sustainability

Article

Travelers on the Railway: An Economic Growth Model of the Effects of Railway Transportation Infrastructure on Consumption and Sustainable Economic Growth

Congliang Wu [1], Ning Zhang [1,*] and Liwen Xu [2]

[1] School of Economics and Management, Beihang University, Beijing 100010, China; congliang0518@163.com
[2] College of Science, Jiangnan University, Wuxi 214000, China; x18101535976@163.com
* Correspondence: nzhang@buaa.edu.cn; Tel.: +86-137-0116-1902

Abstract: The impacts of transportation infrastructure on sustainable economic development are multifaceted. The existing literature works on the assumption that transportation infrastructure influences sustainable economic development by influencing production behavior. By observing the increasingly common phenomenon of family tourism, this paper finds that transportation infrastructure not only affects production behavior, but also directly impacts residents' consumption behavior. Based on this, this paper constructs a growth model in which the traffic infrastructure affects both production and consumption in order to reveal the mechanism by which railway infrastructure changes residents' consumption structures and ultimately promotes sustainable economic growth by promoting private tourism. In order to verify this theoretical proposition, this paper also constructs panel data from the provinces of China from 2008 to 2018 and conducts an empirical study. It was found that railway and railway infrastructure investments can not only directly promote sustainable economic development through the multiplier effect, but can also indirectly promote economic growth by increasing the amounts of private tourism and their proportions.

Keywords: railway infrastructure; economic development; tourism

Citation: Wu, C.; Zhang, N.; Xu, L. Travelers on the Railway: An Economic Growth Model of the Effects of Railway Transportation Infrastructure on Consumption and Sustainable Economic Growth. *Sustainability* **2021**, *13*, 6863. https://doi.org/10.3390/su13126863

Academic Editors: Alireza Ermagun and Manfred Max Bergman

Received: 5 March 2021
Accepted: 13 June 2021
Published: 17 June 2021

1. Introduction

Sustainability is a process that can be maintained for long period. The sustainability of human society consists of three inseparable parts: ecological sustainability, economic sustainability, and social sustainability. Facts show that developing countries are experiencing dual pressure from poverty and ecological deterioration. Poverty leads to ecological deterioration, and ecological deterioration also aggravates poverty. Therefore, sustainable economic development is of paramount importance for developing countries. Only economic sustainable development can solve the huge gap between the rich and the poor and the population and ecological crises. How can sustainable economic development be promoted? China, the largest developing country in the world, provides valuable experience in sustainable economic development for developing countries.

China has officially become the world's second-biggest economy, and the people's living standards have reached a fairly prosperous level [1]. After nearly four decades of sustainable economic growth, China has made remarkable achievements, and that momentum has been held steady into the 21st century [1]. This sustainable economic growth in China is driven by many factors, especially the construction of railways, roads, and infrastructure. In practice, as pointed out by the World Bank, public capital represents the "wheels"—if not the engine—of economic activity [2].

In economic theory, the relationship between infrastructure construction and economic development is generally attributed to the multiplier effect; that is, government investment relies on the amplification of an investment multiplier, which fosters the growth of related industries and then accelerates economic development [3]. Of course, if crowding-out effects are taken into account, investments in infrastructure can be detrimental to long-term economic growth [3]. However, various authors have claimed that using investment multipliers and the crowding-out effect theory alone cannot explain the full role of infrastructure. After many theoretical analyses and empirical studies, the concept of the "crowding-in effect" was put forward. In general, in research on infrastructure in the existing literature, it is generally believed that the construction of transportation infrastructure affects economic development by influencing production behavior, that is, the existing research only focuses on the field of production [3,4].

Does an increase in transportation infrastructure only foster sustainable economic development by influencing production behavior? For example, there is persuasive evidence that the emergence of tourism consumption challenges the above research ideas. Consumption of leisure tourism has entered Chinese families with the increase in disposable income. The railway infrastructures, especially all levels of railways throughout the country, obviously pull on private leisure tourism consumption. In fact, the relevant government departments have recognized the role of transportation infrastructure in boosting the consumption of residents [3]. For instance, the Classification and Evaluation of the Quality Grade of Tourist Attractions and Management Measures for Quality Grade Evaluation of Tourist Attractions were issued by the National Tourism Administration. These reports focused on and clearly illustrated the main role of transportation infrastructure in promoting the consumption of residents. Specifically, the convenience of traffic facilities, including the improvement of traffic accessibility and construction of special transport lines, is important content for measuring the grades of scenic spots. The idea of the above documents is to directly promote tourism consumption through the construction of transportation infrastructure and, ultimately, to promote sustainable economic development [4].

We draw two very different kinds of logic from the above analysis. Under the former logic, as long as the amount of investment is large enough, the purpose of promoting sustainable economic development and raising people's income will be achieved through the investment multiplier effect; whether or not direct consumption can be affected is not considered. In the latter logic, whether or not the railway can effectively promote the consumption of residents has become particularly important [3]. The most essential difference between the two types of logic is that the former logic considers production and the latter logic takes consumption into account [3]. This paper refers to the latter effect as the "service consumption effect" of traffic infrastructure, which distinguishes it from the "multiplier effect", "extrusion effect", and "crowding effect" in the existing literature. Among the commodities stimulated by railways, tourism accounts for a large proportion. This is the basis of this paper—the expansion of the focus from railways to tourism.

The goal of this paper is to explore whether transportation infrastructure can influence sustainable economic development by affecting private consumption beyond productive activities. To analyze the influence of railways on leisure tourism consumption and sustainable economic development, a simple theoretical model is established in this paper. This paper holds that railway infrastructure can not only assist in economic production activities (multiplier effect, etc.), but can also affect residents' preference for leisure tourism consumption, which changes the consumption structures of residents in order to further promote economic development (service consumption effect). In order to verify the series of inferences from the theoretical model, the authors compiled panel data from the provinces of China from 2008 to 2018 and carried out empirical research. The research results are as follows: Railways are positively correlated with sustainable economic development, and the construction of railway infrastructure has indeed changed the consumption structures of residents, thus affecting the consumption of residents; after controlling the railway indicator, the related indicator of leisure tourism consumption is still significantly positively correlated with sustainable economic development, which verifies the "consumption effect" of railways. Finally, it was found that the consumption effect of railways will weaken with the increase in railway infrastructure stock (railway mileage).

The value of this paper is as follows: We extend previous studies along various dimensions. First, unlike most of the previous literature, which focuses on the positive impacts of transportation infrastructure on production, we consider that transportation infrastructure also has an impact on consumption. Second, we consider a theoretical model of the mechanisms of the effects of infrastructure on consumption, unlike earlier studies, which typically considered only empirical research.

The rest of this paper is organized as follows: the second part is a literature review, the third part puts forward the theoretical model and analyzes the equilibrium conditions, the fourth part presents the related proposition of the "consumption effect" of railway infrastructure through the derivation of a model, the fifth part introduces the data used in this paper, the sixth part discusses the empirical results, and the seventh part summarizes the full text and elaborates on some limitations of the article.

2. Literature Review

It has long been recognized that transportation infrastructure is an essential ingredient for economic growth [3]. From the academic perspective, the rapidly growing literature—which can be traced back to the seminal work of Lucas and Aschauer—has operated under the assumption that transportation and other related infrastructures are necessary conditions for economic growth [5,6]. Since then, Easterly and Rebelo [7], Demurger [8], Esfahani and Ramirez [9], Calderón and Servén [10], Zhang [11], Wang [12], and Storeygard [13] have also found that transportation infrastructure can boost economic growth. However, some studies have contradicted this view. Cantarelli et al. and Locatelli et al. found that large transport infrastructure projects were often high-priced and failed to deliver the promised benefits [14,15]. A few researchers found that transport infrastructure had ambiguous, insignificant, or even negative effects on economic growth [16–21]. For a comprehensive review of the literature on transportation infrastructure, economic growth, and the reasons behind the wide range of output elasticities of transportation infrastructure in the literature, please refer to [22–24].

Several recent empirical papers on infrastructure investment related to data from China are those by Liu Shenglong and Hu Angang [25], Liu Xiaoguang et al. [26], Gao Xiang et al. [27], and Ouyang Yanyan and Zhang Guangnan [28]. They considered the issue of the mechanism of infrastructure investment, focusing specifically on the impact of infrastructure investment on production. Liu Shenglong and Hu Angang found that the improvement of transportation infrastructure has a significantly positive impact on China's regional trade [25]. Liu Xiaoguang et al. found that both transportation and communication infrastructures can bring about significant improvements in income distribution; that is, they can narrow the income gap between urban and rural areas [26]. Furthermore, they also found that infrastructure can effectively facilitate the transfer of agricultural labor to nonagricultural sectors [27]. Ouyang Yanyan and Zhang Guangnan found that the supply of infrastructure industries provides a significant output boost for manufacturing and that infrastructure and other private sectors are complementary in output and employment [28].

The purpose of this paper is to explore whether transportation infrastructure can influence sustainable economic development by affecting private consumption beyond productive activities. After Barro's pioneering research, mainstream economists argued that government expenditures will also have a crowding-out effect on the residents' consumption in the long run [29]. However, subsequent studies found that public expenditure does not necessarily crowd out private consumption [3]. In other words, the relationship between public expenditure and private consumption is complementary, rather than a relationship of substitution. In order to explain the phenomenon in which government expenditure promotes personal consumption, scholars have revised the theoretical model in different directions. For instance, consumer heterogeneity, including "Ricardian schematic residents" and "non-Ricardian schematic residents", has been discussed.

To our knowledge, Guo is the only author to assess the contributions of infrastructure to both growth and consumption, again using road density as the infrastructure indicator. They found that infrastructure raises both economic growth and consumption.

This paper considers some limitations of the previous literature. First, some of the above studies only studied the empirical relationship between government expenditure and consumption, but did not provide specific theoretical mechanisms [3]. Second, while previous studies have mentioned the role of consumption in infrastructure investment, they still divided infrastructure investment into the categories of production and consumption and separately discussed the production and consumption effects of these two types of investments [3]. Third, some scholars have revealed the mechanism by which road infrastructure promotes the consumption of private cars, then changes the consumption structures of residents, and, finally, promotes sustainable economic growth. However, the economic significance of their results was deemed implausibly large. Here, the interpretation of results can be difficult due to the fact that China's automobile industry is mainly concentrated in the 38 coastal inland cities. Although road construction can promote the purchase of cars, the effect of consumption of cars cannot promote the economic growth of every province at the same time. For example, there is no automobile industry in the vast western regions. Tourism is the main industry in western China, so automobile consumption plays a very limited role in promoting the economy in this region. As a result, the effects of some variables on economic growth have been artificially exaggerated. In addition, according to authoritative macroeconomic reports, indicators that play a key role in the national economy were underestimated in the model.

In this paper, the theoretical model is revised based on the observation of the actual economic activities. By setting up a generation-overlapping model between the two sectors, the direct impact of traffic infrastructure on the consumption behavior of residents is investigated. In the model, the substitution relationship between leisure tourism consumption and common consumption is considered, and there is no need to divide the effects of transportation infrastructure into productive and consumptive effects. It is worth noting that the model in this paper focuses on the proportion of public expenditure on infrastructure construction and considers it to be the result of the impact of the stock of infrastructure [3]. This is different from the traffic concept of productive public service (public production service) proposed by Barro. In addition, this paper emphasizes the impact of railways on the consumption structures of residents, which is closer to the results obtained by Gonzalez-Navarro and Quintana-Domeque through public policy experiments [3].

3. Railways Affect Both Production and Consumption

In order to explain the problem of how railways simultaneously affect production and consumption in detail, we constructed a resident consumption model, a production technology model, and a government budget constraint model to lay the theoretical foundation for the subsequent qualitative analysis.

3.1. Model Hypotheses

3.1.1. Consumption of Residents

At any point where $t > 0$, there are two generations of residents—young people born at time t and old people born at time $t - 1$. Young people earn their income through labor while making consumption and savings decisions and inheriting the remaining capital after the end of production. Old people hold all their capital at the beginning of the period and lease it to young people for production in order to obtain rental income to buy consumer goods. Assuming that the population remains stable, that is, the number of inhabitants per generation remains the same, it can be standardized to 1.

Consumers buy and enjoy two types of products: common consumer goods, C, and tourism services, LT. The utility of people i at time t can be expressed as

$$u_{i,t} = \ln C_{i,t} + \varphi(R_t) \ln LT_{i,t}, i = 1, 2 \tag{1}$$

where t denotes the time, $i = 1$ represents young people, $i = 2$ indicates old people, and R_t refers to railways. The non-negative function $\varphi(R_t)$ is characterized by the influence of railways on residents' consumption, which is assumed to satisfy $\varphi'(R_t) > 0$, $\varphi''(R_t) < 0$, $\lim\limits_{R_t \to \infty} \varphi(R_t) = \varphi_0 > 0$; that is, the more railways are constructed, the more utility residents get from leisure tourism consumption, but the marginal return on railways decreases. This utility function emphasizes the driving effect of railways on tourism consumption, thus describing the influence of traffic infrastructure on consumption, which is an extension of the existing literature.

When a resident is born at a time point t, the function of the resident's maximization of utility takes the following form:

$$U_t = u_{1,t} + \beta u_{2,t+1} \tag{2}$$

Here, $\beta < 1$ is the utility discount factor.

3.1.2. Technology

The production of products requires the use of capital K, labor input N, and railway infrastructure R. The production function is

$$Y_t = R_t^a N_t^a K_t^{1-a} \tag{3}$$

The railways are provided by the government. Therefore, given the wages (w) and the interest rate (r), the profit maximization problem for an enterprise can be described as

$$\pi_{i,t} = Y_{i,t} - w_t N_{i,t} - r_t K_{i,t} \tag{4}$$

Then, we rewrite (3) as

$$\mathrm{y}_t = \frac{Y_t}{R_t N_t} = (\frac{K_t}{R_t N_t}) = k_t^{1-a}$$

When the number of people in each generation has been standardized to 1 ($N = 1$), we obtain $k_t = \frac{K_t}{R_t}$.

Where k_t represents the amount of capital per unit of railway, which is called the capital–railway density.

We assume that the capital depreciation rate is δ_K, and the accumulation of capital stock satisfies

$$K_{t+1} = I_t + (1 - \delta_k) K_t \tag{5}$$

where I_t represents new investment.

3.1.3. Government Budget Constraint

We assume that the government provides only transportation infrastructure—namely, maintenance and construction of railways. The government receives fiscal revenue by setting a tax rate τ and builds transportation infrastructure (J_t) on the condition of maintaining a balance between revenue and expenditures; that is, $J_t = \tau Y_t$, $\tau \in [0,1]$.

We assume that the depreciation rate of the infrastructure is δ_R, Then, the construction of the railway satisfies

$$R_{t+1} = J_t + (1 - \delta_R) R_t \tag{6}$$

3.2. Model Equilibrium

The final output of the model focuses on four variables: general consumer goods (C_t), leisure tourism (LT_t), investment (I_t), and construction of infrastructure (J_t). Therefore, the economic resource constraint is $Y_t = C_t + LT_t + I_t + J_t$.

Combined with the model's settings, the competitive market equilibrium can be defined as follows:

Competitive market equilibrium: Given the government tax rate, a set of production factor prices, household consumption distribution, labor force distribution, and capital stock distribution, the enterprise's profits are maximized, the residents' utility is maximized, and the market clearance conditions are $Y_t = C_t + LT_t + I_t + J_t$, where $C_t = C_{1,t} + C_{2,t}$, $LT_t = LT_{1,t} + LT_{2,t}$.

Given the above model, the income of the elderly is rent from after-tax capital, and the budget constraint is

$$(1-\tau)(1-a)Y_t = C_{2,t} + LT_{2,t} \tag{7}$$

The young people's income is the after-tax income from labor. They need to redistribute their consumption and savings/investments with their after-tax income. The budget constraint is

$$(1-\tau)aY_t = C_{1,t} + LT_{1,t} + I_t \tag{8}$$

The people's problem is that of choosing the path that maximizes the utility of consumption (2) subject to the budget constraints (7) and (8). We can use the objective function (2) and the budget constraints (7) and (8) to set up the Lagrangian as follows:

$$\begin{aligned} &L_t = \ln C_{1,t} + \varphi(R_t)\ln LT_{1,t} + \beta[\ln C_{2,t+1} + \varphi(R_{t+1})\ln LT_{2,t+1}] \\ &+\lambda_1[(1-\tau)aY_t - C_{1,t} - LT_{1,t} - K_{t+1} + (1-\delta_k)K_t \\ &+\lambda_2[(1-\tau)(1-a)Y_{t+1} - C_{2,t+1} - LT_{2,t+1}] \end{aligned} \tag{9}$$

From the first-order conditions, the following results are obtained:

$$\frac{\varphi(R_{t+1})}{\varphi(R_t)}\frac{LT_{1,t}}{LT_{2,t+1}} = \frac{C_{1,t}}{C_{2,t+1}} = \frac{k_{t+1}^a}{\beta(1-\tau)(1-a)^2} \tag{10}$$

In equilibrium, there is $k_{t+1} = k_t = k^*$, so the equilibrium condition is:

$$(1-\tau(a(k^*)^{-a} + 1 - \delta_k = [\tau(k^*)^{1-a} + 1 - \delta_R](1 + \frac{1}{\beta(1-a)}\frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})}) \tag{11}$$

4. Qualitative Analysis

4.1. Impact of Railway Investment

Railway construction affects the model equilibrium and long-term growth in several ways. This section analyzes the impact of transportation infrastructure investment on capital accumulation and, in turn, the economic growth rate. Because railway investments come from taxes in the government budget constraint, this section examines the role of the tax rate (τ).

4.1.1. Railway Investment and Private Capital Density

It is well known that the government's construction of railways through taxation will have a crowding-out effect on private investments. In the model, there is a negative correlation between the capital–railway density and the tax rate. That is the crowding-out effect of railways.

Proposition 1. *When government expenditure on railway construction increases, the capital–railway density decreases, that is, private capital decreases relative to railways.*

Proof. In order to prove this proposition, it is necessary to prove that, for $\tau \in [0,1)$, $\frac{\partial k}{\partial \tau} < 0$. By rearranging Equation (11), we obtain the following equation:

$$\frac{a + (\delta_R - \delta_K - \frac{1-\delta_R}{\beta(1-a)}\frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})})k^a}{a + (1 + \frac{1}{\beta(1-a)}\frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})})k} - \tau = 0 \tag{12}$$

Taking the derivative with respect to τ, we find that

$$\frac{\partial k}{\partial \tau} = \frac{[a + (1 + \Theta k]^2}{[\delta_R - \delta_K - (1 - \delta_R)\Theta k^{a-1}[a^2 - (1-a)(1+\Theta)k - (1+\Theta)a} \tag{13}$$

$\Theta = \frac{1}{\beta(1-a)} \frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})}$. Note that the numerator in Formula (13) is always positive and the denominator is negative when k is small. When τ = 0, we can rewrite (12) as $a + [\delta_R - \delta_K - (1 - \delta_R)\Theta]k^a = 0$. Thus,

$$\frac{\partial k}{\partial \tau} = -\frac{[a + (1 + \Theta k]^2}{a^2(1 + \Theta + \frac{a}{k})} < 0$$

This outcome shows that k falls if τ rises. This ensures that the formula is always negative. Therefore, for $\tau \in [0, 1)$, $\frac{\partial k}{\partial \tau} < 0$. In other words, the capital–railway density at equilibrium decreases monotonously with the tax rate τ. □

4.1.2. Railway Investment and Sustainable Economic Growth

Similarly to the construction of other infrastructures, the ultimate goal of railway investment is also overall sustainable economic development. Next, we examine the impact of railway infrastructure on sustainable economic growth after adding new variables.

According to the equilibrium conditions of the model, if $k = k^*$ is a constant, then the equilibrium output $y^* = f(k^*)$ is also a constant. As a result, the rate of sustainable economic growth when the model is balanced is as follows:

$$g = \frac{Y_{t+1}}{Y_t} - 1 = \frac{R_{t+1}}{R_t} - 1 = \tau k^{1-a} - \delta_R \tag{14}$$

Equation (14) tells us that sustainable economic development is related to changes in the railway infrastructure, and the multiplier effect of railway investment on sustainable economic growth is obtained.

Proposition 2. *The speed of sustainable economic growth is positively related to the growth rate of the railway. With the increase in the proportion of government investments in transport infrastructure, the rate of economic growth will first rise and then decline.*

This proves directly from the formula that there is a positive correlation between the speed of sustainable economic growth and the railway growth rate.

Then, we can see from Formula (11) that the capital–railway density at equilibrium is negatively correlated with the tax rate τ. So, the rate of sustainable economic growth is a function of the tax rate τ, $g = \tau[k(\tau)]^{1-a} - \delta_R$, and we obtain

$$\frac{\partial g}{\partial \tau} = [k(\tau)]^{1-a} + (1-a)\tau[k(\tau)]^{-a}\frac{\partial k}{\partial \tau} \tag{15}$$

Because $\frac{\partial k}{\partial \tau} < 0$, Formula (15) contains two symbolic terms that are opposite to those on the right of the equation: The first item is positive and decreases with increases in the tax rate τ. The second item is negative, and the absolute value increases with increases in the tax rate τ. When τ = 0, $\frac{\partial g}{\partial \tau} = [k(0)]^{1-a} > 0$, and when $\tau \to 1$, $k(\tau) \to 0$, $\frac{\partial g}{\partial \tau} < 0$. Therefore, if the range of τ (0, 1) changes, sustainable economic growth first increases and then decreases.

When the tax rate is relatively low, the investments in railways are also relatively small, so the crowding-out effect is relatively small and the railway investments have a positive growth externality; therefore, the rate of sustainable economic growth increases with the increase in the tax rate. When the tax rate is relatively high, the crowding-out effect of railway investments on private capital is relatively large, which causes the rate of sustainable economic growth to decrease with the increase in public investment.

4.2. Tourism and Railways: The Impact of Railways on Tourism Consumption and Sustainable Economic Growth

The above section demonstrated that government investments in infrastructure can have a direct impact on sustainable economic growth. Next, the indirect effect of the growth of the transportation infrastructure stock by influencing consumption is investigated—namely, the consumption effect. Specifically, this part of the study is broken down into three subquestions: First, how do railways affect residents' consumption? Second, can railways promote sustainable economic growth by influencing tourism consumption? Third, how does the consumption effect of transportation infrastructure change with the increase in railway mileage stock?

4.2.1. Railways and Residents' Consumption

From the first-order condition of model equilibrium, the optimal consumption decisions of residents are obtained as follows:

$$LT_{1,t} = \varphi(R_t)C_{1,t}, LT_{2,t+1} = \varphi(R_{t+1})C_{2,t+1} \tag{16}$$

From this, it can be concluded that the proportion of residents that spend on tourism is

$$lt_t = \frac{LT_{i,t}}{LT_{i,t} + C_{i,t}} = \frac{\varphi(R_t)}{\varphi(R_t) + 1} \tag{17}$$

Proof A1. When $\varphi'(R) > 0$, we know that

$$\frac{\partial lt_t}{\partial R_t} = \frac{\varphi'(R_t)}{[1 + \varphi(R_t)^2} > 0$$

□

Proposition 3. *Railways can affect residents' consumption structures, and increasing railway stock can increase the proportion of residents' expenditures on tourism; that is, transportation infrastructure can directly promote residents' tourism consumption. The impact of transportation infrastructure on consumption is completely different from the traditional logic that infrastructure affects consumption by increasing residents' income. Of course, as noted above, this particular logic is determined by the nature of the special "consumer goods" of tourism.*

4.2.2. Tourism Consumption and Sustainable Economic Growth

Proposition 4. *If railways can affect tourism consumption and $\varphi'(R) > 0$, the economy grows at a higher rate when infrastructure and consumption are not relevant. Proof: If the utility gained by residents from the use of leisure tourism is related to railway facilities, then $\varphi'(R) > 0$, $\frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})} < 1$; when household consumption is irrelevant to railways, $\varphi(R_t)$ is constant, so $\frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})} = 1$; let $\Phi = \frac{1+\varphi(R_t)}{1+\varphi(R_{t+1})}$. The effect of railways on growth through consumption can be expressed as $\frac{\partial g}{\partial \Phi} = \frac{\partial g}{\partial k}\frac{\partial k}{\partial \Phi} = (1-a)k^{-a}\frac{\partial k}{\partial \Phi}$.*

According to Formula (11), $\frac{\partial k}{\partial \Phi} < 0$, so $\frac{\partial g}{\partial \Phi} < 0$; that is, when railways boost tourism consumption, the economy grows faster.

Proposition 4 depicts the consumption effect of railways on sustainable economic growth; that is, the economic growth rate is higher after considering the influence of railways on residents' tourism consumption.

4.2.3. The Effect of Railway Infrastructure Stock on the Consumption Effect

Proposition 5. *With the increase in railway infrastructure stock, the consumption effect of railways will weaken.*

Proof. In constructing the utility function, we emphasized that the marginal return of railways for leisure tourism consumption is constantly decreasing. Therefore, the relationship between the economic growth and railway stock is

$$\frac{\partial g}{\partial R} = \frac{\partial g}{\partial k}\frac{\partial k}{\partial \Phi}\frac{\partial \Phi}{\partial R} < 0$$

□

Proposition 5: With the increase in railway infrastructure stock, the consumption effect described in Proposition 4 will be weakened with the improvement in railway construction by affecting residents' consumption and, thus, promoting sustainable economic growth.

5. Indicator Selection and Data Description

5.1. Indicator Selection

This study took the gross domestic product (GDP, unit: RMB 100 million) of 30 provinces and autonomous regions as the main economic development index from 2008 to 2018 and calculated the per capita GDP growth rate by using the provincial GDP deflator and the resident population data.

In previous literature, two proxies were used to measure infrastructure: physical measurement of the infrastructure and measurement of the monetary value of the infrastructure. When we use the monetary measurement of infrastructure, it is difficult to distinguish construction expenditures for new infrastructure from the maintenance costs of existing facilities, which will cause differences in the eventual output [22]. Therefore, referring to the treatment methods of Liu Shenglong and Hu Angang, this paper selects the annual mileage of provincial railways as the main explanatory variable. In addition, in order to investigate the different effects of different grades of railways in detail, this paper uses the principal component analysis method to apply weighted treatment to the two types of railways so as to construct a weighted railway index and better characterize the density of railway infrastructure. This paper also calculates the railway density of each province (km of railway per km^2 of land).

As mentioned above, the other main aspect that needs to be studied in this paper is how railways work with tourism to promote economic development; thus, it is necessary to introduce relevant data on leisure tourism. In statistics on tourist receptions, private tourism data better depict the effects of railways on consumption, so data on tourist receptions were introduced.

In this study, we followed previous studies and added a set of control variables: the labor force, which is measured according to provincial year-end statistics of the employed population as a proxy variable. In applying the so-called perpetual inventory method, we made certain assumptions about the assets' lifespan and depreciation. We obtained the capital stock for the current year.

5.2. Data Specification

In this paper, the GDP was selected as the economic development index, and relevant traffic data from 30 provinces from 2008 to 2018 were sorted out to establish panel data. The province-level GDP data came from the China Statistical Yearbook; the data on the total railway mileage and the total road mileage (in kilometers) in different provinces were taken from the China Traffic Yearbook. The data on the numbers of tourist receptions and income were provided by the Ministry of Culture and Tourism. Fixed province-level investments of assets in traffic were supported by the Ministry of Transport. The data sources of this paper additionally included the statistical bulletins of the relevant provinces over the years studied, the Statistical Yearbook of Fixed-Asset Investments in China, and the Statistical Yearbook of Population and Employment in China.

According to the need for empirical analysis, this paper further calculated the growth rates of the related indicators, including the railway growth rate, labor force growth rate, capital growth rate, and other variables. Table 1 reports descriptive statistics for the majority of the data. In this specific study, we also used the logarithms of the main indicators, such as the gross national product (GNP) and total railway mileage, capital, and labor.

Table 1. Descriptive statistics.

Variable	AVG	SD	MAX	MIN
GDP	23,218.015	17,114.592	89,705.23	3387.56
GDP per capita growth	0.091	0.0298	0.17	−0.03
Tourist reception	29,340.34	18,275.13	77,966	2500
Tourism reception growth	0.18	0.12	0.88	0.63
Total railway mileage (km)	4032	1948	12700	1200
Total road mileage	158,659.4	58,776.6	330,000	20,800
Railway growth rate	0.036	0.105	0.801	−0.406
Road growth rate	0.063	0.075	0.510	−0.797
Weighted railway mileage (km)	2307.42	1164.95	7561.8	701.8
Weighted railway mileage growth	0.047	0.039	0.061	0.011
Capital (100 million)	562.43	449.78	1894.27	22.57
Capital growth	0.183	0.105	−0.058	0.711
Labor force (10,000)	2988.07	1562.7	6649	878.01
Labor force growth	0.016	0.024	−0.132	0.237
Capital railway density	0.0382	0.0327	0.1944	0.0010
Railway investment rate	0.0113	0.0119	0.0869	0.0002
Railway density	0.022	0.0142	0.0773	0.0022
The proportion of tourism revenue in the service sector	0.3168	0.1424	1.1673	0.09765
The proportion of the service sector in GDP	0.4293	0.0924	0.8055	0.2905

6. Empirical Results

The analysis of the model shows that the empirical results support the positive impacts of tourism consumption and railway infrastructure on sustainable economic development after adding the consumption effect from the railways. Here, the role of the railways is the core mechanism examined in this paper. It not only affects the consumption of leisure tourism, but also has an effect on other consumption behaviors, as well as other economic variables, such as private investment. Following this logic, the empirical research in this paper was mainly divided into two parts. First, we investigated the interactive relationships between railway mileage, leisure tourism, and economic development from the two angles of total output and output growth. Further, we investigated the mechanism by which railways affect leisure tourism consumption and sustainable economic growth by testing a series of theoretical models. In the estimation method, both a fixed-effect model and a random-effect model were considered. A Hausman test of the two groups of results was carried out. We found that the fitting results of the fixed-effect model were more reasonable. Therefore, the results of the fixed-effect model are reported. Due to spatial limitations, not all regression equations could not be listed, and the actual control variables and instructions are reported in the corresponding tables.

6.1. The Relationships between Railway Infrastructure, Leisure Tourism, and Sustainable Economic Development

6.1.1. The Influence of Tourism and Railways on the Total Output

Starting from Equation (3), the effects of transportation infrastructure, labor input, and capital stock on the total output were investigated. In the regression in column (1), the total highway mileage and total railway mileage were employed at the same time as indicators of transportation infrastructure. The estimated coefficient of the total railway mileage was significantly positive, which indicated that railway construction was significantly associated with output level, which is in line with the basic conclusions of the existing literature.

On this basis, the regression in column (2) adds an indicator for leisure tourism receptions to investigate their role. The results of the regression in column (2) show that there was a significantly positive correlation between the number of tourist receptions and the GDP. Because leisure tourism has very strong consumption attributes, this result is in line with our expectations—namely, an increase in leisure tourism consumption can promote economic development. It is worth noting that in the regression in column (2), the coefficient of the railway mileage is still significantly positive, but the coefficient of the road mileage is not significant.

To investigate whether the estimation results of the regression model in column (2) in Table 2 are reliable, two sets of robustness tests were carried out. Due to spatial limitations, the results of the robustness test are not reported separately, but the results of the robustness test and principal regression are presented simultaneously.

First, in the benchmark regression, the total mileage of the railway was employed as an indicator for China's railway infrastructure. Because railways consist of two types—ordinary and high-speed—it would not be rigorous enough to simply add them together. In order to control such factors, we applied the principal component analysis method to weight the ordinary railways and high-speed railways so as to construct a reasonably weighted railway mileage indicator. In the regression in column (3), the weighted railway mileage indicator was used to replace the total railway mileage, and the coefficient of the estimated leisure tourism continued to be positive and significant.

Second, due to the obvious endogenous nature of the relationship between infrastructure and the level of economic development, we selected the first-order lag and second-order lag variables of the total railway mileage and leisure tourism as instrumental variables for railways and leisure tourism in order to test the robustness of the results estimated above. This set of tool variables passed the weak tool variable test and the overidentification test. Only small changes were made when the lag variables of railways and leisure tourism were added, as reported in column (4). The regression coefficient of leisure tourism jumped from 0.236 to 0.435 (compared to its previous value in column (2)), and the railway variables continued to be significantly positive. Furthermore, the robustness of the conclusion of the benchmark regression was confirmed.

The results of the above-mentioned robust regression show that there are no significant changes in the significance of the core explanatory variables concerned in this paper, and the main results are very robust.

Table 2. Railways, tourism, and economic development.

Dependent Variable	**Log (GDP)**			
Number	**(1)**	**(2)**	**(3)**	**(4)**
Regression model	FE	FE	FE	IV
Total railway mileage	0.315 *** (8.59)	0.197 *** (3.35)		0.89 *** (2.870)
Number of tourist receptions		0.236 *** (13.89)	0.247 *** (14.25)	0.435 *** (16.12)
Weighted railway mileage			0.217 *** (5.39)	
Road mileage	0.175 *** (3.56)	0.003 (0.07)	0.004 (0.009)	0.041 (1.15)
Capital	0.771 *** (34.89)	0.538 *** (18.59)	0.548 *** (18.91)	0.515 *** (10.26)
Labor force	0.689 *** (8.99)	0.457 *** (4.53)	0.449 *** (4.43)	0.351 *** (4.23)
Constant term	−11.357 *** (−25.46)	−5.257 *** (−13.35)	−5.116 *** (−13.14)	−5.019 *** (−8.43)
R^2	0.96	0.97	0.97	–
Sample	281			

The *t*-statistics are in parentheses; ***, **, and * indicate significance levels that are less than 1%, 5%, and 10%, respectively. The model controls for the fixed regions. The following table is the same.

6.1.2. The Relationships between Tourism, Railways, and Sustainable Economic Growth Rate

Based on the empirical analysis of leisure tourism, total railway mileage, and total economic output, this paper reveals that both tourism and railways affect the level of sustainable economic development at the same time. On this basis, we continued to build the regression model to directly examine the impacts of railway construction and the growth of leisure tourism consumption on the speed of economic development. The results are summarized in Table 3.

Table 3. The influence of tourism and railways on the rate of sustainable economic growth.

Dependent Variable	**Per Capita GDP Growth Rate**			
Number	**(5)**	**(6)**	**(7)**	**(8)**
Regression model	FE	FE	FE	IV
Total railway mileage growth rate	0.085 *** (4.57)	0.073 *** (3.90)		0.043 (1.13)
Domestic leisure tourism growth rate		0.036 *** (3.03)	0.036 *** (3.04)	0.211 *** (2.99)
Weighted railway mileage growth rate			0.078 *** (5.26)	
Road mileage growth rate	0.004 (0.42)	0.017 (0.19)	0.017 (0.15)	−0.014 (0.82)
Capital growth rate	0.069 *** (5.54)	0.060 *** (5.16)	0.060 *** (5.18)	0.020 (1.14)
Labor force growth rate	0.94 * (1.69)	0.103 *** (1.90)	0.104 *** (1.92)	0.162 *** (2.92)
Constant term	0.097 *** (32.95)	0.09 *** (24.59)	0.09 *** (24.78)	0.03 *** (1.82)
Sample number				
R^2	0.147	0.173	0.173	–

***, **, and * indicate significance levels that are less than 1%, 5%, and 10%, respectively.

The base specifications are reported in column (5). After controlling for the growth of road mileage, capital, and labor, the coefficient of the total railway mileage growth was significantly positive, which showed that railway infrastructure construction was the key factor in the promotion of sustainable economic development. On this basis, the growth rate of tourism receptions is introduced into the regression in column (6), and the estimated coefficient was significantly positive, indicating that, after controlling for factors such as railway construction, capital accumulation, and labor input, the growth rate of tourism receptions was still highly correlated with the rate of sustainable economic growth.

Finally, we performed two sets of stability tests on the regression model in column (6). In the regression model in column (7), we replaced the growth rate of the total railway mileage with the weighted growth rate of railway mileage. The signs of the main growth determinants were also as expected. To alleviate the problem of endogeneity of the fixed-effect model, the instrumental variable method was used for a robust regression. We used the proportion of income from tourism in the service sector as the tool variable for the growth rate of tourism receptions. Combined with the theoretical model, the proportion of income from tourism was related to the preferences of residents and the density of the railways, which were exogenous to the economic growth rate of the year, but related to the growth rate of tourism receptions (the stage regression coefficient of the tool variables was significant, and the F statistics were greater than 10; it can be considered that there were no problems with weak tool variables). According to our preferred estimate—column (8) of Table 3—the coefficient of the tourism reception growth rate was positive and significant, pointing to a positive contribution from leisure tourism consumption to growth.

6.2. Test of the Railway Consumption Effect

The empirical analysis above confirmed that railway infrastructure construction can not only directly promote sustainable economic development, but can also indirectly affect sustainable economic growth by influencing families' tourism consumption. In combination with the theoretical model in this paper, we continued to verify the mechanisms by which railways affect household consumption and sustainable economic growth.

First, the crowding-out effect (Proposition 1) and the multiplier effect (Proposition 2) of railway investment on capital accumulation are derived. Then, the impact of railways on leisure tourism is qualitatively described to point out that an increase in railways affects the consumption structures of residents (Proposition 3). Finally, this paper proposes that railways and tourism have a consumption effect on sustainable economic development (Proposition 4). It is further deduced that this consumption effect will weaken with increases in railway infrastructure stock (Proposition 5). Then, this series of theoretical judgments is tested through empirical research.

6.2.1. The Impact of Transport Infrastructure Inputs on Capital Accumulation

Proposition 1 considers that there is a negative correlation between the capital–railway density k and the railway investment rate τ. Therefore, first of all, the relationship between the capital–railway density and the proportion of railway infrastructure input to total output is investigated.

The regressions in columns (9) and (10) in Table 4 indicate that the relationship between the railway investment rate and the capital–railway density is significantly negative. The coefficient of the railway investment rate remains stable and negative after controlling for income per capita. This indicates that the capital stock is relatively low in areas with large investments in railway construction; that is, investment in railway infrastructure construction has an obvious crowding-out effect on capital accumulation, which provides strong support for the judgment of Proposition 1. As a test of the stability of this result, in the regression in column (11), the railway investment rate is replaced by the total railway mileage growth rate, and the coefficient is still significantly negative.

Table 4. Capital–railway density and railway investment growth.

Dependent Variable	**Capital—Railway Density**		
Number	**(9)**	**(10)**	**(11)**
Regression model	FE	FE	FE
Railway investment rate	−0.775 *** (−3.37)	−0.594 *** (−1.87)	
Railway total mileage growth rate			−0.102 *** (−2.95)
Income per capita		0.090 *** (−2.91)	0.049 *** (8.92)
Constant term	0.201 *** (15.30)	0.091 *** (−2.90)	−0.061 *** (−6.91)
Sample number			
R^2	0.017	0.190	0.197

***, **, and * indicate significance levels that are less than 1%, 5%, and 10%, respectively. The regression model controls the fixed effects of regional characteristics. The following tables also control the fixed effects of regional characteristics.

6.2.2. The Influence of Railways on Residents' Consumption Structures

The direct influence of railways on tourism consumption is the key mechanism in this paper. In the regression in column (12), we found that there is a significantly positive correlation between railway density and the number of tourist receptions. In the regression in column (13), the density of the weighted railway mileage was used as the substitution variable, and its coefficient was still significantly positive. This set of results shows that railways have a strong promoting effect on tourism.

Furthermore, we measured the influence of railways on residents' consumption structures by using the theoretical model. To describe residents' consumption structures, the indicator of the proportion of income from tourism in the service industry was used as the dependent variable. In the regression in columns (14) and (15) in Table 5, the coefficient of railway density was significantly positive, indicating that the proportion of residents' tourism expenditures in the service industry as a whole was enhanced with increases in railways, which is consistent with Proposition 3.

Table 5. Railways and tourism.

Dependent Variable	The Number of Tourist Receptions		The Proportion of Tourism Revenue		GDP Share Of Tertiary Industry		
	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Regression model	FE	FE	FE	FE	FE	FE	FE
Railway density	0.354 *** (6.73)		0.021 *** (3.18)		0.036 *** (2.58)	0.054 *** (4.79)	
Weighted railway density		1.732 *** (5.19)		0.087 *** (2.51)			0.398 *** (5.98)
Proportion of tourism consumption						−0.793 *** (−7.79)	−8.001 *** (−8.10)
Income per head	1.249 *** (48.69)	1.091 *** (49.27)	0.041 *** (11.36)	0.041 *** (11.40)	−0.079 *** (−12.72)	−0.047 *** (−9.10)	−0.057 *** (−9.11)
Constant term	4.11 *** (169.25)	4.112 *** (172.19)	0.071 *** (27.45)	0.072 *** (27.73)	0.073 *** (100.49)	0.597 *** (24.10)	0.598 *** (70.10)
Sample number							
R^2	0.960	0.960	0.643	0.643	0.538	0.645	0.637

***, **, and * indicate significance levels that are less than 1%, 5%, and 10%, respectively.

The model shows that in addition to the impact on tourism consumption, railways will also affect other service expenditures by consumers and then affect tertiary industry. The regression in column (16) in Table 5 examines the impact of railway density on the service industry as a share of GDP. We found that after controlling for the average income of the region, the railway density was positively correlated with the service industry as a share of GDP. Further, in the regression in column (17), we increased the consumption structure variable, that is, the proportion of income from tourism in tertiary industry, and the coefficient of railway density was still significantly positive, while the coefficient of tourism consumption was significantly negative. The regression in column (18) replaced the railway density calculated with the total railway mileage with the weighted railway index, and the regression results remained unchanged. These results show that railways promote residents' overall consumption, but the impact of railways on residents' consumption structures may have a negative effect on total consumption; that is, tourism consumption replaces other consumption. This is in line with the expectations of this theoretical model.

6.2.3. Railways and Sustainable Economic Growth

The assessment of sustainable economic growth is still the main goal of this paper, so the key test of the mechanisms involved is the examination of the relationship between railway growth and sustainable economic growth. Proposition 2 points out that the growth rate of railway construction is positively related to the speed of economic growth. There is an inverted U-type relationship between the ratio of investment in transport infrastructure and the growth rate of the economy. The regression results in columns (19) and (20) in Table 6 support this proposition. Among them, the primary term coefficient of the railway investment rate is significantly positive and its quadratic term coefficient is significantly negative, which indicates that the contribution of railway investment to overall sustainable economic growth first increases and then decreases. The coefficient of the railway growth rate is significantly positive, which is consistent with the main empirical results in Table 3. Proposition 5 argues that with the increase in railway stock, the consumption effect of railways on sustainable economic growth will gradually weaken. In order to test this inference, the regressions in columns (21) and (22) in Table 6 introduce the rate of tourism's contribution to GDP, the indicator of railway density, and the quadratic term of railway density in order to examine the relationships among tourism consumption as a proportion of tertiary industry, railway stock, and sustainable economic development. The regression results show that the coefficient of the tourism consumption structure is significantly positive, indicating that changes in the consumption structure are significantly related to sustainable economic growth. The coefficient of railway density and its square term are significantly negative, which indicates that the contribution of railway inventory to sustainable economic growth has a decreasing trend. The two regression results are consistent with the judgments of Proposition 4 and Proposition 5.

Table 6. Railways and economic growth.

Dependent Variable	Per Capita GDP Growth Rate			
Number	**(19)**	**(20)**	**(21)**	**(22)**
Regression model	FE	FE	FE	FE
Railway growth rate	0.090 *** (4.91)	0.089 *** (4.65)	0.079 *** (3.91)	0.069 *** (3.64)
Railway investment rate	0.679 *** (2.91)	0.676 *** (2.86)		
Railway investment rate^2	−3.12 *** (−1.93)	−3.41 *** (−2.15)		
Leisure tourism consumption ratio			0.277 *** (3.89)	2.611 *** (4.23)
Railway density			−0.023 *** (−2.61)	−0.021 *** (−2.83)
Railway density^2			−0.007 *** (−2.87)	−0.009 *** (−3.41)
Labor growth rate		0.081 (1.52)		0.411 (0.83)
Constant term	0.092 *** (14.83)	0.088 *** (14.94)	0.075 *** (7.12)	0.072 *** (7.33)
R^2	0.098	0.137	0.160	0.196

***, **, and * indicate significance levels that are less than 1%, 5%, and 10%, respectively.

7. Conclusions

As the foundation of a country's development, the construction of infrastructure plays an irreplaceable role in the national economy and social life. This research shows that the construction of infrastructure may play an even bigger role; it can not only produce a multiplier effect through government investment, but can also crowd out capital accumulation in the private sector. It can also change the industrial structure of a country by promoting the consumption of leisure tourism. The construction of railway infrastructure injects vitality into the sustainable development of China's economy and makes China's economy maintain sustainable, rapid, and healthy development. At the same time, it lays a solid economic foundation for environmental sustainability and social sustainability. Without the sustainable development of the economy, human sustainability would be empty talk.

As we used an archival dataset from a real organization, our study has some limitations that should be noted when interpreting the results. First, the nature of our archival dataset did not allow us to adopt a large number of detailed indications or some details. Our article focuses only on the impact of railway infrastructure on long-distance passenger travel. However, from the perspective of tourist destinations, there are niche destinations that are strongly reliant on their limited infrastructure for attracting visitors, such as trekking and hiking destinations and some religious pilgrimage sites. The development of infrastructure in such places might be detrimental to the destinations. Second, although our article details the contributions of railway infrastructure to sustainable economic growth and the assessment of sustainable growth in the social demand for tourism consumption, we did not measure the environmental degradation caused by railway construction or the environmental pressures associated with the growth of social demand. While we believe that our measures were adequate for the purposes of this study, future research should adopt a more reliable measure of satisfaction in a controlled environment.

Based on the conclusions and limitations of this paper, we need to be aware that the government should maintain continuous investments in the construction of railway transportation infrastructure under the condition of maintaining the coordinated development of economic sustainability, environmental sustainability, and social sustainability because the sustainability of human society consists of three interrelated parts: environmental sustainability, economic sustainability, and social sustainability. We should increase the proportion of green railway transportation; economize and utilize resources and energy; strengthen ecological protection and pollution prevention; and ensure the sustainable development of the economy, society, and environment.

Differently from the previous view that GDP is affected by the multiplier effect and crowding-in effect, this paper suggests that traffic infrastructure investment should not only concern the investment itself, but also consider the impact of railway construction on residents' consumption. Finally, and perhaps most importantly, it is not only necessary to consider the impacts of railways on vehicles in terms of productive demand and higher incomes, but also in terms of consumer demand for railways. At this time, it is not difficult to find that the lack of understanding of the original concept of the consumption effect of traffic infrastructure is unreasonable; thus, it is necessary to investigate the proportions of different types of railways or the construction of only basic railways, rather than the construction of high-speed railways that are conducive to travel and so on.

Author Contributions: Conceptualization, N.Z. and C.W.; methodology, C.W.; data curation, L.X.; writing—original draft preparation, C.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Xiong, A.L.; Xia, S.M. Can innovation really bring economic growth? The role of social filter in China. *Struct. Chang. Econ. Dyn.* **2020**, *53*, 50–61. [CrossRef]
2. World Bank. *Annual Report 1994*; World Bank: Washington, DC, USA, 1994; p. 19.
3. Guo, G.Z.; Liu, R.G.; Huang, Z.Y. Cars on the road: An economic growth model of road infrastructure's effect on consumption and economic growth. *Econ. Res.* **2019**, *3*, 166–180.
4. Zhang, X.; Wang, X.; Wan, G.H.; Sun, F.C. A Comprehensive Framework for Transport Infrastructure for Economic Growth. *Econ. Res.* **2018**, *1*, 50–64.
5. Lucas, R. On the Mechanics of Economic Development. *J. Monet. Econ.* **1988**, *22*, 3–42. [CrossRef]
6. Aschauer, D.A. Is Public Expenditure Productive? *J. Monet. Econ.* **1989**, *23*, 177–200. [CrossRef]
7. Easterly, W.; Rebelo, S. Fiscal Policy and Economic Growth: An Empirical Investigation. *J. Monet. Econ.* **1993**, *32*, 417–458. [CrossRef]
8. Demurger, S. Infrastructure Development and Economic Growth: An Explanation for Regional Disparities in China? *J. Comp. Econ.* **2001**, *29*, 95–117. [CrossRef]
9. Esfahani, H.; Maria, T.R. Institutions, Infrastructure and Economic Growth. *J. Dev. Econ.* **2003**, *70*, 443–477. [CrossRef]
10. Calderon, C.A.; Luis, S. *The Effects of Infrastructure Development on Growth and Income Distribution*; World Bank Policy Research Working Paper; World Bank: Washington, DC, USA, 2004.
11. Zhang, X.L. Does China's Traffic Infrastructure promote Regional Economic growth? Also on the Spatial spillover effects of Traffic Infrastructure. *Chin. Soc. Sci.* **2012**, *3*, 60–77.
12. Wang, X.D.; Deng, D.X.; Zhao, Z.G. Impact of Traffic Infrastructure on Economic growth-an empirical Test based on Interprovincial Panel data and Feder Model. *Manag. World* **2014**, *3*, 173–174.
13. Storeygard, A. Father on Down the Road: Transport Costs, Trade and Urban Growth in Sub-Saharan Africa. *Rev. Econ. Stud.* **2016**, *83*, 1263–1295. [CrossRef]
14. Cantarelli, C.C.; Flyvbjerg, B.; Molin, E.J.; Van Wee, B. Cost overruns in large-scale transportation infrastructure projects: Explanations and their theoretical embeddedness. *Eur. J. Transp. Infrastruct. Res* **2010**, *10*, 5–18.
15. Locatelli, G.; Invernizzi, D.C.; Brookes, N.J. Project characteristics and performance in Europe: An empirical analysis for large transport infrastructure projects. *Transp. Res. Part A Pol. Pract* **2017**, *98*, 108–122. [CrossRef]

16. Crescenzi, R.; Di, D.M.; Rodríguez, P.A. Government quality and the economic returns of transport infrastructure investment in European regions. *J. Reg. Sci* **2016**, *56*, 555–582. [CrossRef]
17. Crescenzi, R.; Rodriguez, P.A. Infrastructure and regional growth in the European Union. *Pap. Reg. Sci.* **2012**, *91*, 487–513. [CrossRef]
18. Evans, P.; Karras, G. Are government activities productive? Evidence from a panel of US states. *Rev. Econ. Stat.* **1994**, *3*, 1–11. [CrossRef]
19. Garcia, M.T.; McGuire, T.J.; Porter, R.H. The effect of public capital in state-level production functions reconsidered. *Rev. Econ. Stat.* **1996**, 177–180. [CrossRef]
20. Ghali, K.H. Public investment and private capital formation in a vector error-correction model of growth. *Appl. Econ.* **1998**, *30*, 837–844. [CrossRef]
21. Maparu, T.S.; Mazumder, T.N. Transport infrastructure, economic development and urbanization in India (1990–2011): Is there any causal relationship? *Transp. Res. Part A Pol. Pract.* **2017**, *100*, 319–336. [CrossRef]
22. Deng, T. Impacts of transport infrastructure on productivity and economic growth: Recent advances and research challenges. *Transp. Rev.* **2013**, *33*, 686–699. [CrossRef]
23. Elburz, Z.; Nijkamp, P.; Pels, E. Public infrastructure and regional growth: Lessons from meta-analysis. *J. Transp. Geogr.* **2017**, *58*, 1–8. [CrossRef]
24. Rietveld, P.; Bruinsma, F. *Is Transport Infrastructure Effective?: Transport Infrastructure and Accessibility: Impacts on the Space Economy*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2012.
25. Liu, S.L.; Hu, A.G. Traffic Infrastructure and China's Regional Economic Integration. *Econ. Res.* **2011**, *3*, 72–82.
26. Liu, X.G.; Zhang, X.; Fang, W.Q. Urban and Rural income Distribution effects of Infrastructure: Based on the Perspective of Labor transfer. *World Econ.* **2015**, *3*, 140–170.
27. Gao, X.; Long, X.N.; Yang, G.L. Traffic Infrastructure and Service Industry Development-evidence from County-level Expressway and second Economic Survey Enterprise data. *Manag. World* **2015**, *8*, 81–96.
28. Ouyang, Y.Y.; Zhang, G.G. Research on the impact of Infrastructure supply and efficiency on made in China. *Manag. World.* **2016**, *8*, 97–109.
29. Barro, R.J. Output Effects of Government Purchase. *J. Polit. Econ.* **1981**, *89*, 1086–1121. [CrossRef]