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Impact Analysis of Transport Policies in China

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Abstract: The relationship between infrastructures and development is an issue widely discussed in the economic literature. In this respect, China is an emblematic case, due to the fact that is often investigated by considering the country as a whole, as if it was a homogeneous entity. In this study, the relationship between the transport infrastructure policy and the Chinese growth rate-starting from the open door policy up to the next Go West policy-is tackled after a preventive articulation of the country in homogeneous areas, which are built on the basis of several variables combination, obtained through statistical techniques for multivariate analysis. The knowledge of the production functions for different homogeneous classes, allows for obtaining the first indications on the investment policy effectiveness in various transport infrastructures, it also allows for having a global view of the development determinants in different areas. In particular, concerning the effectiveness of the rebalancing strategy of the Go West policy, the available data show that there was not a decisive change in favour of the inland areas; that was the reason why the growth differential did not go through the expected inversion.

Key words: Development, foreign direct investment, transport

INTRODUCTION

The expansion of China as an economic power was supported mainly by a fiscal policy favourable to foreign investors who acted as a driving force to attract foreign investment.

As a result of strong economic growth, a dualistic development between coast and inland areas occurred; that dualism has stimulated a strategy of rebalancing with the policy of Go West¹.

Among the issues that affected the gap was the geographic position of coastal areas which played a central role, in that it encouraged foreign investment² (Wei *et al.*, 2005; Khalapyan *et al.*, 2002), together with the existence of a gap in the equipment of the transport infrastructures among the Chinese provinces³; in fact, it is a shared opinion (Argimon *et al.*, 1993; Holtz-Eakin and Schwartz, 1994) that the infrastructure of a given country plays a key role on its level of economic development.

In this context, the role of the transport infrastructures' politics is analyzed in order to explain the Chinese economy's high rate of growth from the open door policy and, therefore, the subsequent policy rebalancing of the Go West.

In particular, we want to see if the economic growth in China's transport infrastructure played a key role, together with other determinants, such as incentives and foreign direct investments (Biehl, 1994; Eberts, 1990; Di Palma and Mazziotta, 2003), by also considering if the most recent policies, implemented by the government in the transport sector, managed to pursue the aim of reducing the dualism between coastal and inside areas.

THE CLUSTER ANALYSIS

At present, some researchers Fleisher and Chen (1997), Mody and Wang (1997), Raiser (1998), Demurger (2002) and Bosworth (2007) already considered that issue: however, in our view, an analysis of the country of China as a single aggregate could not grasp the different impacts, which took place in different provinces, as a result of the policies put in place.

Our analysis, carried out on a large scale (China), as well as at a greater level of detail (provincial), shows the differences obtained through these two approaches.

In order to construct a production function that allows us to assess the weight of various determinants of development, considering China as a single aggregate appears ineffective, while readable results can be obtained

¹The Chinese government announced the Go West Policy in 1999; it promised to invest billions of yuan in the construction of public infrastructures in the internal provinces Tibet, Chongqing, Gansu, Shaanxi, Xinjiang, Yunnan, Ningxia, Qinghai, Guizhou, Sichuan, Guangxi.

²About 70% of foreign investments were allocated to coastal areas from 1980 to 2005; the last occup about 7.6% of the territory of China.

³The other provinces, except coastal areas, show indexes of growth, between 1980 and 2006, below the national average.

by taking homogeneous areas; it must be built not on the basis of aprioristic joints, but through a combination of several indicators, with the support of statistical techniques of multivariate analysis.

In this sense, the Chinese territory has been reviewed through the cluster analysis methodology, which allows us to identify areas with homogeneous characteristics, by considering the multiplicity of possible determinants of development as variables.

In fact, the employed technique defines the characterizing elements of the social and economic structure of the Chinese provinces and reading of the main peculiarities, with particular attention to the role that some aspects have assumed in the increase of the gap in terms of attractiveness of the investments, like transport infrastructures (Mazziotta, 1998). It allows us to obtain the location of group provinces that are characterized from the same distinctive elements and therefore, have interior homogeneous characteristics and are possibly the most heterogeneous between the groups.

Therefore, a homogeneous class will be described as a combination of social-economic and territorial characters that constitute an informative base to use like support in order to employ the existing resources at best.

The study area covers the 26 Chinese provinces⁴ and the three municipalities: the data used make reference of 2005⁵.

We have defined a battery of 61 variables, chosen between those considered more correlated to the represented phenomenon: of these, 59 refer to the year 2005, the other 2 represent the average annual rates of change over the period 1992-2005 (GDP per capita⁶ and foreign investment⁷): in this way it's intended to integrate the reading of the situation up to 2005, with some indicators that reflect the differential growth of the variables that affect the reached value of GDP in 2005.

This data is expressed on the provincial level and describe the main elements of the territory⁸.

As the absolute data, related to areas of various dimension, do not allow some comparisons between the various considered areas, we have proceeded to the normalization of the elementary variables, relating some of them to the territorial surface of the interested area (obtaining the variables of type: density of the highway net for square kilometre of surface), relating others to the

population (obtaining variables of type: number of occupied with regard to the population) and other to the pil regional (e.g. incidence of the industrial sector on the gross domestic product).

The reclassification established six homogeneous classes of socio-economic provinces.

Figure 1 shows the territorial distribution of the six classes.

The first two classes (A and B) are formed by the provinces/municipalities that are more developed and also characterized by high rates of GDP per capita, exports and infrastructure equipment; these are the coastal areas and the municipalities of Beijing, Shanghai and Tianjin.

The class, consisting of the inside provinces (D), presents signs of development and further, three classes (C, E and F), consisting of the North, South and West provinces, which have a total territorial expansion of nearly 75% of China-whose development is based predominantly on the primary industry, with low rates of export, inadequate infrastructures and low levels of foreign direct investment - seem to show that the opening of markets did not affect these areas.

In summation, it is possible to understand the main differences between:

- More developed areas (coastal areas and municipalities), in which the great economic growth coincided with the beginning of open door policy, which established a tax incentive system that encouraged the inflow of foreign capital into these areas
- Developing countries (located in the central areas)
- Other provinces, in which the policy of openness was subsequently implemented, giving the result that the foreign investment came only from 2000 and to a lesser extent than the one coming from the other areas

In conclusion, it has found that, among the aspects that certainly affected the gap, the lack of adequate transport infrastructure in the West played a key role; in fact, in all its provinces and for all types of transport infrastructure (excluding highways), the inland areas recorded today an equipment that is still largely below the national average despite the fact that those areas are full of resources.

⁴The lack of available data has not concurred to consider in the statistic analysis that the provinces of Hainan and Tibet, therefore they have been excluded. Moreover, the area of Chongqing is not considered because it has assumed municipality status just from 1997, being in the antecedent period annexed to the municipality of Sichuan.

⁵Year 2005 is the last annuity that concurs a complete documentation.

⁶The average annual rate of growth has been constructed using the composed mounting methods.

⁷The variable average annual rate of variation in the period 1992-2005 of the foreign investments is the average annual variation of the considered period.

⁸The data has been selected from the database The China Data (University of Michigan), officially authorized from the National Bureau of Statistics in China.



Fig. 1: Division of the Chinese provinces in homogenous classes

THE FUNCTION OF PRODUCTION

The knowledge of the production functions, for different homogeneous classes, gives the first indication of the investment policies' effectiveness in various transport infrastructures and explains the determinants of development in different areas.

Considering the strategic role played in the economic development of a country by transport sector, transport infrastructures have been integrated in the aggregate production function by the economic literature (Aschauer, 1989; Biehl, 1986).

Several studies (Munnell, 1993; Evans and Karrans, 1994) have shown that the correlation between the overall infrastructure equipment of a country and its economic development is largely quite high: the building of a communication network reduces transport costs and facilitates trade, improves public services, encourages industrial development and often promotes propensity to export.

Based on these considerations, it has been preferred to estimate the coefficients of a production function through a multiple regression model⁹, using cross-section data for 28 Chinese provinces.

The analysis, disaggregated at the regional level, uses cluster analysis results, considering both homogeneous areas and development determinants, that obviously are different in several homogeneous areas. Therefore, it has been not attempted a single function across the whole China, but several functions, one for each homogeneous area, for which the most significant explanatory variables has been identified, considering GDP per capita as dependent variable.

To calculate the value of foreign investment, as a predictor variable of GDP, we have built per year the indicator as the sum of the previous ten years, assuming that this is the time in which an investment generates its benefits (for example, investments in 2005 are equal to the sum of investments made from 1995 to 2004). Moreover, given the characteristics of each class, this functions has

⁹The method used for the analysis is Partial Least Squares (PLS-software SIMCA-P by Umetrics).

been integrated with one or more variables describing the economic sector (primary, secondary or tertiary) that mostly characterizes each homogeneous class and that, therefore, represents private capital.

We have verified that the provinces with higher levels of growth rate of GDP (coastal areas and municipalities) react to changes in infrastructure and foreign investment more than the others.

The emerged results, in the first place, demonstrated the effectiveness of the studies that are disaggregated in the economic policies analysis comparing to those that consider China as a single aggregation.

In fact, through an analysis of the data of a single production function, which is valid for the whole of China, the existence of considerable significance in the relationship between product per capita and transport indicator, which describes the motorway network (elasticity equal to 0.64), suggests that the infrastructure is a powerful predictor of the level of GDP per capita regional; the coefficient for the railways, instead, has significantly lower values (elasticity equal to 0.05) and no values at all with reference to ports/waterways.

From the disaggregated analysis result some important considerations:

- All the estimated functions show high levels of R2
- There exists, on average, a strong correlation between the pil per capita and the foreign investments for all the groups: as it was to attend, the elasticity coefficient shows advanced values in the A and B classes (the coastal zones, respectively 0.52 and 0.48)

In fact, these classes have been privileged from Chinese policy in terms of distribution of the incentives; these resulted from the attractive elements for the foreign capitals:

- At a disaggregated level, however, the levels of the elasticity of GDP per capita about transport infrastructures are variously differentiated between classes of provinces; in fact, the homogeneous areas A and B show high levels of elasticity for both highways and ports, while these are almost zero in

relation to the railways. Coherently with the morphological structure of the country, the variable that describes the development of ports assumes significance only in classes that include coastal areas (A and B)

- The significance of the railways, as a predictor of economic development is, however, present only in the inland areas (D) and to the North of the coastal (E), while the indicator that mostly influences all the classes are highways (with the exception of classes C and E) with greatest values in coastal areas (in class A the elasticity is equal to 0.42) and lowest values in the border areas (0.05)
- It is missing a relation between the pil per capita and the infrastructure in border area C
- Moreover, we have introduced in the analysis the main sectors, economic (primary, secondary and tertiary) that mainly represent the homogeneous class according to the definition from the cluster analysis, in order to consider other possible factors of the regional development. While the secondary sector introduces a positive incidence in all the classes with different levels of elasticity, reaching the maximum values in the coastal areas (A), with 0,42 and the minimum values in the area D, with 0.07; the primary and tertiary sector characterize only some areas

In particular, the primary and secondary sectors introduce high coefficient in-group C, the inner areas (respectively 0.45 and 0.33); while class D introduces positive coefficients with reference to the secondary and tertiary sectors (with values for both fields of 0.88):

- Greater levels of the rate of growth of the pil values correspond higher coefficients of elasticity with reference both to the transport infrastructures and to the foreign investments;

It is evident that the disaggregate functions, offering greater information, explain better the total function (China), in spite of this it shows a good value of R2.

Table 1 shows the summary of the multiple regression: variable dependent pil per capita (1992-2005)¹⁰.

¹⁰The VIP Value (Variable Importance in the Projection) is given from the sum of the dimensions of all the contributions VIN (Variable Influence) included in the model:

$$VIP_{ap} = \sum_a (VIN)_k$$

where, a represents the number of dimensions PLS.

It is possible to compare the values VIP of the variables y between each other. The variables that introduce a high VIP value (>1) result to be much more influential for the explanation of the variable.

THE TRANSPORT POLICY

The carried out analysis have confirmed the existence of a dualism in the country between the inner areas and those situated on the coast.

The inequalities are imputable, above all, to the different development rates of the various provinces: biggest in the coastal areas compared to the Central and Western provinces.

This has increased not only the gap to the economic level, but also to social and cultural levels¹¹.

One of the greatest difficulties is the lack of infrastructure in the Western areas, had they been supported from the beginning, they would have carried numerous advantages; the inner zone, in fact, is equipped with many resources¹².

The comeback of the Chinese West represents a fundamental element for the creation of stability under many aspects.

In 1999 when the Chinese government launched a strategy, called Go West policy, in order to support the development of inland areas¹³ (12 provinces, autonomous regions and many municipalities), we would expect a rebalancing of the policies put in place, in collaboration with the World Bank, in order to promote diversification in the construction of infrastructures, with reference to the transport sector, in favour of the inland areas and in line with the results obtained from the our function of multiple regression.

In particular this policy, or at least in its purposes, aimed to promote the development in most vulnerable areas through an intensification of investment policy, mainly in transport infrastructure.

In this sense, a review on the effectiveness of the recent policy for the transport infrastructure was attempted.

In this context, we aim to verify which weight the enunciated Go West policy has had in bringing about the evolution of the transport infrastructure capital with regard to the more underprivileged areas.

The determination of the role of strengthening the infrastructural capital in the processes of regional increase and the consequent reduction of differences has obviously needed the preliminary quantitative identification of the present amount of infrastructures within the territory. The punctual knowledge of the infrastructural equipment measure and, still more, of the plans in phase of realization in China and in the various regions, it is rather problematic to obtain due to the lack of documentation statistics available.

Between the opportunities that China has in order to catch up prefixed objectives from the government, one of the more useful is international funding.

Therefore, after examining the influence of various infrastructures of transport in the region increases like influence variable of the pil per capita, we would like, in conclusion, to estimate the political ramifications of transports executed by the government, with reference to the projected realizations within the economic-financial care of the World Bank.

In other words, we want to verify if the government has achieved the prefixed objectives through the go West policy and those of the World Bank that has placed the accent above all on the great topics of the relief of the poverty and the regional equilibrium¹⁴.

Therefore, we have analyzed 26 infrastructural projects financed in China by the World Bank together with the government from 2000 to 2007¹⁵ (Table 2) about roads and freeways, ports and navigation channels and railroads in order to estimate where these works have been planned and consequently in order to comprise if the financings have been allocated to help the poor provinces, or if they have been granted to the more developed provinces, in order to continue to attract foreign investors.

The projects are described in the table that follows (Table 1) those, which have benefitted more provinces, have been indicated in both and the total cost of the operation shared between the same.

¹¹For many years the government policies have allowed much attention to the cities development, neglecting the requirements of the inner and rural zones.

Between the several problems of these zones, there is a population excess; backwardness of the agricultural techniques; low yields; free will of the local power, unemployment and lack of a social protection systems.

¹²The western regions of China represent an important member in the structure of the energetic resources of the country. In fact, the inner region possesses 65% of the mining repository in China, comprised of gas and oil, and 76% of the relative water resources, while in the border zone between the province of Shaanxi, Shanxi and Inner Mongolia it has about 60% of the country's coal reservoirs.

¹³The main objectives of the "Go West policy" regard the allocation of public funds in favor of these zones, in order to privilege increase of production and, consequently, to improve the living conditions, and to develop of the tertiary sector.

¹⁴In the last years, the Chinese leadership have declared to solve the gap problem.

The People National Assembly has announced participation in support of the zones in difficulty for example cuts to the farm worker taxes, increments of investments in the primary sector for technological processes, mechanization, and subsidies directed to the farmer.

The strategy promoted from the B.M. it is based on four fundamental points:

- To promote the system of the reform and from the point of view of the opening towards the external market, and in order to develop a better macroeconomic administration;
- To fight the poverty through the adoption of participations in support of the disagiate populations;
- To support the development of infrastructures in order to increase the growth of the country and integration in the international market;
- To realize environmental policy.

¹⁵The data are drawn from the official website of the World Bank. The realization of the infrastructures is scheduled within 2013.

Table 1: Summary of the multiple regression: variable dependent pil per capita (1992-2005)

		A		B		C		D		E		F		Total	
Mean annual growth rate (1992-2005)	U.m.	15.6%	113.29	14.6%	105.92	14%	101.51	13%	94.77	13%	94.60	13%	92.01	14%	=100
GDP per capite 2005	yuan	23088	140.98	44233	270.09	12352	75.42	10302	62.91	14549	88.84	8292	50.63	16377	=100
Popolation 2005	10000 pers.	34350	28%	4359	4%	10345	8%	49580	40%	16467	13%	9319	0.07	124420	100%
Surface	km ²	663400	7%	34300	0%	4057400	46%	1802600	20%	989100	11%	1350500	0.15	8897300	100%
		Coeff.	Vip	Coeff.	Vip	Coeff.	Vip	Coeff.	Vip	Coeff.	Vip	Coeff.	Vip	Coeff.	Vip
Constant		1.93		1.779		1.76		1.91		2.08		1.96		1.08	
IDE	10000 dollar	0.52	0.92	0.48	1.22	0.19	1.05	0.36	1.4	0.22	1.15	0.32	1.6	0.25	1.06
Railway	10000 km							0.03	0.88	0.11	0.54			0.06	0.53
Highways	10000km	0.42	1.26	0.20	1.08			0.18	0.96			0.05	0.26	0.64	1.57
Ports/channels	10000 tonn	0.32	0.83	0.28	0.28										
Primary sector	100 mL yuan					0.45	1.49	0.07	1.18	0.14	0.92	0.03	0.14		
Secondary sector	100 mL yuan	0.42	0.66	0.26	1.2	0.337	1.4	0.07	0.88	0.31	1.27	0.16	0.81		
Tertiary sector	100 mL yuan			0.3	1.21			0.3	0.89	0.28	1.27				
R2X(cum)		0.76		0.78		0.85		0.66		0.77		0.65		0.62	
R2Y(cum)		0.76		0.97		0.88		0.75		0.89		0.35		0.66	
Q2		0.73		0.96		0.86		0.74		0.86		0.33		0.33	

Table 2: Projects realized with the funding of the World Bank (the costs are expressed in million USA dollars)

Municipalities	Go West policy	N° projects	Roads/ highways	Railways	Ports/ channels	Project cost	Funding mondial 1 bank	Mondial bank (%)	Cluster (%)
Jiangsu C		0							
Fujian C		1	x			1,400	320	23	
Shandong C		0							
Guangdong C		1			x	130	45	35	
Zhejiang C		2	x	x		1,211	33	19	
Totale A	0	4	2	1	1	2,741	598	26	18
Beijing N		0							
Tianjin N		1	x			335	150	45	
Shanghai C		0							
Totale B	0	1	1	0	0	335	150	30	2
Gansu S	X	1		x		1,300	160	12	
Mongolia N		2	xx			530	200	38	
Xinjiang O	X	2	xx			604	250	41	
Shanxi N		0							
Totale C	2	6	5	1	0	2,434	610	32	16
Anhui S-E		1	x			631	250	40	
Sichuan S	X	1	x			400	180	45	
Guangxi S	X	2	x		x	696	245	35	
Hunan S-E		3	x	x	x	1,461	372	25	
Jiangxi S-E		2	xx			1,248	400	32	
Henan S-E		1	x			342	150	44	
Hebei N		1	x			286	100	35	
Shaanxi O	X	1	x			735	300	41	
Totale D	3	12	9	1	2	5,799	1,997	35	39
Liaonong S-E		1	x			525	218	42	
Jilin N-E		0							
Hubei S-E		4	xxx		x	2,028	750	37	
Heilongjiang N-E		0							
Totale E	0	5	4	0	1	2,553	968	38	17
Yunnan S	X	1		x		582	100	17	
Ningxia O	X	0							
Qinghai O	X	0							
Guizhou S	X	1		x		582	100	17	
TOTALE F	4	2	0	2	0	1,164	200	22	8
CINA di cui: 29		29	20	5	4	15,026	4,523	30	100
Go West 9	9	9	5	3	1	4,899	1,335	27	30
Other 20		20	15	2	3	10,127	3,188	31	70

The first column introduces the name of the Chinese province distinguished by cluster of belongings; in the second column there are those that are a member of the Go West policy.

It follows the distinction of projects based on the typology: roads and freeways, railroads, ports and navigation channels. The cost of each project, expressed

in million dollars, is the total, that it needs for the realization of the program, composed of the financing of the Bank (in the subsequent column) and the government of the People's Republic of China.

For every project, the percentage of participation of the organization has been calculated, from a minimum of 12% in the province of Gansu to a maximum of 45% in

Sichuan (both are in the Go West policy). All the financings are of Specific Investment Loans, that is the typology of lend in the field of infrastructures in the long term.

Table 2 shows the projects realized with the funding of the World Bank (the costs are expressed in million USA dollars)¹⁶.

The analysis showed that only 30% of the committed resources were intended to Go West provinces, but the interventions are differentiated in respect of those types that, according to our analysis, would cause greater development in terms of growth of GDP Regional.

In fact, a greater portion of the plans (12 projects, equal to 39% of all costs), is situated in cluster D, formed from the central provinces in which there are three of the Go West policy provinces.

Eighteen percent of the resources are allocated in coastal areas; if we add to this the values that related to the municipalities, we reach the conclusion that in the most developed areas it is assigned about 20% of the resources allocated in order to redress the regional imbalance.

At the same time, class F, exclusively composed from South and West provinces, has received 8% of the total financing.

The funding distributed from the World Bank corresponds to 30% of the total budget, of this just 27% has interested the provinces afferent to the Go West policy, while the remaining part is allotted equally between the other provinces.

With reference to the type of projects realized, nearly 70% of the plans encompass roads and freeways; moreover, only 5 projects are related to railway lines and just 4 that plan the realization of new navigable ports.

Comparing the type of actions undertaken by the Chinese government, the results obtained from the multiple regression, from which we have obtained the coefficients of elasticity for the several transport modalities, it appears that the policy has been direct for every class of province, just towards those fields that they would have brought, second our assumptions, a greater benefit in terms of increase to the regional pil.

In conclusion, the developed analysis shows the effort of the Chinese government that, through infrastructural projects, are oriented towards a re-balancing of the dualism; however, the destined areas aren't those defined from the Go West policy, the Western provinces, but rather the inner provinces, however outside to the phenomenon of markets opening.

CONCLUSIONS

The open door policy has led to a diversified structure of openness on several levels, which should integrate coastal areas, border areas and inland areas. This did not happen.

The provinces which had the double role as doors for the development of an economy direct to the exchange with foreign countries, through the export of products and import of advanced technologies, were few, as engines for the acceleration of economic development of the country.

The choice of the Chinese Government to remedy this unstable equilibrium situation was implemented in 1999 through the Go West policy that, among other objectives pursued, emphasized the infrastructures in the Western areas.

The check of the policy enunciated has been done by comparing the actions put in place, implemented with the technical and financial assistance from the World Bank, together with the determinants of development concerning the value of regional GDP per capita, as they have been identified on the basis of the cluster analysis.

The analysis has showed, however, that the impact appears more relevant in the central area (group C), where most of the infrastructures were designed; coherently, through the cluster analysis, we had already verified a process of development.

In conclusion, the commitment of the Chinese Government is not yet adequate to solve the problems of imbalance between the coast and the West.

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¹⁶The other two Go West Policy provinces excluded from the analysis are Chongqing and Tibet.

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