The Effect of Labor Transfer Based on Panel Data on Farmers' Per Capita Consumption of Commodity Energy

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Abstract. Rural labor transfer is an inevitable phenomenon in the process of urbanization, and it is also the most important driving factor for residents' energy consumption and carbon emissions growth. This paper collects the panel data of 29 provinces or autonomous regions from 1997 to 2015. We classify the concept of labor force transfer and the number of labor force transfer and the proportion of labor force transfer. We use tobit fixed effect model to study impact of labor force transfer on the energy consumption of peasant household in the national and regional perspectives. Findings: Labor transfer from the national perspective has significantly increased per capita household commodity energy (coal, oil, liquefied natural gas, natural gas, electricity) consumption in the country's perspective; labor migration in the eastern region has affected per capita household oil, natural gas and liquefied gas at the regional perspective. The impact of consumption was the most significant. The labor force transfer in the central region had the most significant effect on the per capita coal consumption of rural households. The shift of labor force in the western region had the most significant effect on the per capita household electricity consumption of rural households.

1 Research Background

In recent years, with the improvement of the level of science and technology, mechanized tools have been continuously applied to agriculture to greatly increase farmers' productivity, and the ability of agriculture to absorb labor force has reduced the number of surplus laborers in rural areas. Judging from the experience of developed countries, the continued transfer of rural population to cities and local non-agricultural sectors is the only way for a country to realize the "dream of a rich nation." According to the "2015 Monitoring Report for Peasant Workers" promulgated by the National Bureau of Statistics, the total number of migrant workers in China during the 12th Five-Year Plan period was 225.78 million, 262.61 million, 269.94 million, 273.95 million, and 27.747 million. In 2015, the total number of migrant workers in the east, middle and west regions was 10.76 million, 96.09 million, and 37.78 million [1]. The above data shows two points: First, the national labor force transfer rate has decreased from 4.4% in 2011 to 1.3% in 2015, but it still shows an overall upward trend. Second, the phenomenon of labor transfer is unbalanced in the regional development, especially in the east. The region is most common, followed by the middle and western regions. That is to say, the massive transfer of rural labor force not only enables the rational allocation of social labor resources, but also has a positive impact on the coordinated development of China's urban and rural economy and regional economy.

The transfer of rural labor force significantly increases the income of transferors and indirectly raises the income and consumption level of the entire family[2]. The improvement of the living
standards of rural residents makes the transition from traditional biomass energy to energy consumption patterns based on commodity energy. According to the "China Energy Statistical Yearbook" promulgated by the National Bureau of Statistics, during the 12th Five-Year Plan period, the total energy consumption of China’s rural residents was 178.01 million tons of standard coal, 186.46 million tons of standard coal, 194.92 million tons of standard coal, 203.63 million tons of standard coal, and 211.81 million tons of standard coal. The commodity energy consumption in east, Central and West regions in 2015 was 16.39 million tons of standard coal, 73.69 million tons of standard coal, and 59.89 million tons of standard coal [3]. The above data shows two points: First, the consumption of commodity energy in China's rural areas continues to increase at a rate of 8.45 million tons of standard coal per year; Second, the development of commodity energy consumption in China's rural areas is uneven, and the energy consumption of commodities in the eastern region is the largest. The second is in the west. That is to say, the gradual increase in the share of energy consumption of commodities not only promotes the upgrading of energy consumption structure of rural households, but also ensures the sound and rapid development of China's economy.

2 Research Design
First of all, most of the current studies focus on the positive effects of the transfer of labor. Labor transfer is an important factor in promoting regional economic growth and narrowing the gap between urban and rural areas[4]. The shift of rural population to urban and local non-agricultural sectors is a phenomenon of widespread social migration, and it is also a country’s transformation from agriculture to industry. The Lord must go through the road and play an active role in promoting urban and rural development. The non-agricultural transfer of labor provides a channel for the realization of demographic dividends in rural areas, thereby enhancing the utilization efficiency of the labor force. It is also an important driver of improving China’s overall labor productivity and future economic development [5]. Farmers as the main economic activity subject in rural areas, the status of labor transfer has a direct impact on their livelihoods and regional ecological security[6]. Rural labor transfer achieves poverty reduction by increasing non-agricultural income, increasing agricultural labor productivity, and adjusting rural industrial structure. [7].

Second, the current domestic and international research on energy consumption of rural households mainly starts from the aspects of consumption status, consumption structure and influencing factors. China’s energy consumption is still dominated by traditional biomass energy. Regional energy consumption imbalances are serious. Rural residents, especially in the northeastern and western regions, still use traditional biomass energy in large quantities. The energy availability of some commodities is low, and clean energy is still in place. In the initial stage, there was a huge health loss to residents [8]. Some scholars have found that the education level of the head of household and the experience of non-agricultural employment have important influence on the energy consumption of farm households[9]. The income level of rural households, the education level of family members and occupations are important factors affecting farmer household fuelwood consumption[10]. The level of economic development has the most significant impact on the energy consumption of rural households. The energy consumption in the backward areas of the economy is dominated by traditional biomass energy, and the areas with better economy are in the process of transition from biomass energy to commodity energy [11].

Finally, Domestic research on labor transfer and rural household energy consumption are still lacking, especially using macro data to explore the relationship between the two countries from a national and regional perspective. Wang Ping et al. found that the transfer of labor was the main influencing factor affecting farmers' choice of different energy consumption through micro-research. There was a significant positive correlation between labor transfer and farmer household coal and electricity consumption, and it was significantly negative with farmer household straw and firewood consumption. Relationships [12-13]. In addition, the transfer of labor not only increased the per capita energy consumption of rural households, but also promoted changes in energy consumption structure [14].
In summary, although the number of rural labor transfer and the overall energy consumption in rural areas show an overall upward trend, due to the unbalanced development level of the regional economy, there are significant differences in labor transfer between the eastern, central and western regions, and the quality of household energy consumption. In this context, this paper uses the panel data of 29 provinces, municipalities, and autonomous regions in China from 1997 to 2015 to explore the impact of labor transfer on the per capita household commodity energy consumption in rural areas. The research questions include: (1) If there is a national perspective, the labor transfer has a significant impact on the per capita household consumption of commodity energy (coal, oil, liquefied natural gas, natural gas, and electricity)? (2) Is there a significant difference in the per capita household consumption of commodity energy (coal, oil, liquefied natural gas, natural gas and electricity) from the perspective of regional perspective in the shifting labor force in the eastern, central and western regions? (3) What are the internal causes of changes in the per capita household consumption of commodity energy (coal, oil, liquefied gas, natural gas, and electricity) caused by labor transfer?

3 Data and Methods

3.1 Sources of data
This paper uses panel data to analyze the impact of labor force transfer on per capita household commodity energy consumption. The sample involves rural coal of 1997-2015 in 29 provinces, municipalities, and autonomous regions in China’s (where there was a severe lack of energy consumption data in Shanghai and Tibet over the years) Consumption of coal, oil, liquefied gas, natural gas and electricity (data from the "China Energy Statistical Yearbook"). According to the imbalance of China’s economic development level, these 29 provinces, municipalities and autonomous regions are divided into three regions: East, Central and West. The eastern region includes Beijing, Fujian, Hainan, Hebei, Liao Ning, Guangdong, Jiangsu, Tianjin, Shandong, Zhejiang, the central region includes Anhui, Henan, Jiangxi, Hunan, Jilin, Neimenggu, Hubei, Shanxi, Heilongjiang and the western regions include Chongqing, Gansu, Guangxi, Yunnan, Guizhou, Xinjiang, Ningxia, Qinghai, Shaanxi, Sichuan.

3.2 Variable measurement

3.2.1 Dependent variable
The dependent variable is the more commonly used commodity energy in rural households. Measured by the five projects of per capita coal, per capita oil, per capita liquefied gas, per capita natural gas, and per capita electricity consumption, and measured by “the coefficient of energy per unit of coal equivalent/the number of permanent residents in the family in one year”.

3.2.2 The independent variable
The independent variable is the proportion of labor transfer and labor transfer to the total number of households. Labor transfer refers to the transfer of farmers from the agricultural sector to non-agricultural sectors, including transfer to cities and local non-agricultural transfer. In this paper, we use the statistical yearbook data to indirectly calculate the number of labor transfer in various provinces, cities and autonomous regions in China, and learn from Professor Lu Xueyi’s measurement method [15].

3.2.3 Control variables
Control variables include family characteristics and energy availability. Household characteristics of rural households are an important factor affecting the energy choices of rural households. They include household per capita income, the number of permanent residents in the household and the educational level of family members [9]. Family income includes family agricultural income, working income, and other disposable income; family resident population refers to the number of people living
in rural areas for more than 6 months in a year; family member education refers to the average educational level of family members; energy availability is per capita cultivated area is measured.

3.3 Research Methods
In this paper, the panel Tobit effect model is used. The individual fixed effect model in the model describes different intercepts for different sections (time points) and different time series (individuals). The model is described as follows:

\[ y_{it} = \beta_1 x_{it} + \alpha_1 + \alpha_2 D_2 + \ldots + \alpha_T D_T + \gamma_1 W_1 + \gamma_2 W_2 + \ldots + \gamma_N W_N + \varepsilon_{it} \]

\[ \varepsilon_{it}(i = 1,2,\ldots,N, t = 1,2,\ldots,T), \text{represent the random error.} \]
\[ y_{it}, x_{it}(i = 1,2,\ldots,N, t = 1,2,\ldots,T), \text{respect the dependent and the independent variable.} \]

4 The Results and Conclusions

4.1 Describe the Result
Table 1 (See Appendix 1) shows that the number of labor transfer from the national and regional perspectives is around 1.3 and the proportion of labor transfer and labor transfer in the middle and western regions is slightly higher than that in the eastern region; the per capita coal consumption in the central region is significantly higher than that in the east and west. The per capita energy consumption of the rest of the population resides between the east and the west; the per capita oil, per capita liquefied gas, per capita natural gas, and per capita electricity consumption in the central region are higher than those in the central and western regions; per capita income and education level are from high to low. It is the eastern region, the central region, and the western region; the resident population and per capita arable land area of the family are from the highest to the lowest, namely, the western region, the central region, and the eastern region.

4.2 The results of the Regression
Table 2 (See Appendix 2) shows the regression analysis of the impact of labor transfer on rural households' per capita commodity energy consumption from the national and regional perspectives. The results show that there is a significant positive correlation between the proportion of labor force transfer and the number of labor force transfer from the perspective of the country and the per capita coal, oil, natural gas, liquefied gas, and electricity consumption of the households. From the regional perspective, there was a significant positive correlation between the transfer of labor force, the number of labor transfer, and the coal consumption of households in the eastern, central and western regions, and the correlation coefficient in the central region was higher than that in the eastern and western regions; the transfer of labor in the central region was higher than that in the eastern and western regions; the number of labor shifts in the eastern, middle, and west areas was significantly positively correlated with the per capita liquefied gas consumption of the households and the correlation coefficient was high. The lowest is east, west, and central regions; the number of labor transfer in the east, middle, and west regions is significantly positively correlated with the per capita household gas consumption of rural households, and the correlation coefficient is from high to low, east, west, and central regions respectively; There was a significant positive correlation between the number of labor force shifts in western China and the per capita electricity consumption of rural households, and the correlation coefficient in the western region was higher than that in the eastern and central regions.

4.3 Discussion
From a national perspective, the transfer of labor force has a significant positive impact on household energy consumption per household, which means that the increase in the proportion of labor transfer
and the number of labor transfer has boosted the energy consumption per capita in rural areas. The main reasons are as follows: First, the greater the number of displaced persons, the more households have migrant workers, which means that the family’s ideological and ideological renewal is faster, family income is significantly improved, and environmental protection awareness is gradually strengthened. Household consumption is increasingly close to towns. The consumption level has led to a preference for convenient, fast and easy-to-buy commodity energy[16]. Second, the increase in the number and proportion of labor transfer indicates that the family is engaged in or invested in agricultural production with reduced energy and behavior. Therefore, the residual stalks in the farming process will be reduced accordingly [17], thus to the certain extent, farmers are encouraged to choose commodity energy other than traditional biomass energy.

From the regional perspective, labor transfer in the East, Middle, and West regions has a different degree of influence on the household's commodity energy consumption. First, the economic development in the western region is lagging behind. Farmers have high dependence on traditional biomass energy and low dependence on commodity energy consumption before labor transfer. With the gradual outward shift of the labor force and the abundant resource reserves in the western region, farmers' households are also consuming energy. However, the overall level of development is still lower than in the eastern and central regions. The improvement of economic level, urbanization level, population density and reduction of household size have a driving effect on electricity [18]. Therefore, the transfer of labor force in the western region has the largest per capita power consumption of rural households, followed by the eastern and central regions. Second, the eastern region. High level of economic development and convenient transportation facilities. Farmers have a high degree of dependence on commodity energy before labor transfer. After labor transfer, the influx of large numbers of laborers in the central and western regions and the deepening of non-agricultural transfer in the eastern region are further deepened. The level of urbanization in the east is high and The population density ambassador has a large amount of energy consumption in the entire region. Since per capita GRP and civil car ownership have a significant impact on oil consumption, the shift in labor force makes the dependence on petroleum in the eastern region particularly obvious, while the left-behind elderly and women and children after labor transfer will reduce oil consumption. The area is relatively slow; liquefied gas is a relatively active species in petroleum products. Since the oil reserves in the eastern region are abundant and imports and exports are convenient, the total consumption is greater than that in the central and western regions; the level of income of residents, the population increase, and the increase in the proportion of the three industries will drive the consumption of natural gas throughout the country, and the most flexible population in the eastern and western regions and the development of the “West-to-East Gas Transmission” project will enable the natural gas consumption capacity in the east and west to be stronger, while the central region will mainly focus on coal consumption. And lack of gas sources, less consumption. Thirdly, the labor force transfer conditions, economic conditions and infrastructure in the central region all fall between the eastern and western regions, and due to their single type of energy reserves(mainly based on coal resources), it can be seen that the transfer of labor does not affect their coal. The main factor of consumption, and therefore other energy consumption in the central region is between the east and the west, but the per capita coal consumption is significantly higher than the eastern and western regions.

In addition, the per capita household income, household resident population, education level, and per capita arable land area in household characteristics from the national and regional perspectives have a certain impact on the energy consumption of various households. The increase in per capita household income and household resident population has promoted the consumption of commodities such as oil products, liquefied natural gas, natural gas, and electricity. Households with higher education levels are more likely to use high-quality commodity energy such as natural gas and liquefied gas.
5. Conclusion
In this paper, through the study of the impact of labor transfer on the energy consumption of rural households, the following two conclusions are drawn:

(1) From the perspective of the whole country, the transfer of labor has a significant impact on the consumption of various households' commodity energy. The increase in the number of labor shifts and the proportion of labor shifts, the increase in people's household income levels, changes in energy consumption concepts, and the tendency to use efficient and fast commodity energy.

(2) From the regional perspective, the shift of labor force in the eastern region has the most significant impact on the energy consumption of farmer households, especially oil, liquefied gas, and natural gas. The shift of labor force in the western region has a certain role in promoting households' commodity energy, especially electricity consumption, but the overall level is still low. In East China and Central China, in the central region, except for the high consumption of coal, the rest of the energy consumption is between the east and the west.

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Appendix 1:

Table 1 survey of basic situation of farmers in the region

|                          | National (n=522) | East area (n=180) | Central Region (n=162) | Western Region (n=180) |
|--------------------------|------------------|-------------------|------------------------|------------------------|
|                          | Mean             | Standard deviation| Mean                   | Standard deviation     |
| Coal consumption per capita (Kgce) | 91.02            | 87.02             | 51.99                  | 59.41                  |
| Per capita oil consumption (Kgce) | 10.07            | 13.14             | 14.15                  | 16.49                  |
| Per capita liquefied gas consumption (Kgce) | 7.19             | 13.13             | 15.02                  | 19.23                  |
| Per capita natural gas consumption (Kgce) | 0.045            | 0.21              | 0.078                  | 0.30                   |
| Per capita electricity consumption (Kgce) | 100.82           | 72.25             | 130.18                 | 98.19                  |
| Labor force transfer(Number of people) | 1.34             | 0.49              | 1.30                   | 0.41                   |
| The proportion of labor transfer (%) | 0.32             | 0.11              | 0.32                   | 0.08                   |
| Per capita income(yuan) | 4625.3           | 3185.59           | 6374.54                | 3885.12                |
| Family resident population(Number of people) | 3.78             | 0.65              | 3.71                   | 0.63                   |
| Education level(year)  | 2.80             | 0.16              | 2.95                   | 0.07                   |
| Per capita cultivated area(Mu/person) | 2.29             | 0.49              | 1.79                   | 0.31                   |

Source of data: Total rural labor transfer = Number of rural migrant workers in rural areas + Rural labor force in non-agricultural industries = (Number of employees in cities and towns - Number of urban workers) + (Number of employees in rural areas - Number of employees in agriculture), among them, rural employment The number is the number of rural employees, the primary industry is the number of urban employees = the total number of employees - rural employees, the number of urban workers = the number of registered unemployed / registered unemployment, rural employees, primary industry practitioners, The data of total employees, registered unemployed persons, and registered unemployment rate are all from the Statistical Yearbook of each province; the data of rural coal consumption, oil consumption, liquefied gas consumption, natural gas consumption, and electricity consumption are all from 1997 to 2015. From the "China Energy Statistical Yearbook" of the past years, the per capita household income, household resident population, education level, per capita arable land, and other data are from the "China Household Survey Yearbook".
Appendix 2:
Table 2 The Regression Analysis of the Effect of Labor Transfer on Farmers' Household Commodity Energy Consumption from the National and Regional Perspectives

| variable                  | National (n=522) | East area (n=180) | Central Region (n=162) | Western Region (n=180) |
|---------------------------|------------------|-------------------|------------------------|------------------------|
| Dependent variable        |                  |                   |                        |                        |
| Coal                      | 165.68           | -328.00           | 75.44                  | -5.96*                 |
| Oil                       |                   |                   | 20.35*                 |                        |
| Liquefied gas             | 310.88           | -3.56             | 25.96                  | 7.53                   |
| Natural gas               |                   |                   | 8                        | 9.94*                  |
| Electricity               |                   |                   | -6.78                  | -75.87                 |
| Coal                      |                   |                   | -27.50*                | 12.71                  |
| Oil                       |                   |                   | 927.64                 | 24.16                  |
| Liquefied gas             |                   |                   | 274.99*                | 78.57                  |
| Natural gas               |                   |                   | -5.88                  |                        |
| Independent variable      |                  |                   |                        |                        |
| Labor force transfer      | 41.89**          | 22.26***          | 13.14**                | 0.74**                 |
|                           | 56.39**          | 34.57*            | 17.94**                | 1.37*                  |
|                           |                   |                   | 0.96**                 | 144.73*                |
|                           |                   |                   | 12.97+                 | 3.62+                  |
|                           |                   |                   | 0.37+                  | 0.58*                  |
|                           |                   |                   | 34.40*                 | 0.64                   |
|                           |                   |                   | 10.91***               | 0.97*                  |
|                           |                   |                   | 4.11***                |                        |
| The proportion of labor   | 41.89+           | 115.82***         | -7.05                  | 6.41**                 |
| transfer                  | 379.07**         | 175.88**          | 8.16                   | 1.24                   |
|                           |                   |                   | 849.23**               | 0.92                   |
|                           |                   |                   | 116.1*                 | 9.31                   |
|                           |                   |                   | 7.37+                  | 6.67+                  |
|                           |                   |                   | 399.51                 | -399.51                |
|                           |                   |                   | 116.1*                 | 10.22                  |
|                           |                   |                   | -16.20+                | 4.90                   |
|                           |                   |                   | 4.50**                 |                        |
| Control variable          |                  |                   |                        |                        |
| Per capita household      | 0.0006           | -0.0017           | 0.0001                 | 0.00                   |
| income                    |                   |                   | 0.01                   | 0.01+                  |
|                           |                   |                   | -0.0081                | 0.0001                 |
|                           |                   |                   | 0.00                   | 0.0006***              |
|                           |                   |                   | -0.001                 | 0.0001                 |
|                           |                   |                   | 0.00                   | 0.0001                 |
|                           |                   |                   | 0.00                   | 0.0001+                |
|                           |                   |                   | 0.00                   | 0.0004***              |
|                           |                   |                   | 0.00                   | 0.0002***              |
| Family resident population| 5.89             | 13.67***          | 12.84**                | 0.22                   |
|                           | 45.99+           | 22.91**           | 0.97                   | 1.91*                  |
|                           |                   |                   | -21.65                 | 0.64                   |
|                           |                   |                   | 0.82                   | 1.25+                  |
|                           |                   |                   | 1.69***                | 36.20                  |
|                           |                   |                   | 64.22***               | 12.60*                 |
|                           |                   |                   | 0.31                   | 0.019                  |
| Education level           | 154.75           | -56.03            | 4.21                   | 1.54                   |
|                           | 5.25*            | 24.24             | -33.30                 | 48.56                  |
|                           |                   |                   | 5.23                   | -5.39                  |
|                           |                   |                   | -201.40                | 48.99                  |
|                           |                   |                   | 27.34+                 | 11.70*                 |
|                           |                   |                   | -193                   | 523.27                 |
|                           |                   |                   | -22.35                 | -66.16                 |
|                           |                   |                   | 6.99                   | 1.64                   |
| Per capita arable land    | 0.82             | -13.08            | -11.24                 | -0.13                  |
|                           | -1.04            | 0.61              | 3.68                   | -0.64                  |
|                           |                   |                   | 0.84                   | -62.18                 |
|                           |                   |                   | -15.07+                | 1.07                   |
|                           |                   |                   | -1.61+                 | -1.11                  |
|                           |                   |                   | 47.26                  | -22.35                 |
|                           |                   |                   | -20.02                 | 1.56                   |
|                           |                   |                   | 0.52                   |                        |
| R²/Wald chi²(p)           | 0.167            | 0.556             | 421.62                 | 43                     |
|                           |                   |                   | (0.00)                 | (0.00)                 |
|                           |                   |                   | 0.811                  | 0.248                  |
|                           |                   |                   | 0.616                  | 189.36                 |
|                           |                   |                   | 0.00                   | 19.53                  |
|                           |                   |                   | 0.821                  | 0.525                  |
|                           |                   |                   | 0.464                  | 85.57                  |
|                           |                   |                   | 0.00                   | 12.12                  |
|                           |                   |                   | 0.0594                 | 0.866                  |
|                           |                   |                   | 0.063                  | 0.664                  |
|                           |                   |                   | 146.64                 | 0.1122                 |
|                           |                   |                   | 0.923                  |                        |

Data Source: Refer to Table 1  *** p<0.001; ** p<0.01; * p<0.05; +p<0.1