

Spatio-Temporal Impact of Rural Livelihood Capital on Labor Migration in Panxi, Southwestern Mountainous Region of China

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Abstract: Labor migration to urban centers is a common phenomenon in the Panxi region of the southwestern mountainous region of China, mainly owing to inadequate livelihood capital in rural areas. Numerous studies have been conducted to explore the relationship between labor migration and its causes, such as individual and family characteristics, but few studies have focused on livelihood capital. This paper examines the impact factors on labor migration employment location selection and duration from a household livelihood capital perspective. A case study of 279 households from 10 villages in the area was carried out in February 2016. We used both qualitative and quantitative methods to analyze the data. On the basis of the 279 questionnaires, the proportion of households with non-labor migration is 48.4%, whereas households with labor migration within a local city and migration across regions account for 28.7% and 22.9%, respectively. Social, financial, and human capitals are the primary factors that influence migrants' employment location choice positively. Among them, social capital has a significant impact on both migration within a local city and across regions; each of the regression coefficients is 1.111 and 1.183. Social, human, and financial capitals also have a positive impact on the duration of labor migration, and similarly, social capital is the highest coefficient with 2.489. However, physical capital only partly impacts labor migration across regions, whereas the impact of labor migration within a local city, and the duration, are not significant. Furthermore, the impact of household natural capital on migration space and time are all negative relationships, especially for labor migration across the regions and duration, with coefficient scores of 4.836 and 3.450, respectively. That is to say, a laborer is inclined to migrate within a local city for a short term, or not migrate at all, if natural capital is abundant. Our analysis results show that household livelihood capital has a strong spatio-temporal impact on labor migration.

Keywords: labor migration; livelihood capital; spatio-temporal impact; southwestern mountainous region; China

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1 Introduction

With the extent of reform and development that has occurred in China since the 1980s, the rate of urbanization has accelerated, particularly in the 21st century. Ac-

cording to China's National Bureau of Statistics, China's urban population proportion has reached 56% in 2015, with a total urban population of 7.71×10^8 (China National Statistical Bureau, 2016). During this urbanization process, there has been an influx of surplus rural

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labor, migrating from the middle and west of China to the east (Zhu, 2003). The southwestern mountainous region of China includes Tibet, Sichuan, Yunnan and Guizhou provinces. Compared to the midwestern China, these areas are characterized by complex terrain, remote geographical locations, and fragile ecological environments. For most households in these regions, agricultural production has been the primary livelihood; however, a large amount of the labor force has migrated to non-farm employment to achieve higher incomes. For example, Sichuan Province had a labor force of 2.49×10^7 people migrate in 2016, an increase of 1.26×10^5 people compared to 2015 (Sichuan Provincial Human Resources and Social Security Department, 2017). Labor migration has become a crucial issue and the solution requires coordinated development between urban and rural areas in China's western mountains.

Over the years, labor migration has been increasingly studied. Based on the analytical framework of the 'push-pull' theory, the crucial 'push' forces that affect the migration of a rural laborer are: modernization of agricultural production, rural per capita arable land, and output of non-agricultural industry; whereas the 'pull' forces are: higher income levels of urbanization (Kumar and Sidhu, 2005), high levels of economic development (Etzo, 2011), and urban modernization (Sridhar et al., 2013; Zhong, 2014). The gap between urban-rural income and the release of a surplus rural laborer are considered to be the dominant factors of rural labor migration (Zhao, 1999b; Zhang and Song, 2003; Zhong and He, 2004; Grau and Aide, 2007). Bounded rationality in economics is another perspective. Because of external environmental uncertainty, incomplete information available for laborers, and the cognitive limitations of different laborers, making the decision to migrate is often based on the restricted condition of individuals' bounded rationality (Li and Chen, 2007). According to the cost-benefit perspective, the process of migration selection is also a process of balancing costs and benefits (Sprengr et al., 2010).

Increasingly, scholars have begun to make efforts to study the labor migration at the micro level. It is generally believed that individual and familial characteristics are most closely related to the migrant laborers' employment location selection. Some scholars have researched the micro impact factors of labor migration, such as personal and household characteristics of a

workforce (Zhao, 1999a; Cheng and Pan, 2012; Xu et al., 2015b), quality and structure of the laborers, educational investment (Prayitno et al., 2013; Xu et al., 2015a), social trust and networks (Guang and Zheng, 2005; Gao et al., 2009; Gao and Lu, 2010), land and labor resource endowment (Tian et al., 2010; Xu, 2014), household farm machinery ownership (Zhou et al., 2010), and household registration systems (Boman, 2014).

Individual characteristics are the paramount driving forces that impact a migrant laborers' choice concerning whether to migrate (Lamonica and Zagaglia, 2013). Based on the probit model, Sridhar et al. (2013) showed that women prefer urban areas for employment opposed to rural areas. In contrast to Sridhar's study, Xu et al. (2015b) argued that there is a converging trend in female and male laborers' location decisions; however, the difference is not pronounced. There is an increasing recognition that for laborers with poor human resources, the fastest method of increasing income is to leave the local villages to engage in non-agricultural jobs (Knight et al., 2011; Jia et al., 2013; Prayitno et al., 2013). Some studies found that age and skill significantly affected the location choice of migrant laborers (Liu et al., 2011; Coffey et al., 2015). In particular, in Liu's study, they proved that, compared to employment in a local city, migrant laborers with skill advantages performed better in selecting a cross-regional profession. Moreover, some studies observed that highly educated rural laborers are more inclined to choose employment far from their hometown (Thissen et al., 2010; Fu and Gabriel, 2012).

Regarding household characteristics, the burden of the domestic household population is considered to be a crucial factor in promoting a laborer to seek a job out of the rural area (Sridhar et al., 2013). Moreover, Ullah (2004) found that a household with young children prevents family members from choosing non-farm jobs far from their home. Meanwhile, Liu et al. (2011) noted that each additional 0.067 ha of per capita of cultivated land increases a migrant laborer's probability of selecting employment inside the home province by 1.57%, and the mechanization of family agricultural production has a significant negative impact on choosing employment outside the province. Additionally, social networks play an important role in laborers' employment location selections. At the household level, studies show that social networks can prompt rural laborers to span long dis-

tances in their choice of employment locations (Zhang et al., 2008; Gao et al., 2009).

Limited studies explored the influence factors on the duration of non-farm employment. As explained by Foster and Rosenzweig (2007), research regarding short-term migration is limited by the nature of existing datasets. However, some scholars made an effort to explore the influence factors on the duration of labor migration. A study conducted by Ju et al. (2008) showed that a laborer in a highly populated household is inclined to undertake long-term migration for non-farm employment. Moreover, the total household cultivated land and household farm machinery ownership have a negative impact on the duration of non-farm employment. Deng (2015) observed that households with more extensive social resources are more inclined to have laborers migrating externally for long-term employment.

Based on existing literature, numerous studies have researched the influence factors on migrant laborers' employment location selections in terms of personal characteristics, household characteristics, or both. However, these two aspects have not been studied sufficiently. First, comprehensive studies on both employment location choice and employment duration of labor migration are relatively scarce. In particular, few studies observed the impact factors on labor migration employment from the household livelihood capital perspective. Second, there is a lack of empirical studies on the sensitivity of labor migration to livelihood capital.

After more than 30 years of mass out-migration of the labor force, the livelihood capital situation of households has changed evidently. On the one hand, rural households have improved their livelihood standards via the method of out-migration in mountainous areas. On the other hand, with the policy of western development strategy and the rise of central China, the orientation and intensity of rural labor migration has changed a lot. For instance, some migrants choose to work near their hometown to save travelling time and living costs. Rural livelihood has a relevant relationship with labor migration, and many studies have already explored the impact of labor migration on livelihood (Li et al., 2010). However, only few studies have paid attention to the influence of livelihood on labor migration. Two goals this study aims to achieve include: 1) To explore whether livelihood capital has any impact on labor migration from a spatio-temporal perspective. 2) To explore the

impact degree of different livelihood capitals.

2 Analytical Framework

Over the past few decades, many institutions, such as FAO (Food and Agriculture Organization), UNDP (United Nations Development Programme), and DFID (Department for International Development), have defined and developed the frameworks of sustainable livelihoods. Among them, DFID (1999) proposed the sustainable livelihoods analysis framework to analyze different impact factors that contribute to livelihood: vulnerability of livelihoods, livelihood capitals, livelihood strategies, and institutional processes and outcomes. Inspired by the livelihood capital analysis framework, many scholars examined the impact of livelihood capital on livelihood strategy, including the five capitals of human, social, financial, physical, and natural (Babulo et al., 2008; Ulrich et al., 2012; Fang et al., 2014).

The DFID's framework reveals an understanding of poverty and points to potential opportunities for eradicating it, revealing how people use their property, rights and possible strategies to pursue a better livelihood (Chakravarty, 1983; Ashley and Carney, 1999). Livelihood capitals represent the resource endowments of rural households, or more precisely, livelihood capitals include the capacity, assets (including physical and social resources) and activities that people need to make a living. Different portfolios of livelihood capitals can achieve different results, and regarding whether to migrate or not, those individuals with more capital usually possess more options and have the ability to ensure their livelihood security. Out-migration for non-farm employment has become the main route for people to convert their livelihood resources and create positive livelihood outcomes. Through exchanging the use rights of the household labor force, labor migration enhances the household's ability and opportunity to occupy other capital ownership. Migration can obviously alleviate poverty and improve the livelihood standard, while the final outcomes or influences of the change in livelihood capital reflect labor migration.

Actually, livelihood strategies have a broad definition, including the activities and choices that people make so as to achieve their livelihood goals (Carlson and Crowley, 2005). That is to say, livelihood strategies can also be understood as the non-farm employment

duration and location choices made by migrant laborers as their livelihood goals. Thus, in our study, we develop the analysis framework of sustainable livelihood by establishing a new correlation analysis framework of livelihood capital on labor migration (Fig. 1). From a spatio-temporal perspective, we define the impacts of livelihood capital on non-farm employment location and non-farm employment duration, respectively, as the impacts of livelihood capital on spatial and temporal characteristics of labor migration.

3 Materials and Methods

3.1 Study Area

Panxi Region stretches between 27°32'N–27°21'N and 101°08'E–102°25'E in the southwestern region of Sichuan Province (Fig. 2). The region encompasses the cities of Panzhihua, Xichang and parts of the Liangshan Yi Autonomous Prefecture and is situated at the confluence of the Jinsha, Anling, and Yalong rivers covering a total area of approximately $6.3 \times 10^6 \text{ km}^2$. This region is located in the Hengduan Mountain area, at an altitude of between 488–4409 m with a relatively large terrain relief. Panxi is a multi-ethnic region composed of people from 32 ethnic groups, where 18.8% of the residents belong to minority groups, mainly Yi, Hui, and Tibetan. The Panxi region is well-suited to this study, because there is considerable out-migration each year. The whole area is characterized by subsistence farming with low output, and thus numerous people out-migrate to urban centers for better livelihoods. As an example, according to our estimate, a labor force of 1.2×10^6 people migrated outside for employment in 2014. The Panxi region is a pivotal place for western urbanization in

terms of spatial layout of the mountains, and labor migration is the top priority of urbanization. Thus, we chose Panxi Region as our study area, and we propose some implications for the sustainable development of the Panxi region.

3.2 Data sources and selection

This study primarily used data from a survey that was conducted between 19–26, February, 2016 in the Panxi Region. The survey mainly obtained data from an investigation of local residents, and adopted the methods of structured interviews and semi-structured interviews. The selection of sample points was considered mainly by local elevation, distance from Panzhihua and Xichang, and level of out-migration. Finally, we extracted ten villages in total, and 279 valid questionnaires (1385 persons) were obtained (Table 1). A total of 478 laborers migrated elsewhere for employment, of which the proportion of male and female was 58.6 : 41.4. The education level of the laborers was mainly junior high school, accounting for 66.9%, followed by university level, accounting for 17.9%. Four nationalities, Han (61.9%), Yi (32.6%), Zang (3.1%), and Hui (2%) characterized these migrant laborers. The average wage of a migrant laborer was 3.45×10^3 yuan (RMB) (5.13×10^2 USD) per month.

The content of the research involved two aspects: household livelihood and employment condition of labor migration. The livelihood capital survey mainly included human, social, financial, physical, and natural capital; the survey of labor migration involved employment cognitive appraisal, work skills, the will to migrate, location of main employment and employment duration, access to employment information, main areas of employment, and problems while working, *etc.*

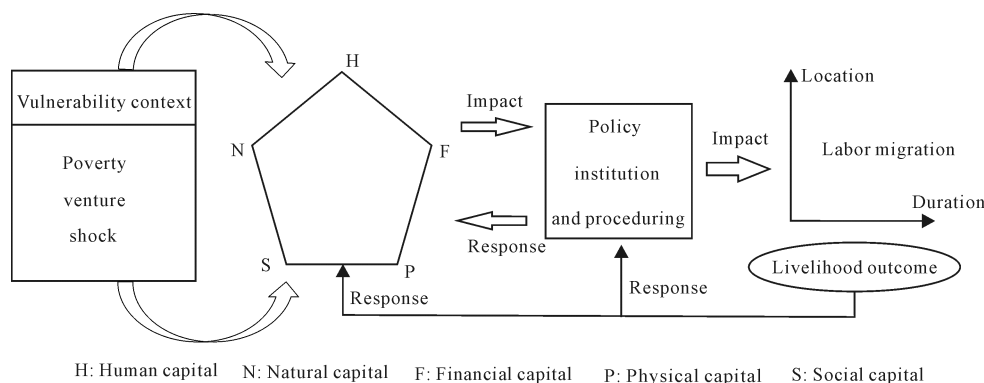


Fig. 1 An improved analysis framework of livelihood capital and labor migration

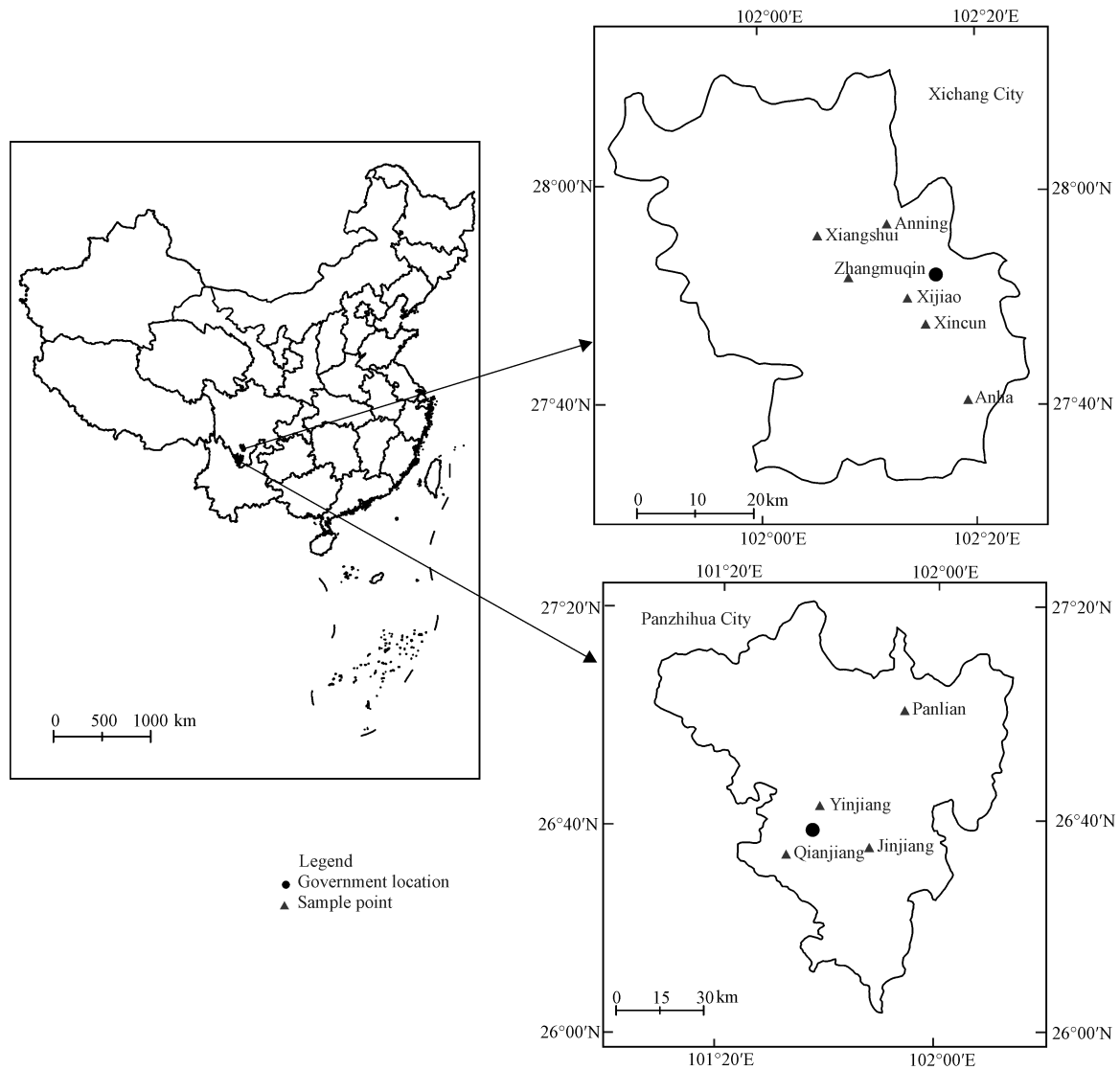


Fig. 2 Location of study area

Table 1 Characteristics of the study villages

Village	Altitude	Distance (km) ^{a)}	Migration	Households surveyed ^{b)}
Anning	1550	14	Medium outmigration	34
Xijiao	1400	5	Low outmigration	20
Anha	2300	26	High outmigration	51
Xiangshui	1850	24	High outmigration	10
Zhangmuqin	1800	16	High outmigration	11
Xincun	1500	7	Low outmigration	26
Jinjiang	1100	15	Medium outmigration	17
Qianjin	1200	10	Medium outmigration	18
Yinjiang	1350	8	High outmigration	21
Panlian	1100	55	High outmigration	61

Notes: a) We selected a straight-line distance from the village to the government office house. b) During our survey of the villages, we asked the village leaders to go with us so they could advise which households had or did not have migration labor. However, in that season, many people were doing their farm work or had already migrated outside for employment so some of the households were selected randomly

3.3 Index selection and measuring method

There were two separate dependent variables in our study: the migrant's non-farm employment location and duration each year. We measured the duration of labor migration from 0 to 365 days. The process of labor migration is actually a decision-making process about where to migrate and for how long to migrate (Liu et al., 2011), the spatio-temporal impact of this article more precisely refers to space and time choices. Most of the current literature has focused on decision-making (migration or non-migration) or migration to the inner or outside province (Guang and Zheng, 2005; Poncet, 2006; Li, 2010). However, as shown in Fig. 2, Panxi area is located at the edge of southwestern Sichuan Province, which is a mountainous region. During the survey, we found that the furthest distance most mountain dwelling people moved was Panzhihua or Xichang cities. In their eyes, Chengdu was too far to move to. If a laborer migrated to outside of Panxi region, he usually could not take care of his family because the cost of commuting was too high.

To further understand the spatial differences of migration, we divided the migration types as follows: non-labor migration (no laborer in the household migrated outside for non-farm employment); labor migration within a local city (laborers were engaged in non-farm employment within their home city); and labor migration across regions (laborers were engaged in non-farm employment outside of their home city). These three types accounted for 48.4%, 28.7% and 22.9%, respectively, in our study. The type of labor migrating within a local city was mainly concentrated in Panzhihua and Xichang, with a small amount near Panxi area, so we categorized it as a local city. The type of labor migrating across regions was mainly concentrated in Chengdu, Guangzhou, Shenzhen, Chongqing, Hangzhou, Zhongshan, Beijing, Foshan and Kunming. The occupation types of the migrated laborer included construction workers, service workers (such as cooks, security guards, and waiters), clerks in some enterprises, drivers, and a few were teachers and doctors. However, there were still a few laborers engaged in short-time hired jobs which were not so stable.

A basic and popular selection of indicators in the analysis of survey data was put forward by Sharp (2003), and by combining the DFID's framework and the research method of Fang et al. (2014), five capitals

were selected as the independent variables: human, natural, financial, physical, and social capital. According to DFID's framework, livelihood capitals are the basement resources when individuals or households make their livelihood choices (DFID, 1999). Among them, human capital usually refers to household labor capacity, skill and male adult labor; social capital usually represents the social resources or social networks the household possess; financial capital mainly means the cash that a household can acquire to govern; natural capital refers to the natural resources that household members can utilize for a living; physical capital usually contains the material equipment or infrastructure for farmers production or living. Based on the definition of capital, the questionnaire method, and the characteristics of the regional conditions, as well as the applicability of data, our study identified 15 crucial indicators to describe the properties of the five capitals (Table 2). Table 2 lists the crucial properties and proxy variables related to the case. Along with the indicators, we selected the ratio of labor force in a household instead of selecting the number of household laborers as typically used in traditional research. Choosing this indicator was considered as common sense, as the more surplus laborers a family unit has, the more possibility there is for laborers to migrate. In order to accurately reflect the effect of cultivated land on the release or constraint of a labor force, we used the per capita arable land as an indicator.

3.4 Calculation of weighted scores

This study used the entropy value method (EVM) to calculate the weights of each indicator. EVM is a weight measure method from thermodynamics, where, using EVM to analyze the weight of each indicator is mainly considered the concept and properties of entropy, but also contains the relative importance degree of each indicator (Song et al., 2017). Using the EVM to calculate the weight can eliminate the interference of human factors, so that the evaluation results are more scientific and reasonable. The steps were as follows: 1) We processed the outliers of each capital indicator value using Microsoft Office Excel 2010. 2) Using the principle of EVM, we first calculated the entropy value of each indicator. Then, we calculated their utility values by using the entropy of each indicator; if the utility value was greater, it indicated more importance on evaluation of this indicator to the variable. Finally, we obtained the

Table 2 Livelihood capital measurement index system

Capitals ^{a)}	Proxy indicators	Weights ^{b)}	Min.	Max.	Mean	STDV ^{c)}
Human capital (Z1)	Family size (Persons)	0.05				
	The ratio of labor account for the family (Percent)	0.32	0.008	0.952	0.560	±0.213
	Labor skill (Index)	0.63				
Social capital (Z2)	Consumption in human relationships ^{d)} (Yuan ^{e)})	0.25				
	Whether family members or relatives work for government (Index)	0.45	0.049	0.931	0.360	±0.173
	Employment channel (Index)	0.30				
	Per capita annual income (Yuan)	0.46				
Financial capital (Z3)	Family saving (Yuan)	0.28	0.013	0.945	0.353	±0.247
	Family loan (Yuan)	0.26				
	House type (Index)	0.12				
	Household appliance ownership (Index)	0.08				
Physical capital (Z4)	Household livestock ownership (Index)	0.56	0.025	0.962	0.377	±0.201
	Household vehicle ownership (Index)	0.24				
Natural capital (Z5)	Per capita arable land of labor (ha)	0.88	0.001	0.479	0.067	±0.085
	Homestead area (M ²)	0.12				

Notes: a) The livelihood capitals were calculated by Formula (3). b) The weights were calculated by Entropy Value Method. c) STDV: Standard deviation. d) It is a prevalent custom in China to attend your friends' or relatives' ceremonies with a gift of money. e) During our study period, 1 yuan \approx 0.1531 US dollars.

weight of each indicator. Using this process, we could determine the significance of each indicator that contributed to the individual capital. We write the equation as:

$$w_i = \frac{d_i}{\sum_{i=1}^n d_i} \quad (1)$$

where, w_i is the i th indicator, d_i is the utility value of each indicator.

3.5 Measuring method of livelihood capital

Through the comparison of the description indicators with each livelihood capital, the dimensions and orders of magnitude were found to differ for each indicator. Therefore, this research used the method of data range standardization to process the indicators into the same dimension. The processing equation is as follows:

$$L_i = \frac{X_i - X_{i\min}}{X_{i\max} - X_{i\min}} \quad (2)$$

where, L_i represents the normalized value for the i th indicator, X_i is the original value for X , $X_{i\max}$ is the maximum value of X , and $X_{i\min}$ is the minimum value of X . We write the formula of livelihood capital, Z_i , as:

$$Z_i = \sum_{i=1 \dots 5} L_{ij} W_{ij} \quad (3)$$

where Z_i is the value of i th livelihood capital, L_{ij} represents the j th standardized value of i th livelihood capital, and W_{ij} indicates the j th weight for the i th livelihood capital.

3.6 Adoption of the models

In this research, logistic regression and linear regression were used to explore the relationship between livelihood capital and the spatial-temporal types of labor migration, respectively. Livelihood capital was the independent variable, and we processed it as a continuous variable using its index. Regarding the two dependent variables in this study, the space variable was an unordered categorical variable, whereas the time variable was defined as a continuous variable. Using the modeling method of Fang et al. (2014), the study adopted a multinomial logistic regression model to analyze the spatial impact of livelihood capital on labor migration. Accordingly, we defined non-labor migration, labor migration within a local city, and labor migration across regions as 1, 2, and 3, respectively; non-labor migration was taken as the reference group. The logistic equations are as follows:

$$\ln(P_{y2} / P_{y1}) = \beta_{20} + \beta_{21}Z_1 + \dots + \beta_{2m}Z_m \quad (4)$$

$$\ln(P_{y3} / P_{y1}) = \beta_{30} + \beta_{31}Z_1 + \dots + \beta_{3m}Z_m \quad (5)$$

where, P_{y1} is the type of non-labor migration, P_{y2} refers to labor migration within a local city, and P_{y3} is the labor migration across regions. β_{20} to β_{2m} and β_{30} to β_{3m} are the estimated coefficients. Sensitivity analysis is a method of quantitatively describing the importance of the independent variable on the dependent variable. The greater the sensitivity coefficient is, the greater the effect of the independent variable on the dependent variable (McKay et al., 2000). Referring to the sensitivity analysis method proposed by Fang et al. (2014), we write the equation as:

$$\Omega' = \exp(\beta_j + \beta_0 + \sum_{i=1 \dots m} \beta_i Z_i) = \Omega \exp(\beta_j) \quad (6)$$

where we define $\exp(\beta_j)$ as the sensitivity of the labor migration space to livelihood capitals, and Ω is the probability ratio. This means that, compared to non-migration, the probability of labor migration within a local city, or non-local migration, increases $\exp(\beta_j)$ times if the livelihood capital Z_i increases by one unit. Considering the features of the time variable, the linear regression formula for the temporal impact of livelihood capital on labor migration is:

$$Y = a_0 + a_1 X_1 + a_2 X_2 + \dots + a_m X_k + \varepsilon \quad (7)$$

where, Y , as the independent variable, is the duration of labor migration; X_k ($k = 1, 2, 3, \dots, m$), as the dependent variable, refers to the livelihood capital; a_0 to a_m is the model parameter; and ε is the error term. The crucial point of interest is the possibility of a correlation between the independent variables, traditionally called multicollinearity. Through the variance inflation factor (VIF) method, we found that the centered VIF value was 3.174 ($VIF < 10$); thus, there was no multicollinearity problem. SPSS 19.0 was used to conduct the

statistical analyses in our study.

4 Results

4.1 Spatial impact of livelihood capital on labor migration

As shown in Table 3, the spatial impact of household social capital on labor migration was the most significant factor, and its coefficient value was the largest. Comparison of the regression coefficient ($1.111 < 1.183$) showed that household social capital had a more significant spatial impact on labor migration across regions than migration within a local city.

In accordance with the sensitivity analyses (Figs. 3 and 4), the probabilities of labor migration within a local city and migration across regions dramatically increased by 203.6% and 226.4%, respectively, if social capital increased by one unit. Regarding the size of the regression coefficient, there was a high possibility of migrant laborer employment far from home if they had stronger social capital.

Household natural capital was also an extremely important factor influencing the migrant employment location choice, but it was negative. The regression coefficient comparison result of $4.836 > 0.276$ indicated that laborers were prone to migrate across regions if they lacked natural capital. Furthermore, with respect to the sensitivity analysis, it should be noted that the probability of labor migration within a local city decreased by 24.1%, and labor migration across regions decreased by 88.3%, if nature capital increased by one unit.

Human capital only impacted labor migration within a local city. However, it had no significant impact on labor migration across regions. In accordance with sensitivity analyses, the possibility of labor migration

Table 3 Multinomial logistic regression estimates and test statistics of livelihood capital on labor migration space

Capital	Space type of labor migration ^{a)}			
	Migration within a local city		Migration across the regions	
	Regression Coefficient ^{c)}	OR ^{b)}	Regression Coefficient ^{c)}	OR ^{b)}
Human capital	0.316**	1.371	-0.112	0.894
Social capital	1.111**	3.036	1.183**	3.264
Financial capital	0.72*	2.054	0.817**	2.264
Physical capital	-0.209	0.811	0.873*	2.393
Natural capital	-0.276*	0.759	-4.836**	1.883
Constant	-1.237**	—	-1.427***	—

Notes: a) The reference category is non-migration. Number of observations = 279; Wald χ^2 (12) = 103.54; Pseudo R^2 = 0.1743. b) OR (odds ratio) = EXP(B). c) * Significant at $\alpha = 0.10$; ** Significant at $\alpha = 0.05$; *** Significant at $\alpha = 0.01$.

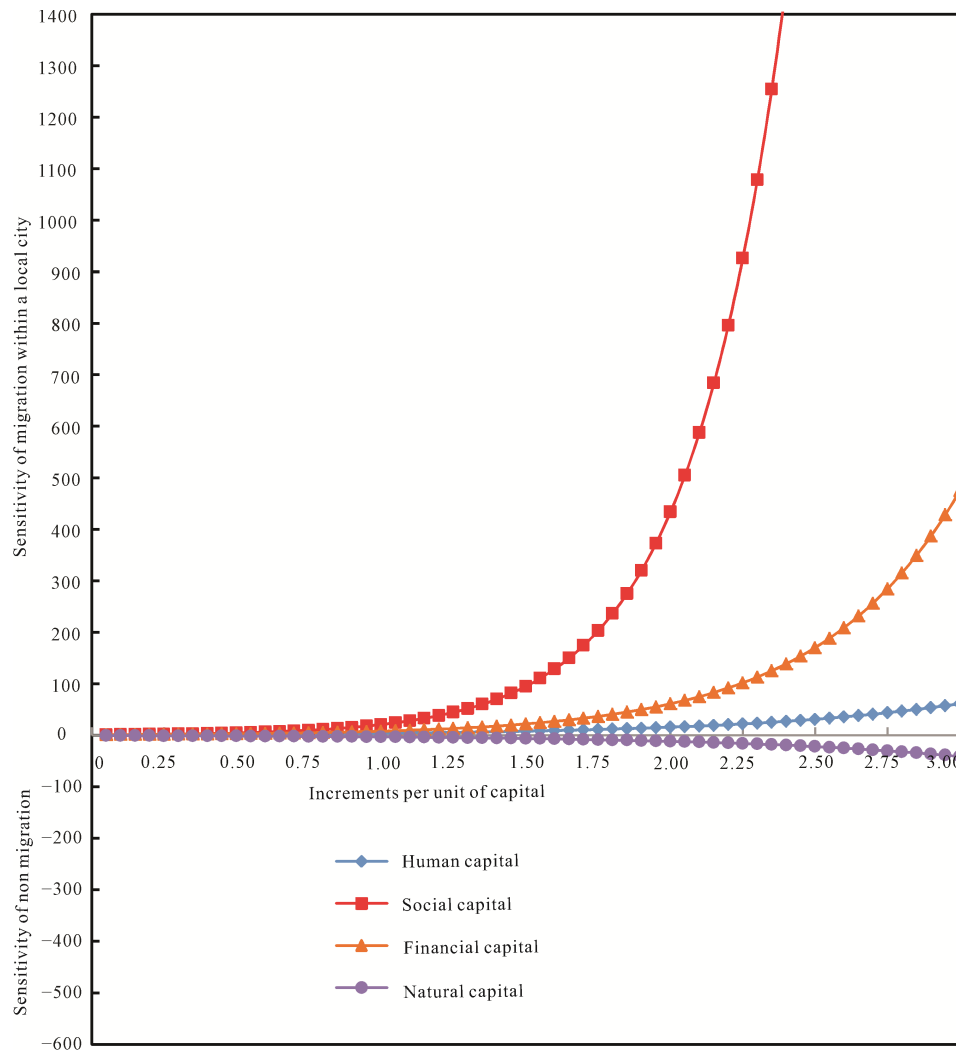


Fig. 3 Sensitivity of labor migration within a local city

within a local city increased by 37.1% if the household human capital increased by one unit.

Financial capital was another significant factor that affected the migrants' employment location choice. Comparison of the regression coefficients ($0.817 > 0.720$) showed that laborers tended to migrate across regions if financial capital increased. Moreover, sensitivity analysis showed that the probability of labor migration within a local city increased remarkably, by 105.4%, and the probability of labor migration across regions increased dramatically, by 126.4%, if financial capital increased by one unit.

Physical capital had no significant impact on labor migration within a local city, but affected labor migration across regions. From the sensitivity analysis perspective, the probability of labor migration across regions was increased by 139.3% if physical capital in-

creased by one unit.

4.2 Temporal impact of livelihood capital on labor migration

As shown in Table 4, from the level of significance, social capital was significant at the 1% confidence level, which was the highest; human capital and natural capital were significant at the 5% confidence level; and financial capital was significant at the 10% confidence level. Physical capital did not pass the test and the other four capitals were put into the linear regression model. That is to say, with the exception of physical capital, the livelihood capitals had a significant influence on the duration of labor migration. Social capital, financial capital and human capital were the positive influence factors. Among them, social capital appeared to be a strong impact on the non-farm employment duration, and the

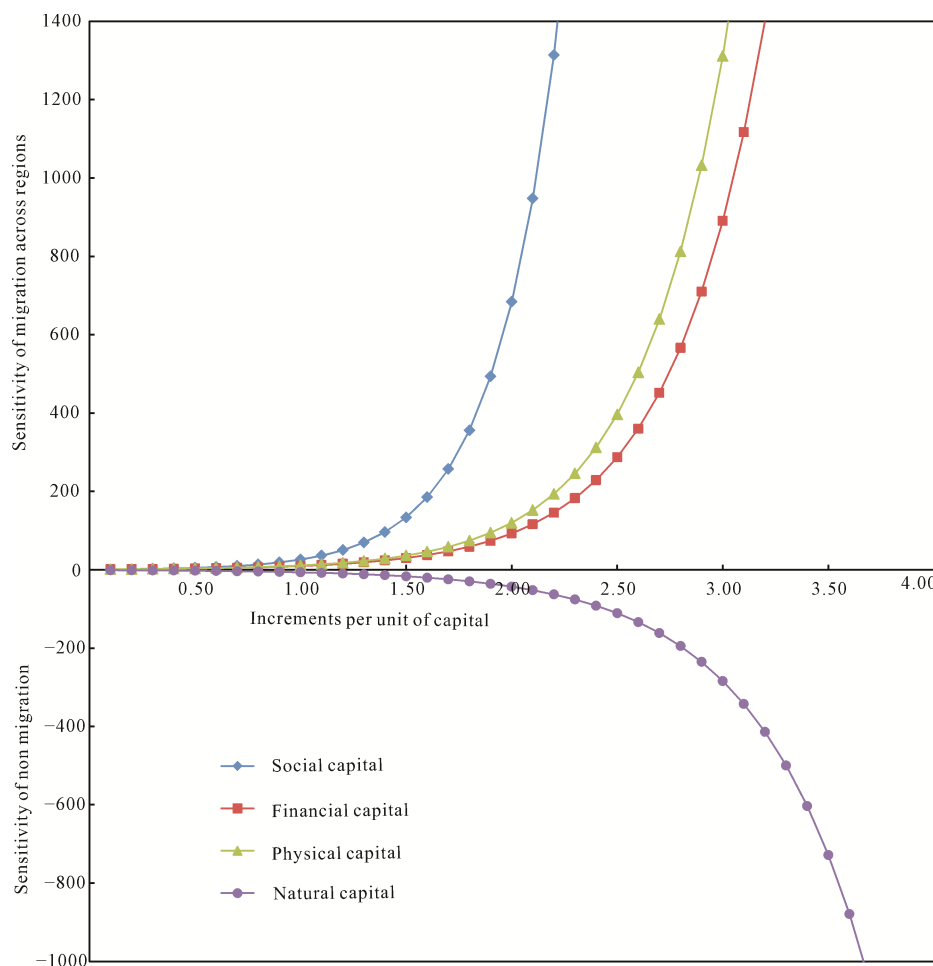


Fig. 4 Sensitivity of labor migration across regions

Table 4 Linear regression test statistics of livelihood capital on labor migration duration

Capital	Parameter estimation	Standard coefficient	T ^a
Human capital	1.309	0.101	2.634**
Social capital	2.489	1.150	4.731***
Financial capital	1.378	0.124	1.352*
Physical capital	0.277	0.010	0.265
Natural capital	-3.450	-2.054	-2.435**
Constant	10.807	—	12.302***

Notes: a) * Significant at $\alpha = 0.10$; ** Significant at $\alpha = 0.05$; *** Significant at $\alpha = 0.01$

regression coefficient was the highest, scoring 2.489. In other words, controlling the other variables or conditions, the non-farm employment duration of labor migration increased by 2.489 days, if social capital increased by one unit. Similarly, we could explain the regression coefficient of human and financial capitals in the same way. However, natural capital also had a strong influence on the duration of labor migration,

which scored 3.450, but was a negative influence. That is to say, controlling the other variables or conditions, if natural capital was added by one unit, the labor would probably decrease by 3.450 days for non-farm employment.

5 Discussion

5.1 Spatio-temporal impact of social capital on labor migration

As shown in Tables 3 and 4, social capital strongly influences labor migration both spatially and temporally. Similarly, there is a growing recognition that when laborers have more social resources, they are more inclined to select employment locations far from home (Gao et al., 2009; Liu et al., 2014; Xu et al., 2015b). According to the definition of our study, social capital mainly refers to household-owned social resources and social networks. In fact, the social networks or social

resources can provide some non-farm employment information and different kinds of support for the potential laborer who may want to migrate outside. Thus, social capital can decrease the risk and cost of out-migration, and can usually guide the migrating laborer to choose the employment location. Moreover, our result is consistent with those from the actual survey. As one respondent stated:

My husband and law father are builders. They have migrated to Guangdong (province located in the south of China) for two years. They got this job from a relative who is an engineering contractor. He has a big building project in Huizhou, Guangdong. This project will last for five or six years, and they will continue to work there for few years.

Furthermore, we find that, the job obtained using social networks will last longer and be more stable. This is consistent with a previous study (Deng, 2015) that concludes that social capital has a positive impact on long-term migration. This result also reflects a phenomenon that, in some remote mountainous rural areas of China, the level of electronic information is not high, and finding a job through the network is still an important channel.

5.2 Spatio-temporal impact of natural capital on labor migration

Natural capital also has strong influence on the labor migration, but is negative for time and space. This is inconsistent with previous research (Xu et al., 2015b); however, our result is similar to the research conducted by Liu et al. (2014) in that a laborer is less likely to migrate across regions if natural capital is abundant. A feasible reason for this difference may be because the research area of Liu et al. (2014) and that in this study have more abundant arable land than the research area of Xu et al. (2015b). This reflects natural capital, such as arable land, as the dominant factor on the employment location selection. Moreover, for natural capital, this fully explains why land is the chief resource of the people. During our investigation in Panxi, a village leader described the phenomenon as follows:

Some villagers will not choose the employment location too far from our village. That is because they have plentiful arable land to cultivate. Choosing an off-farm employment close to their homes enables them to help

with farming activities in the field during busy season.

Accordingly, if households have less arable land, the restraints on the labor force are less and the laborer will work outside for a longer duration. This is consistent with a previous study (Ju et al., 2008) that states that migrant laborers are less likely to migrate long-term if they have more arable land resources. We also find that, with the increase of natural capital, households are more inclined to engage in agricultural production, via land cultivation or animal husbandry as the main source of family livelihoods.

5.3 Spatio-temporal impact of human capital on labor migration

Human capital has always been one of the key factors in determining the choice of labor migration, both spatially and temporally. As an essential position of the western development strategy, Panxi area has had rapid development in recent years. Urban construction and economic and industrial development have increased by leaps and bounds, especially in the tourism industry. Consequently, the development of the economy has brought more jobs for the local rural surplus labor force. During our survey in Panxi, we found another interesting phenomenon: If a laborer has professional skills, it is easy to find a suitable job in a local city, and, consequently, laborers are less likely to migrate across regions for work. These results are in contrast to those of previous studies (Gao et al., 2009; Liu et al., 2014), which mostly concluded that there is a high possibility of labor migration across regions if human capital is abundant. This may be related to the phenomenon of labor backflow, which China has experienced in recent years. The positive and negative direction of the regression coefficient is also evidence of this point of view (Table 3). However, for human capital, laborers with professional skills can engage in stable work; accordingly migration duration is longer. This is inconsistent with the research conducted by Ju et al. (2008). They argue that laborers' skill has no significant impact on the non-farm employment duration. Furthermore, a laborer is more inclined to migrate long-term if the household has sufficient laborers. As one respondent stated: *For cultivating our arable land, two people are enough. So every year my husband and I will go outside to find some jobs. My parents will cultivate the arable land and take care of our children.*

5.4 Spatio-temporal impact of financial capital on labor migration

Higher financial capital usually represents a higher income or more governable funds for households. The higher the financial capital of the household, the more likely members of the household are to engage in secondary or tertiary industry. When the labor force realizes that the income of migrants outside is higher than non-migration, the labor force will be more inclined to migrate. In fact, the level of wages in large cities or eastern developed cities is higher than at the local city level. So the labor force will naturally choose travelling to the distant city to obtain a higher income. This result is in accordance with a previous study (Xu et al., 2015b): the higher the total income, the greater the possibility that laborers migrate far from their hometown. This can also be explained with increasing recognition that financial capital may be accumulated by the migrants over time from remittances (Fang et al., 2014; Liu et al., 2014). The results also indicate that a strong relationship exists between household financial capital and labor migration duration. On the one hand, a greater accumulation of money enhances the ability of labor migration; on the other hand, labor migration increases revenue and raises financial capital. There is a mutual promotion between labor migration and financial capital. As a result, the labor migration duration is also longer.

5.5 Spatio-temporal impact of other factors on labor migration

Because the object of this study is the livelihood capital variable which is the household unit, the model does not consider the influence factors of age, gender, family location and other factors on labor migration. But we did conduct a description statistical analysis of these variables. We conclude that among the 478 migrant laborers, the age of the laborer is mainly distributed between 16–60 years old, with the 20–50 age groups being relatively large. Males are more inclined to migrate than females, and each group is 280 and 198, respectively. The combination of the analysis of the livelihood capital and existing research (Gao et al., 2009; Liu et al., 2011) shows that men are more inclined to migrate cross regions and young laborers are more adventurous and tend to migrate long distances when selecting the employment position. We found that household location factors

have no strong link to the spatial and temporal effects of labor migration. Physical capital only has a partial effect on labor migration across regions, and for labor migration within a local city and the duration of labor migration, it has no influence. So we think that physical capital may have no effect on labor migration. Or maybe the results that we can not currently explain and need to be explored in future research.

6 Conclusions

Livelihood capital is a crucial factor that impacts labor migration, both temporally and spatially, in mountainous areas. By using household survey data and the improved analysis framework of sustainable livelihood, we employed multinomial logistic regression and linear regression models to explore the spatio-temporal impact of livelihood capital on labor migration. Our analysis results show that household livelihood capitals have a strongly spatio-temporal impact on labor migration. Social, human, and financial capitals have a positive impact on the employment location and duration of labor migration, while the impacts of household natural capital on migration location and duration are all negative. Physical capital only partly impacts labor migration across regions, whereas the impacts of labor migration within a local city, and the duration, are not significant. In addition to these conclusions, our study has further special applications. Our study contributes to the literature by enhancing the understanding of out-migration, from the livelihood capital perspective, in mountainous areas. Moreover, we also provide a comprehensive study method for the labor migration space and time. Therefore, when policy makers develop the local economy and maintain sustainable development of agriculture, they may consider improving the livelihood capital standard of native inhabitants.

However, this study has several limitations. First, the improved sustainable livelihoods framework in our research does not cover the vulnerability and institutional aspects of livelihoods. This may be an important shortcoming, and needs to be considered in future research. Second, because the variable in our study is the household unit, the research framework is the impact of household livelihood capital on labor migration. So there could be several other factors, such as the individual's age or gender that were not contained in the

model. The future study framework and model can be designed so as to be suitable for both individual factors and household livelihood capitals. Third, the location selection of labor migration was divided into three spatial types which may not be suitable for other mountainous areas. We strongly suggest quantifying the spatial distance of each laborer as a dependent variable in the case of large sample sizes. Fourth, this research is concerned only with mountainous areas, which is a restriction. Our future study should focus on exploring rural migrants' livelihood capital differences and its influence on labor migration between plains, hills, and mountainous areas.

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