P_m, where

$$u = e^{\sigma\sqrt{2\Delta t}}, \tag{2}$$

$$d = 1/u \tag{3}$$

$$P_u = \left(\frac{e^{\frac{\mu\Delta t}{2}} - e^{-\sigma\sqrt{\frac{\Delta t}{2}}}}{e^{\sigma\sqrt{\frac{\Delta t}{2}}} - e^{-\sigma\sqrt{\frac{\Delta t}{2}}}}\right)^2, \tag{4}$$

$$P_d = \left(\frac{e^{\sigma\sqrt{\frac{\Delta t}{2}}} - e^{\frac{\mu\Delta t}{2}}}{e^{\sigma\sqrt{\frac{\Delta t}{2}}} - e^{-\sigma\sqrt{\frac{\Delta t}{2}}}}\right)^2, \tag{5}$$

and

$$P_m = 1 - P_u - P_d. \tag{6}$$

In general there are $2i+1$ nodes at time $i\Delta t$ such as in a tree in Figure 1, which assumes that $n=3$. We denote the lowest node at time $i\Delta t$ by $(i,0)$, the second lowest by $(i,1)$, and so on. The value of W at node (i,j) is thus given $W(0)u^{\max[0,j-i]}d^{\max[0,i-j]}$.

If we were valuing a regular option, we would work back from the end of the tree in Figure 1 to the beginning, calculating a single option value at each node. To value a path-dependent option, one approach is to value the option at each node for all alternative values of the path function $F(t,W)$ that can occur. We denote the kth value of F at node (i,j) by $F_{i,j,k}$, and define $v_{i,j,k}$ as the value of the security at node (i,j) when F has this value. The value of the derivative security at its maturity, $v_{n,j,k}$, is known for all j and all k. To calculate its value at node (i,j), where $i<n$, we note that the wage income has a probability P_u of moving up to node $(i+1, j+2)$, a probability P_m of remaining unchanged of node $(i+1, j+1)$, and a probability P_d of moving down to node $(i+1, j)$. Consequently, the kth value of F at node (i,j) leads to the k_u th value of F at node $(i+1, j+2)$ when there is an up movement in the wage income, to the kth value of F at node $(i+1, j+1)$ when the wage income remains unchanged, and to the k_d th value of F at node $(i+1, j)$ when

there is a down movement in the wage income. For a European-style derivative security, this means that

$$v_{i,j,k} = e^{-r\Delta t}[P_u v_{i+1,j+2,k_u} + P_m v_{i+1,j+1,k} + P_d v_{i+1,j,k_d}]. \qquad (7)$$

If the derivative can be exercised at node (i,j), the value in Equation (7) must be compared with the early exercise value, and $v_{i,j,k}$ must be set equal to the greater of the two.

We illustrate the approach by considering a three-period American sequential lookback call option on the wage offer portrayed in Figure 1. This pays off the amount by which the maximum wage offer observed during the option's life exceeds the search cost at the time of exercise. Figure 2 shows that we set $F(t,W)$ equal to the maximum wage offer realized between time zero and time t. Consequently, $F(t,W)$ can have one or two numbers at each node. For example, at node (3,6), $F(t,W) = W(0)u^3$ and thus $v(W,F,t) = W(0)u^3 - c$. At node (3,4), $F(t,W)$ is equal to either $W(0)u^2$ or $W(0)u$ such that $v(W,F,t)$ is equal to either $W(0)u^2 - c$ or $W(0)u - c$.

Insert Figure 1 Here

Figure 2 shows the terminal payoff for node (3, *j*), where *j*=0,…,6, the payoff for early exercise for node (2, *j*), where j=0,…,4, for node (1, *j*), where *j*=0,1,2, and for node (0,0) . For example, for node (3,4) the terminal payoff will be equal to $W(0) - c$ if the wage income moves through either the path [0,0] → [1,2] → [2,3] → [3,4], [0,0] → [1,1] → [2,2] → [3,4] or the path [0,0] → [1,0] → [2,2] → [3,4], and it will be equal to $W(0)u - c$ if the wage income moves through the path [0.0] → [1,2] → [2,4] → [3,4]. For node (2,2), the payoff for early exercise is given by $W(0) - c$ if the wage income moves through either the path [0,0] → [1,1] → [2,2]

or the path 0,0 → 1,0 → 2,2, and it is given by $W(0)u - c$ if the wage income moves through the path 0,0 → 1,2 → 2,2 .The payoff for the other nodes can be derived following similar arguments as above.

Insert Figure 2 Here

Our goal is to find the reservation wage at initial date, denoted by $W^*(0)$, which is determined by the condition as follows:

$$W^*(0) = v_{0,0,k}, \tag{8}$$

where $v_{0,0,k}$ is determined by Equation (7).

The case in which a searcher searches for a minimum commodity price may be analyzed following the same procedures as above. Assuming that $W(t)$ denotes the commodity price, we can derive Figure 3, which shows the terminal payoff at the final date, and the payoff for early exercise at the other dates when all previous offers can be recalled.

Insert Figure 3 Here

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3. Comparative-Statics Results

We will first consider the benchmark case in which a job searcher has the option only to search for another period, i.e., $N = 1$. As such, the reservation wage will be determined by the value of $W(0)$ that is exactly equal to the expected present value of waiting for another period, i.e.,

$$W(0) = e^{-rdt}[P_u(W(0)u - c) + (1 - P_u)(W(0) - c)] \tag{9}$$

Multiplying both sides of Equation (9) by e^{rdt} and then rearranging yields

$$c = W(0)[1 - e^{rdt} + P_u(u - 1)] \tag{10}$$

In Equation (10), the term on the left-hand side, c, is the marginal cost (MC) for searching another period, and the terms on the right-hand side are the marginal benefit (MB) from searching for another period, which is increasing rather than decreasing with the wage offer as obtained in the BSM (McCall, 1970). This explains why we reach different findings from those of the BSM as shown below.

Figure 4 uses the wage offer $W(0)$ in the horizontal axis, and both the marginal cost c, and the marginal benefit $W(0)[1-e^{rdt}+P_u(u-1)]$ in the vertical axis. Given that $W^*(0)$ satisfies the condition shown in Equation (10), it follows that a job searcher will not accept the job offer if $W(0)<W^*(0)$, and will accept it immediately if $W^*(0)\geq W(0)$. Figure 4 shows that when c increases, the marginal cost curve shifts upward, indicating that the job searcher requires a higher reservation wage to cover this adverse impact. This resembles the standard result of real options literature (e.g., Dixit and Pindyck,1994) stating that larger sunk cost of investment delays a firm's investment timing decision.

Insert Figure 4 Here

Figure 5 investigates the impacts of the discount rate (r), the expected appreciation rate of the wage offer and the volatility of that appreciation rate (μ and σ, respectively) on the reservation wage. When r decreases or μ and σ increase, the marginal benefit curve shifts upward such that the reservation wage moves downward. These results accord well with intuition. As the job searcher discounts future less (r decreases), the opportunity cost for accepting the job offer immediately decreases such that the searcher will ask for a lower reservation wage. Furthermore, a job searcher will benefit from waiting if the wage offer is either expected to be more prospective in the future or more volatile because armed with the recall option the searcher can avoid the downside movement, while benefiting from the upside movement of the job offer.

Insert Figure 5 Here

Given that neither c nor r affects the evolution of $W(t)$ as shown in Equation (1), it follows that a job searcher who either incurs a lower search cost or discounts future less is more likely to stop searching because the searcher's reservation wage will then be lower. Moreover, a searcher who faces a larger μ or σ is also more likely to stop searching for the following two effects that reinforce each other. First, the searcher will ask for a lower reservation wage, as shown in Figure 5. Second, a larger μ or σ makes hitting any given reservation wage more often.

Let us consider the case in which a commodity searcher looks for the minimum price. Suppose that the searcher can only search for another period, then the reservation price at the initial date, denoted by $W^*(0)$, i.e., the maximum commodity price acceptable to the searcher, is given by the condition as follows:

$$c = W(0)\left[e^{d\,t} - 1 + (1 - d_d P)\right] \tag{11}$$

We then obtain the following comparative-statics results. When a searcher incurs a larger search cost to unveil the commodity price, the searcher is more willing to stop searching by tolerating a higher price. The figure thus resembles that in Figure 4. Furthermore, the curve of the marginal return from searching for a commodity's price shown in Figure 5 will shift downward when the searcher discounts future less (r decreases), the expected appreciation rate of the commodity price (μ) increases, and the volatility of that appreciation rate (σ) decreases. As a result, all these three scenarios lead to a higher reservation price. These results accord well with intuition. A searcher who discounts future less is naturally willing to accept a higher current price. A searcher who expects the commodity price to grow more rapidly in the future will accept a higher current price sooner to avoid the adverse impact in the future. A searcher who expects the commodity price to be less volatile has a less valuable recall option and will thus accept a higher current price sooner. Given that neither c nor r affects the evolution of $W(t)$, we thus conclude that a commodity searcher is more likely to stop searching if the searcher incurs a larger search cost or discounts future less. In addition, we also conclude that the searcher is more likely to stop searching when the commodity price appreciates more rapidly both because the reservation price will then increase and because a given reservation price will be hit more often. However, it is ambiguous whether the searcher is more likely to stop searching when the commodity price becomes less volatile because while the reservation price will increase, yet a given reservation price will be hit less often.[3]

We may compare the policy implications of our model with those of the BSM (McCall, 1970). McCall (1970) argues that one may add an exogenous given wage

[3] Our results are in line with those of the BSM shown in Rothschild (1974) who indicates that the reservation price will be higher if the search cost increases, the searcher discounts future less, the probability mass of commodity offer moves to the left, or there is a mean-preserving contraction on the commodity offer distribution function.

income that denotes the value of remaining unemployed. Consequently, a job searcher whose reservation wage lower than this amount becomes a discouraged worker who voluntarily drops out of the labor market. While MaCall assumes that a job searcher can recall all previous offers when the search period is infinite, yet this recall option generates no value because the searcher faces the same distribution function of wage offers over time. Consequently, he finds that the marginal return from searching for another period is decreasing with the wage offer. As a result, a searcher's reservation wage will be lower such that the searcher is more likely to be discouraged if the search cost is higher (the marginal cost increases) or the new distribution of wage offers stochastically dominates the old (the marginal return decreases). In order to avoid these adverse effects, he recommends that the regulator should reduce the search cost or raise the skill level of workers. By contrast, our model suggests that a job searcher who incurs a lower search cost has a lower reservation wage and is thus more likely to be employed if the value of remaining unemployed is sufficiently small. Consequently, the regulator can increase the number of employed workers and reduce the number of frictional unemployed workers by reducing the search cost. Furthermore, Lippman and McCall (1976c) extend the BSM to an environment in which the mean of the distribution function of wage offers shifts rightward and the search cost shifts downward over time, and find that the reservation wage will shift upward. They argue that this implies that more people become frictional unemployed when the economy moves forward more favorably. In our model, the expected appreciation rate of the wage offer μ may be used to capture the trend of the economy's environment. However, we find that when the environment of the economy moves favorably forward in the sense that μ is increased, then the reservation wage is reduced. Finally, Weitzman (1979) argues that when there is a mean-preserving spread on the distribution function of wage offers, then the marginal return from searching for another period will shift rightward such that the reservation wage will increase. By contrast, in our model when the growth rate of the wage offer becomes more volatile over time, the reservation wage will decrease.[4]

4. Numerical Analysis

We use the finite difference method as developed by Brennan and Schwartz (1978) and Hull and White (1990) to conduct the numerical analysis. We choose benchmark values resemble those chosen by Dixit and Pindyck (1994, Chapter 5) so as to make the theoretical predictions in the last section more vivid. Consider a

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[4] Weitzman (1979) also shows that the reservation wage will increase if the job searcher discounts future less, which is just opposite to our result.

searcher who expects the wage offer or the commodity price to appreciate 2% per year ($\mu = 0.02$) and the volatility of that appreciation rate to be equal to 20% per year ($\sigma = 0.2$). The searcher is risk-neutral and discounts all future income and costs at the riskless rate equal to 5% per year ($r = 0.05$) and incurs a constant search cost that is normalized at one, i.e., $c = 1$. Consider that the job offer or the commodity offer arrives at 60 times per year (or approximately per offer six days), and consider both cases where the searcher has three offers ($N = 3$) and 60 offers ($N = 60$) during the search period, respectively. Given these parameters values, when a searcher can recall all previous job offers, the searcher will not accept the job offer until the wage income exceeds 49.74 for $N = 3$ and 8.17 for $N = 60$. Furthermore, a commodity searcher will not accept the offer until the commodity price falls short of 33.46 for $N = 3$ and 1.60 for $N = 60$ when the searcher can recall all previous offers. By contrast, if a commodity searcher is not able to recall any previous offer, then the searcher will not stop searching until the commodity price falls short of 164.2 for $N = 3$ and 32.03 for $N = 60$. Consequently, the searcher will wait longer with the recall option than without this option. This accords well with intuition: when a searcher understands that it is not possible for him/her to retain the right of each previous offer, the searcher will then be more impatient in purchasing the commodity.

In the following, we will focus on the case where both the job offer and the commodity offer can be recalled. Figures 6 to 10 present the graph for the reservation wage and the reservation price in which one parameter ($N, c, r, \mu,$ *or* σ) is changed around its benchmark value, while the other parameters are held at their benchmark values. Figure 6 shows that both the reservation wage and the reservation price are decreasing convex to the number of offers left during the search period when N varies from 1 to 120. In other words, a job searcher is more likely to accept a job offer and a commodity searcher is less likely to purchase a commodity when the searcher expects to have more opportunities to search in the future. Moreover, the additional offer opportunity that encourages the searcher to accept the job offer and that discourages the searcher to accept the commodity offer exhibits a more significant influence when the number of offers are fewer, thus suggesting that the searcher needs to be more cautious about the timing to stop searching when fewer opportunities are left for searching.

We find that the results of Figures 7 to 10 are in line with those of the two conditions analyzed before, i.e., Equations (10) and (11), even though both conditions assume that $N = 1$ (rather than $N = 3$ or 60). Figure 7 shows that both the reservation wage and the reservation price are decreasing with the search cost (c) in the region (0, 2). In other words, the existence of the search cost discourages the job searcher to accept the offer, while encouraging the commodity searcher to accept the offer.

Figure 8 shows that the reservation wage is increasing with, while the reservation price is decreasing with the riskless rate in the region (3%,7%). In other word, a foresighted searcher (r is low) is more likely to accept both the job offer and the commodity offer.

Figure 9 shows that the reservation wage is decreasing with the appreciation rate of the job offer and the reservation price is increasing with the expected appreciation rate of the commodity price in a region in which μ varies in the region (0, 4%). In other words, a job searcher who expects the job market to become more prospective in the future is more likely to accept the job offer immediately, while a commodity searcher who expects the commodity inflates more in the future is also more likely to stop searching immediately.

Finally, Figure 10 shows that the reservation price increases with the volatility of the job offer and the reservation price decreases with the volatility of the commodity price in the region (10%, 30%). In other words, a more volatile job market will encourage the searcher to accept the job offer immediately. However, it is still ambiguous whether a more volatile commodity market will encourage the searcher to accept the commodity offer immediately because a given reservation price is more likely to be hit even though the reservation price decreases.

5. Conclusion

We investigate a searcher's incentive to stop searching for a highest wage or a minimum commodity price in the framework of discrete-time lookback option. During the search period, the searcher decides whether to accept an offer or decline it and then to pay sunk costs to search for another period. Each of the wage offer and the commodity price evolves over time as a geometric Brownian motion such that the searcher holds a finite-time lookback option, given the assumption that the searcher can recall all previous offers. A job searcher who incurs larger search costs will ask for a higher wage and is thus less likely to stop searching. In contrast, a commodity searcher who incurs larger search costs is willing to accept a higher price and is thus more likely to stop searching. A more volatile return from the wage offer will not only decrease a searcher's reservation wage because he/she owns a more valuable recall option, but also touch a given reservation wage more often. Consequently, the searcher is more likely to stop searching. By contrast, a more volatile commodity price will not only decrease a searcher's reservation price, but also touch a given reservation price more often. Consequently, it is indeterminate whether the searcher is more likely to stop searching.

This article builds a very simplified model to investigate the determinants of the reservation wage for a job searcher and the reservation price for a commodity searcher. We can extend the model in the following ways. First, we may allow a searcher to vary the intensity of search as addressed in Lippman and McCall (1976c). Second, Burdett and Vishwanath (1988) extend the BSM into an environment in which learning takes place during job search such that the reservation wage declines as a consequence of the selection process. We may incorporate Grenadier and Malenko (2010) and Miao and Wang (2007), both consider learning in a dynamic environment, into our model to address this issue. Finally, we do not consider the problem faced by a producer to post a commodity price to search for consumers or to bargain the commodity price with consumers. We may follow the two papers by Arnold and Lippman (1998; 2001) to allow these two considerations.

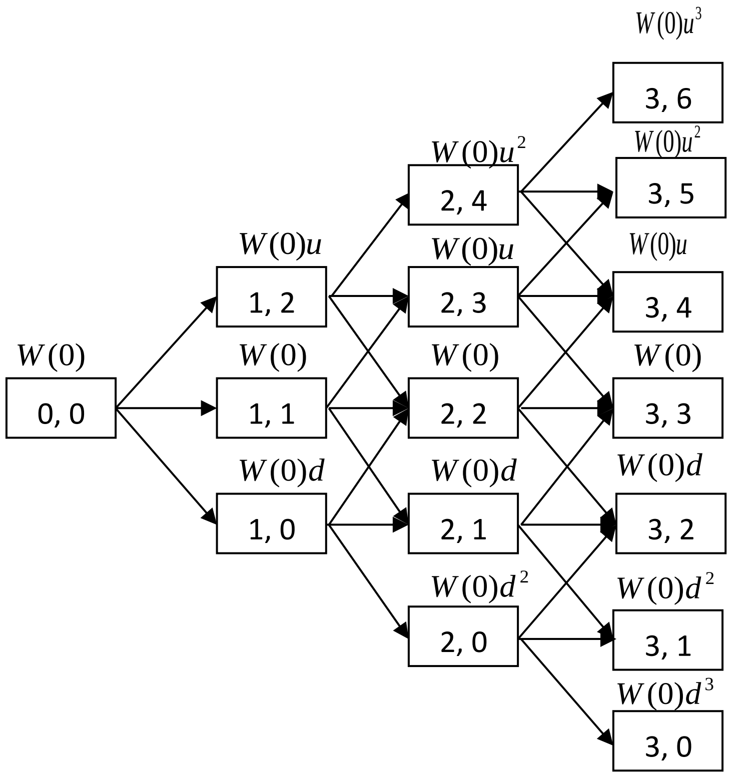

Figure 1: The Trinomial Tree For Wage Offer Movements

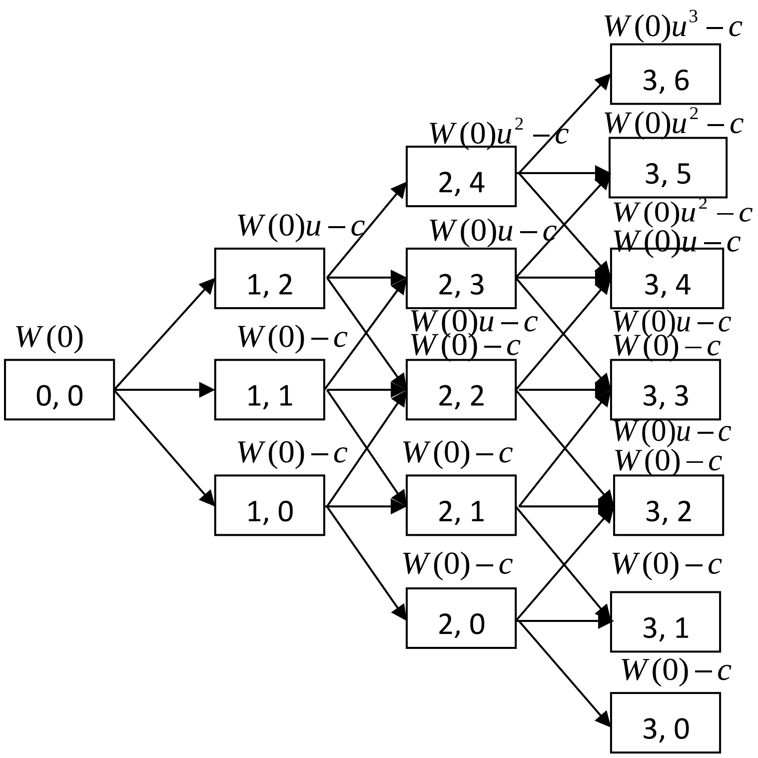

Figure 2: Terminal Payoff When Job Offers Can be Recalled

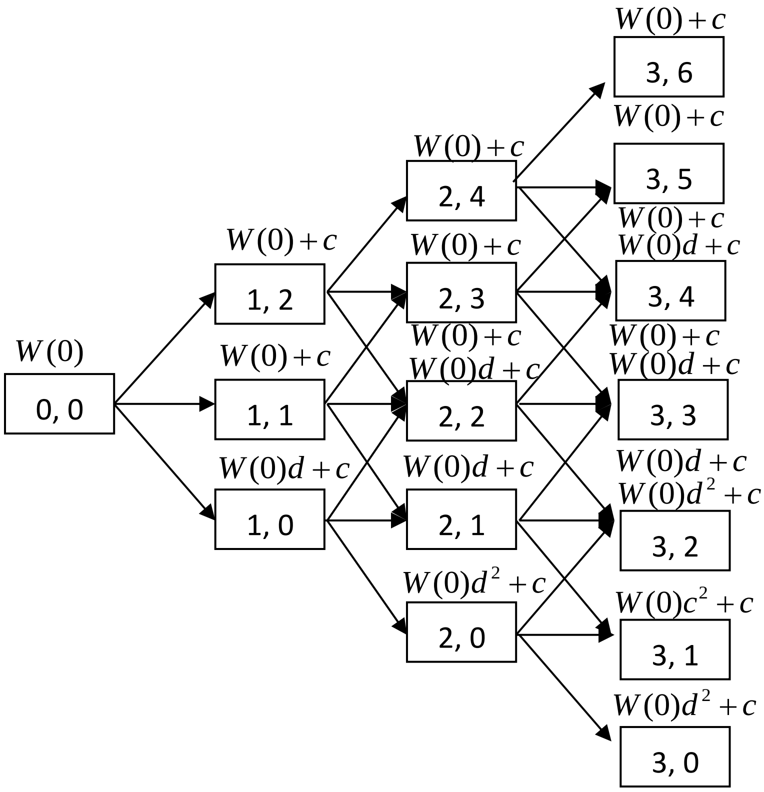

Figure 3: Terminal Payoff When Commodity Offers Can be Recalled

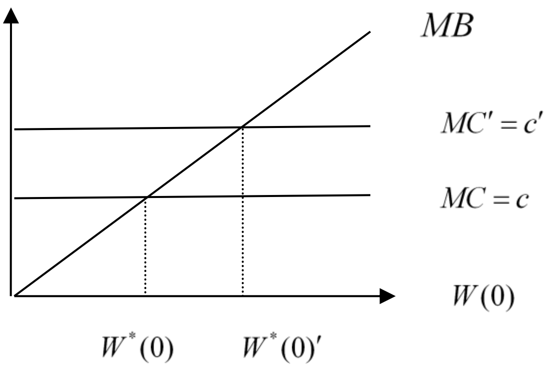

Figure 4: The impact of an increase in the search cost on the reservation wage. An increase in the search cost will shift upward the marginal cost curve, thus increasing the reservation wage from $W^*(0)$ to $W^*(0)'$. Note that $MB = W(0)[1 - e^{rdt} + P_u(u-1)]$.

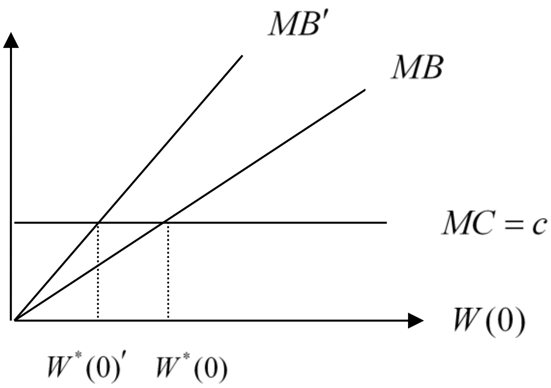

Figure 5: An increases in the expected growth rate of wage offer, a larger volatility of that growth rate, or a lower riskless rate will shift upward the marginal benefit curve, thus decreasing the reservation wage from $W^*(0)'$ to $W^*(0)'$.

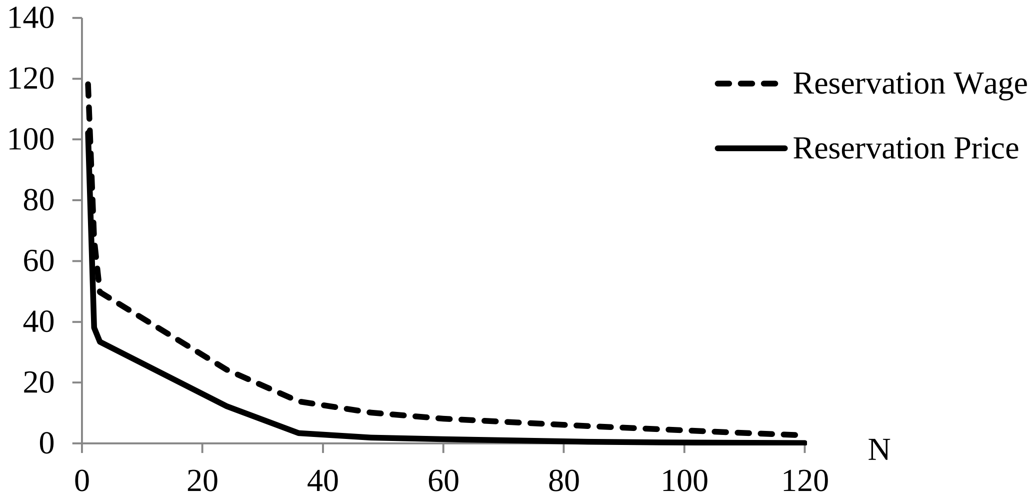

Figure 6: The relationship between the reservation wage (the reservation price) and the number of wage offers (price offers), N.

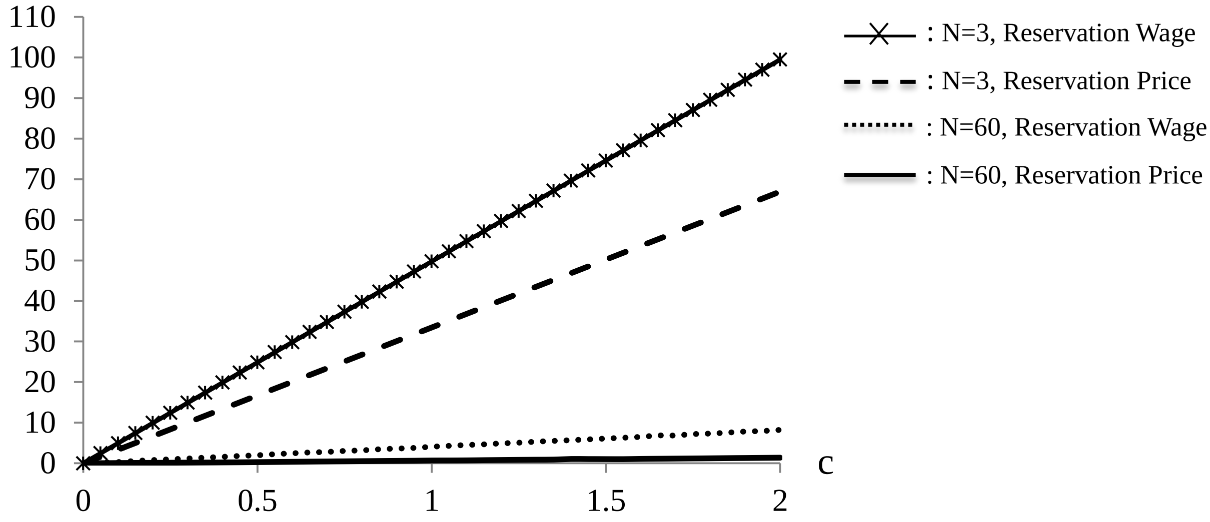

Figure 7: The relationship between the reservation wage (the reservation price) and the search cost (c).

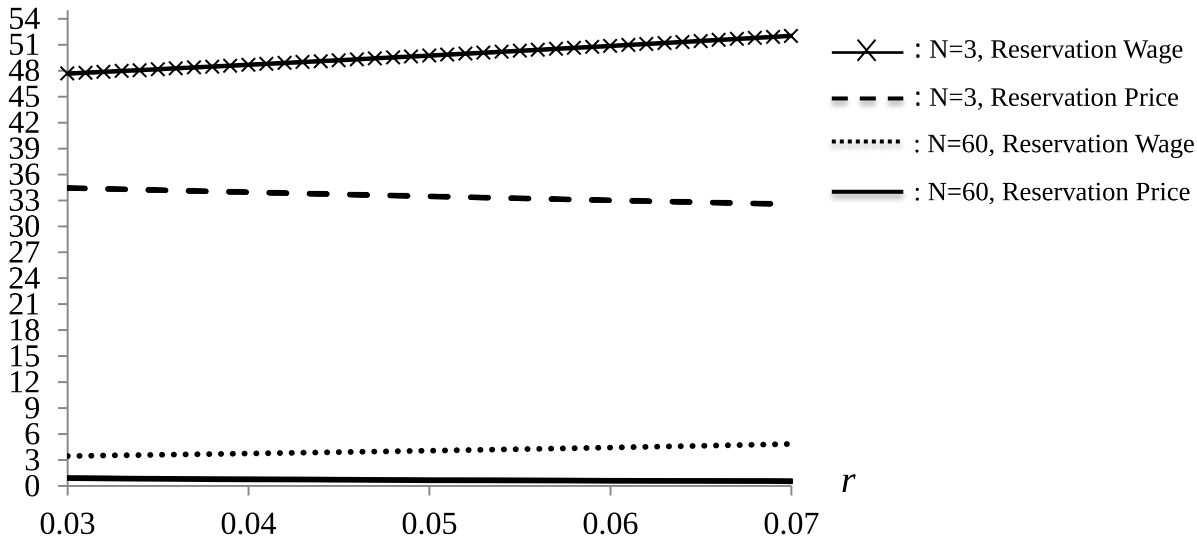

Figure 8: The relationship between the reservation wage (the reservation price) and the riskless rate (r).

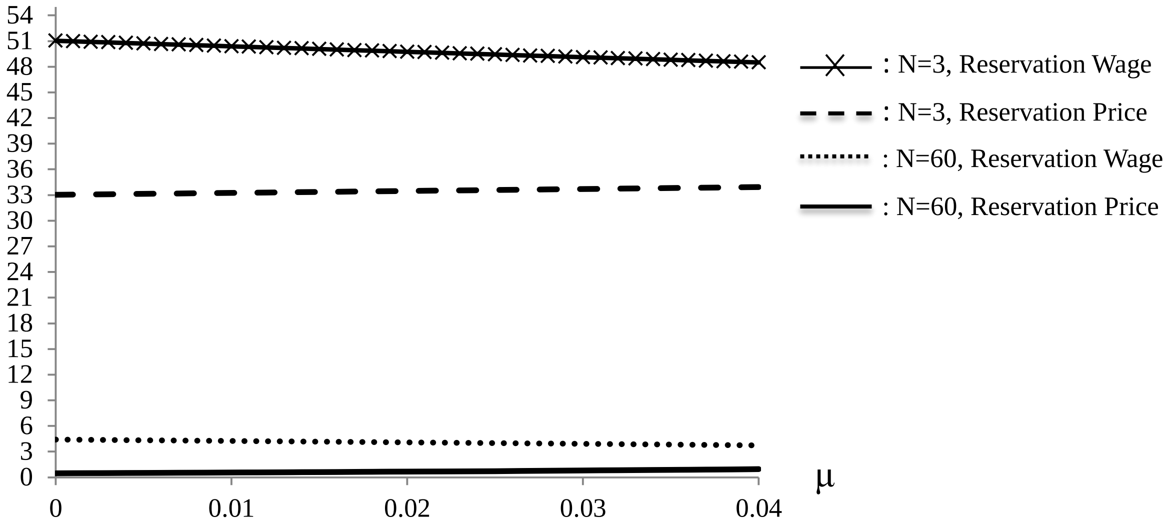

Figure 9: The relationship between the reservation wage (the reservation price) and the expected appreciation rate of the wage income (the commodity price) μ.

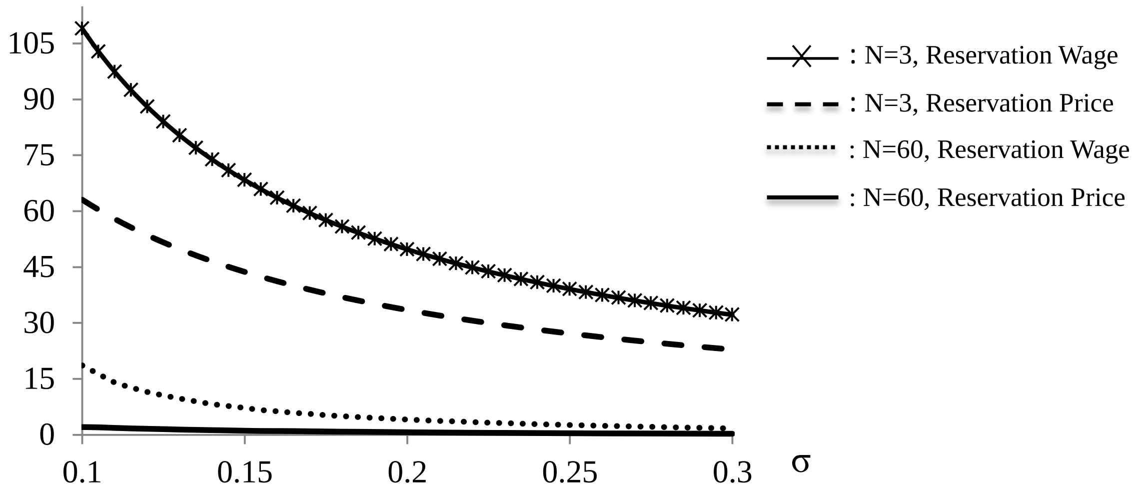

Figure 10: The relationship between the reservation wage (the reservation price) and the volatility of the appreciation rate of the wage income (the commodity price) σ.

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