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Is it Redistribution or Centralization? On the Determinants of Government Investment in Infrastructure

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IS IT REDISTRIBUTION OR CENTRALIZATION?
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Abstract:
The dilemma efficiency versus equity, together with political partisan interests, has received increasing attention to explain the territorial allocation of investments. However, centralization intended to introduce or reinforce hierarchization in the political system has not been object as of now of empirical analysis. Our main contribution to the literature is providing evidence that meta-political objectives related to the ordering of political power and administration influence regional investment. In this way, we find evidence that network mode's (roads and railways) investment programs are influenced by the centralization strategy of investing near to the political capital, while investment effort in no-network modes (airports and ports) appears to be positively related to distance. Since investment in surface transportation infrastructures is much higher than that in airports and ports, and taken into account that regions surrounding the political capital are poorer than the average, we suggest that centralization rather than redistribution has been the driver for the concentration of public investment on these regions.

Keywords: Investment, infrastructures, centralization, redistribution

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Introduction

The economic literature has given increasing attention to the analysis of the factors that explain the regional allocation of public investment in infrastructure (Yamano and Ohkawara, 2000; de la Fuente, 2005; Kemmerling and Stephan, 2002 and 2010; Knight, 2004; Castells and Solé-Ollé, 2005; Bel and Fageda, 2009; Solé-Ollé, 2010). Research in this field has heavily focused in the dilemma efficiency versus equity, together with political partisan interests, to explain the territorial allocation of investments.

However, focusing only on this dilemma might cause overlooking of one of the possible potential objectives that policy of transportation infrastructures and services can seek: determining the patterns of political power and territorial administrative hierarchization. In an interesting paper, Faguet (2004) tries to explain why there is so much centralization. His model locates central government in a particular geographical space, the capital, and considers self-interest on the part of the capital residents. According to Faguet's analysis, centralization is a consequence of the interest of those who live in the capital city. In this way, they benefit directly from a strongly centralized government within a context where territorial governments enjoy weak constitutional guarantees.

The using of infrastructure policy to foster centralization has been analyzed in the economic history literature for the Australian case (for instance Wotherspoon (1979), Docwra and Kolsen (1989), and Gray (2009) and the Spanish case (Bel, 2010). However, as far as we know the literature lacks robust empirical evidence on this hypothesis. We believe this approach can help to understand why infrastructure investment is allocated by the central government. This can add to the analysis based on the efficiency-equity dilemma and its extension by considering political factors.

Our main contribution to the literature is providing evidence that meta-political objectives related to the ordering of political power and administration influence regional investment. Spain proves to be an interesting field to check whether policies aimed to administrative and political centralization have influenced the regional allocation of investment. The main results from our empirical analysis show that investment programs in network modes (roads and railways) is negatively related to the distance to the capital city; thus, they are influenced by the centralization strategy of investing near to the political capital. On the contrary, while investment effort in no-network modes (airports and –of course- ports) appears to be positively related to distance. Investment in surface transportation infrastructures is much higher than that in airports and ports. Given that regions surrounding the political capital are relatively poorer, this suggest that centralization rather than redistribution has been the main driver for the concentration of public investment on these regions.

The remaining of the paper is organized as follows. First we review the related literature. Next we explain our empirical strategy. Then we present our results, and discuss their main implications. Finally, we draw our main conclusions.

Literature review

The economic literature has given increasing attention to the analysis of the factors that explain the regional allocation of public investment in infrastructure. Early works in this literature, such as Yamano and Ohkawara (2000) and de la Fuente (2005), focused on the efficiency-equity traditional trade-off. Other works, while still paying attention to the trade-off between efficiency and equity, extend the analysis to include the role of political factors as determinants of government investment in infrastructure.

In this way, Kemmerling and Stephan (2002) show that –together with equity motivations- the distribution of investment grants among cities is positively related to the political support the incumbent party enjoys in each city. In the same way, Knight (2004) analyzes the US Congressional votes over transportation projects funding, and finds that the probability of supporting the projects is increasing in own-district spending.

On their side, Castells and Solé (2005) find that political considerations matter, since governments invests more in the regions where electoral productivity is higher. More recently, Bel and Fageda (2009) find that regional investment in airports in Spain is positively related to the electoral support to the incumbent party in the national government, and it is positively related as well to the party alignment between the national government and the regional government (that is to say, both of them belong to the same political party).

Following this stream of the literature, Kemmerling and Stephan (2009) emphasize the importance of country-specific political institutions in order to explain the regional distribution of investments. To analyze this issue, the authors undertake a cross-country empirical analysis, considering France, Germany, Italy and Spain. This set of countries includes Federal (Germany and Spain) as well as Unitarian (France and Italy) countries, as well as a variety of electoral systems.

Kemmerling and Stephan (2009) distinguish between (1) normative factors -efficiency, redistribution and equity-, noting that efficiency and redistribution are usually conflicting objectives; and (2) political factors, within which they emphasize the ideological stance of political parties (assuming left-wing and regionalist/separatist parties positively related with investment in the region), partisanship (those regions where the governmental party is the same as the party in the national government receive more investment), and (3) electoral interest of the national government (higher investment in pivotal regions and in party's strongholds).

The results obtained from the empirical estimation suggest that efficiency concerns are important in all countries, and redistribution is an important objective in all countries as well (although not statistically significant for France). However, the equity objective shows more ambiguous results, and no strong conclusion can be made about it. Regarding political variables, the results are much more mixed, and show important differences between countries. In this way, partisan strongholds receive more investment in Spain and Italy, but this does not happen in Germany and France. Regional parties are positively related to regional investment in Spain, but they are not so in Italy. Regarding left parties, they are related to higher regional investment in Italy and France, but they are not so in Germany and Spain. All in all, there exists a wide diversity regarding the effects of political variables, and two general results are emphasized by the authors: (a) ideological variables only play a significant role in centralized systems, and (b) electoral incentives play a role in most countries.

Solé-Ollé (2009) analyzes why "fiscal deficits" related to infrastructure are subject to harsh discussions. First, because infrastructure related fiscal deficits sustained overtime lead to too small infrastructure capital stocks in rich regions; second, because the central government has considerable discretion in the territorial allocation of infrastructure investments; and third, because it is not clear what 'objective criteria' of infrastructure investment allocation means. Of course, there is an important distinction to keep in mind in order to interpret the concepts. On one hand, we can think of the existence of tactical redistribution, usually called pork barrel politics. On the other hand, we can consider the existence of programmatic redistribution, based on the citizen-candidate approach. Here what matters is that preferences on how to organize society influence as well political decisions.

Solé-Ollé (2009) uses data on investment and capital stock at the province level data for 1978 through 2004. Data for 1964-1977, before the democracy was reestablished in Spain, is considered too in the study, but is not included in the analysis for the political variables. The author includes four political variables in his empirical model; (1) *Margin*, deriving from the swing voter theory; (2) *Votes/seats*, related to maximizing effectiveness of money invested to 'buy' votes; (3) *Aligned governments*, that is to say, Do your comrades rule the region?; and (4) *Pivotal*: indicating whether the central government needs support from regional specific parties. Regarding the results obtained from the estimations, all these variables work reasonably well, although results for alignment are mixed: alignment is usually significant for Social-democrat –PSOE- governments, but it is not for Conservative –PP- governments.

Overall, Solé-Ollé's results suggest that regional allocation of infrastructure investment in Spain is heavily affected by politics, both by tactical redistribution as well as by programmatic redistribution. It is worth emphasizing the specific results obtained regarding the two reasons explaining why a region would obtain less investment than deserved: a) being a region with low political power, and b) belonging to a group (according to the region's characteristics) that enjoys low political power.

The analysis of Solé-Ollé (2009) results seem to be particularly consistent, perhaps reflecting the fact that single-country studies usually allow using a wide set of variables. Undoubtedly, his estimation benefits from this.

One interesting question that can relate to previous studies is that of how to approach the efficiency criteria. On one way, relating regional output to the regional infrastructure stock seems a sensible way to approach the issue in an aggregated way. However, this type of analysis could benefit from using a more detailed and disaggregated analysis. Rich regions do not always have high project impact, and poor regions do not always have low project impact. It crucially depends on the previous stock of a *given type of infrastructure*. For instance, Spanish motorways plan 1984-1991 emphasized investment where high capacity roads were absent. It was likely following an efficiency criterion. Technically, what really matters in not whether a region is rich or poor, but the traffic intensity (e.g. average daily traffic) adjusted for the existing motorway capacity (current level of service).

More importantly, a further distinction that could be useful to take into account is that distinguishing between budged funded infrastructures and user funded infrastructures. The first one is the case of railway infrastructure in all countries, and most motorways in Spain and (almost all) in Germany. However, most motorways in France and Italy are tolled (as well as a non negligible part –roughly the 25%- of the motorway network in Spain). Generally, airports and ports are funded with users' charges (even if some cross subsidies are allowed in the different countries). It is quite possible that national government will use different criteria on the regional allocation of specific infrastructure investment depending on how the investment is going to be funded. Basically, redistribution and political objectives would likely have more room in budged funded infrastructures than in infrastructures that are paid for by the users. Therefore, disaggregated analysis, distinguishing by infrastructure type could provide interesting and more robust results.

As we mention above, Faguet (2004) tries to explain the centralization hypothesis. In this paper, we take Spain as a field to check this hypothesis. We argue that our approach can help to understand why infrastructure investment is allocated by the central government. This can add to the analysis based on the efficiency-equity dilemma and its extension by considering political factors.

The empirical analysis

- **Data and variables**

First, we describe the variables used in the empirical analysis and explain the sources of this information. We have data for 51 provinces ("provincias") in the period that goes from 1981 to 2005.[1] To this regard, data for each variable is obtained at the level of each Spanish province. Overall, we have about 1275 observations. Next we present and describe our main variables:

Dependent variable

We are interested in finding determinants of investment efforts realized by central government during the period studied. Therefore, we use as dependent variable the ratio of gross investment in transportation infrastructure by the central government *(I)* over the gross stock of capital in transportation infrastructure in the previous period (k_{t-1}). Information for these variables has been obtained from the website of FBBA-IVIE. Data is expressed in thousands of current euros and is available for each transportation mode: roads, railways, airports and ports.

Regressors and instruments

1. Distance from the city center of the capital of each region to the city center of Madrid (*Distance_capital*). Data for this variable has been computed using the algorithm of google maps where we account for the shortest distance in kilometers by road. This variable measures the centralization objective of central government.

[1] The only province not considered in our sample is Ceuta- an autonomous city of Spain located on the north African side of the strait of Gibraltar- due to lack of information for several variables.

2. Gross domestic product per capita (*GDP_per_capita*). Information for this variable has been obtained from the Spanish Statistics Institute (INE). Data is expressed in thousands of current euros. This variable captures economic wealth and as a consequence measures the redistribution objective of central government through infrastructure investment effort. Related to GDP, we also use the mean number of schooling years of active population (*edu*), which serves as one of the instruments used to predict current GDP in our effort to overcome endogeneity problems. Information for this variable has been obtained from the website of FBBA-IVIE.

3. Percentatge of votes of the incumbent party in the central government in the elections to the central parliament across regions (*votes*). Information for this variable has been obtained from the website of Ministry of domestic affairs. This variable captures political opportunistic behavior of the incumbent party in central government.

4. Population (Pop). Information for this variable has been obtained from the Spanish Statistics Institute (INE). Data is expressed in terms of total number of inhabitants. This is a measure of mobility needs.

5. Land area of the province (*Land*). Information for this variable has been obtained from the Spanish Statistics Institute (INE). Data is expressed in terms of square kilometers. This is a variable accounting for mobility needs as well.

- **The estimation strategy**

Given our cross section time series data we have performed different estimations to test our main hypotheses. First, we regress total investments on several groups of determinants (**Model 1**), in which we consider political objectives of redistribution, centralization and electoral opportunism – our policy regressors-, as well as we include other control variables. The centralization objective is determined by the use of the distance from the capital city to the province receiving investments as a covariate. Therefore, we expect a negative relationship between the variable Distance to the capital and total investment effort in order to confirm our hypothesis. Similarly, a negative correlation between GDP per capita and total investment effort would mean that redistribution is considered when designing total investments programs. Since the literature also supports that governments – or the incumbent party - tend to favor political communities where they receive more electoral votes, we introduce this opportunistic behavior by including the variable *Votes* in the model. In this regard, we expect a positive relationship between the percentatge of votes of the incumbent party in the central governments and the amount of investments in the corresponding province.

Among control variables we can distinguish three groups of regressors. The first group is formed by covariates capturing mobility needs as population (Pop) and land area (Land), while the second group of regressors control for investment inertia and previous capital stock as determinants of current investments. To this regard, the variables introduced are the first lag of total investment efforts (i_{it-1}^{total}) and the first lag of capital stock per capita (k_{it-1}^{total}). The last group of regressors contain in the first place a dummy variable (D^{foral}) denoting with value 1 the provinces that hold responsibilities – due to political decentralization –on network modes as roads and rail transportation and 0 otherwise. Secondly, we add the time trend to take into account the time dimension of our data.

Regarding expected relationships of the control variables, we expect investment efforts being positively associated with mobility needs but mixed - or at least not clear- effects with the second group of regressors. In fact, government investment programs tend to cover more than one year, what implies an inertia that should appear positively correlated with current total investments. However, there are less investment needs in regions where investment effort has increased during the last years covering recent needs of better or new infrastructure. A similar uncertainty can be attributed to past capital stock. Indeed, regions with more capital stock present lower needs of public investment but it is also reasonable to consider that once you have an infrastructure you need to maintain and renew the stock. Following this argument we could expect a positive relationship between the lag of capital stock and current investments. Being this said, recent literature support a negative correlation between investment efforts and previous capital stock in Spain (Sole-Ollé, 2009)

Finally, as the remaining control regressor, the binary variable (D^{foral}) should produce negative impacts on central government investments in the modes that are under the responsibility of regional governments. Therefore, since those modes are network modes, which account for most central government investments, it is straightforward to expect this negative relationship.

Next we present the specification of **Model 1**:

Model 1: $i_{it}^{total} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{total} + \beta_7 k_{it-1}^{total} + \beta_8 D^{foral} + \beta_9 Time\_trend + \varepsilon$

Although we test our hypothesis on the political objectives undertaken by Spanish central governments in their design of investment programs, recall that we are also interested in distinguishing statistical impacts by transportation mode in order to show that only considering total investments can lead us to a misinterpretation of results. For this reason it is desirable to replicate the estimation strategy differentiating between network modes (roads, rails) and no-network modes (airports, ports) as **Model 2** and **Model 3** do. This difference will account for the different characteristics of network and no-network infrastructure. Indeed, network infrastructure constraints the ability to extent the transportation stock, a limitation not suffered by no-network infrastructure. As a consequence, investments' regional distribution should be affected and restricted by the existing network only in the case of network modes. This means that we expect a stronger relationship between investment efforts and existing capital stock in the case of network infrastructure. The different two aggregated models by mode are presented below:

Model 2: $i_{it}^{network} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{network} + \beta_7 k_{it-1}^{network} + \beta_8 D^{foral} + \beta_9 Time\_trend + \varepsilon$

Model 3: $i_{it}^{no\text{-}network} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{no\text{-}network} + \beta_7 k_{it-1}^{no\text{-}network} + \beta_8 D^{island} + \beta_9 Time\_trend + \varepsilon$

As the reader will observe, the no-network investment effort equation includes a variable not included in the network investment effort equation. This covariate is a dummy variable that identifies with 1 those provinces being an Island (D^{island}) and 0 otherwise. This binary variable is considered necessary to account for investments of point-to-point transportation infrastructures as ports and airports. These provinces (islands) are not linked to the rest of the network infrastructure due to obvious reasons. In this regard, the estimation that uses as dependent variable the aggregate investment and the investment in network modes exclude from the sample those provinces located on islands. Our main goal is to distinguish between different policy objectives of the central government and including islands in the estimations that consider network modes could distort results of the variable for the distance to the capital.

If differences between network and no-network infrastructure can lead to information losses or misinterpretation by mixing together, it is also interesting to replicate the same empirical strategy for each transportation mode to further investigate investment policy heterogeneity.

This excercise, based on models **4-7**, which models only consider each mode's investment effort separately - road, rail, airports and ports, respectively- is presented in the appendix, as well as their associated main results.

It is worth mentioning that the only difference between **Model 4** and the basic **Model 2** for network investments is the introduction of private investments in the road mode equation. These investments are carried out by private toll motorway companies and therefore we expect lower investment efforts where there is private investment acting as substitute of public stocks.

- Estimation and results

Next we present the results of the estimation of the total investment effort equation (**Model 1**). First of all, **table 1** and **table 2** show the descriptive statistics and the correlation matrix of the main variables used in the empirical analysis. From these tables, we can see that all variables have enough variability and multicollineality between regressors does not seem to be a problem.[2]

Insert table 1 about here

Insert table 2 about here

We estimate the investment equations using the Two-Stage Least Square estimator (2SLS-IV) because the variable of GDP per capita may be endogenous. Indeed, we suspect that the level of investments and income in a province are determined simultaneously. More investments in transport infrastructure should produce a substantial economic impact in the province that take benefit from those investments. As instruments of the GDP per capita, we use the first lag of the GDP per capita and the mean number of schooling years in each province as a proxy of the level of education. Note that the Hansen test and the test of significance of the instruments do not reject the null hypotheses that the instruments are exogenous and strongly correlated with the instrumented variables (See **table 3**). Thus, these tests provide evidence of the validity of the instruments.

Note also that we compute standard errors robust to any bias from heteroskedasticity. Additionally, we adjust our estimates by clustering observations from the same region to account for the possible correlation between observations (provinces) from the same region ("Comunidad Autónoma").

[2] The only exception is the high correlation between GDP per capita and the stock of capital. As we will see below, this high correlation does not distort the individual interpretation of results for these variables.

Our estimation procedure does not take into account the panel data nature of the sample. The use of a fixed-effects model is not appropriate in our context since this technique drops anything that is time-invariant from the model, such as the distance to Madrid or being an island. A random-effects model is not appropriate because the individual effects related to provinces are likely correlated with the error term, as indicated by the Hausman test. Finally, the Hausman-Taylor estimator is not appropriate either since it assumes that all explanatory variables are exogenous.

Tables 3 displays the results of the estimates of the investment effort equations. We first estimate the total investment equation considering all transportation modes and then we differentiate between network modes (roads, railways) and no network modes (airports, ports) as described in the previous section. The resuls of the estimates of these specifications are indicated in **table 3**. In table A1, in the appendix, we also show the results of the estimates of the investment effort equations for each transportation mode. Recall that a major point in our analysis is to identify differences between investment patterns in network and no-network modes.

Insert table 3 about here

Results for total investments (**Model 1**) provide the expected relationships - with the only exception of GDP per capita, which appears positively related to total investments per capita- and shows a good fit of the model (R^2 = 0.56; F-test = 772.51***). In fact, our results confirm the centralization hypothesis by finding a negative and highly statistically significant impact of the coefficient associated with the distance to the political capital. Regions close to Madrid seem to receive more investment efforts than regions far from it. On the contrary, the redistribution objective accounted by the GDP per capita variable does not seem to play a significant role in central government investment programs. Indeed, we find a statistically significant relationship of its coefficient that implies more investment efforts in rich provinces and less efforts in poor regions. Being the first two policy variables statistically significant, the number of electoral votes received in a given province by the incumbent party ruling central government does not seem to drive total investment plans, at least when we consider all modes from an aggregate point of view.

Regarding mobility needs as investment determinants we find disappointing effects by not being any of the variables used – population and land area – statistically significant at 10%, although they present a positive impact on the dependent variable and land area’s coefficient appears to be significant at 15%. More significant are the variables accounting for investment inertia and existing capital stock. On one hand, the lag of total investments (**i_{it-1}**) is positively correlated with total investments and highly significant, making clear that investment programs usually cover several years. On the other hand, the impact produced by the lag of capital stock (**k_{it-1}**) on current investment efforts is negative, as is consistent with recent literature. This implies that total investments efforts tend to promote new infrastructure in provinces with lower stock endowment.

Finally, note the importance of using a variable denoting the regional governments enjoying political powers on network modes. The highly significant coefficient associated with these cases confirms that central government reduces its investment efforts where powers have been transfered.

Model 2 (network modes) and **model 3** (no network modes) show that most **Model 1** (aggregate investment) results are driven by network modes. The model fit drops and there are several coefficients' signs and statistical significance that change in **Model 3** in comparison to **model 1** and **model 2**. For instance, network mode's investment programs are influenced by the centralization strategy of investing near to the political capital, while no-network modes's investment effort appears to be positively related to distance. This means, as expected, that large ports and large airports can be found only far from the political capital. Being Madrid a city situated in the geographic center of Spain – unlike the most political capitals in Europe, which enjoy close access by water transportation modes- makes obvious the result for ports, although also in airports the transportation policy has avoid regional investments close to Madrid. This is the same to say that no relevant airports have been created to compete with the capital's airport. This is confirmed by **model 6** (airports) and **model 7** (ports) for each no-network modes.

The rest of policy variables provide mixed results as well. First, the variable of GDP per capita seems to be relevant in no-network modes while it appears positively correlated with network investments. Second, the variable *Votes* enjoys one of the only statistically significant coefficients of **Model 3** (no network modes) when, at the same time, is not relevent across previous models.

Significant differences can also be found in variables measuring mobility needs. Land area is associated with more network investment efforts, while in the case of no-network investments is the population the variable that appears relevant at 10%. Regarding the rest of variables we find that investment inertia's coefficient is the only variable that shares the same sign and statistical significance in both network and no-network models, although its coefficient drops appreciably when we just consider no network modes. Previous stock is not a driving determinant of investments in no-network efforts and being an island is only significant at 15%.

Insert table 4 about here

Finally, the results by transportation mode within network and no-network investments can be checked in the **Appendix** (**Table A1**). The results show that the road and port investments equations provide better model fit than rail and airport models. In fact, the lack of data regarding specific traffic by mode could be a reason of their weakness. All in all, we find that the distance to the political capital is still statistically significant in all cases except for airports, although its sign is positive for ports and negative for network modes consistently with results already presented. Again, the redistribution objective does not play any role in determining specific mode investment efforts. The electoral opportunistic strategy now arises as one important determinant of investment efforts in the case of roads, airports and ports. Interestingly, private investments in road transportation lead by toll motorway companies diminish public investment effort in regions having these private concessions. Also, islands seem to receive higher investment efforts for no-network – airports and ports – infrastructure than continental provinces, as was also expected.

Concluding remarks

The literature on determinants of regional allocation of infrastructure investment has shown that efficiency and redistribution are important drivers of the decisions made by the central governments regarding infrastructure investment. Besides this, political factors related to electoral strength and party alignment play a role as well. In addition to this, we claim that it shoul be paid more attention to factors related to wider meta-political objectives that the central government can follow by means of specific policies such as infrastructure investment.

Our results regarding variables traditionally used in the literature (economic as well as political) are generally consistent with previous empirical evidence. Regarding our main empirical contribution, we find that investment in network modes is influenced by the centralization strategy of investing near to the political capital. On the contrary, investment effort in no-network modes appears to be positively related to distance. Since investment in surface transportation infrastructures is much higher than that in airports and ports, and taken into account that regions surrounding the political capitals are poorer than the average, we suggest that centralization rather than redistribution has been the driver for the concentration of public investment on these regions.

The Spanish case illustrates that centralization can be a main driver of the allocation of surface transportation infrastructure. And it could well be the case that, sometimes, we take as redistribution what really is connecting the capital-city (geographical center) with peripherical regions with infrastructures that happen to cross through less developed regions. Is it redistribution or centralization?

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TABLES

Table 1. Descriptive statistics of the variables used in the empirical analysis (N = 1275)

Variable	Mean Value	Standard Deviation	Minimum value	Maximum value
$\dot{i}^{total}$	0.041	0.03	0.00007	0.32
$\dot{i}^{network}$	0.041	0.052	0	1.10
$\dot{i}^{no\text{-}network}$	0.09	0.34	0	9.82
k_{t-1}^{total}	3.14	2.46	0.24	16.22
$k_{t-1}^{network}$	2.90	2.45	0.01	16.22
$k_{t-1}^{no\text{-}network}$	0.24	0.38	0	2.88
Distance_capital	426.53	320.81	0	1770
GDP_per_capita	9,702.98	5,566.76	825.71	28,971.92
Land	10,162.75	4,847.82	12.3	21,766
Population	779,964.1	938,331.4	52,388	5,964,143
Votes_Incumbent_Party	41.89	9.87	15	66

Table 2. Correlation Matrix of the variables used in the empirical analysis (N=1150)

	$\dot{i}^{total}$	$\dot{i}^{net.}$	$\dot{i}^{no\text{-}net.}$	$k_{t-1}^{tot.}$	$k_{t-1}^{net.}$	$k_{t-1}^{no\text{-}net}$	**Dist.**	**GDPc**	**Land**	**Pop.**	**Vot.**
$\dot{i}^{total}$	1										
$\dot{i}^{network}$	0.98	1									
$\dot{i}^{no\text{-}network}$	0.01	-0.009	1								
k_{t-1}^{total}	-0.07	-0.06	0.012	1							
$k_{t-1}^{network}$	-0.07	-0.06	0.008	0.99	1						
$k_{t-1}^{no\text{-}network}$	-0.04	-0.06	0.04	0.17	0.05	1					
Dist.	-0.12	-0.14	0.07	-0.15	-0.21	0.47	1				
GDPc	-0.06	-0.07	0.08	0.81	0.78	0.37	-0.003	1			
Land	0.19	0.22	-0.06	-0.04	0.007	-0.42	0.32	-0.19	1		
Pop.	0.11	0.06	0.06	-0.20	-0.24	0.24	0.10	0.11	-0.14	1	
Votes	0.17	0.18	0.02	-0.06	-0.05	-0.09	-0.06	-0.16	0.40	-0.03	1

Note: In the computation of correlations, we exclude provinces that are located on islands.

Table 3. Investment equation estimates (2SLS)

	Model 1: All modes	Model 2: Network modes	Model 3: No network modes
Distance_capital	-9.06e-06 (2.37e-06)***	-0.000010 (2.41e-06)***	0.00015 (0.00008)*
GDP_per_capita	6.37e-07 (2.09e-07)***	5.73e-07 (1.91e-07)***	0.000010 (7.31e-06)
Land	2.14e-07 (1.33e-07)$^{+}$	2.97e-07 (1.35e-07)***	-4.06e-06 (4.38e-06)
Population	1.30e-10 (4.56e-10)	-3.23e-10 (3.97e-10)	1.42e-08 (6.94e-09)*
Votes- Incumbent_Party	0.00006 (0.00008)	0.00004 (0.00009)	0.0022 (0.00069)***
$\mathbf{i_{it-1}}$	0.71 (0.032)***	0.70 (0.03)***	0.15 (0.08)*
$\mathbf{k_{it-1}}$	-0.0016 (0.00039)***	-0.0015 (0.00036)***	-0.069 (0.06)
$\mathbf{D^{foral}}$	-0.0085 (0.0019)***	-0.009 (0.001)***	-
$\mathbf{D^{island}}$	-	-	0.07 (0.04)$^{+}$
Time_trend	-0.0001 (0.0001)	-0.00013 (0.00019)	-0.004 (0.004)
Intercept	0.012 (0.003)***	0.013 (0.004)***	-0.08 (0.04)*
N $\mathbf{R^2}$ **F (joint sig.)** **Hansen Test** **F-test of excluded instruments**	1104 0.56 772.51*** 0.12 27885.30***	1104 0.55 1077.73*** 0.003 25995.74***	1112 0.05 20.04*** 0.39 23517.90***

Note 1: Standard errors in parenthesis (robust to heteroscedasticity and clustered by region)
Note 2: Stastistical significance at 1% (***), 5% (**), 10% (*), 15%($^{+}$)
Note 3: Instruments for GDP per capita are the following: mean number of schooling years and first lag of GDP per capita.
Note 4: Hansen Test: H_o is no overidentification of all instruments. Excluded instruments test: H_o is weak identification of all instruments.

Appendix

Here we present the models used to estimate investment efforts by each transportation mode separately. Their results are also presented below.

Model 4: $i_{it}^{roads} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{roads} + \beta_7 k_{it-1}^{roads} + \beta_8 D^{foral} + \beta_9 Time\_trend + \beta_{10} D^{toll\_roads} + \beta_{11} Time\_trend + \varepsilon$

Model 5: $i_{it}^{rail} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{rail} + \beta_7 k_{it-1}^{rail} + \beta_8 D^{foral} + \beta_9 Time\_trend + \varepsilon$

Model 6: $i_{it}^{airports} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{airports} + \beta_7 k_{it-1}^{airports} + \beta_8 D^{island} + \beta_9 Time\_trend + \varepsilon$

Model 7: $i_{it}^{ports} = \alpha + \beta_1 Distance\_capital_i + \beta_2 GDP\_per\_capita_{it} + \beta_3 Votes_{it} + \beta_4 Pop_{it} + \beta_5 Land_i + \beta_6 i_{it-1}^{ports} + \beta_7 k_{it-1}^{ports} + \beta_8 D^{island} + \beta_9 Time\_trend + \varepsilon$

Table A1. Investment equation estimates (2SLS)

	Model 4: Roads	Model 5: Rail	Model 3: Airports	Model 4: Ports
Distance_capital	-9.12e-06 (2.60e-06)***	-0.00004 (0.00002)*	0.000003 (0.00004)	0.00002 (7.79e-06)***
GDP_per_capita	7.75e-08 (2.44e-07)	3.81e-06 (2.63e-06)	0.00001 (7.83e-06)$^{+}$	-1.75e-07 (3.09e-07)
Land	1.32e-07 (1.37e-07)	6.98e-07 (8.67e-07)	-1.80e-06 (3.85e-06)	-5.79e-07 (2.49e-07)
Population	-1.69e-09 (5.86e-09)***	2.60e-10 (2.76e-09)	1.61e-08 (5.57e-09)***	2.26e-09 (1.01e-09)**
Votes-Incumbent_Party	0.00008 (0.00004)*	0.00003 (0.0006)	0.0017 (0.0006)**	0.00021 (0.00008)***
$\mathbf{i_{it-1}}$	0.68 (0.018)***	0.51 (0.09)***	0.15 (0.07)**	0.66 (0.09)***
$\mathbf{k_{it-1}}$	-0.0019 (0.0007)**	-0.028 (0.009)***	-0.25 (0.18)	0.008 (0.002)**
$\mathbf{D^{foral}}$	-0.009 (0.001)***	-0.015 (0.013)	-	-
$\mathbf{D^{island}}$	-	-	0.17 (0.06)**	-0.024 (0.005)***
$\mathbf{i^{private}}$	-0.0009*** (0.001)	-	-	-
Time_trend	7.97e-08 (0.0002)	-0.0007 (0.026)	-0.06 (0.045)	0.000029 (0.00001)
Intercept	0.015 (0.0036)***	-0.0007 (0.026)	-0.06 (0.04)	-0.005 (0.003)*
N $\mathbf{R^2}$ **F (joint sig.)** **Sargan Test** **F-test of excluded instruments**	1104 0.56 1686.62*** 0.001 23378.66***	1104 0.26 66.30*** 0.46 30129.99***	1112 0.04 12.55*** 0.31 23012.17***	1112 0.65 104.94 2.42 23078.00***

Note 1: Standard errors in parenthesis (robust to heteroscedasticity and clustered by region)
Note 2: Stastistical significance at 1% (***), 5% (**), 10% (*), 15%($^{+}$)
Note 3: Instruments for GDP per capita are the following: mean number of schooling years and first lag of GDP per capita.
Note 4: Sargan Test: H_o is no overidentification of all instruments. Excluded instruments test: H_o is weak identification of all instruments.

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