Original Paper

Exploration of Dynamic Optimization Paths for Work Search Models under Incomplete Information Conditions

Xian Jingchen[1] & Liu Qing[2]

[1] College of Finance and Economics, Sichuan International Studies University, Chongqing 400031

[2] Chongqing Caixin Group Co., Ltd., 400000

Abstract

This article is based on the application exploration of dynamic optimization theory under incomplete information conditions. Based on the job search model and its extended model, this theory is analyzed in detail, explaining the relationship between unemployment rate and wages in the labor market, exploring the impact of Western labor unemployment formation, summarizing the experience of urban unemployment in the process of social construction in the new era, and developing high-quality and high-quality employment work for college students, It will have very important inspiration and reference significance.

Keywords

job search, frictional unemployment, labor market tightening

1. Introduction

The theory of market friction can better explain the issue of market supply and demand, but the complexity of the labor market makes its interpretation questionable. Professor Peter Diamond, an American economist at MIT, took the lead in paying attention to the problem of how to clear up the labor market, and first used the basic theory of market friction to explain it, which then led to a deeper question: what proportion of structural changes in the labor market and market economic factors affect the high unemployment rate respectively. Dale T. Mortensen of Northwestern University and Christopher A. Pissarides, a Cyprian and British economist currently at the London School of Economics and Political Science, went further, mainly addressing issues related to labor job search optimization theory and its application in macrodynamic economics, deepening people's understanding of the recovery of labor market imbalances after economic crises. And a relatively clear answer was given to the question of whether there must be a Walras equilibrium price mechanism in the labor market. Three economists have made significant contributions to relevant economic theories.

So, what are the contributions of these three scholars' theories in economics? Below is a brief review to share with colleagues.

2. Theoretical Review

2.1 Basic Model

Stigier (1961, 1962) and McCall (1965) studied the search behavior in the commodity market and labor market, respectively. McCall also made preliminary assumptions and carefully classified and compared the fixed cost, search likelihood, and expected wage of labor job search. In the labor market, the cost of job search arises due to insufficient information flow. In this model, a simple and effective economic application of dynamic optimization theory is provided. In the basic search model, the established wage distribution appears through fixed or random time intervals, so economic entities can only decide whether to accept the established wage for employment or reject the current wage, in order to continue searching for better job opportunities. Unemployed individuals face two simple stochastic dynamic optimization problems: their conscious or unconscious acceptance or rejection of potential job opportunities, resulting in the probability of an increase or decrease in the labor market, and a corresponding price probability distribution of wage prices in the labor market. In this way, the behavior of the same unemployed individual will affect the structure of the labor market and the labor market, and further assumptions are made, the unemployed must make a decision when to work, given the distribution of job opportunity information. If the unemployed person is a rational person, he will make a trade-off between continuing to lose his job and continuing to look for work. The time cost depends on the comparison between the marginal utility of his unemployment and the future wage income, that is, the marginal cost of the search is equal to his marginal revenue. As long as he finds any job whose wage is greater than the minimum expected wage and accepts the job, he can stop the job search; Otherwise, they will continue to search for their next job until they meet the minimum wage requirements.

In 1971, Professor Diamond refuted this theory based on the perspective of the supply side-employers: "If the response of employers is introduced, then wages will inevitably be distributed at a point, which is the market equilibrium point of the labor market" (This point may be much lower than the point where unemployed people are willing to provide labor income). To better understand this result, we assume that the economy is composed of a large number of homogeneous labor suppliers and homogeneous manufacturers, and define the supply paradigm of retaining wages, indicating the reasonable response of workers to the wages provided by manufacturers. Due to the tolerance (threshold) that can drive workers to accept reasonable or even unreasonable wage quotes, it is not profitable for manufacturers to quote high prices (as per capita profits usually decrease with the increase of labor costs). In the general equilibrium theory state, the wage distribution is concentrated on the threshold minimum wage value, and the relationship shows that this wage is equal to the immediate income of workers. Therefore, manufacturers have no incentive to pay wages above the minimum acceptable level. Based on this model, we cannot explain why wages are distributed at one point.

2.2 Equilibrium Search Model

In the most basic model, the premise is that the labor supply in the basic market is in a static state, without considering job search, career conversion, or the relative reality of local personnel mobility. Therefore, Burdett (1978); Jovanovic (1984) and Mortensen (1985) extended the job search model by incorporating local equilibrium, voluntary labor mobility, and even introducing non wage factors such as job security and pension plans to construct a static local equilibrium model and achieve generalization of the model (Of course, while considering generalization, we also consider long-term and short-term issues, namely cross period decision-making).

Albert and Axell (1984) began to consider more non wage factors, as well as the constraints of labor suppliers, and added factors such as labor heterogeneity. However, this method also cannot explain the causes of wage differences among workers in the market well (only a small part can be explained). Burdett and Mortensen (1998) constructed a market equilibrium model after adding such factors as on-the-job job search and strategic expansion of manufacturers. And it is believed that when the market is in a stable and balanced state, the clearance of the labor market ends with the mutual identity of the labor supplier and the unemployed transitioning to a certain equilibrium; To break this equilibrium, it is necessary to consider the length of unemployment for the unemployed, as well as changes in various factors such as the rise in market wage balance and unemployment insurance. Among them, an increase in market wage balance will actually increase unemployment. Due to the establishment of the equilibrium search model, quantitative processing was carried out, and the relative examination factors were relatively complete. So compared to other working models, it has relatively strong comprehensive explanatory power in empirical research.

There are two situations that need to be explained in the process of job search for unemployed individuals: firstly, the existence of frictional unemployment. It is generally believed that rational practitioners will optimize their employment behavior based on wages as the actual guidance for employment standards. For job vacancies provided by the market, they may not immediately match each other, which precisely explains the influencing factors of frictional unemployment and its duration; Secondly, higher education level labor force workers in the market may expect higher expected wages due to their higher entry conditions. Therefore, every job seeker will choose their minimum wage requirement at the marginal wage point, as the expected unemployment cost time brought about by job search is exactly equal to the expected benefits brought about by the high wages of the new job. That is, the marginal revenue brought by the minimum wage is exactly equal to its marginal cost. Of course, if employment is constrained by various conditions and adopts expediency measures to reduce employment conditions, entering the low latitude labor market from the high-dimensional labor market, voluntarily giving up some employment standard terms and restrictions, and temporarily shelving their own professional capital asset capacity, it also occurs from time to time. This has a strong correlation with the tolerance of the unemployed (unemployment boundary threshold); Of course, generally speaking, this belongs to short-term behavior. If it involves intertemporal aspects, the employment standard conditions will increase, and the current assumptions and results need to be re verified. Therefore, for employers, who are the demand side of employment, it is necessary to consider whether the behavior of applicants involves intertemporal differences (although there is little difference in wages between the long and short term, there may be significant differences in implicit wages such as benefits, which may have different wage cost pressures on employers).

3. Dynamic Optimization Path for Job Search

3.1 Cross Period Work Search Path

The search model did not indicate a strong correlation between the cyclical relationship between wages and employment and the external conditions for improving job search and job matching; Secondly, this theoretical model does not clearly explain the proportion of job search disadvantage and matching disadvantage caused by information asymmetry in general unemployment; In the complex economic structure environment, the mismatch between workers and jobs leads to general unemployment, of which some unemployment cannot be ignored because of the dynamic changes of the economy and the complexity of the labor market (that is, frictional unemployment is a long-term fact, while structural unemployment is also a long-term economic phenomenon). Therefore, a work search model with cross period is established to further explain.

We are now discussing an unemployed worker who may receive one job with the same job opportunity per period as g, the salary distribution is: $F(G) = prob\{g \leq G\}$, and there is the following information $B < \infty$, that makes $F(0) = 0, F(B) = 1$. The worker has two options:

(1) Choose to give up this job, in which case he or she will receive c_{xybx}, a certain amount of unemployment insurance benefits and wait until the next period to obtain another job opportunity with a salary distribution of F;

(2) The worker can accept the job, in which case he or she will receive wages for each subsequent period g_{wl}. Resignation and dismissal are not allowed.

Let y_t be the income of the t unemployed in the future period, we have $y_t = c_{xybx}$. If they accept a job with a salary of g_{wl}, we have it $y_t = g_{wl}$. Unemployed workers seek a strategy to maximize $E\sum_{t=0}^{\infty} \beta^t y_t$, Where $0 < \beta < 1$ is a discount factor. $q(g_{wl})$ is the expected value of $\sum_{t=0}^{\infty} \beta^t y_t$ for workers holding w job opportunities, When the worker's behavior is optimal, they will inevitably consider whether to accept or reject the job.

The worker still chooses to maximize benefits in two situations:

(1) Accept job opportunity g_{wl} and always work at this salary;

(2) Rejecting this job opportunity, c_{xybx} is obtained in this period, and a new job opportunity g'_{wl} follows the distribution F in the next period. And revealed the solution of this equation.

By using equation (2), we can transform equation (1) into a general equation with retained wage $\bar{g}_{wl}$. Assigning $q(\bar{g}_{wl})$ and using equation (2), we have a result with retained wages.

Two properties can be obtained from (3). Firstly, given F, when the unemployment insurance benefit c_{xybx} increases, it may also increase. Secondly, given the increasing expectation of c_{xybx} risk, it will lead to growth. The second property can be directly derived from the property of (3) and the expectation of increasing risk, which leads to an upward movement of $\beta(Eg_{wl} - c_{xybx}) + \beta F(g_{wl})$. Due to the growth of unemployment insurance benefits or the expansion of risks, there will be a future change in retained wages. Therefore, from the expression of the value function in equation (2), it can be seen that the situation of unemployed workers is improving in this state. It is evident that an increase in unemployment insurance benefits will increase workers' welfare. In our discussion, unemployed workers have the option to accept a job with an asset value equal to at a salary of. In the case of increased risk, the high probability of high wage opportunities $g_{wl}/1-\beta$ increasing the value of a search job, while the high probability of low wage opportunities appearing will have little effect, as job choices will never be exercised at such low wages.

3.2 Macro Economic Model of Job Search

The model is based on the neoclassical view of perfect competition labor market, which believes that the implicit dependence on the completion of the Walrasian equilibrium guarantees the continuous clearing of prices in the market, and the coordination of transactions. It is believed that resource allocation is a process without cost and friction, which means there is no involuntary unemployment in the market.
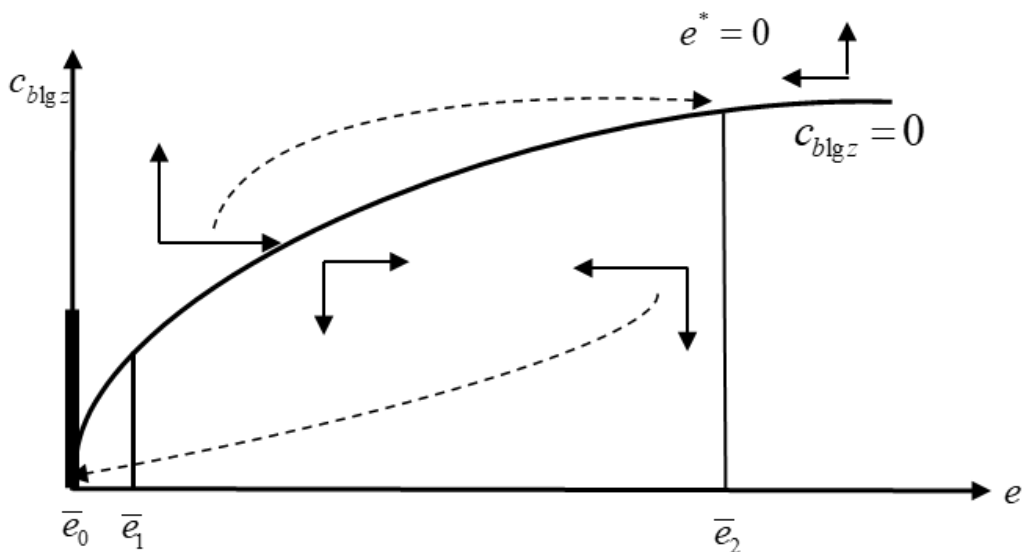

Figure 1. Schematic Diagram of Convergence Synthesis of Work Search Paths

The extended neoclassical model can demonstrate that as economic entities adjust their labor supply based on price or production shocks, employment fluctuations occur, but the labor market, like other markets, continues to clear. The search model applied to the labor market can explain the existence of frictional unemployment through the passive waiting behavior of economic entities for job opportunities.

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Diamond has established an extended model of the job search model as follows:

Let the utility of consuming a product be y, and the production cost is proportional to the non negative random variable c_{xybx}, with a lower bound of $\underline{\varepsilon}$ and a known distribution function of $G(\ )$. Namely $G(x) = \Pr(\varepsilon \leq x)$ and $G(\underline{\varepsilon}) = 0$. The economic entity seeks to maximize its expected lifetime discounted utility value as $V = E\sum_{t=0}^{\infty} e^{-pti2} Ut_i$, where $Ut_i = yt_i - \varepsilon t_i$.

The time of any unemployed person is continuous, and economic entities that are not engaged in production or consumption may be in a certain state of production and consumption, that is, within a given time, economic entities may be engaged in production or consumption or leisure. Therefore, it can be considered that economic individuals are in two states: (1) when searching for production opportunities under unemployment; (2) And when they are in a state of employment and seeking new trading partners for trading.

The process of finding production opportunities and trading partners follows a normal distribution with economic individual characteristics. The model assumes that the key is to find more and more economic entities for new transactions under the premise of having production jobs. Therefore, the total unemployment rate increases as a function, and as more new trading partners are added, it is easier to discover new trading partners, In order to shorten the search time and reduce the corresponding search costs (*but there is a paradox here: when adding conditions with information asymmetry, the more information asymmetry there is, the higher the search cost may be, and the search time and search costs may not only not be reduced but also increase*), so as to complete the search of the work with the lowest search cost. Therefore, the decision of economic entities to decide whether to proceed with production has a positive spillover effect on the trading opportunities of other economic entities. When economic entities decide production, they do not consider spillover effects, and the result will be that the equilibrium of economic activities will be at a low level of local optimum. It can be seen that those who are optimistic or pessimistic due to externality have potential self actualization, and externalities are also the source of multiple equilibrium possibilities.

Therefore, economic individuals will make the following production decisions:

(1) Firstly, the decision-making of economic individuals will adopt the principle of retaining the current level;

(2) Economic individuals will choose all production opportunities where their production costs are lower than the critical value, that is, strive for all acceptable costs to carry out production.

Under the premise of utility, when the employment rate is e, the lifetime expected utility of the employed is $W_e(e)$, while the utility expected value of the unemployed corresponding to e is $Wu(e)$. For economic individuals, the total employment rate determines the probability that they will discover trading partners in the current period, with $b = (e)$: if e is larger, economic individuals can increase their consumption level faster. Therefore, the employment value is an increasing function of e. The unemployment value partially depends on the employment value, which is also a function of e. For economic individuals, analyze the employment at time point t. The probability of an employee

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finding a trading partner and spending money in the current period and becoming unemployed again is

$b(e_t)h$. The probability that the corresponding employed person cannot achieve consumption and

maintain employment status is a specific value and the possibility of changes in employment rate.

At the same time, it can be seen that for each economic individual, the pathway of e changing over

time is exogenous, but individual decision-making also determines the equilibrium state of e. The

proportion of people in employment at each time point is an increasing function of $b(e)$. The

probability of an employee discovering a trading partner and consuming them to become unemployed

is $eb(e)$. Therefore, the proportion of people who change from employed to unemployed in each

period is $1-e$. The proportion of unemployed population in each period a. The probability of the

unemployed discovering production opportunities is a, and as long as $c_{xybx} \le c_{b\lg z}$ (unemployment

insurance is less than the retained wage), the unemployed can be converted into employment.

Due to the increase in $c_{b\lg z}$, it means that economic entities are more willing to use production

opportunities to provide employment, and the balanced employment level increases with the increase in

$c_{b\lg z}$. Correspondingly, the probability of $c_{xybx} \le c_{b\lg z}$ is $G(c_{b\lg z}) = \Pr(c_{xybx} \le c_{b\lg z})$.

We analyze the above and believe that at least for the initial values of predetermined variables, there exists a two-point equilibrium trajectory that tends towards a high level of economic activity in a steady state or origin shutdown equilibrium. Therefore, there are two types of natural unemployment rates that exhibit significant differences in height or long-term equilibrium. In many cases, both equilibrium paths may tend towards one of the two steady-state states mentioned above. Therefore, which equilibrium path we face will depend on the ability of economic entities to coordinate their behavior towards a low natural unemployment rate. Coordination problems can be considered based on the self actualization tendency of optimistic or pessimistic emotions. To some extent, this also leads to the possibility that the Rational expectations hypothesis cannot fully adapt to the search model. The economic agents know the structure of the economic model and can calculate the corresponding equilibrium path. However, because the economic agents are uncertain about which equilibrium the economy chooses, there is still uncertainty about the realization of the specific economic path.

The importance of external economic entities participating in the above resource allocation process lies in the fact that the more easily accessible economic entities are at the same time, the easier it is for each economic entity to find trading partners (establishing a unified labor market is beneficial for labor demanders, suppliers, and even other related parties). Roughly speaking, the increase in economic activities makes it easier for traders to find trading partners, and the Externality of economic subjects' decisions affect the transactions of other traders. The result is that the equilibrium no longer has Pareto optimality, as economic individuals do not consider the external effects of their behavior. In addition, pessimistic or optimistic expectations that tend to self actualize can lead to multiple equilibria. So there are two types of natural unemployment or long-term equilibrium, and there is a significant difference in the natural unemployment rate between the two states. In many cases, both equilibrium paths may lean towards one of the two steady-state states mentioned above. For this reason, the government also faces

coordination issues, that is, the choice of which equilibrium path to be in depends on the mediation ability of economic entities to coordinate their own behavior and tend to lower the natural unemployment rate. Therefore, government policies play a role in correcting Externality and helping economic individuals choose a good balance. Government policies can help improve the optimal coordination between economies that cannot be achieved through the market due to externalities.

3.3 A Dynamic Optimization Model for Work Search Paths

Next, we will consider the dynamic optimization problem of job search from the Gross National Income model. First, if Y is defined as total output, the national Production function is described as follows: $Y = F(K, L)$

(1) Considering factors such as population size, which remains constant in the short term, it can be assumed that there is only one single commodity in a socio-economic entity, and its utility function is as follows: $\sum_{t=0}^{\infty} \beta^t U(c_t)$.

(2) Considering time: the time Bank rate $\beta \in (0,1)$, the utility function $U(\ )$ is increasing, and all economic individuals need the same unit of labor time in each period. Under the condition of measuring the endurance (threshold) of economic individuals, economic individuals may not consider the work under the cooperation of labor (L) and capital (K) in order to achieve the expected consumption of c_t as t.

(3) Considering the premise of returns to scale: but the property of returns to scale remains unchanged, we discuss that $F(\ )$ is an increasing function. If we change both input ratios λ at the same time, the rate of change in output will also be λ, indicating the existence of the following equation: $F(\lambda K, \lambda L) = \lambda F(K, L)$, Let $\lambda = 1/L$ in the above equation, then the simple equation of the Production function is obtained as follows:

$$F(K/L, L/L) = (1/L) \Rightarrow F(K, L) = LK(K/L, 1)$$

(4) Considering the premise of per capita capital: the per capita capital stock is (K/L), and the per capita Production function is defined as follows:

$$f(k) \equiv F(k, 1)$$

Accordingly, the Production function in the form of total output can be written as follows:

$$Y = Lf(k)$$

The per capita output $y = K/L$ Production function becomes the function of per capita capital stock:

$$y = f(k)$$

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The competent social and economic departments will certainly realize the lifelong Utility maximization problem maximization of representative economic entities through production, consumption and investment decisions. At the same time, by limiting the established production technology and available resources, it is possible to choose to maximize consumption by maximizing the utility function of economic entities. That is to say, including non depreciated capital, the per capita production $f(k_t)$ can be used for both current consumption and future production of capital. The initial capital stock k_t during a given period t not only fully describes the current economic state, but also correspondingly determines the possibility of consumption in the current and future periods. Corresponding to the established Kx1, social planners are directly concerned with the current consumption choices. In other words, since $k_{t+1} + c_t$ is equal to the current output, it can be considered that the planner's choice is to invest k_{t+1}.

The equation has unique bounded Continuous function solution V. This function is not only the present value function involved in social planner problem (P), but also an incremental function. The strategy to determine the optimal capital stock in the next period corresponds to $g(\ )$, which is regarded as a defined Continuous function with respect to the function of the state variable k_t in the current period. Based on the above proposition, determine the important properties of the strategy function through the optimization problem of the equation. The properties of the strategy function and the optimal capital stock path correspond to the established strategy function $g(\ )$, and the time path of the optimal capital stock is the solution of the difference equation $k_{t+1} = g(k_t)$.

Through the aforementioned discussion, we can easily consider the resource constraints of c by solely utilizing the capital stock. By using the first-order conditions of the maximization problem, we know the optimal capital sequence $\{k_t^*\}$, which monotonically generates the steady-state capital stock of the economy, and use the constraint conditions to infer the optimal consumption path. We are now using potentially more convincing methods to analyze the dynamic characteristics of the optimal growth model.

Based on the above equation, we know that there exists a unique solution $\overline{k}$ to the equation. Facing the given $\overline{k}$, the steady-state consumption $\overline{c}$ can be determined through the equation. We hope to determine a corresponding solution to the optimization problem from all solutions of the equation. In order to select a special solution, we need to use two boundary conditions to determine the point corresponding to the optimal solution on the Phase plane through which the equations must pass. The

initial capital stock $k(t=0)=k_0$ is a fixed constant, and the economy will start from the vertical line of k on the Phase plane. On the other hand, since the free variable c does not have a natural initial value, it is necessary to determine its time path through other methods to prove that the optimal consumption and investment plan is one of the approaches to the saddle point. This conclusion can be intuitively demonstrated by verifying the phase diagram of the equation system on the basis of increasing consumption but not exceeding the feasible boundary of current production $(c \leq f(k))$. By verifying the equation system, it can be concluded that all paths except for the trajectory towards the saddle point ultimately either tend towards the k-axis or towards current consumption, depleting all production without leaving any output at the feasible boundary for the next period. Both of the above situations mean that consumption will continue to be 0 after trending towards 0. Obviously, the path with consumption of 0 cannot be optimal, and only the path towards the saddle point is feasible. A more formal way to determine the optimal path is to use the so-called cross-sectional condition.

4. Policy Recommendations

There is still room for further improvement in the theoretical model of job search. In the context of various forms of employment and the coexistence of employment difficulties for various groups, this theory provides a powerful tool for the formulation and effectiveness evaluation of labor market policies, and provides valuable insights for improving the operational mechanism of China's labor market. We can consider the following aspects:

4.1 Play a Role in Optimizing the Allocation of Market Economy

We will continue to adhere to the market-oriented reform process of ensuring the free flow of workers and equal employment, establish a unified big data labor market for urban and rural areas, establish a mechanism for comparing employment information, eliminate restrictive employment regulations, establish a mechanism for matching abilities with positions, promote fair and legal competition in employment positions, continuously enrich employment opportunities and positions, and broaden the range of choices for workers. Ensure the free flow of labor between urban and rural areas, and then solve the structural contradiction of labor supply and demand imbalance.

4.2 Establish a Nationwide Big Data Employment Market and Security System for College Students

Directly establish internal communication systems with the Ministry of Education, local education regulatory departments, market management departments, and labor security departments, connect with other employment departments and institutions through the big data port of the education department, establish one-to-one corresponding mechanisms, accelerate the establishment of regional and national employment service contact mechanisms, and control and guarantee the total amount of employment and unemployment; Public employment service institutions can be established to strengthen the construction and management of labor market intermediary organizations.

4.3 Employment of New Rural Surplus Labor Force

At present, with the acceleration of agricultural industrialization and the improvement of basic knowledge level, there is bound to be a problem of surplus rural labor force. For this part of the new surplus rural labor force that already has a certain amount of agricultural knowledge reserves and urban living ability, there are two ways to guide this. One is to transfer labor methods on site, and through the increase of agricultural industrialization, the internal production structure of agriculture can be extended to extend the agricultural industry chain, Provide more labor positions to solve the problem of some surplus rural labor; The second is to guide the entry into the city, strengthen the training and learning of labor skills during the process of entering the city, accelerate the formation of integration of agricultural industry services, further promote the production and operation mode of urban service companies, thereby opening up new economic growth points and promoting rural economic development.

4.4 Refine the Multi-Level Unemployment Insurance System

Each region can refine the minimum living security system for urban and rural areas based on local conditions. Firstly, refine the minimum living guarantee system for urban residents; The second is to improve the rural social security system and actively explore the establishment of a rural minimum living security system. In short, we need to expand social coverage and socialization, thereby promoting social stability and achieving full employment.

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