The Multi-Player Evolutionary Game Analysis for the Development of Vocational Education

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Abstract. The local government of China serves as a supervisor of vocational education. The vocational education governance is actually a dynamic game process involving local governments, vocational schools and enterprises. This study attempts to construct a multi-player evolutionary game and show the results that the external benefits of developing vocational education positively influence the probability of local governments choosing cooperative strategies. The choice of local government has a key impact on the strategic choice of vocational schools and enterprises. The vocational education policy would not only affect the calculation of benefit-cost, but also the strategic choice of local governments, vocational schools and enterprises. The research results can help local governments to formulate policies for vocational education development.

Keywords: Local government, Game theory, Vocational education.

1 Introduction

China has built the largest vocational education system in the world. Graduates of vocational education have also become a new force to serve local economic construction and support the development of enterprises.

Since the mid-1980s, most OECD countries have introduced educational reforms that promote decentralization and school autonomy policies in order to improve the quality of education and administrative efficiency [1]. While the political motivations and extent of devolution vary from country to country, devolution in education governance in general refers to the transfer of decision-making power from central government to local government, communities and schools [2]. The decentralization of the central government power in China is driven by the reform of the economic system [3]. It can bring development dividends by mobilizing local power and resources to address education issues locally in a country as large and diverse as China [4]. Financial constraints of central government are also seen as the main motivation for the devolution of education [5]. With the decentralization of power, the relationship between power and responsibility of the central and local governments has changed [6]. The central government retains the power to guide and supervise major educational policies, principles and overall plans, while strengthening the responsibility and differentiated management of local governments. Especially after the decentralization reform
of the fiscal system in the mid-1990s, economic control and administrative ability of the central government’s declined greatly, which resulted in the serious weakening of the national capacity in leading the development of vocational education. Local governments have policy and funding responsibility for vocational education [7].

With the increasing complexity and instability of the educational environment, the role of central government is indeed changing, and its task tend to direct a complex system of many different stakeholders with different interests, so that the government is no longer directly controlling the homogenous stakeholders. The system of government has also been changed, with the focus shifting from direct regulation to indirect incentives and governance with different monitoring and reporting practices [8]. Money can be regarded as one of the most important incentives. In terms of funding, two main trends can be observed. First, funding sources are becoming more diverse [9], with tuition fees and third-party revenue becoming more important; Second, the way of allocating state funds among various stakeholders has also changed, including that part of the funds allocated to students or enterprises in the form of state-subsidized loans or preferential tax regulations, state funds are allocated in the form of block grants, each stakeholder has the right to freely use resources, and the importance of performance-based contracts has also increased [10].

But this view overestimates the role of markets and society [11]. The fact is that government operations increasingly rely on non-governmental partners [12]. This does not imply any necessary decline in the power of government, but rather that the formal, rational bureaucratic model is no longer appropriate, and that it is actually more appropriate for government to involve a wide range of actors in its work. Such participation may be aimed at improving the efficiency and effectiveness of government. As for who are the broad participants, scholars accept the stakeholder theory. The most widely accepted definition of stakeholder comes from Freeman [13], who believes that people or groups that affect or are affected by organizational goals are all stakeholders. There are at least two types of stakeholders. The first category is internal stakeholders, including at least teachers and students of vocational education schools. The second category includes external stakeholders consisting of corporate employers, industry organizations, the media and other social actors. External stakeholders will often fund the school and have a high level of interest in how the school functions [14]. The different characteristics of stakeholders will produce certain demands, which will affect the behavior of vocational education system. Therefore, it is very important to deal with the relationship between vocational education system, government, schools, enterprises and society. Different stakeholders have different influences on vocational education schools and even vocational education. Therefore, attention should be paid to the benign cooperative interaction between different stakeholders [15], as well as cooperation and conflicts in different fields [16].

As the natural stakeholder of vocational education, vocational schools also take the main responsibility. Vocational schools represent a vocationalization of academic learning [17], and play an important role in the external governance of vocational education. It is almost impossible for other stakeholders to conduct activities independently without vocational schools [18]. China’s vocational schools have the right of autonomy, which is influenced by the process of gradually transferring the organizing right of vocational education to the education department which belongs to various departments the 1990s. The regulation of vocational education by the education section has positive significance for the unified exercise of the right of education management, but it also cuts off the connection between industrial departments and vocational schools. Vocational schools become purely educational institutions, unable to obtain corresponding resources from industrial departments, and it is difficult to achieve cross-border [19].
The typical stakeholder of the market is the enterprise. Under the planned economy, vocational education was established by a large number of industrial ministries and organized by state-owned enterprises [6]. With the transformation of the market economic system, the industrial ministries and commissions have gradually withdrawn from the field of vocational education, and enterprises’ participation in vocational education has gradually become a part of enterprises’ social responsibility. Businesses are not only concerned about the sustainability of their economic benefits, but also seek opportunities to play a role in regional and social development [20]. Changing skill requirements in the labor market have led vocational education stakeholders to search for new skill formation strategies [17]. The resources and capabilities of business will play a vital role in supporting the improvement of education in general and vocational education in particular [21], for their active participation can effectively synchronize the spheres of work and education [22].

2 The Evolutionary Game Model

According to the above discussion, the most important stakeholders of vocational education include local governments, enterprises, vocational schools. To some extent, the government, vocational schools and enterprises are limited rational due to their cognitive ability and preference for vocational education. Therefore, evolutionary game theory is more suitable for discussing the game among the three stakeholders. Evolutionary game theory discusses the interaction between stakeholders and the relationship between individuals and groups [23]. The stakeholders optimize their own strategies by constantly observing and learning the strategies of other stakeholders. After repeated games, the three stakeholders gradually determine the optimal strategy.

2.1 Assumptions of the Game Models

To conduct a quantitative analysis of the influence of decisions made by local governments, vocational schools and enterprises on the governance of vocational education, the following hypotheses are advanced according to the needs of the model.

Assumption 1. The main responsibility of developing vocational education lies in the local government, whose strategy is \{active regulation, passive regulation\}. The active regulation strategy refers to the behavior of local governments to increase investment, increase investment, take incentives and control measures to guide the behavior of vocational schools and enterprises, and the cost is $S_1$. Passive regulation strategy refers to that the local government only responds to the requirements of the higher authorities, which costs $S_2$. The strategy of vocational schools is \{active investment, passive investment\}. The strategy of active investment refers to that vocational schools actively respond to the changes and demands of the labor market, and jointly build schools, training bases, production, education and research centers, etc. with enterprises, which costs $I_1$. The passive investment strategy refers to that vocational schools only invest according to the requirements of their superiors with the cost $I_2$. The strategy of the enterprise is \{active participation, passive participation\}. The strategy of active participation refers to the investment of enterprises in running schools, including the joint construction of practice and training bases, the admission of teachers to practice in enterprises, and the investment in production, teaching and research. The enterprises need to pay a high cost $C_1$ when an enterprise implements an active participation strategy. The enterprise may choose passive participation strategy to pursue short-term benefits, which costs $C_2$. 
Table 1. Payoff matrix of local government, vocational school, and enterprise

<table>
<thead>
<tr>
<th>Active participation by enterprise (z)</th>
<th>Active investment by vocational school (y)</th>
<th>Passive participation by enterprise (1-z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active regulation by local government (x)</td>
<td>( \alpha ) = ( yz(\lambda P + M - S_1 - B_u - B_e) + y(1-z)(M - S_1 - B_u) + (1-y)z(M - S_1 - B_e) + (1-y)(1-z)(-S_1) )</td>
<td></td>
</tr>
<tr>
<td>Passive regulation by local government (1-x)</td>
<td>( \alpha ) = ( yz(\lambda P + M) + y(M - B_u) + z(M - B_e) - S_1 )</td>
<td></td>
</tr>
<tr>
<td>Active investment by vocational school (y)</td>
<td>( M - S_1 + B_u )</td>
<td></td>
</tr>
<tr>
<td>Passive investment by vocational school (1-y)</td>
<td>( O - I_1 + B_u )</td>
<td></td>
</tr>
<tr>
<td>Active participation by enterprise (z)</td>
<td>( R - C_1 + B_e )</td>
<td></td>
</tr>
<tr>
<td>Passive regulation by local government (1-x)</td>
<td>( -S_2 )</td>
<td></td>
</tr>
<tr>
<td>Active investment by vocational school (y)</td>
<td>( -I_2 )</td>
<td></td>
</tr>
<tr>
<td>Passive investment by vocational school (1-y)</td>
<td>( -C_2 )</td>
<td></td>
</tr>
</tbody>
</table>

**Assumption 2.** Local government, vocational schools and enterprises will obtain the external income \( P \) only when the three players choose active strategies. \( \lambda P, \mu P, \xi P \) is the external income obtained by the local government, vocational schools and enterprises respectively, and \( \lambda + \mu + \xi = 1 \).

**Assumption 3.** Local government, vocational schools and enterprises will obtain economic benefits \( M, O \) and \( R \) when at least two of the three players choose active strategies. In addition, the vocational school will obtain additional income \( B_u \), including special subsidies, awards, and performance evaluation in the government departments, if the local government takes active regulation strategy and the vocational school actively invests. In the same way, when the local government takes active regulation strategy and the enterprise actively participates, the enterprise will obtain additional benefits \( B_e \), which includes special subsidies, awards, and political goodwill in the government departments.

Based on the above assumptions, there are eight game types among the three stakeholders. This study defines the main parameters that affect the selection of strategies by the three stakeholders and the payment matrix of evolutionary game (as described in table 1).

### 2.2 Expected Benefits of Game Stakeholders

Local government, vocational school and enterprise are not completely rational, who will adjust strategies through multiple games, learning and trial and error [24], so as to achieve Nash equilibrium.

1. **Strategy stability analysis of local governments**

   The expected returns of local government when choosing positive and negative regulation strategies are:

   \[
   \alpha_1 = yz(\lambda P + M - S_1 - B_u - B_e) + y(1-z)(M - S_1 - B_u) + (1-y)z(M - S_1 - B_e) + (1-y)(1-z)(-S_1) \\
   = yz(\lambda P + M) + y(M - B_u) + z(M - B_e) - S_1 \\
   \alpha_2 = yz(M - S_2) + y(1-z)(-S_2) + (1-y)z(-S_2) + (1-y)(1-z)(-S_2) = yz M - S_2
   \]

   The average benefit of local government is:

   \[
   \hat{\alpha} = x\alpha_1 + (1-x)\alpha_2 \\
   = xyz(\lambda P - M) + x(y(M - B_u) + z(M - B_e) - xS_1 + (1-x)(yz M - S_2)). \tag{1}
   \]

   Then the replication dynamic equation of local government in the tripartite evolutionary game is:
\[
F(x) = \frac{dx}{dt} = x(\alpha_1 - \alpha) = x(1 - x)(yz\lambda P - yz2M + yM - yB_u + zM - zB_e - S_1 + S_2).
\]

(2) Strategy stability analysis of vocational school
The average benefit of vocational school:
\[
\hat{\beta} = y\beta_1 + (1 - y)\beta_2 = xyz(\mu P - O) + xy(O + B_u) + yzO - yI_1 + (1 - y)(xzO - I_2).
\]

Then the replication dynamic equation of local government in the tripartite evolutionary game is:
\[
F(y) = \frac{dy}{dt} = y(\beta_1 - \hat{\beta}) = y(1 - y)(xz\mu P - xz2O + xO + xB_u + zO - I_1 + I_2).
\]

(3) Strategy stability analysis of enterprise
The average benefit of enterprise:
\[
\hat{\gamma} = z\gamma_1 + (1 - z)\gamma_2 = xyz(\xi P - R) + xz(R + B_e) + yzR - zC_1 + (1 - z)(xyR - C_2).
\]

Then the replication dynamic equation of local government in the tripartite evolutionary game is:
\[
F(z) = \frac{dz}{dt} = z(\gamma_1 - \hat{\gamma}) = z(1 - z)(xz\xi P - xz2R + xR + xB_e + yR - C_1 + C_2).
\]

(4) Evolutionarily Stable Strategy analysis among stakeholders
To determine the equilibrium solution to the trilateral game, the simultaneous replicator dynamics equations are created as Eq. 7.

\[
\begin{align*}
F(x) &= \frac{dx}{dt} = x(1 - x)(yz\lambda P - yz2M + yM - yB_u + zM - zB_e - S_1 + S_2) \\
F(y) &= \frac{dy}{dt} = y(1 - y)(xz\mu P - xz2O + xO + xB_u + zO - I_1 + I_2) \\
F(z) &= \frac{dz}{dt} = z(1 - z)(xz\xi P - xz2R + xR + xB_e + yR - C_1 + C_2)
\end{align*}
\]

If \(F(x)=0, F(y)=0, F(z)=0\), the dynamic equilibrium point of the evolutionary game system are \(D_{s1}(0, 0, 0)\), \(D_{s2}(0, 0, 1)\), \(D_{s3}(0, 1, 0)\), \(D_{s4}(0, 1, 1)\), \(D_{s5}(1, 0, 0)\), \(D_{s6}(1, 0, 1)\), \(D_{s7}(1, 1, 0)\), \(D_{s8}(1, 1, 1)\).

Stability analysis of equilibrium point is shown in table 2.
Table 2. Stability analysis of equilibrium point

<table>
<thead>
<tr>
<th>Equilibrium solution</th>
<th>Eigenvalue</th>
<th>Positivity / Negativity</th>
<th>Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_{s1}(0, 0, 0)$</td>
<td>$- (S_1 - S_2)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (I_1 - I_2)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (C_1 - C_2)$</td>
<td>$\cdot, \cdot, \cdot$</td>
<td>Stable (ESS)</td>
<td></td>
</tr>
<tr>
<td>$D_{s2}(0, 0, 1)$</td>
<td>$- (S_1 - S_2 - M + B_e)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (I_1 - I_2 - O)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_1 - C_2$</td>
<td>$U, U, +$</td>
<td>Unstable</td>
<td></td>
</tr>
<tr>
<td>$D_{s3}(0, 1, 0)$</td>
<td>$- (S_1 - S_2 - M + B_u)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_1 - I_2$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (C_1 - C_2 - R)$</td>
<td>$U, +, U$</td>
<td>Unstable</td>
<td></td>
</tr>
<tr>
<td>$D_{s4}(0, 1, 1)$</td>
<td>$- (S_1 - S_2 - \lambda P + B_e + B_u)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_1 - I_2 - O$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_1 - C_2 - R$</td>
<td>$U, U, U$</td>
<td>ESS Or Unstable</td>
<td></td>
</tr>
<tr>
<td>$D_{s5}(1, 0, 0)$</td>
<td>$S_1 - S_2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (I_1 - I_2 - O - B_u)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (C_1 - C_2 - R - B_e)$</td>
<td>$+, U, U$</td>
<td>Unstable</td>
<td></td>
</tr>
<tr>
<td>$D_{s6}(1, 0, 1)$</td>
<td>$S_1 - S_2 - M + B_e$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (I_1 - I_2 - \mu P - B_u)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_1 - C_2 - R - B_e$</td>
<td>$U, U, U$</td>
<td>ESS Or Unstable</td>
<td></td>
</tr>
<tr>
<td>$D_{s7}(1, 1, 0)$</td>
<td>$S_1 - S_2 - M + B_u$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (I_1 - I_2 - O - B_u)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$- (C_1 - C_2 - \xi P - B_e)$</td>
<td>$U, U, U$</td>
<td>ESS Or Unstable</td>
<td></td>
</tr>
<tr>
<td>$D_{s8}(1, 1, 1)$</td>
<td>$S_1 - S_2 - \lambda P + B_e + B_u$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_1 - I_2 - \mu P - B_u$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_1 - C_2 - \xi P - B_e$</td>
<td>$U, U, U$</td>
<td>ESS Or Unstable</td>
<td></td>
</tr>
</tbody>
</table>

U means Unknown.

3 Numerical Simulation of the Evolutionary Game Model

According to the critical condition and with reference to Ran (2016), set the eigenvalue as: $P = 8, \lambda = 0.375, \mu = 0.375, \xi = 0.25, M = 3, O = 3, R = 5, S_1 = 6, S_2 = 5, I_1 = 4, I_2 = 2, C_1 = 7, C_2 = 3, B_u = 2, B_e = 2$. Therefore, the dynamic equilibrium points of the evolutionary game system are $D_{s1}(0, 0, 0), D_{s4}(0, 1, 1)$. This study conducts computer simulation by adjusting the initial probability of local governments, vocational schools and enterprises to choose positive strategies (figure 1).

Under this parameter setting, no matter what the probability of active strategy selection is at the initial stage, the final strategy selection of local governments is passive regulation. However, the probability of vocational schools and enterprises choosing active cooperation strategies is about 55%.

In order to accurately judge the influence of local government’s initial decision-making on vocational schools and enterprises, the selection probability of local government’s initial active regulation strategy is set to 0.2, 0.5, 0.8. Correspondingly, the probability of vocational schools and enterprises choosing active strategies at the initial stage is combined between [0.2, 0.5, 0.8] to obtain dynamic simulation figure.

When $x = 0.2$, the local government will not choose active regulation, and the final strategies will achieve {passive regulation, passive investment, passive participation}, unless $y = 0.8, z = 0.8$. The strategies will achieve {passive regulation, active investment, active participation}. 
When $x = 0.5$, $y = 0.2$, $z = 0.8$, the final strategies {passive regulation, passive investment, passive participation} are reached, while when $x = 0.5$, $y = 0.8$, $z = 0.2$, the final strategies are {passive regulation, active investment, active participation}, which proves that compared with enterprises, vocational schools play a key role in the active cooperation between schools and enterprises.

There are two parts of the benefits of local government. One is economic benefits $M$ when at least two of the three stakeholders choose active strategies, including the increase in the wealth of workers and regions, consumption growth, industrial development and tax increase, as well as the reduction of financial pressure caused by the improvement of voca-
tional education investment structure, etc. The other is external income $\lambda P$ only when the three stakeholders choose active strategies, including the benefits of further gathering local resources outside the local region due to the good development of vocational education, the gathering of skilled talents, and the smooth industrial upgrading and transformation.

Therefore, the setting of $M$ is adjusted from 3 to 10, the distribution proportion of local governments in external income $\lambda = 0.625, \mu = 0.25, \xi = 0.125$. So the dynamic equilibrium points of the evolutionary game system are $D_{11}(0, 0, 0), D_{17}(1, 1, 0)$. Regardless of the initial probability of the three stakeholders choosing the positive strategy, local governments and vocational schools have a 97% probability of choosing the positive strategy, while enterprises will choose the passive participation strategy (figure 3). As shown in figure 4, the selection probability of the active participation strategy in the initial stage of the enterprise is set to 0.2, 0.5, 0.8. Correspondingly, the probability of the local government and vocational schools to select the active strategy at the initial stage is a combination of [0.2, 0.5, 0.8]. The result shows that no matter the enterprise’s willingness to actively participate in the initial stage is high or low, the enterprise will not actively participate in the end, and the game will thus move towards the equilibrium state of \{active regulation, active investment, passive participation\}.

Figure 3. Tripartite evolution phase space diagram

The benefits of the enterprise consist of three parts. First, the economic benefits $R$ obtained by the enterprise when at least two stakeholders in the game choose to adopt an active strategy, including the benefits from long-term human resource reserves, upgrading the technological innovation industry, and policy replenishment. Second, the external benefits obtained by the enterprise $\xi P$ only when all three stakeholders choose active strategies, including potential commercial benefits and goodwill brought by more dynamic economy. Third, when the government takes active regulation and the enterprise actively participates, the enterprise will obtain additional benefits $B_e$, including special subsidies, incentives and political goodwill.

To analyze the sensitivity of the vocational school adopting active strategies, the paper adjusted the setting of $R$ from 5 to 10, $B_e$ from 2 to 3 while $B_u$ from 2 to 1. The cost of active investment of vocational schools $I_1$ increases from 4 to 6 according to the benefits of
the enterprise depending on the cooperation of vocational school. The dynamic equilibrium points of the evolutionary game system are $D_{s1}(0, 0, 0), D_{s6}(1, 0, 1)$.

According to the computer simulation, the probability of local government and enterprises choosing active strategy is 97%, while the final strategy of vocational schools is negative investment (figure 5). Regardless of whether the vocational school’s willingness to actively invest in the initial stage is high or low, the vocational school will not actively invest in the end, and the equilibrium state will move towards to active regulation, negative investment, active participation. This result (figure 6) is very similar to that in figure 4, except that the vocational school and enterprise switch strategy choices.

The benefits of vocational school are also composed of three parts. First, when at least two stakeholders choose an active strategy, the benefits ($O$) of vocational school include training cost saving, benefits from converting technological achievements, policy supplement, etc. Second, the external benefits of vocational schools $\mu P$ only when all three stakeholders choose the active strategies, includes more educational resources invested by external players due to the good development of regional vocational education, as well as the benefits of school reputation and potential students. Third, when the government takes active regulation and the vocational school actively participates, the vocational school will get additional benefits $B_u$, including special subsidies, awards, performance evaluation of government departments, etc. Through the simulation above, it has been found that $B_u$ and $\mu P$ have an important influence on the strategy selection of vocational school, so adjust $B_u$ from 1 to 3, $P$ from 8 to 15, and $\lambda$ from 0.625 to 0.6, $\mu$ from 0.25 to 0.27, $\xi$ from 0.125 to 0.13. The dynamic equilibrium points of the evolutionary game system are $D_{s1}(0, 0, 0), D_{s6}(1, 1, 1)$. The computer simulation results are shown in figure 7 and figure 8.
Figure 5. Tripartite evolution phase space diagram

Figure 6. Dynamic simulation diagram $y = 0.2, 0.5, 0.8$
Figure 7. Tripartite evolution phase space diagram

Figure 8. Dynamic simulation diagram $x = 0.2, 0.5, 0.8$
4 Discussion and Conclusion

Evolutionary game analysis found that $D_{s2}(0, 0, 1)$, $D_{s3}(0, 1, 0)$ and $D_{s5}(1, 0, 0)$ would not be ESS stable points under any benefit-cost parameter setting, meaning that the possibility of only one stakeholder actively cooperating and the other two stakeholders negatively participating would not exist. Thus, only three possibilities need to be explored: all three respond negatively; Or active cooperation between two stakeholders; Or all three stakeholders actively cooperate. Obviously, the negative response of all three stakeholders is not good for the local government or society, so this study discusses how to achieve a positive cooperation strategy of two or three stakeholders.

Based on the first parameter setting, the local government eventually moves towards passive regulation. On one hand, the strategic choice of vocational school and enterprise exerts little influence on local government; on the other hand, the benefit and cost structure largely determine the action of local government. In order to enable local government to take active regulation, it needs to have higher returns, which also means that the greater the potential economic problem of the region, which can be solved by the development of vocational education, the greater the external benefits local government will get from the active cooperation with vocational schools and enterprises, and the greater the possibility of local government to take active regulation. Local government’s view on the external benefits of active regulation and the benefit-cost structure plays a key role in the game.

Therefore, the second parameter simulation improves the benefit parameter of local government, and enterprises will eventually move towards the strategic choice of passive participation. It can be inferred that the behavior of enterprises is related to the distribution of external income $\xi$. To a certain extent, enterprises will evaluate the overall development results of vocational education. If the overall development situation is good, enterprise will be more willing to actively participate. If the expected external return ($P$) is great, while the distribution coefficient $\xi$ is small, enterprise still lack the motivation to participate actively. It should be noted that enterprise’s participation in vocational education is required to be included in corporate social responsibility reports in China, especially state-owned enterprises and industry leaders. This shows that enterprises have the obligation to assume the responsibility for the development of vocational education but lack institutional constraints. In addition, enterprises can also choose environmental protection, disaster relief donations, poverty alleviation, etc. to fulfill their social responsibilities, which has brought higher reputation to enterprises. Therefore, if the government with greater influence promises that the potential return of active cooperation among the three stakeholders is greater than the cost, and will bear corresponding responsibilities, it will help vocational education get rid of the plight of the isolated system.

The third parameter simulation improves the benefit of the enterprise. Vocational schools are financially dependent on the local government, especially public vocational schools, but the main reason for their pursuit of a high ranking is the increased legitimacy and goodwill of the local government conferred by a high ranking rather than the economic benefits, which means that vocational schools are sensitive to changes in $B_u$.

This study constructed an evolutionary game model of local government, vocational school and enterprise, and simulated to reveal the key factors and constraints affecting the active actions and expand the traditional research methods of vocational education. Although the results of evolutionary game analysis can be persuasive and can explain the current dilemma of vocational education, the neglect of social stakeholders also weakens the scientific nature of this study. Future research may try to introduce stakeholders such as industry organizations.
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