University Transportation Research Center - Region 2

Final Report

The Politics of Infrastructure Investment Decision-Making: Report of the Statistical Analysis of Selected Hypotheses

Performing Organization: The City College of New York, CUNY

March 2014

Sponsor:
University Transportation Research Center - Region 2

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The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation's economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is "Planning and Managing Regional Transportation Systems in a Changing World." Presently, under the direction of Dr. Camille Kamga, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC's three main goals are:

Research

The research program objectives are (1) to develop a theme based transportation research program that is responsive to the needs of regional transportation organizations and stakeholders, and (2) to conduct that program in cooperation with the partners. The program includes both studies that are identified with research partners of projects targeted to the theme, and targeted, short-term projects. The program develops competitive proposals, which are evaluated to insure the mostresponsive UTRC team conducts the work. The research program is responsive to the UTRC theme: "Planning and Managing Regional Transportation Systems in a Changing World." The complex transportation system of transit and infrastructure, and the rapidly changing environment impacts the nation's largest city and metropolitan area. The New York/New Jersey Metropolitan has over 19 million people, 600,000 businesses and 9 million workers. The Region's intermodal and multimodal systems must serve all customers and stakeholders within the region and globally.Under the current grant, the new research projects and the ongoing research projects concentrate the program efforts on the categories of Transportation Systems Performance and Information Infrastructure to provide needed services to the New Jersey Department of Transportation, New York City Department of Transportation, New York Metropolitan Transportation Council , New York State Department of Transportation, and the New York State Energy and Research Development Authorityand others, all while enhancing the center's theme.

Education and Workforce Development

The modern professional must combine the technical skills of engineering and planning with knowledge of economics, environmental science, management, finance, and law as well as negotiation skills, psychology and sociology. And, she/he must be computer literate, wired to the web, and knowledgeable about advances in information technology. UTRC's education and training efforts provide a multidisciplinary program of course work and experiential learning to train students and provide advanced training or retraining of practitioners to plan and manage regional transportation systems. UTRC must meet the need to educate the undergraduate and graduate student with a foundation of transportation fundamentals that allows for solving complex problems in a world much more dynamic than even a decade ago. Simultaneously, the demand for continuing education is growing – either because of professional license requirements or because the workplace demands it – and provides the opportunity to combine State of Practice education with tailored ways of delivering content.

Technology Transfer

UTRC's Technology Transfer Program goes beyond what might be considered "traditional" technology transfer activities. Its main objectives are (1) to increase the awareness and level of information concerning transportation issues facing Region 2; (2) to improve the knowledge base and approach to problem solving of the region's transportation workforce, from those operating the systems to those at the most senior level of managing the system; and by doing so, to improve the overall professional capability of the transportation workforce; (3) to stimulate discussion and debate concerning the integration of new technologies into our culture, our work and our transportation systems; (4) to provide the more traditional but extremely important job of disseminating research and project reports, studies, analysis and use of tools to the education, research and practicing community both nationally and internationally; and (5) to provide unbiased information and testimony to decision-makers concerning regional transportation issues consistent with the UTRC theme.

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Project's Website:
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Principal Investigator:

Dr. Joseph Berechman
Professor and Chair, Department of Economics
The City College of New York
160 Convent Avenue
New York, NY 10031
Tel: (212) 650-6214
Email:jberechman@ccny.cuny.edu

Dr. Patrizia Nobbe
The Graduate Center, City University of New York
New York, NY 10016
Email: pnobbe@gc.cuny.edu

Performing Organization: The City College of New York, CUNY

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Mailing Address:

University Transportation Reserch Center
The City College of New York
Marshak Hall, Suite 910
160 Convent Avenue
New York, NY 10031
Tel: 212-650-8051
Fax: 212-650-8374
Web: www.utrc2.org

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The Politics of Infrastructure Investment Decision-Making: Report of the Statistical Analysis of Selected Hypotheses

Patrizia Nobbe and Joseph Berechman

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1. Introduction

The objective of a statistical analysis of the politics of mega-project decision-making is to examine political and other project indicators and compare their impact on project decisions and performance. To our knowledge, no statistical analysis that establishes systematic political patterns across international, multi-type transportation mega-projects exists. Hence we developed an extensive database with relevant variables.

1.1. Notes about the Database

The database comprises 60 projects in 22 countries, which include railways, highways and bridges, subways, tunnels and intermodal projects. The investment volume is typically at least $1 billion per project. More than 60 variables for each project allow insights into the politics and economics of project decision-making. We included political contextual and project-specific variables, and will introduce relevant variables in each section below. Appendix B provides a complete list, including categories, coding and a few notes about the data. Appendix C describes the project and variable distribution and frequencies in detail. We collected the information mainly from three public sources: 1) newspapers, 2) project websites, and 3) the database of the OMEGA Research Centre at the City College in London (OMEGA, 2010).

1.2. Statistical Tests

We used a variety of statistical tests, depending on the nature of the variables and the potential relationships. Binomial tests assess data representativeness; different theory-led correlation tests and non-parametric tests (Mann-Whitney U) display significant associations. Multivariate linear, binary and multinomial regressions test more complex models. While we will explain each test in a footnote the first time we use it, Appendix F provides an overview of all these tests.

1.3. Project Selection

We selected the 60 projects near or above the threshold of $1 billion (2010 $). A few projects are below that threshold, but they were listed as mega-projects in various other sources. Further, we selected projects to achieve proportionality along some major dimensions: 1) regional proportionality (We aimed to have at about five projects on each continent, at minimum); 2) at least five projects in each of the assigned project ranges (inner-city, metropolitan, regional, national, international); and 3) at least five observations for project types like highways, bridges, tunnels or other. One of the issues of the selection is that we do not (or cannot) know, in each case, what the project alternatives were. This affects the analysis because we only take into account projects that proceeded to completion (except in the five cases of canceled projects). The analysis thus has a "positive" bent, in the sense that it does not tell what would *not* work.

1.4. Data Representativeness

The projects constitute a significant portion of the total investment volume of a given time period in their respective countries. In Appendix D, we compiled a list of percentages of the aggregated investment volume of the database projects per country and the respective national transportation infrastructure investment volume. The list establishes the proportions of the

dataset vis-à-vis the real world, and thus the representativeness of the data. By average, the projects constitute between 1 and 44 percent of the national transportation investment volumes, with an average of 13.5 percent, which makes the data very representative.

1.5. Notes about the Presentation of the Results

The report is organized by five themes: 1) macro-political indicators and their relationship to project decision-making, 2) project decision-makers, 3) transparency matters and the basis of the decisions, 4) the role of opportunity and crises situations for mega-projects, and 5) the nature of funding as political dependent and independent factors. In the end, we will offer a general conclusion about the nature of project decision-making according to the data.

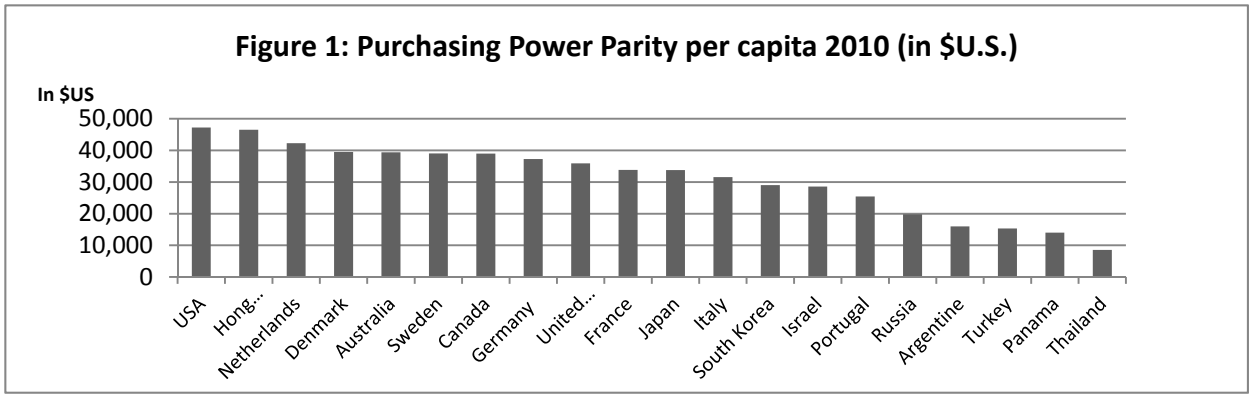
Each of the five core sections starts out by introducing and evaluating the core data. We then present various hypotheses and models and say a few words about the data and the chosen tests. After presenting the significant results in tables, we will explain them and assess their explanatory power. In the conclusion of each core section, we summarize the most important results, with notes of caution where appropriate. Each section may also be read as a stand-alone report on the important associations.

The hypotheses are partly derived from the literature, and partly guided by our own data exploration. For space reasons we will generally only display significant associations.

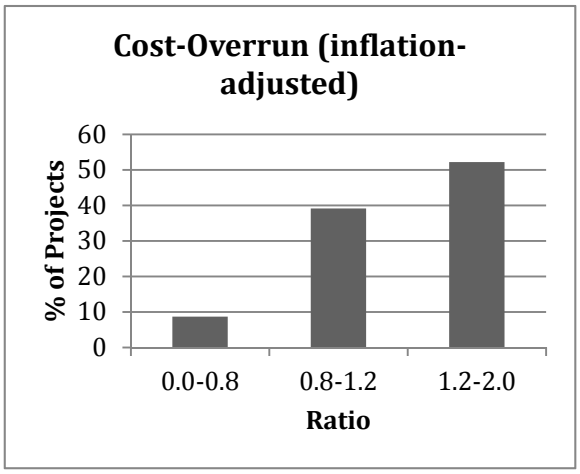
2. Macro-Political Factors and their Influence on Project Decision-Making

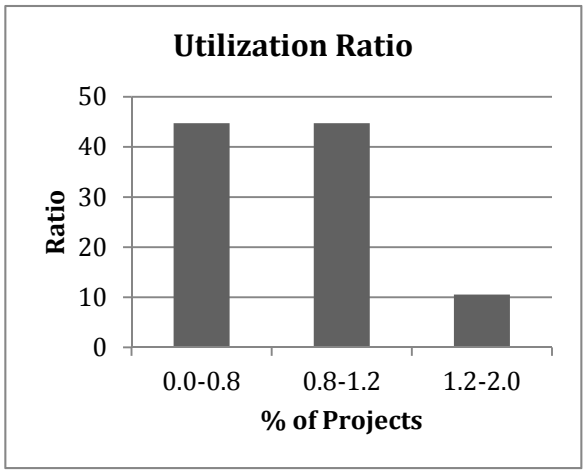
First we will look at possible effects of macro-level factors on transportation infrastructure investment characteristics and decisions. Macro-level factors include 1) the structure of the political system, 2) the type of the legislative system, 3) the type of party system, 4) the type of voting system, 5) cultural and 6) economic factors.

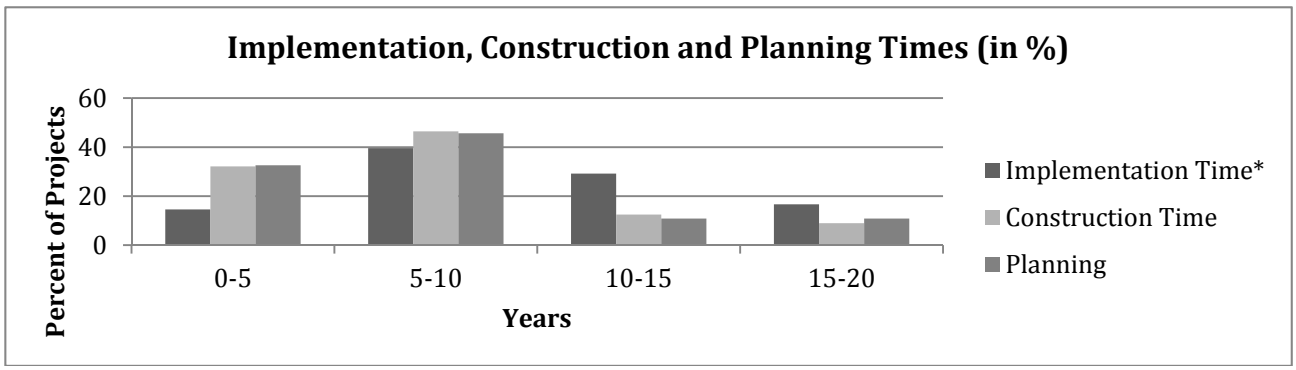
The political system variable (V9) records whether a country is federalist or centralized. 65% (39 projects) are located in centralized states. The "type of legislative system" variable (V10) captures whether the legislature is bi-or unicameral. 52% (31) are in states with a unicameral legislature. The "party system" binary (V55) distinguishes between two- and multiparty systems on the national level. 73% (44) are in multiparty systems. The variable "type of voting system" (V56) distinguishes between proportional, majority/plurality and mixed voting systems. 33% (20) of the projects are in proportional systems, 40% (24) in the second category, and 20% (12) in the third. Four projects could not be clearly categorized. Further, 32% of the projects (19) are located in Anglo-Saxon countries (the U.S., Great Britain and Australia). The majority of them is located in the U.S. The data includes macro-economic variables like GDP Purchasing Power Parity (V5) and GDP measures over time (V6, V7, and V8). Figure 1 shows the distribution of purchasing power across countries.



Because much of the mega-project literature is interested in project success factors (Flvybjerg et al., 2003), we examine associations between macro-political types and project success, which is defined in terms of project cost overrun ratios, project utilization and project construction or implementation times. The figures display frequency distributions.







The distribution of cost overrun and utilization ratios is uneven. Consistent with the literature, more than half of the projects experience cost overrun. Over 40% of the projects vastly fail their projected user numbers, but at least 10 percent exceed their projected goals. The overview of the planning, implementation and construction times suggests that these project phases are normally distributed but right skewed, as some mega-projects experience really long project phases.

Persson's work deals with the impact of macro-political electoral institutions on policy outcomes, and inspires the hypotheses in this section. Persson does not directly study megaprojects. Rather, his work emphasizes the importance of macro-structures on policy outputs, e.g. government spending or corruption indices.[1] Others have analyzed macro-level impacts, too; other authors work on the difference between proportional vs. majority systems on redistributive policies.[2] The argument is that proportional representation systems do have predominantly center-left government coalitions; center-right governments occur more frequently in majoritarian voting systems. But to clarify: whether there is a relationship between macro-political categories and particular mega-project investment decisions is not well explored.

We will first explore relationships between variables by non-parametric tests (Mann-Whitney U Tests and Spearman rank order) and correlations.[3]

2.1. Exploring Relationships between Variables

We will first list a set of hypotheses that guide the statistical tests, present the most significant findings in subsequent tables, describe them in more detail, and then summarize the results.

H2.1: Projects built in centralized governments are more successful.

H2.2: Macro-political factors such as the political system, the legislative structure, the party and the national voting system impact funding sources for projects.

H2.3: Bond-funded investment is more prevalent in federalist than in centralized countries.

H2.4: Project decision-making in federalist countries is more transparent than in centralized countries.

Table 2.1: Macro-Political Variables (Mann-Whitney U-Tests and Kruskal-Wallis Tests)

List of Predictors		Political System (Mann-Whitney)		Legislative Structure (Mann-Whitney)	
		Test statistic U (df)	Z (N)	Test statistic U (df)	Z (N)
H2.2	Prov. Funding	244 (1)*	-2.209		
	Bond Funding	527 (1)**	2.900	538 (1)*	2.421 (56)
H2.4	Transparency	271 (1)*	-2.219		

Reported in the table are only significant results: *sig≤.05, **sig≤.01, U=test statistic, df=degrees of freedom, Z=standardized coefficient, N=number of projects included in the analysis

Summary: Table 2.1 displays the most important findings.[4] We used the Mann-Whitney U-Tests[5] because we compared project characteristics between two macro-political categories.

[1] Persson, Torsten. "Do Political Institutions Shape Economic Policy?" *Econometrica* 70, no. 3 (2002): 883-905.
[2] Grossman, Gene M., and Elhanan Helpman. *Special Interest Politics*. Cambridge, Massachusetts: MIT Press, 2001.; Iversen, Torben, and David Soskice. "Electoral Institutions and the Politics of Coalitions: Why Some Democracies Redistribute More Than Others." *American Political Science Review* 100, no. 2 (2006): 165-81.
[3] For a description of each test see Appendix F.
[4] Important note: throughout the report we will only display those with significant outcomes.
[5] The non-parametric or rank order Mann-Whitney U Test ranks two independent groups by ranking them or comparing their means against an assumed distribution (for instance whether one population features larger values of a specific outcome than another). As opposed to parametric alternatives, the Mann-Whitney U Test is less susceptible to abnormal distribution of the data and unequal sample sizes. The output is the Mann-Whitney U value, the interpretation of which depends on the sample size, and the p value, which indicates whether there is a statistically significant difference between both groups (if so, then p<.01).

Most associations are weak, except for one bond type association. Provincial funding sources play a larger role in federalist than in unitary political systems (Mann-Whitney U=244, Z=-2.209, sig≤.05). More literally, there is a probability of 1 in 25 for this distribution to occur normally under the null hypothesis – rare enough to suggest there is a statistically significant difference in ranked distributions between groups (given sig≤.05, 2-tailed): the use of provincial funding sources varies between federalist and unitary countries in the real world.

Further, significant associations between the political system and bond funding show that projects in centralized systems are more often bond-funded than in federalist systems (U=527, Z=2.900, sig≤.01), with only about a 1:100 chance for the distribution to occur by chance. The political system variable is also associated with project transparency (U=271, Z=-2.219, sig≤.05): projects in federalist countries are more transparent than projects in centralized countries.

Project funding also differs by the type of legislative structure. In countries with bicameral legislatures project bond funding, compared to other funding types, is underrepresented (U=581, Z=2.421, sig≤.05). Finally, the Kruskal-Wallis test[6] (7.869, sig≤.05) shows that cost overrun is highest in projects in proportional voting systems, followed by mixed systems, and lastly by plurality/ majority systems. Now we will turn to discuss the findings in the light of the hypotheses.

H2.1: Projects built in centralized governments are more successful. The hypothesis was rejected. Macro-political characteristics and project success measures are not correlated, at least not directly. (Again, the results are not displayed in the table because we only display significant associations.)

H2.2: Macro-political factors such as the political system, the legislative structure, the party and the national voting system impact funding sources for projects. The political system and legislative structure bear on the typical types and sources of funding employed in mega-projects: regional/provincial funding sources play a larger role in federalist countries (U=244, Z=-2.209, sig≤.05) and private sources play a larger role in centralized countries (U=485, Z=2.015, sig≤.05, 2-tailed). The first association is not surprising: only projects under federally organized governments (21 out of 60) have sub-national (state or regional level) funding sources. The second association will be further investigated in Section 5.

H2.3: Bond-funded infrastructure investment is more prevalent in federalist than in centralized countries. The hypothesis was rejected: bond-based funding is more prevalent in centralized (U=527, Z=2.900, sig≤.01) than in federalized states. Any causation between macro-political arrangement and funding types are likely also driven by factors we am not able to account for. These may include overall public finance practices in each individual country and larger political-economic policies of the type analyzed by Persson[7] in general.

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[6] The non-parametric Kruskal-Wallis test is an extension of the Mann-Whitney U Test. The test allows comparing more than two independent groups. Similar to the Mann-Whitney Test, the data does not need not be in equal interval scale, the population does not need to be normally distributed, and the samples need not have equal variances. It assumes that the dependent variable is measured at an ordinal level, and that the independent variable consists of more than two independent categories. The test provides a ranking for each group, and the statistical significance, which allows for conclusions about the effect of the independent variables on the groups.

[7] Persson, Torsten. "Do Political Institutions Shape Economic Policy?" *Econometrica* 70, no. 3 (2002): 883-905.

H2.4: Project decision-making in federalist countries is more transparent than in centralized countries. The hypothesis was confirmed: decision-making is more transparent in federalist countries (U=271, Z=-2.219, sig≤.05). It is possible that the comparatively large number of U.S. projects in the database drives the association, because projects receiving federal funds in the U.S. (without the federal government being a decision-maker) face thorough documentation requirements.

The next set of hypotheses guides the exploration of voting systems and Anglo-Saxon states (the U.S., Great Britain and Australia) with other variables.

H2.5: Infrastructure projects in two-party systems are underwritten by a greater variety of funding sources than projects in multiple party systems.

H2.6: Anglo-Saxon projects face more opposition than projects in centralized countries.

H2.7: The nature of the voting system affects project success measures like cost overrun.

Table 2.2: Macro-Political Variables (Mann-Whitney U-Tests and Kruskal-Wallis Tests)

List of Predictors		Voting System (Kruskal-Wallis)		Anglo-Saxon (Mann-Whitney)	
		Test Statistic	(N)	Test statistic U (df)	Z (N)
H2.6	Opposition (ideol.)			490 (1)	2.460 (58)
H2.7	Cost Overrun	7.869	(41)		

Reported in the table are only significant results: *sig≤.05, **sig≤.01, U=test statistic, df=degrees of freedom, Z=standardized coefficient, N=number of projects included in the analysis

Summary: Project opposition is stronger in Anglo-Saxon countries than in others (490/ 2.460). Cost overrun is associated with proportional voting systems (7.869). Referring back to the hypotheses:

H2.5: Infrastructure projects in two-party systems are underwritten by a greater variety of funding sources than projects in multiple party systems. The hypothesis was rejected. We are not surprised and conclude that lots of different factors other than macro-structural ones drive the funding composition of projects.

H2.6: Anglo-Saxon projects face more opposition than projects in centralized countries. The dataset contains four types of project opposition: political, ideological, issue-oriented or no opposition. The hypothesis was confirmed for "ideological" opposition (490/ 2.460*).[8] We will analyze the association in a regression model in Section 2.3 below. There seems to be less opposition to projects in centralized than in federalist systems (Mann-Whitney U-Test 490/ 2.460* - not displayed in table).

H2.7: The nature of the voting system affects project success measures like cost overrun. The test statistic is not really telling, since the voting system variable has three categories (see Appendix B). The box plots associated with the Mann-Whitney U Test show that cost overrun is highest in proportional voting systems (like Denmark), followed by mixed voting systems (Germany). It is lowest in plurality voting systems like the United States.

[8] For distributions and categorizations, view Appendices B and C.

Next we examined some associations with Spearman's rank order correlations[9] for ordinal variables and Pearson's[10] for the scale variables.

H2.8: Macro-political organization affects choices between project types like highway or rail.

H2.9: Local decision makers are more involved in project decisions in federalist countries than in centralized ones.

Table 2.3: Macro-Political Variables (Spearman Rank Order and Pearson's Correlations)

List of Predictors		Political System	Legislative Structure	Party System
H2.9	Decision-Makers: local			.273* (57)
	Decision-Makers: regional	-.682** (59)	-.428** (59)	.361** (57)
	Decision-Makers: national	.543** (59)	.423* (54)	-.341** (57)
	Decision-Makers: international	.315* (59)	.323* (59)	

Reported in the table are only significant results: *sig≤.05 **sig≤.01; values: Pearson's R (and number of projects)

Summary of the Results: The correlations between provincial and national decision-makers and the political system are highly significant. The association between political systems and regional decision-makers is quite strong (-.682). At a .01 probability level regional decision-makers are more involved in decision-making in federalist governments than in centralized ones (-.682, sig≤.01). National decision-makers in centralized countries (.543, sig≤.01) are more involved in project decision-making than their pendants in federalist governments. International infrastructure decision-makers play a larger role in centralized countries (.315, sig≤.05).

The legislative structure impacts decision-makers as well. There are more regional/ provincial decision-makers in bicameral legislative systems (-.428, sig≤.01) and more national (.423, sig≤.05) and international decision-makers (.323, sig≤.05) in unicameral legislative systems. In the macro-political categories only the type of party system has a systematic effect on the involvement of decision-makers on the local level: local decision-makers are less involved in multiple-party systems than in two party systems (.273, sig≤.05); the same is true for provincial/regional decision-makers (.361, sig≤.01). There are more national decision-makers involved in project decision-making in two-party systems than in multiparty systems (-.341, sig≤.01).

H2.8: Macro-political organization affects choices between project types like highway or rail. The hypothesis was not confirmed.

H2.9: Macro-level political factors determine who plays a role in mega-project decision-making. The data validates associations between macro-level factors and decision-makers, at least on

[9] The Spearman Rank Order Test is a non-parametric measure testing an association between two variables, e.g. if the value of one variable increases or decreases depending on the value of another one. The test may be used with discrete or ordinal data. Similar to the Pearson's Correlation coefficient, ranges of outcomes are between -1 and 1, with -1 being a negative correlation, 1 being positively correlated, and a value of 0 describing no correlation. Spearman correlations are less sensitive to outliers than the parametric Pearson's correlations.

[10] Pearson's correlations are measures of linear statistical correlation or the dependence between two variables, e.g. if the value of one variable increases or decreases depending on the value of another one. The values of the outcome coefficient range between -1 and 1. The closer the coefficients are to the values 1 and -1, the stronger the correlation. With a coefficient of 0 the variables show no statistical association. The negative or positive value describes the direction of the curve. The Pearson's test, a parametric test, works best with scale data.

some dimensions. As expected, national decision-makers are more strongly involved in centralized countries. However, even though the statistical probability is strong, the association is not (-.341, sig≤.01). The participation of local decision-makers in project decisions is lower in centralized than in federalist countries, so one part of the hypothesis could be confirmed (.273, sig≤.05). But the correlation is weak also. Projects located within centralized countries (and those with one legislative house) have more international decision-makers than projects in federalist countries with two houses (.315, sig≤.05). This is not surprising, as many of the European Union member-states are smaller and centralized, and border-crossing supra-national infrastructure in the European Union keeps expanding.

There are not many two-party dominated countries in the world, and 20 percent of the projects are located within one of them (the United States), so the significant results with respect to party systems should not be overstated. But the displayed tendency reinforces the other trends in the table, with the addition that local decision-makers are less involved in projects in multi-party systems (.273, sig≤.05). While pleased that the results show that the data is consistent, we will check for some additional intervening factors in the next section.

2.2. Regression Models

In this section we examine various effects of macro-structural variables on a range of dependent variables. The results in Table 2.1 already indicated an association, so it is likely that the more pronounced devolution of decision authority in federalist systems impacts funding choices available at the state and local levels.

H2.3: Bond-funded infrastructure investment is more prevalent in federalist than projects in centralized countries.

We hypothesize that the political system affects funding types. Specifically, we assume that the structure of federalist countries supports bond-funding schemes for infrastructure investment.

We add project types and project location as independent variables in Model 1. Based on the structure of the dependent variable and model fit tests, we chose a linear model.[11]

Model 1: V36=a+Var9x+Var54x+Var11x
Y = Funding Type: Bonds (V36)
X = Political System (V9), Project Types (V54), Project Location (V11)

Table 2.4: The Impact of Macro-Political Influences on Project-Related Variables: Bond Funding (Linear and Binary Regressions)

List of Predictors	Model 1 (linear regression)	Model 2 (binary regression)
Political System	29.794**	1.933/ 6.908**
Project Type	25.028* (highways)	-1.340/ 3.819* (highways)
Project Location	16.123* (inner city)	
Constant	21.531*	-396/ .673**
N	57	57
Model Fit	.246	.167/ .236

For linear regression: displayed: B values, *sig≤.05 **sig≤.01; Model fit: Adjusted R Squared; n.s. = not significant. For binary regression: Beta/ Exp(B); *sig≤.05 **sig≤.01; Model fit: Cox & Snell R Square/ Nagelkerke R Square;[12] n.s. = not significant.

[11] Regression analysis allows making quantitative predictions about the effects of one or more variables on a "dependent" variable. The independent variable/s exercises a hypothesized influence on the dependent variable: depending on the values of the independent variable/s, the dependent variable changes as well. Depending on the type of model, the relationships may be linear, quadratic or cubic.
Linear Y=b0+(b1*t)
Quadratic Y=b0+(b1*t)+(b2*t**2)
Cubic Y=b0+(b1*t)+(b2*t**2)+(b3*t**3)
In the given relationships Y is the dependent variable and b represents the slopes of the functions. In linear, quadratic and cubic model specifications, the dependent variables are continuous. Linear, quadratic or cubic model choices refer to the hypothesized curve of the slope: a linear function assumes a straight curve, quadratic and cubic ones curved slopes (i.e. they signify thresholds at which the association noticeably changes). Associated tests of statistical significance evaluate how likely it is that the predicted shapes of the associations reflect the true associations in the real world.
R Squared is the typical "model fit" test that assesses how well the hypothesized model fits the sample data. The closer the value is to 1, the better the model. For a more detailed overview over regression assumptions, see Appendix F.

[12] The Cox & Snell R Squared and Nagelkerke R Squared are used as model fit tests for binary regressions. I report both values in the database. The two model fit tests technically differ from the R Squared values that assess model fit in linear regressions, but their interpretation is similar: The closer the value is to 1, the better the does the model fit the data points in the database – or, the larger the value the better the model fit.

Qualitative Interpretation: The results of the models, with about 25 percent explanatory range each, are not insignificant for social science data. Overall, the models show that the political system has some influence on project funding types.

Model 1 in Table 2.3 shows that bond funding is more typical in centralized than in federalist countries (29.794, sig≤.01). The B value of 29.79 suggests a steeper curve. We added project type as a control variable, because in most countries funding sources and types differ by project type. The results confirm a positive relationship between highway projects and bond funding (25.028, sig≤.05) and with inner city projects (16.123, sig≤.05). Projects in non-federal systems are more often funded by bonds, particularly highway and inner city projects.

Model 2: $$P(V36) = \frac{1}{1 + e - (a + bV9 + cV54)}$$

Y = Funding Type: Bonds (V36)

X = Political System (V9), Project Types (V54)

After having turned the dependent variable into a binary, we use binary regression in Model 2, which is a better model specification. The test confirms the result of the first model by showing that bond funding is more prevalent in centralized than in federalist countries (1.933/ 6.908).

Quality of the Statistical Results: The models meet all necessary assumptions for linear regressions, although the Shapiro-Wilk test[13] for the normality of error is a bit low. Non-parametric tests like binary logistic regressions require the data to meet fewer assumptions than parametric tests. We tested the quality of the binary logistic regression results by looking at the ROC (Receiver Operations Graphs) curves of the results.[14] Specific results are displayed in Appendix E, an explanation of the statistical tests that have been conducted is in Appendix F.

H2.4: Project decision-making is more transparent in federalist than in centralized countries. Here we hypothesize that the political system affects project transparency. Again, the devolution and fragmentation of the political landscape in many federalist countries might account for different cultures of decision-making or documentation. A binary regression model[15] is employed to capture a transparency trend in either direction. We turned the transparency data, usually a scale variable (described in more detail in Section 3 below), into a binary.[16] We included project types and project location in the model.

Model 1: $$P(V50) = \frac{1}{1 + e - (a + bV9 + cV54 + dV11)}$$

Y = Transparency (V50)

[13] This test uses studentized residuals to determine whether the assumption of the "normality of error" is met. That means that residuals, or errors, should be random and normally distributed at the values of the dependent variable. Any value that is larger than p<.05 (if that it the set threshold, or "alpha value") is good to go, meaning that the errors are normally distributed, and p=1 is perfect.

[14] For an explanation of ROC curves, see Appendix F. Individual ROC Curve graphs and more information are displayed in Appendix E.

[15] Binary logistic regressions are selected when the dependent variable is a binary variable, and the independent variables scale or ordinals. Non-parametric tests require for the data to meet fewer assumptions than parametric tests.

[16] we did test linear models, too, without a significant result.

X = Political System (V9), Project Types (V54), Project Location (V11)

The data rejects the hypothesis - there were no significant results for the influence of the type of political or legislative structure on project transparency when holding constant project types or location. The model (or limits to the data) cannot explain the association indicated by the non-parametric tests above.

H2.6: There is more project opposition in Anglo-Saxon states than in others. We hypothesize that Anglo-Saxon political culture affects project opposition. We assume opposition may vary by culture because decision frameworks, implementation requirements and actors differ in each country. Hypothetically states may be grouped: Anglo-Saxon states are a "type" with a particular culture of public spending that differ from spending patterns in Scandinavian or European states (Esping-Andersen, 1990). The different patterns of project opposition could be a result of less egalitarian approaches to public spending in Anglo-Saxon countries, which would in turn provoke stronger responses to large-scale investment decisions. The selection of the hypothesis is further supported by the significant results of the parametric tests in Table 2.2. We added the variables "project types" and "project location" to the model.

Because the outcome variable is binary[17] we chose a binary logistic regression. We will first show Model 1, and a variation of the model (Model 2) below Table 2.5. Second order effects can be ruled out because all variables in the model are binaries.

Model 1: $$P(V28) = \frac{1}{1+e-(a+bV59+cV12+dV52)}$$

Y = Ideological Opposition (V28)

X = Anglo-Saxon (V59), Project Types (V12), Decision Makers (V52)

Table 2.5: Effects on Ideological Opposition (Logistic Binary Regression)

List of Predictors	**Model 1**	**Model 2**
Anglo-Saxon	1.743/ 5.715*	1.270/ 3.559*
Project Type: rail	n.s.	n.s.
Project Location: inner city projects		1.606/ 4.984*
Local Decision-Makers	n.s.	
Constant	-1.332/ .264**	-2.370/ .093**
N	57	58
Model Fit	.134/ .188	.177/ .249

Displayed: Beta/ Exp(B); *sig≤.05 **sig≤.01; Model fit: Cox & Snell R Square/ Nagelkerke R Square; n.s. = not significant.

Summary of the results: The results in Table 2.5 do somewhat support the hypothesis. Model 1 shows that ideological opposition is stronger in Anglo-Saxon countries (1.743/ 5.715, p>.01) than in other parts of the world. At the same time, project types and levels of decision-making do not impact opposition; the associations are insignificant.

Model 2: $$P(V28) = \frac{1}{1+e-(a+bV9+cV12)}$$

Y = Ideological Opposition (V28)

X = Anglo-Saxon (V59), Project Types (V12), Project Location (V12)

[17] We categorized the opposition types by absence or presence of opposition; for the different types: Appendix B.

Model 2 shows that ideological opposition is stronger in Anglo-Saxon countries (1.270/ 3.559, p>.05), while the project type is not significant. Altshuler and Luberoff[18] hold that inner-city transportation projects are particularly contested. Local decision-makers were not significant in Model 1, so we tested for inner-city projects to explain opposition. As it turns out, ideological opposition is strongest for inner-city projects (1.606/ 4.984, p>.05), thus confirming Altshuler/Luberoff's thesis.

However, there are three caveats: first, Altshuler and Luberoff[19] are only discussing U.S. cities; second, they focus primarily on opposition to highway projects; and third, they discuss soaring opposition in the 1960s and 1970s, after the highway boom that destroyed entire – especially poorer - neighborhoods. The majority of our projects started in the 1980s. These caveats do not prevent a cautious conclusion, though, since the majority of the Anglo-Saxon projects are in the United States. So the hypothesis is supported.

Statistical Quality: Here, the quality of the results, in statistical terms, is fair, with ROC values in the range of 72% to 76%.

2.3. Summary

Macro-political factors do not significantly impact decision-making, project success or transparency, nor do they directly impact project choice, variability or number of funding sources. These results are consistent with our expectations, and we conclude that any number of different factors, other than macro-structural ones, drive project decisions. There are three areas where macro-political factors exercise limited influence.

1. Macro-level factors and different levels of decision-making are associated. As expected, national level decision-makers exercise more influence in centralized countries, where transportation investments and policies are also more centrally organized. Regional level decision-makers, on the other hand, play a larger role in federalist countries.

Further, projects located within centralized, smaller countries have more international decision-makers than projects in federalist countries. The explanation is that most European countries are centralized. In addition, European projects usually receive partial funding from the European Union, which are here counted as international. We will pick up on this in more detail in Section 3 (Table 2.2).

2. There are some tentative indicators that macro-political characteristics impact funding types. For example, bond funding plays a stronger role in centralized countries. We will explore this concept further in Section 5 on project decisions and the nature of funding (Table 2.1 and Model 2.3).

3. Ideological opposition is stronger in Anglo-Saxon countries than in other countries. Possible caveats, however, are given in the discussion for Model 2.6 (Table 2.3 and Model 2.6).

4. The non-parametric tests held that the political system affects project transparency. Since we were not able to confirm this in the regression analyses (which included various explanatory

[18] Altshuler, Alan, and David Luberoff. *Megaprojects: The Changing Politics of Urban Public Investment*. Washington, D.C.: Brookings Institution Press, 2003.
[19] Altshuler, Alan, and David Luberoff. *Megaprojects: The Changing Politics of Urban Public Investment*. Washington, D.C.: Brookings Institution Press, 2003.

variables to the model), we assume the differences are driven by something for which we cannot account. We will explore the issue of transparency further in Section 4 below.

3. Project Decision-Makers

3.1. The Data

Because transportation and investment policies and procedures vary by country, state or project type, we expect different proportions and compositions of decision-makers per project. We distinguished five levels of decision-making: local actors, regional or state actors (mainly the subnational units in federalist systems), transportation agencies, national and international decision-makers. Included are those decision-makers that took part in any major political decision points. Most projects involve national level decision-makers (70% of the projects), followed by regional (40%), Transport Agency decision-makers (23.3%), local (21.6%) and international ones (15%). Since we are looking at different countries with multiple decision-making frameworks, it is difficult to establish how representative these proportions are, or which thresholds apply (with the exception of national decision-makers, which we will discuss following the presentation of the results).

Binomial tests[20] (below) show that none of these ratios, except for the regional decision-makers ratio, are likely to exist by chance at a 50 percent threshold. So they might be true representatives of the general population.

Local decision-makers:	prop. 0.5, test stat=46, Z=4.166, sig≤.05, two-sided
Regional decision-makers:	prop. 0.5, test stat=35, Z=1.302, n.s., two-sided
TA decision-makers:	prop. 0.5, test stat=45, Z=3.906, sig≤.05, two-sided
National decision-makers:	prop. 0.5, test stat=42, Z=3.125, sig≤.05, two sided
International decision-makers:	prop. 0.5, test stat=50, Z=5.208, sig≤.05, two-sided

Since there is no internationally comparative literature on mega-projects that would assess these ratios, it is difficult to gauge what the proportions should be to be truly representative. The tests show that at a 0.5 threshold, the proportion of national-level decision makers (70%) is too large to likely happen by chance. However, the literature *does* acknowledge strong national-level involvement in megaproject decision-making. Thus we raised the test threshold to 60 percent. The result was insignificant (prop. 0.6, Test Stat=42, Z=1.621, n.s. (one-sided)), which means that the sample would be a more or less accurate application of reality – provided national decision-makers are routinely involved in multi-billion dollar project investments. Altogether, this confirms that the national level, statistically speaking, assumes the largest role in project decision-making. We already know that the ratios vary by type of government system (see Table 2.2).

3.2. Exploring Relationships between Variables

The relationships are given by the following hypotheses:

H3.1: Anglo-Saxon projects involve more local and regional decision-makers in project decisions.

[20] Binomial tests test the probability that a binary sample reflects a likely distribution in the general population. Statistical tests operate with the default threshold of .5 (50%). With this threshold, the sample distribution is evaluated against the probability that the data distribution corresponds to 50/50 in the real world. The test value reflects the deviation from that probability. The threshold may be changed to reflect hypothesized proportions of the given general population based on theory or observation.

H3.2: The types or nature of the project stimuli influence the types of project decision-makers.

H3.3: There is less project opposition when national decision-makers are involved than when decisions are made on sub-national levels.

H3.4: National level decision-makers conduct more cost-benefit analyses than project decision-makers on local or regional levels.

H3.5: Project-planning times are longer for national level projects than projects on other levels.

Table 3.1. displays parametric test results.

Table 3.1: Parametric Tests (Spearman and Pearson's Correlations)

List of Predictors		Local Decision-Makers	Regional Decision-Makers	TA Decision-Makers	National Decision-Makers
H3.1	Anglo-Saxon		.561** (58)		-.680** (58)
H3.2	Special situation			.338** (58)	
H3.3	Opposition: ideological		.458** (58)	-.394** (58)	-.277* (58)
	Opposition: none	.306* (58)			
H3.5	Planning Years***		-.369* (46)		-.376** (58)

Displayed: Pearson's R, *sig≤.05 **sig≤.01, ***Pearson Correlations, TA=Transportation Agency

Summary: The results indicate less project opposition when local decision-makers are involved (.306, sig≤.05), although the relationship it not strong. Regional decision-makers are more involved in Anglo-Saxon countries (.561, sig≤.01). They also face more ideological opposition (.458, sig≤.01), while the number of planning years for projects decreases in their presence (-.369, sig≤.05). More transportation agency decision-makers are involved in special-stimulus situations (.338, sig≤.05) (for a more detailed explanation, see Appendix B), while projects tend to face less ideological opposition (-.394, sig≤.05). Local level decision-making is associated with more opposition[21] (.306, sig≤.05). Finally, national decision-makers are less involved in Anglo-Saxon countries (-.680, sig≤.05) and in the face of ideological opposition (-.277, sig≤.05). The number of planning years decreases when they are involved (-.376, sig≤.05).

H3.1: Anglo-Saxon projects involve more local and regional decision-makers in project decisions. Fewer national but more regional level decision-makers are involved in Anglo-Saxon project decision processes than outside that sphere. Pearson's R indicates a strong association (.561**). Thus, the hypothesis was confirmed for regional and national levels of decision-making. However, the correlation between regional level decision-makers and Anglo-Saxon countries should not be overstated, as it rests on the fact that most Anglo-Saxon countries are also federally organized. Hence, it is not surprising that regional authorities are the key decision-makers in most projects there – this was already discussed this following Table 2.2.

H3.2: The types or nature of the project stimuli influence the types of project decision-makers. Transportation agency decision-makers are more strongly involved in projects that were implemented in preparation for, or in the wake of, special scenarios like German reunification projects or special constructions for the Olympics. The association is likely the consequence of

[21] The coding is counter-intuitive.

implementation agencies being created for such special purposes. In the scenarios either the historic-institutional legacy of decision-making is disrupted, or established practices are not available, so special agencies handle project decisions and implementation.

H3.3: There is less project opposition when national decision-makers are involved than when decisions are made on sub-national levels. In some cases project decisions are being moved up to the national level to avoid conflict, if there is a strong potential for opposition on the local level. Indeed, we found that (ideological) project opposition is stronger when regional level decision-makers are involved than any other level, and less on TA and national levels. So H3.3 was confirmed. In combination with the results of Table 3.2 it may be inferred that the national level is more willing to take on projects that are cost-intensive (experience more cost overrun) but that are deemed necessary and do not inspire opposition. (The findings in Table 5.1 that projects with national funding sources meet their user projections better than projects with other funding sources, confirm this.)

H3.4: National level decision-makers conduct more cost-benefit analyses than project decision-makers on local or regional levels. Transport authority decision-makers do not appear to conduct more CBAs than other levels. The national level – as held by the hypothesis – does not influence the use of CBAs, either. So the hypothesis was not confirmed.

H3.5: Project-planning times are longer for national level projects than projects on other levels. The association between national and regional decision-makers and planning years is negative. So the number of planning years is shorter when these decision-making level are involved. The hypothesis is not confirmed. A lot of factors may play a role. The involvement of national decision-makers suggests different possible planning practices. Long-range planning and budgeting is more probable for national-level projects, while the practice of one-year planning cycles is generally more prevalent at local levels and the planning process and related issues thus more dispersed – and likely longer.

Next, we compare how levels of GDP, costs and cost overruns and some timing variables are affected by the presence or absence of types of decision-makers by conducting Mann-Whitney U-Tests. These tests, because they compare groups, allow seeing whether and which decision-making levels affect the variables. We thus hope to gauge the possible effects of different decision levels.[22]

H3.6: The higher the GDP PPP, the more project decisions are made at the national level.

H3.7: If (special-purpose) transportation agencies are involved, cost overruns are smaller.

H3.8: National level decision-makers tend to take on more complex, long-term projects.

H3.9: National level decision-makers are involved with the more expensive projects (costs/km).

H3.10: Project decision-making levels changed over time, specifically from the 1980s onward. More projects are now decided on sub-national levels.

Table 3.2 shows associations from the non-parametric tests.

Table 3.2: Non-Parametric Tests: Associations between Project Decision-Makers and Selected Variables (Mann-Whitney U-Test)

	Local Decision-Makers		Regional Decision-Makers		Transportation Agency Decision-Makers		National Decision-Makers	
	U (df)	Z	U (df)	Z	U (df)	Z	U (df)	Z

[22] More details on the test may be found in Appendix F.

H3.6	**GDP PPP**	372 (1)**	1.823 (58)						
	GDP 2010	412 (1)*	2.066 (59)	712 (1)**	4.525 (59)				
	GDP 2000	443 (1)**	2.636 (59)						
H3.7	**COR**					103 (1)*	-2.248 (43)	315 **	2.476 (43)
H3.8	**Decade Inception**	390 (1)*	2.265 (58)					188 **	-2.837 (58)
	Year of Inception							178 **	-2.920 (58)
H3.9	**Constr. Time**							452 **	3.322 (53)
H3.10	**Costs per km**	328 (1)*	2.087 (51)						

Displayed: U=test statistic (df=degrees of freedom), Z= standardized coefficient, N=project count, *sig≤.05 **sig≤.01,

Summary of the Results: Local decision-makers are positively associated with a country's wealth: the richer a country, the more local decision-makers are involved in project decisions (372, 1.283 sig≤.01, .412, 2.066 sig≤.05, .443, 2.636 sig≤.01). The same is true for regional decision-makers (712, 4.525, sig≤.01). Also, it appears local decision-makers have increased their relevance over the past few decades (.390, 2.265 sig≤.05). The change over time has been established through a variable that assigns an increasing value to each passing decade during which the main project decision was made. Higher values are associated with newer projects. Additionally, local decision-makers are associated with larger project costs per kilometer (328, 2.087, sig≤.05). Projects implemented by transportation agency decision-makers experience fewer cost overruns (103, -2.248, sig≤.05). National decision-makers are associated with larger cost overrun (.315, 2.476, sig≤.01) and longer construction times (.452, 3.322, sig≤.01). At the same time, their relevance has diminished over time – both measured by decade (188, -2.837, sig≤.01), and by inception year (.178, -2.920, sig≤.01).

H3.6: The higher the GDP PPP, the more project decisions are made at the national level. The hypothesis was not confirmed. Non-parametric tests show that the richer a country, the more decision-makers participate on a local level (372, 1.283 sig≤.01, .412, 2.066 sig≤.05, .443, 2.636 sig≤.01). The data shows no significant association between wealth and the national decision level. It is possible that the correlation is driven by the fact that a relatively large number of projects in the data set are located in very wealthy federalist countries (12 out of 60 projects in the U.S.), where the devolution of decision-making is stronger than in centralized countries (Table 2.2).

H3.7: If (special-purpose) transportation agencies are involved, cost overruns are smaller. The hypothesis was indirectly derived from the literature (e.g. Doig, 1983, Bordeaux, 2008) – and confirmed. Transportation-agency led projects have fewer cost overruns than projects decided by other levels of decision-making (103, -2.248, sig≤.05). The hypothesis was based on the assumption that the specialized organization of established transportation agencies may improve implementation efficiency. TAs further hold the potential to shelter decisions from political impacts, thus making implementation more efficient. Additionally we found that cost overruns are higher for national projects

H3.8: National level decision-makers tend to take on more complex, long-term projects. Local-level decision-makers gained influence over time (.390, 2.265 sig≤.05), while national-level decision-makers lost their influence (by inception decade: 188, -2.837, sig≤.01; by inception year: .178, -

2.920, sig≤.01), which confirms Altshuler and Luberoff's[23] devolution thesis (even though they were only focusing on the U.S.). We did not find any significant results for international decision-makers.

H3.9: National level decision-makers are involved with the more expensive projects (costs/km). The data confirms the hypothesis. Again, national decision-makers might take on complicated (and maybe less profitable) projects that are not pursued by lower decision-making levels. Related: longer construction times may drive up project costs, as well.

H3.10: Project decision-making levels changed over time, specifically from the 1980s onward. More projects are now decided on sub-national levels. Interestingly, projects with local decision-making participation have higher costs per kilometer.

3.3. Regression Models

The correlation results suggested that there is less "ideological opposition" when national decision-makers are involved (H.3.3.). This indicates that the national level takes on projects the public deems important, but that are possibly expensive. We test this association in the models below. For Model 1, we added the number of years a project has been considered as an indicator for project opposition: projects that have been around for a long time (as ideas) might be controversial and expensive. On the other hand they might also face less opposition, because the public has waited for them for a long time. The Second Avenue Subway in New York is an example. We included the decade of project approved, because we assume that the earlier projects are more likely to have encountered opposition.[24] Special interests (as project stimulus) might not sit well with the general population, either, when selecting a large-scale construction project.

H3.3: There is less opposition to projects when national decision-makers are involved, than lower level decision-making.

Model 1: $$P(V28) = \frac{1}{1+e-(a+bV52+cV26+dV58+eV19)}$$

Y = Ideological Opposition (V28)

X = National Decision Makers (V52), Years of History (V26), Decade of Inception (V58), Project Stimulus (V19)

In the model, y (ideological opposition) is a binary variable, impacted by national decision-makers and the control variables. We selected a binary logistic model first, because the outcome variable is binary, and because we don't expect strong attenuation affects. In the second model we treated the binary as a scale variable to test a non-linear model; hence, some of the statistical assumptions will not directly be met. Table 3.3 displays the results of the model. Model 2 will be described in more detail below the table.

Table 3.3: The Effects of National Decision Participation on Ideological Opposition (binary logistic and non-linear regression)

List of Predictors	Model 1 (logistic)	Model 2 (non-linear)
National Decision-Makers	-2.185/ .112*	-.337*
Years of History	-.021/ .979 (n.s.)	

[23] Altshuler, Alan, and David Luberoff. *Megaprojects: The Changing Politics of Urban Public Investment*. Washington, D.C.: Brookings Institution Press, 2003.

[24] Ebd.

Decade of Inception [grouped]	-609/ .544*	
Project Stimulus (special inter.)	.1262/ 3.531 (n.s.)	
Funding Type Bonds		.014*
Funding Type Bonds squared		.054 (n.s.) (squared)
Project Type Rail		
Constant	-2.397/ 10.989 *	.359**
N	50	55
Model Fit	.190/ .273	.125

Displayed in Model 1: Beta/ Exp(B); Model fit: Cox & Snell R Square/ Nagelkerke R Square; Displayed in Model 2: Beta; Model Fit: Adjusted R Squared; *sig≤.05 **sig≤.01.

National decision-makers affect ideological opposition negatively in both models. That is, the stronger the national level is involved, the weaker is ideological opposition to a project. Model 1 lists the log-odds and regression coefficients for further independent variables. The history variable has no significant effect. The time the project has been considered, however, does have an effect: the younger a project, the less likely it is that it faces project opposition. Admittedly, the time measure categories are rather crude (all projects before 1990, those until 1995, until 2000, and since). We may infer, however, that projects are less contested now than they were in the past. Another variable, project stimulus (projects constructed because of special interests), is not significant.

Model 2 includes a quadratic interaction (bonds) to account for a potential attenuation of the curve.

Model 2: $V28=a+b(V52)+c(V36)+d(V36)^2+error$
Y = Ideological Opposition (V28)
X = National Decision Makers (V52), Funding Type: Bonds (V36) + Funding Type: Bonds^2

The model predicts that national decision-makers have a negative impact on project opposition, as well. Additionally, we included bond funding, because (depending on country or state specific policies) bonds are usually outside the typical (and often contested) funding pots. Hence, we would (carefully) expect bond-type funding to have a negative impact on "political opposition," and a positive impact on "ideological opposition." While there was no indication that "political opposition" is affected (not displayed in the table), bond-funded projects appear to be accompanied by "ideological opposition" (.014*). The hypothesized exponential relationship was not confirmed.

Statistical Quality: The quality of the statistical results in Table 1, Model 1 is good (see the ROC data presented in Appendix E). Model 2: The Shapiro-Wilk test for testing the normality of error is off (.000). That means the sample population is not normally distributed, so the finding should be disregarded.

3.4. In Summation

The results reported in Section 3 suggest the following effects for decision-making levels and transportation mega-projects:

1. National level decision-makers in Anglo-Saxon countries are not significantly involved in infrastructure investment decisions (Table 3.1). Anglo-Saxon countries are mostly federally organized, so decisions are likely localized. In centralized countries, on the other hand, infrastructure investment decisions are rather handled top down.

2. National level projects face less "ideological opposition" than projects involving other decision levels (Table 3.4), a finding that is complemented by the fact that inner-city projects face more opposition than projects of metropolitan, regional or national relevance (Table 3.1). To connect to point 1, Anglo-Saxon countries are more *laissez-faire*, at least compared to continental Europe (Esping-Andersen, 1999). Laissez-faire decision-making might lead to stronger economic and other types of inequality (in this case, transportation access), which might inspire more opposition. On the other hand, a culture of opposition is also strongly developed in states like France, which are not within the laissez-faire group. For a conclusive statement, the association should be explored by case studies.

3. The importance of national decision-making diminished over time, while local level decisions proliferated (Table 3.2). The Mann-Whitney U-Tests show that local decision-makers are associated with younger projects and national level decision-makers with older projects.

4. National level projects experience more cost overruns. Projects involving TA decision-makers experience fewer cost overruns (Table 3.2.). National level projects have longer construction times, which are positively associated with cost overruns (Pearson's R .328*). The costs per km, interestingly, are higher for projects involving local decision-makers. There are two likely explanations: first, the most expensive projects, which are tunnels (including subways) and multi-lane highways, are built in inner cities and often under (at least partial) local jurisdiction. Second, the projects going beyond local jurisdictions are not only less expensive because they are being built through less developed land. Railroads are overrepresented in the categories beyond city-limits, because they usually are projects of supra-regional significance with less local authority.

4. Mega-Projects and Transparency

In this section we will focus on two variables: transparency and cost-benefit analyses (CBA), and their relationship with other variables.

4.1. Data Characteristics

By project transparency, we mean the degree to which project decisions are documented, decision criteria are clear, and the information publicly available. The transparency variable is a composite variable containing information about cost-benefit studies, environmental analyses, risk analyses and economic studies: the more documents that were publicly available, the higher the assigned transparency score. On this scale, 26% of our projects (16 projects) are not transparent, 38% medium transparent (23), and 37% in the upper ranks of transparency (23).

The cost-benefit analysis variable is dichotomous. It indicates the absence or presence of such a study, although we only counted studies as "done" if they were publicly reported, and we also counted studies as present that may have been carried out less rigorously than they should have been. Since cost-benefit studies are (ideally) an important investment decision criterion, we tested most associations below with both the transparency and the cost-benefit analyses variable. Only statistically significant results will be reported.

Transparency is an important aspect in the megaproject literature and cost-benefit analyses are being "routinely carried out as part of mega-project preparation".[25] But we did not find published systematic numbers for the proportions of transparent mega-projects accompanied by CBAs. The database provides a ratio of cost-benefit studies done or not done is at about 50 percent (N=60, studies done=27 (45%), not done=33 (55%)). This is within the normal range if 50% CBA would be normal (binomial test: Z=.645, n.s.). Although there is no established threshold in the literature, the number appears to be low. If we take partial or incomplete cost-benefit analyses into account (N=60, studies done=21 (35%), partial=11 (18%), not done=28 (47%)), the number of CBAs increases. We assume that the sample comes close to being an accurate representation of project decision-making in the real world.

The transparency variable is a composite variable, so we cannot conduct a similar test here. We will explore what potentially affects the variables "transparency" and "CBA" and also how they affect various other variables.

4.2. Exploring Relationships between the Variables

Based in parts on the literature and in part on the analyses, we built several models that explore the role of transparency in megaproject decision-making. We will first list a set of hypotheses that guide the statistical tests, then present the most significant findings in subsequent tables, and then summarize the results and discuss them in the light of the hypotheses. Again, we use both parametric and non-parametric tests to account for the different data characteristics. In Table 4.1, we use the non-parametric Mann-Whitney U Tests to compare rail projects with non-rail projects, different types of project stimuli and decision-makers, and project opposition.

H4.1: Rail projects are more transparent than highway projects.

H4.2: Projects that arise from special occasions are less transparent.

H4.3: Project transparency increases with the rank of the decision-maker.

Table 4.1: Transparency, Cost-Benefit Analyses, and other Variables (Mann-Whitney U Tests)

		Transparency (V50)			Cost-Benefit Analyses (V41)		
	Variables	**U(df)**	**Z**	**N**	**U(df)**	**Z**	**N**
H4.1	**Project Type Rail**	543 (1)*	2.131	60		n.a.	
H4.2	**Stimulus/ Addendum**	137 1)*	2.047	59		n.s.	
H4.3	**Decision-Makers: Provincial**	584 1)*	2.610	50		n.s.	
	Decision-Makers: National	244 1)*	-1.965	59		n.s.	

Displayed: U=test statistic, df=degrees of freedom, Z= standardized coefficient, N=project count.; *sig≤.05 **sig≤.01.; *** for Stimulus 5 there are only 3 observations in one category; n.s.: not significant; n.a.: not applicable.

Summary of the Results: Rail projects (543, 2.131, sig≤.05), and provincial/regional level (.584, 2.610, sig≤.05) as well as national level projects (.244, -1.965, sig≤.05) are more transparent. Transparency is also positively associated with ideological project opposition (573, 3.230, sig≤.01), and with network expansion projects (137, 20.47, sig≤.05) - although there are only few observations. Cost-benefit analyses play a larger role in "crisis and opportunity" projects (517, 2.112, sig≤.05) and with provincial/regional decision-makers (564, 2.310, sig≤.05).

[25] Flyvbjerg, Bent, Nils Bruzelius, and Werner Rothengatter. *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge/ New York: Cambridge University Press, 2003, p. 5.

H4.1: Rail projects are more transparent than highway projects. Rail projects are indeed more transparent than non-rail projects (543, 2.131, sig≤.05). They are the only project type with a significant association to transparency.

H4.2: Projects that arise from special occasions are less transparent. The hypothesis was not confirmed. Instead, when testing for other project stimuli it turns out that projects that are additions to already existing networks have better transparency indicators than projects being built for other reasons.

H4.3: Project transparency increases with the rank of the decision-makers. The hypothesis was not confirmed. Transparency is actually higher on regional/ provincial levels (.584, 2.610, sig≤.05) and significantly lower when national decision-makers are involved (244, -1.965, sig≤.05). Project documentation on regional decision levels might be more public because funding applications to higher levels of decision-makers often require such documentation.

Further tests are presented in Table 4.2, guided by the following hypotheses:

H4.4: The wealthier a country, the more transparent are its projects.

H4.5: Projects in centralized countries are more transparent than in federalist countries.

H4.6: Entirely new projects are more likely to have CBAs than network expansion projects.

H4.7: The less transparent a project, the more protest potential is there.

H4.8: Project transparency affects project success (here, cost overruns) negatively.

H4.9: Inner-city projects are more typically based on cost-benefit analyses.

Table 4.2: Transparency, Cost-Benefit Analyses, and other Variables (Pearson's and Spearman's Correlations:)

		Transparency (V50)		Cost-Benefit Analyses (V41)	
Variables		Correlation Coefficient	N	Correlation Coefficient	N
H4.4	**GDP PPP 2010**	.431**	60	.261*	60
H4.5	**Political System**	-.296*	60		
H4.6	**Description**	-.258*	60	n.s.	
H4.7	**Opp: political**	.330*	59	.267*	59
	Opp: ideological	.424**	59	.338*	59
H4.9	**Inner-City**			.287*	60

Values: Pearson's R for H4.4, H4.5, and H4.9; Spearman's correlations for H4.6 and H4.7; *sig≤.05 **sig≤.01; n.s. = not significant.

Summary of the Results: Decision-making transparency is higher in wealthier countries (.431, sig≤.01), and more cost-benefit analyses are being conducted there (.261, sig≤.05). The decision process is more transparent in federalist countries (-.296, sig≤.05) than in centralized ones. Transparency is lower (-.258, sig≤.05) in network expansion projects (-.300, sig≤.05) than in newer projects. Interestingly, transparency and cost-benefit analyses are positively correlated with political opposition (.330, sig≤.05 and .267, sig≤.05 respectively) and with ideological opposition (.424, sig≤.01 and .338, sig≤.05). Finally, cost-benefit analyses are more likely in inner-city projects (.287, sig≤.05) than for projects with a larger range.

H4.4: The wealthier a country, the more transparent are its projects. The hypothesis was confirmed: wealthy countries are associated with more transparent project implementation (.431, sig≤.01; more cost-benefit analyses: (.261, sig≤.05)).

H4.5: Projects in centralized countries are more transparent than in federalist countries. The hypothesis was not confirmed. Projects in federalist countries are more transparent than

projects in centralized countries (-.296, sig≤.05). The comparatively large number of U.S. projects (a federalist country) in our database is one possible reason. The U.S. has strict environmental impact analyses requirements for projects with federal funding. This is also consistent with the finding above that sub-national decision-making is more transparent.

H4.6: Entirely new projects are more likely to have CBAs than extensions to existing networks. The hypothesis was confirmed. There is lower project transparency in projects that are built as additions to already existing networks (transparency: -.258, sig≤.05; the relationship refers to the "description" variable that measures whether a project is a new or stand-alone project, or an addition to an existing one). New projects are under more justification pressure because they have not been tested (at least in the respective area). They might also have no supporters, yet. Third, network additions produce network benefits that ease the justification process. (Also see Section 5.)

H4.7: The less transparent a project, the more protest potential is there. Project transparency and opposition are clearly associated, but it is unclear what was first: (a lack of) project documentation or opposition. We selected the hypothesis for further analysis below.

H4.8: Project transparency affects project success (here, cost overruns) negatively. Cost benefit analyses are more easily available (and conducted) for inner-city projects than for projects that reach beyond.

H4.9: Inner-city projects are more typically based on cost-benefit analyses. The data confirms the hypothesis.

4.3. Regression Models

To assess the influence of the contextual variable GDP on transparency (as observed in Table 3.2), a linear model is used. We hypothesize that a higher GDP correlates with higher transparency because more funding might be available to conduct project studies (at least in capitalist democracies), and more planning and implementation practice, too. Also, wealth correlates with a degree of democratization, and policy requirements in richer countries may be more publicly oriented and stricter.

The first model focuses on the effects of Gross Domestic Product/ Purchasing Power Parity (GDP PPP) and of funding sources on transparency. We assume a linear relationship because we do not expect a particular threshold of wealth to make a difference. The hypothesis is given as:

Hypothesis 4.2: The wealthier a country, the more transparency in project decision-making.

Model 1: Y(V50)=a+b(V5)+c(V12)+error
Y = Project Transparency (V50)
X = GDP PPP (V5), Project Type (V12)

The linear model (Model 1) includes a variety of independent variables based on the literature and correlation results above. The results are presented in Table 4.4.

Table 4.4: Structural Effects on Project Transparency (Linear and Non-Linear Regressions)

List of Predictors	Model 1	Model 2	Model 3	Model 4
GDP PPP	.012**	.011**	.001** (squared)	.011**
Project Location		n.s.		
Project Type: highway	.256*	.284*		.255*

Project Type: rail	.148*	.185*		n.s.
Project Description				n.s.
Decision-Makers: local			-1.085**	
Constant	-.026	-.086		.180
N	60	59	59	59
Model Fit	.255	.261	.261	.261

Values: Beta; *sig≤.05 **sig≤.01, Model fit: Adjusted R Squared; n.s. = not significant.

All models show that GDP PPP indeed increases transparency, although the effect is not strong. Model 1 explains variation in transparency best: GDP PPP (.012, sig≤.01), highway (.329, sig≤.05) and rail projects (.207, sig≤.05) predict transparency.

Model 2 confirms the main causalities of Model 1.

Model 2: Y(V50)=a+b(V5)+c(V11)+d(V52)+error
Y = Project Transparency (V50)
X = GDP PPP (V5), Project Description (V11), Project Type (V12)

WE added project location (whether a project is an inner-city project or ranging beyond that) to Model 2, but the added effect was not significant.

Model 3 holds that a country's wealth and the participation of local decision-makers increases project transparency. We chose a quadratic model because it best fit the data.

Model 3: $Y(V50)=a+b(V5)^2+(V52)+error$
Y = Project Transparency (V50)
X = GDP PPP (V5) squared, Decision-Makers (V52)

The rationale behind the hypothesis is that decision-makers on the local level are better informed about local transportation needs and need to document them better to convince the immediate constituencies and potential funders. However, the established relationship is negative: when local decision-makers are involved in project implementation, project transparency declines (-.243, sig≤.05). The model fit is at 23.3 percent, which is strong for a social science association. In Table 4.2, we observed that project transparency is positively correlated with federalist countries, so transparency is larger there. However, the main input variables are correlated as well, rendering the results not very useful.

Model 4 adds project type and the description variable as an independent variable.

Model 4: Y(V50)=a+b(V5)+c(V12)+d(V11)+error
Y = Project Transparency (V50)
X = GDP PPP (V5), Project Type (V12), Project Description (V11)

Though GDP is still significant (.011, sig≤.01), and the highway variable as well (.294, sig≤.05), rail projects and the description variables – while impacting the model fit – are not significant.

Quality of the Statistical Results: All results are ok, except for the lack of fit test for Model 3, which is too low. Linear models describe the relationship better than squared ones.[26]

H4.8: Project transparency affects project success (here, cost overruns) negatively.

[26] For more detail see Appendix E.

Though the bivariate tests did not show significant associations, the literature hypothesizes that transparency and cost overrun are related.[27] Hence we continue the analysis. Adding additional variables to the model, we expect project success to increase (or cost overruns to decrease) when CBAs are conducted. Originally, we chose a logistic regression model (Model 1), because we assume a binary outcome: cost overrun or not. Since private funding serves as an indicator for improved project outcomes, we added it as independent variable. Because some types of projects are more prone to cost overruns than others (tunnel projects), we control for project types, too. If the hypothesis were correct, we would expect that, in the presence of CBAs, decent transparency and private funding projects experience fewer cost overruns. But there were no significant results.

Model 1a: $$P(V33) = \frac{1}{1 + e - (a + bV41 + cV35 + dV12)}$$
Y = Project Success Variables: Cost Overrun (V33)
X = Cost-Benefit Analysis (V41), Private Funding (V35), Project Type (V12)

Model 1b: $$P(V33) = \frac{1}{1 + e - (a + bV50 + cV35 + dV12)}$$
Y = Project Success Variables: Cost Overrun (V33)
X = Transparency (V50), Private Funding (V35), Project Type (V12)

There were no significant results, even when testing other model specifications.[28] The data do not reveal that the presence or absence of cost-benefit analyses, and the degree of transparency, significantly impacted project cost overrun. We conclude that such an association cannot be captured with our data.

H4.7: Project transparency affects project opposition: the less transparent a project, the more protest potential there is.

Because the dependent variable is a binary, we chose a binary logistic model to evaluate the effect of project transparency on project opposition.

[27] Most prominently: Flyvbjerg, Bent, Nils Bruzelius, and Werner Rothengatter. *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge/ New York: Cambridge University Press, 2003. Berechman, Joseph. *The Evaluation of Transportation Investment Projects*. 2009.

[28] we tested the following linear and quadratic specifications. None of them produced significant results:

Model 2a: Y(V33)=a+b(V41)+c(V35)+d(V12)+error
Y = Project Success Variables: Cost Overrun (V33)
X = Cost Benefit Analysis (V41), Private Funding (V35), Project Type (V12)

Model 2b: Y(V33)=a+b(V50)+c(V35)+d(V12)+error
Y = Project Success Variables: Cost Overrun (V33)
X = Transparency (V50), Private Funding (V35), Project Type (V12)

Model 3a: Y(V33)=a+b(V41)+c(V35)+d(V35)^2+(V12)+error
Y = Project Success Variables: Cost Overrun (V33)
X = Cost Benefit Analysis (V41), Private Funding (V35), Project Type (V12)

Model 3b: Y(V33)=a+b(V50)+c(V35)+d(V35)^2+(V12)+error
Y = Project Success Variables: Cost Overrun (V33)
X = Transparency (V50), Private Funding (V35), Project Type (V12)

Model 1: $$P(V28) = \frac{1}{1 + e - (a + bV50 + cV11 + dV36)}$$

Y = Project Opposition: Ideological Opposition (V28)

X = Transparency (V50), Project Location (V11), Funding Types (V36)

This produced the following results:

Table 4.3: Impact of Transparency on Ideological Project Opposition (binary logistic regressions)

List of Predictors	Model 1	Model 2	Model 3	Model 4
Transparency	1.644/ 5.178**	5.519/ 245**	4.732/ 113.4**	3.919/ 50.354**
Inner City	2.023/ 7.565*	1.754/ 5.780*	1.562/ 4.768 *	1.764/ 5.833*
Project Description			n.s.	
Project Type				n.s. (rail)
Funding Type: grants	-.025/ .975*			
Funding Type: Gov't Loans	-.037/ .964*			
Stakeholders: private		1.585/ 4.879*		
Constant	-4.267/ .014*	-5.340/ .005**	-4.152/.016*	-3.760/ .023*
N	53	59	59	59
Model Fit	.358/ .507	.295/ 412	.252/ .353	.248/ .347

Values: Beta/ Exp(B); Model fit: Cox & Snell R Square/ Nagelkerke R Square; *sig≤.05 **sig≤.01; n.s.=not significant.

All models confirm that transparency impacts project opposition, but not in the hypothesized direction.

The results for Model 1 show that transparency significantly affects opposition (1.644 / 5.178, sig≤.01) by increasing it. The positive impact of inner-city projects on opposition (2.023/ 7.565, sig≤.05; meaning more opposition in inner-cities) strengthens the relationship. We added project location as a factor, because construction projects in dense urban areas affect more people than elsewhere and may thus provoke them to protest more easily, especially when some groups are disproportionately affected. Further, public grants (-.025/ .975, sig≤.05) and government loans (-.037/ .964, sig≤.05) reduce project opposition. The model fit is a bit over 35%. We may conclude that if projects are not transparent and are additionally located in urban areas, they are likely to encounter protests. Government grant and loan funded projects, on the other hand, diminish opposition risk.

Model 2: $$P(V28) = \frac{1}{1 + e - (a + bV50 + cV11 + dV51)}$$

Y = Project Opposition: Ideological Opposition (V28)

X = Transparency (V50), Project Location (V11), Stakeholders (V51)

Model 2 hypothesizes that in addition to transparency (squared to test for an attenuating effect) and inner city location, the participation of private stakeholders increases the odds of ideological opposition further. With 30%, the model fit is good enough to conclude that private sector participation plays a role in creating "ideological" project opposition.

Model 3: $$P(V28) = \frac{1}{1 + e - (a + bV50 + cV11 + dV18)}$$

Y = Project Opposition: Ideological Opposition (V28)

X = Transparency (V50), Project Location (V11), Project Description (V18)

Model 3 is a non-linear logistic model that includes transparency (squared), project location, and the status of a project within a network as independent variables. Transparency and inner-city location are significant indicators again, while V18 is not. The model fit is 25%.

Model 4: $$P(V28) = \frac{1}{1 + e - (a + bV50 + cV11 + dV12)}$$

Y = Project Opposition: Ideological Opposition (V28)

X = Transparency (V50), Project Location (V11), Project Type (V12)

In Model 4, we replaced the "project description" variable with project type, but here, too, while the transparency and project location associations remain, the project type does not add an additional significant element to explain project opposition. The model fit slightly decreases.

The relationship between the transparency and the opposition variable is positive in all models, which rejects the hypothesis. We will discuss this finding in the summary of this section.

Statistical Quality: The quality of the statistical result ranges between fair and good. In terms of statistical quality, Model 1 is the best model.[29]

4.4. Discussion of the Findings

There are three main findings.

1. According to the first two sets of correlations and non-parametric tests, the transparency "landscape" is as follows: project decision-making is more transparent in wealthy than in poorer countries; rail projects are more transparent than highway, tunnel or other projects; and there are more cost-benefit analyses done for inner-city projects than for others. Further, we also found that greater project transparency is associated with more project opposition (addressed in point 3, below); projects in centralized countries and with national decision-makers are less transparent; and entirely new projects (not extensions of existing networks) are also less transparent.

2a. Transparency increases with a nation's wealth. Further, the decision-making process of highway and railway projects is better documented in wealthier countries. Government grants and loans do not raise project transparency norms but appear to diminish them.

2b. Project transparency and cost-benefit analyses do not impact project performance. Oddly enough, the more transparent a project, the more project opposition exists.

3. That raises the question of directionality: since it is not unusual for mega-project planning and implementation processes to run more than ten years it is difficult to determine which variable is a cause, and which is effect: project opposition may occur either before or after a study was conducted. The data suggests allows speculating about opposition being the catalyst for project studies or the result of their absence. In this sense, the transparency results are inconclusive.

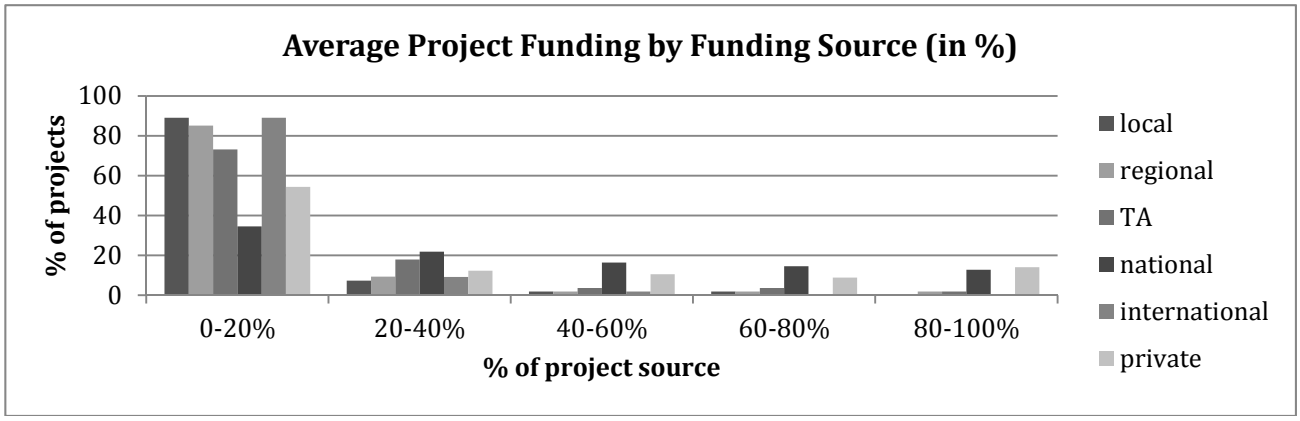
[29] More details may be found in Appendix E.

5. The Nature of Funding

This section examines the nature of project funding and associations with project decision-making factors. The nature of funding for a project has political implications because funding sources determine the decision-makers. Funding sources are also indicative of the local or national significance of a project. The funding sources variable distinguishes between local, and provincial funding sources, transportation authority funding, and national, international and private funding sources by determining the respective percentage of the funding source of the total project cost.

Local funding sources: mean 5.25 (St.D. 12.9, Min .00, Max. 73), N=55 projects (of 60).
Provincial funding sources: 9.09 (St.D. 19.55, Min .00, Max. 100), N=55 projects.
Transportation Authority: 12.01 (St.D. 12.01, Min. 00, Max. 98), N=55 projects.
National funding: 37.73 (St.D. 32.79, Min. 00, Max. 100), N=56 projects.
International funding: 4.86 (St.D. 10.73, Min. .00, Max. 50), N=55 projects.
Private funding: 29.7 (St.D. 35.45, Min. .00, Max. 100), N=57 projects.

The comparatively high values of the standard deviations reflect that funding sources for megaprojects are really diverse. For instance, there are fully privately funded projects in the database (like Australia's City Link), a project that is fully funded by national sources (the Frejus Road Tunnel in Italy), and one nearly completely by transportation agencies (AirTrain JFK). On the other hand there are projects were multiple funding sources are evenly spread. The missing projects are results of non-transparent decision-making. The frequency distribution provides more detail:



It may be seen that the darkest columns, national funding sources, dominate all but the first 0-20% cluster. That means that national funding sources provide most funding in the 20-40% range, in the 60-80% range, and nearly most of the fully nationally funded projects, competing only with privately funded ones.

5.1 Funding Sources

We tested a range of associations that contain project funding. The hypotheses below guide them.

H5.1: The wealthier a country, the more sources of funding are available at the national level.

H5.2: Local funding sources became more important over time.

H5.2.1: The number of funding sources (or funding complexity) increases over time.

H5.3: Projects underwritten with national funding will take longer to implement.

H5.4: Projects underwritten with national funding will experience more cost overruns.

H5.5: The more national funding, the better the projects meet utilization goals.

H5.6: Projects underwritten with private funding will experience fewer cost overruns or better utilization ratios.

H5.7: When special interests are involved in project decision-making, the funding sources become more complex.

Table 5.1: Funding Sources (Pearson's Correlations)

List of Predictors		Local	Provincial	National	International	Private	Number of Sources
H5.1	GDP		.287* (54)		-.283* (54)		
H5.2 & H5.2.1	Decade Inception Year of Inception	.245* (53)					.313* (54)
H5.3	Years to Completion			.225* (47)			
H5.3.1	Constr. Time			.402* (49)		-.216* (50)	
H5.4	COR		-.249* (41)	.232* (42)	.382* (41)		
H5.5	Utilization Ratio			.275* (34)			
H5.7	Special Interests (Stimulus)						.300* (54)

Values: Pearson's R (number of projects); *sig≤.05 **sig≤.01.

Summary: The table shows that a country's wealth correlates positively with regional funding sources (.287, sig≤.05) and negatively with international funding sources (.-283, sig≤.05). The number of locally funded projects (like local decision-makers above) increased over time (.245, sig≤.05), and so did the number of funding sources in general (.313, sig≤.05). The latter indicates the diminishing importance of national governments for infrastructure investment.

Projects underwritten with national funding have longer completion (.225, sig≤.05) and in construction times (.402, sig≤.05). (Project construction time decreases, however, when private funding is involved (-.216, sig≤.05).) Nationally funded projects experience larger cost overruns (.232, sig≤.05), but their utilization ratio is better than for projects without national funding (.275, sig≤.05). Cost overrun is negatively associated with regional funders (-.249, sig≤.05) and positively with international funders (.382, sig≤.05) – meaning that projects with international funding more often run over budget. Finally, when "special interests" appear to be among the project stimulus sources, funding complexity (number of funding sources) increases (.300, sig≤.05).

H5.1: The wealthier a country, the more sources of funding are available at the national level. There is no significant association between national funding sources and wealth, so the hypothesis was not confirmed. Instead, a country's wealth correlates positively with regional funding sources (.287, sig≤.05) and negatively with international funding sources (-.283, sig≤.05). That the wealthiest country in the dataset, the U.S., is also a federalist country and with 12 out of 60 cases disproportionately represented, might explain the first association. The large number of wealthy European countries that build supranational infrastructure (European funding pots are counted as international here) possibly drive the association between "wealth" and "international funding sources."

H5.2: Local funding sources became more important over time. We determined a change over time by 1) capturing in which decade the main implementation work took place, and 2) using the year of inception as indicator.[30] Then we correlated these two time indicators with the share of local funding sources. The hypothesis was confirmed: we find that local funding sources (like local decision-makers above) increased over time (.245, sig≤.05). This corresponds with Altshuler/Luberoff's hypothesis of the devolution of infrastructure responsibilities (in the U.S.).[31]

H5.2.1: The number of funding sources (or funding complexity) increases over time. The number of funding sources for projects also increased over time (.313, sig≤.05), further illustrating the diminishing importance of national funding for infrastructure investment.

H5.3: Projects underwritten with national funding will take longer to implement. Projects underwritten with national funding take longer to construct (.402, sig≤.05) and complete (.225, sig≤.05). The hypothesis is confirmed.

H5.4: Projects underwritten with national funding will experience more cost overruns. The data confirms the hypothesis (.232, sig≤.05).

H5.5: The more national funding, the better the projects meet utilization goals. On the other hand, the utilization ratio of nationally funded projects is better than the ratio for projects without national funding (.275, sig≤.05). So this hypothesis was not confirmed. We will discuss this below.

H5.6: Projects underwritten with private funding will experience fewer cost overruns or better utilization ratios. The hypothesis was not confirmed. But construction times decrease when private funding is involved (-.216, sig≤.05). That could either reflect private sector efficiency or the tendency of the private sector to select lower-risk projects.

H5.7: When special interests are involved in project decision-making, the funding sources become more complex. The data confirms the hypothesis. When "special interests" appear to be among the project stimulus sources, funding complexity (number of funding sources) increases (.300, sig≤.05). This may indicate that the projects are not the most transport-economically beneficial or seek socio-politically equal access to transportation.

In the following, we conducted non-parametric tests.

H5.9: Project funding varies by region (like continent, or culture).

H5.10: Inner-city projects, because of their limited reach, are less likely to receive international funding.

H5.11: Funding sources impact project opposition types.

H5.12: The type of funding and the availability of a cost-benefit analysis for a given project determine the general degree of project support (measured by the absence of opposition).

H5.13: Rail projects are less likely to be privately funded than any other project type.

Table 5.2: Funding Sources (Mann-Whitney U Test)

[30] See Appendix B for more detail.

[31] Altshuler, Alan, and David Luberoff. *Megaprojects: The Changing Politics of Urban Public Investment*. Washington, D.C.: Brookings Institution Press, 2003.

List of Predictors		Provincial		Transportation Agency		National		International		Private		Number of Sources	
		U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)
H5.9	Continent: Europe	265 (1)*	-2.082 (54)			512 (1)*	2.298 (55)	538 (1)*	3.658 (54)				
	Asia							2135 (1)*	-2.298 (54)				
	Australia					22 (1)**	-2.621 (55)					23 (1)**	-2.657 (55)
	North-America			366 (1)**	2.688 (54)			150 (1)*	-2.577 (54)				
H5.10	Inner-city							301 (1)*	-.980 (54)				
H5.11	Opposition: political	301 (1)*	-.642 (53)										
	Opposition: ideological							213 (1)*	-2.182 (53)				
H5.13	Project Type: Rail			472 (1)**	2.692 (54)					226 (1)*	-2.332 (56)	462 (1)*	2.012 (55)

Values: U=test statistic, df=degrees of freedom, Z= standardized coefficient, N=project count;*sig≤.05 **sig≤.01.

Summary of the Results: European infrastructure projects are more nationally funded (.512, 2.298, sig≤.05) and internationally (.538, 3.658, sig≤.05). There are fewer sub-national/ regional level investments (.265, -2082, sig≤.05). Further, the role of international funding is particularly low in Asia (2135, -2.298, sig≤.05). In Australian projects, national funding does not play a large role (22, -2.621, sig≤.01), and the number of funding sources is low (23, -2.657, sig≤.01). In North America, transportation agencies tend to be more involved (366, 2.688, sig≤.01) and international funding is low (150, -2.577, sig≤.05).

As expected, international funding sources only play a small role in inner city project funding (301, -.980, sig≤.05). Further, there is more (political) opposition to projects that involve regional funding than to projects involving other funding sources (301, -.642, sig≤.05). There is less (ideological) opposition where international funding is involved (213, -2.182, sig≤.05). (For the different types of opposition, see Appendix B.) Finally, we found that rail projects positively correlate with transportation agency funding resources (472, 2.692, sig≤.01) but negatively with private ones (226, -2.332, sig≤.05). Interestingly, rail projects also have a larger number of funding sources than projects of other types (462, 2.012, sig≤.05).

H5.9: Project funding varies by region (like continent, or culture). Unsurprisingly, provincial funding sources are not as common in Europe (where states are often centralized and transportation often organized on a national level) (.265, -2082, sig≤.05). National funding sources are particularly strong in Europe (.512, 2.298, sig≤.05) and rare in Australia (22, -2.621, sig≤.01). Transportation agency funding is strong in North America (366, 2.688, sig≤.01). International funds are least used in Asia (2135, -2.298, sig≤.05) and North America (150, -2.577, sig≤.05) and most often in Europe (.538, 3.658, sig≤.05) (due to European Union funds). There are no particular findings with respect to private sources. Insofar as there are significant associations, all have to do with macro-political organization factors.

H5.10: Inner-city projects, because of their limited reach, are less likely to receive international funding. International funding sources indeed do not play much of a role for inner-city projects (301, -.980, sig≤.05). One likely explanation is that inner-city projects are usually embedded in different layers of funding options, such as city, regional, or national funding pots, and a city is

barely divided among two countries that would provide funding. Further, inner city project decision makers are less likely to be in international funding opportunity networks.

H5.11: Funding sources impact project opposition types. The hypothesis was confirmed. There is more (political) opposition to projects that receive regional funding than to projects involving other funding sources (301, -.642, sig≤.05) and less (ideological) opposition where international funding is involved (213, -2.182, sig≤.05).

H5.12: The type of funding and the availability of a cost-benefit analysis for a given project determine the general degree of project support (measured by the absence of opposition). The hypothesis was not confirmed. The relationship is not displayed in Table 5.2 because it is insignificant.

H5.13: Rail projects are less likely to be privately funded than any other project type. The hypothesis was confirmed. Unlike other project types, rail projects are often funded by respective transportation agencies (472, 2.692, sig≤.01) and much less by private sources (226, -2.332, sig≤.05). Also, rail projects appear to have, on average, a larger variety of funding sources than other project types (462, 2.012, sig≤.05).

5.3 Regression Analyses

Since there is a lot of discussion about the impact of private vs. public sources, particularly with respect to efficiency, we examined possible associations in more detail (Donahue and Nye, 2002). We hypothesize that funding sources impact the degree of cost overrun.

H5.4: Projects underwritten with national or private funding will experience cost overruns.

In Models 1a and 1b we used a simple linear regression model to see whether the amount of national or private funding impacts project performance.

Model 1a: V33=a+b(V35)+c(V12)+error
Y = Cost Overrun (V33)
X = National Funding (V35), Project Type (V12)

Model 1b: V33=a+b(V35)+c(V12)+error
Y = Cost Overrun (V33)
X = Private Funding (V35), Project Type (V12)

Although correlated (Table 5.1.), the regression models show no association between private funding/national funding sources and cost overruns, when adding project type as control variable. Again, we tried several model specifications, because a quadratic function is possible, none of which produced any significant results.[32] Thus a relationship between funding sources and cost overrun could not be conclusively established.

[32] Model 2 is a quadratic function, to account for possible attenuated curves, followed by binary regressions. None of them produced any significant results.

Model 2: V33=a+b(V35)+c(V35)^2+d(V12)
Y = Cost Overrun (V33)
X = Private funding (V35), Project Type (V12)

Model 3: $P(V33) = \frac{1}{1+e-(a+b(V35)+cV12))}$
Y = Cost Overrun (V33)

H5.3 Projects are completed faster when private funding sources are involved than with national funding sources.

As indicated in Table 5.1, private and national funding sources are important indicators for project completion time. Hence, we ran the models with both private funding sources (Models 1a and 2a) and national funding (Models 1b and 2b). We selected a binary logistic model[33] because we were interested in the general trend.

Model 1: $$P(V24) = \frac{1}{1+e-(a+bV35+cV12)}$$

Y = Years to Completion (V24)
X = Private funding (V35), Project Type (V12)

Table 5.3. displays the results of different variations of the model.

Table 5.3: Funding Sources and Project Type Predict Part of the Variation in Project Years to Completion (Binary Logistic Regressions)

List of Predictors	Model 1a	Model 2a	Model 1b	Model 2b
	Private		National	
Source of Funding	-.026/ .974*	-.303/ .971*	.021/ 1.021*	.021/ 1.022*
Project Type: Rail	-1.626/ .197*		n.s.	
Project Type: Tunnel		1.717/ 5.566*		n.s.
Location: Regional		n.s.		
DM: Local				
Constant	1.570/ 4.808*	.034/ 1.035	-.531/ .588	-1.098/ .043
N	48	48	47	47
Model Fit	.124/ .166	.170/ .226	.106/ .141	.129/ .172

Values: Beta/ Exp(B); Model fit: Cox & Snell R Square/ Nagelkerke R Square; *sig≤.05 **sig≤.01, DM=decision-makers.

The results for Models 1a and 2a clearly show that the nature of funding sources impacts project completion years. If private funding sources are involved, completion times go down (-.026/ .974, sig≤.05). National funding sources are associated with longer completion times (.021/ 1.021, sig≤.05). The project type is only significant in Model 2a (-1.626/ .107, sig≤.05).

Model 1b: $$P(V24) = \frac{1}{1+e-(a+b(V35)+cV12))}$$

Y = Years to Completion (V24)
X = Private funding (V35), Project Type (V12): rail

Model 2b: $$P(V24) = \frac{1}{1+e-(a+b(V35)+cV12))}$$

Y = Years to Completion (V24)
X = Private funding (V35), Project Type (V12): tunnel

The results for Model 1b vary by project type. The results displayed in Model 2a show that the project completion time decreases with private funding (-.303/ .971, sig≤.05) and – not surprisingly – increases for tunnel projects. Model 2b shows that project completion time goes

X = Private funding (V35), Project Type (V12)

Model 4: $$P(V33) = \frac{1}{1+e-(a+b(V35)+c(V35)^2+dV12))}$$

Y = Cost Overrun (V33)
X = Private funding (V35), Project Type (V12)

[33] It is equally possible to assume linear relationships; the results are similar.

up for nationally funded projects (.021/ 1.022, sig≤.05), but whether these are tunnel projects or not is insignificant.

Additionally, we were interested in location effects on project completion time (because we assume the more jurisdictions are involved or people are affected, the more potential for complicated project implementation). The results, in all cases, were insignificant. One of the models (Model 2a) is displayed below, though, because including the regional location variable positively affected the model fit. In this case, the model explains 17 percent of the affect on project completion (Cox & Snell R^2 of .170).

Quality of Statistical Results: The quality of the statistical results ranges between poor (Models 1a and 1b) and fair (Models 2a and 2b). Details may be viewed in Appendix E.

5.4. Findings

With respect to funding sources, the following patterns emerge:

1. The data reconfirms the results of Section 2: national funding and international funding sources play a larger role in European infrastructure decisions. The finding also echoes the results from Section 3. These concerned the heightened role of national decision-makers in Europe, where the close proximity of European countries promotes border-crossing infrastructure projects and hence international funding.

2. Provincial funding sources play less of a role in Europe. International funders play less of a role in Australia and North America, probably because of wealth and geographical reasons in both cases. The South American projects all have international funders (but the association should not be overstated: we have only three South American projects). North American projects receive much funding from transportation agencies, which confirms the particular political patterns in the U.S. Projects in wealthier countries and inner-city projects have fewer international funding sources. Rail projects are negatively associated with private funding.

3. The importance of funding complexity and local funding sources increases over time and across countries.

4. Project success measures: project correlations show that cost overruns increase with national and international funding (not confirmed in the regression analyses), and decrease when underwritten with provincial funding sources. But then, nationally funded projects also take longer to construct and to complete (confirmed by the regression models), but also better meet funding projections. Different explanations are possible:

(i) National governments are more likely to take on complex and expensive projects. However, different projects could fall into this category: huge prestige projects like the Channel Tunnel Rail Link, or Øresund Bridge. Who would fund them if not national governments? Both projects are also utilized reasonably well.

(ii) National governments take on disproportionately cost-inefficient projects. Nationally funded projects perform worse than projects funded by other sources in all measures except project utilization.

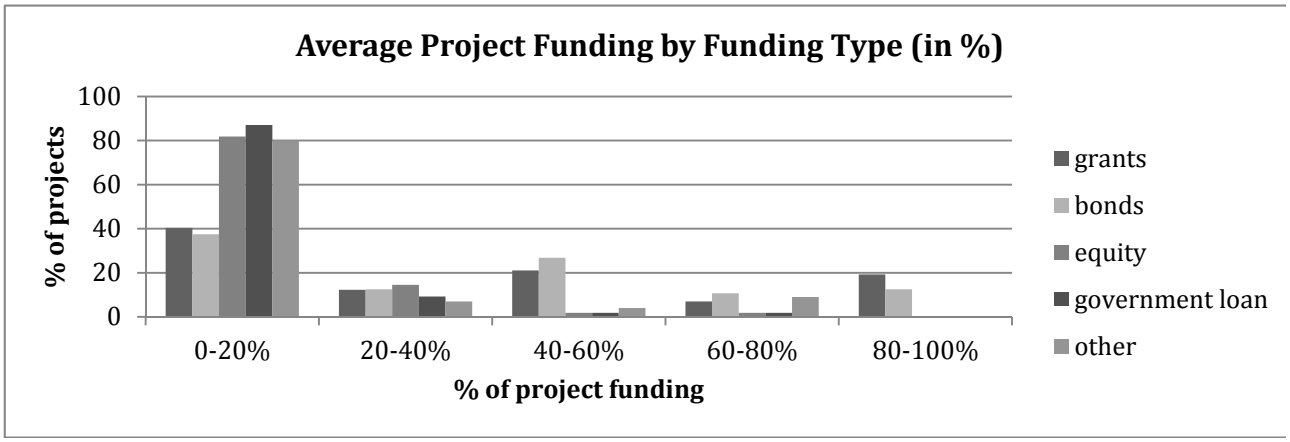
5. We were not able to conclusively confirm whether private vs. national sector funding makes a difference for project efficiency.

5.5 Funding Types

There are five funding type categories: grants, bonds, equity, government loans, and other. As with funding sources, they are given as percentages of total funding. Here is the distribution:

Grants: mean: 39.28 (St.D. 35.98, Min. .00, Max. 100), N=57 projects (of 60).
Bonds: 36.49 (St.D. 31.69, Min. .00, Max. 100), N=56 projects.
Equity: 8.99 (St.D. 14.46, Min. .00, Max. 67.5), N=55 projects.
Government loans: 5.79 (St.D. 14.3, Min. .00, Max. 77), N=57 projects.
Other: 11.17 (St.D. 21.98, Min. .00, Max. 75), N=54 projects.

The missing projects are the result of entirely non-transparent project documentation. The following figure displays a more detailed frequency distribution:



The figure shows that equity, government loans and other funding types are providing the smaller portions of project funding (0-20%), while grants and bonds are those funding types that may fully fund projects (80-100%).

The hypotheses are given as follows.

H5.13 GDP impacts funding types.

H5.14 The nature of project funding impacts project-related factors like construction time.

H5.15 The nature of project funding impacts project utilization ratios.

H5.16 Projects with equity funding are more often canceled than projects with other types of funding.

Table 5.4: Funding Types (Parametric Tests – Pearson's Correlations)

		Grants	Bonds	Equity	Government Loans	Other
H5.13	GDP 2010			-.443** (55)		
	GDP 2000			-.359** (55)		
	GDP 1990			-.439** (55)		
H5.14	Construction Time	.407** (51)		-.362** (51)		
H5.15	Utilization Ratio			-.357* (36)		
H5.16	Cancelled Projects			.279* (55)		

Values: Pearson's R (and number of projects); *sig≤.05 **sig≤.01.

Summary of the Results: The higher the GDP, the fewer projects are funded through equity funding, the data suggests (-.443/ -.359/ -.439, sig≤.01). Equity funding is also (negatively) correlated with construction time (-.362, sig≤.01) and project utilization (-.357, sig≤.05). In the first case, that means that equity-funded projects have shorter construction times, but their actual use falls systematically behind the projections. Equity funding is also associated with

project cancellations (.279, sig≤.05). Also, grant funding and construction time are positively associated (.407, sig≤.01): grant funded projects have longer construction times.

H5.13 GDP impacts funding types. Equity funding is strongly associated with GDP: the richer a country, the fewer equity financed projects (-.443/ -.359/ -.439, sig≤.01). This is an interesting finding, and we will explore it in a regression analysis below.

H5.14&3.15&3.16: The nature of project funding impacts project-related factors like construction time and project utilization ratios. Equity funding is partly associated with more successful projects – i.e., projects with short construction times (-.362, sig≤.01) (but projects that meet fewer user projections) (-.357, sig≤.05). It is also associated with project cancellations (.279, sig≤.05). Further, construction times increase for projects that receive government grants (.407, sig≤.01).

H5.17 Funding types differ across the world – e.g., government grants are most common in Europe.

H5.18 Funding types differ across projects – e.g., it is atypical for rail projects to be financed by bonds.

H5.19 Funding types affect project opposition – i.e., private funding is more associated with project opposition than grant funding.

Table 5.5: Non-Parametric Tests Funding Types (Mann-Whitney U Test)

		Grants		**Bonds**		**Equity**		**Government Loans**		**Other**	
		U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)	U (df)	Z (N)
H5.17	Europe					231 (1)**	-2.723 (55)				
	Australia	26 (1)**	-2.540 (57)					169 (1)**	3.239 (54)		
	Asia					356 (1)**	2.659				
	North America			151 (1)*	-2.021 (56)					325 (1)*	2.308 (54)
H5.18	Rail					202 (1)*	-2.494 (56)			407 (1)*	2.151 (54)
H5.19	Issue-oriented Opp.			532 (1)*	2.635 (55)						
	No Opposition	391 (1)*	2.196 (56)							178 (1)*	-2.046 (53)

Values: U=test statistic, df=degrees of freedom, Z= standardized coefficient, N=project count;*sig≤.05 **sig≤.01.

Summary: Equity funding is less prevalent in Europe (231, -2.723, sig≤.01) compared to the other continents. In Australia, government loans dominate over other funding types (169, 3.239, sig≤.01), while grant funding is less prevalent (26, -2.540, sig≤.01). Asian projects have a larger share of equity funding (356, 2.659, sig≤.05). North American projects use less bond funding (151, -2.021, sig≤.05) but "other" funding types[34] (325, 2.308, sig≤.05). Rail projects are rarely funded through equity-type funding (202, -2.494, sig≤.05) and more through "other" types (407, 2.151, sig≤.05). Bond funding is more associated with issue-oriented opposition (532/ 2.653, sig≤.05). Grant-funded projects (391/ 2.196, sig≤.05) experience less project opposition, while "other" funding types are associated with more (178/ -2.046, sig≤.05).

H5.17 Government grants are most common in Europe. The non-parametric tests fail to confirm the specific hypothesis. But they do confirm regional differences: Australian projects are less likely to be funded by government grants (26, -2.540, sig≤.01) and more by government loans

[34] See Appendix B

(169, 3.239, sig≤.01) than projects in other countries. North America has comparatively little bond funding (151, -2.021, sig≤.05). Equity funding is more typical in Asian countries (356, 2.659, sig≤.05), while the opposite is the case in Europe (231, -2.723, sig≤.01). While this is interesting, there are probably a lot of factors weighing on funding type decisions.

H5.18 Funding types differ across projects – e.g., it is atypical for rail projects to be financed by bonds. Compared to other projects, rail projects are not typically funded by equity funding (202, -2.494, sig≤.05) and more by "other" funding types (407, 2.151, sig≤.05). Therefore the hypothesis was confirmed. One possible reason is that railroads usually need a lot of government support (e.g., in Germany) because their economic competitiveness is contested.

H5.19 Funding types affect project opposition – i.e., private funding is more associated with project opposition than grant funding. The hypothesis was confirmed, and the data show that issue-oriented opposition hits bond-backed projects disproportionately (532, 2.635, >.05). Grant-funded projects, on the other hand, are comparatively opposition-free (391, 2.196, >.05). We will analyze the correlation in more detail in the following binary regression models.

H5.19 Private funding is more associated with project opposition than grant funding.

Model 1: $$P(V28) = \frac{1}{1 + e - (a + b(V36) + cV50))}$$

Y = Project Opposition (V28)

X = Type of Funding (V36), Transparency (V50)

Model 1 is the main model for the hypothesis. That does not mean that the funding type (private or public) causes opposition, but that it is indicative of a certain problematic project perception. The project opposition variable has four categories, and we tested the impact of funding types on each category, with varying additional control variables. Similarly, as with the dependent variable, we also tested all the categories of funding types. In Table 5.6, we show the best models in terms of significant associations and model fits.

Table 5.6: Impact of Funding Types on Types of Opposition (Binary Logistic Regression)

List of Predictors	Model 1a: Issue-Oriented Opposition	Model 1b: Ideological Opposition	Model 1c: Ideological Opposition	Model 1d: No Opposition
Type of Funding	.025/ 1.025* -- Bonds	n.s.-- Bonds	.041/ 1.042* "other types"	.024/ 1.205* -- Grants
Transparency		4.715/ 111.638**	6.897/ 989.2**	
Location: Inner-City			2.170/ 8.761*	
Location: National				n.s.
Project Description		n.s.		-1.591/ .204*
Constant	-.903/ .406	-3.524/ .029	-6.102/ .002	-1.635/ .195*
N	55	55	53	56
Model Fit	.118/ .157	.211/ .301	.366/ .518	.165/ .249

*sig≤.05 **sig≤.01, Beta/ Exp(B); Model fit: Cox & Snell R Square/ Nagelkerke R Square

Model 1a: $$P(V28) = \frac{1}{1 + e - (a + bV36)}$$

Y = Project Opposition (V28): issue oriented

X = Type of Funding (V36)

The results show that funding types, particularly bond funding, correlate with "issue-oriented" opposition. The model fit of .118 is the best. To fully explain the association, however, in-depth case studies are necessary.

Model 1b: $$P(V28) = \frac{1}{1 + e - (a + bV36 + cV50 + dV18)}$$

Y = Project Opposition (V28): ideological opposition

X = Type of Funding (V36), Transparency (V50), Project Description (V18)

In Model 1b, "ideological opposition" is the dependent variable. We added project transparency because non-transparent projects may "trigger" project opposition, as found in Table 4.2 above. We hypothesize that transparency (and funding types) affect opposition, and not vice versa, although the causal direction might, in theory, be ambiguous. The results show that transparency does affect opposition (4.175/ 111.638, sig≤.01). The funding types (bonds) and whether a project is and old or a new one ("project description") were not significant. The model fit was a little more than 20 percent (Cox & Snell R Squared, .211).

Model 1c: $$P(V28) = \frac{1}{1 + e - (a + bV36) + cV50 + dV11)}$$

Y = Project Opposition (V28)

X = Type of Funding (V36), Transparency (V50), Project Location (V11)

Model 1c assumes that there are causal effects of funding type, transparency and project location on (ideological) opposition. Funding type "other" (those that did not fit any of the other categories) affects opposition (.041/ 1.042, sig≤.05). Transparency is still significant (6.897/ 989.2, sig≤.01), as are inner-city projects (2.170/ 8.761, sig≤.05).

Model 1: $$P(V28) = \frac{1}{1 + e - (a + bV36 + cV11 + dV18)}$$

Y = Project Opposition (V28)

X = Type of Funding (V36), Project Location (V11), Project Description (V18)

The fourth successful model includes the "no-opposition" category of the opposition variable. Projects are "free" of opposition if we found no trace of it after intense research. As it turns out, projects financed with public grants face less project opposition (.024/ 1.205, sig≤.05) (the variable is counter-intuitively coded). While the location variable had no significant effects, the description variable had: newer projects face more opposition than projects that are additions to already existing networks (-.1591/ .204, sig≤.05).

Quality of Statistical Results: The quality of the results varies between good (Model 1c) and fair (all others). The details and ROC curves are displayed in Appendix E.

5.6 In Summation

1. Equity: With increasing wealth of a country, the use of equity funding decreases. Wealthier countries still provide more moneys for public infrastructure. Poorer countries need to find other sources for their infrastructure projects. The distribution of funding types varies by region: equity funding is less important for European than for Asian projects. Australian projects use more government loans than grants.

Different funding types are associated with different impact measures: projects with equity funding have shorter construction times– but they also barely meet their projected user goals. Also, equity funding seems to be associated with project cancellations, although this finding is tentative due to the relatively small sample of cancelled projects.

2. Bond funding, mainly used in North America, raises the likelihood of (issue-oriented) opposition.

3. Public grants are statistically associated with the absence of opposition and with extended construction times – both in correlations and the regression analyses. Model 4 in Table 5.6. shows the odds of opposition going down with grant funding, particularly when the projects are additions to already existing networks and not entirely new ones.

6. Conclusion

6.1. Macro-level Government Arrangements

Project decisions differ in federalist and centralized countries, but most decisions still involve national decision-makers and national level funding across the world. [35] The data shows no significant association between wealth and the national decision level, or associations between voting and party systems and the other variables.

Generally, national decision-makers are more involved in European countries, while project decisions in federalist and Anglo-Saxon states – generally more laissez-faire – take place on sub-national levels. This suggests that fragmentation and devolution are a predominantly American phenomenon. As a result of the European integration process, most border-crossing projects are in Europe as well. European integration is also the reason for several European countries to decentralize, as the European Concept of the Regions[36] provides cultural and infrastructure funding to further cross-national European cooperation.

National level decision-making relates to project success – here measured as construction time, utilization ratios, and cost overrun: One of the most interesting findings is that the data indicates that national governments are more willing to take on risky projects.

Projects involving national decision-makers experience both longer construction times and larger cost overruns. At the same time, the number of cost-benefit studies does not increase when national decision-makers are involved as compared to projects directed on sub-national levels. Compared to projects involving other levels of decision-making, however, national projects fare better in terms of user numbers.

Also projects decided on the national level, or with national funding, are associated with less "ideological" opposition. We discussed possible reasons for this in the conclusion to Section 3,

[35] There are different motivations for investment decisions made on the national level. First, it makes more sense for a national government to invest in transportation infrastructure, because of scale and net effects, as well as the advantages of experience. Second, infrastructure may contribute to international competitiveness, so most governments (on all levels, actually) have an interest in advancing it. An example is the Alameda Corridor, which successfully demonstrated to members of Congress the national economic effects of the project for their districts. Third, national governments are, at times, more interested in providing equal access to transportation for socio-political reasons rather than for transport-economic efficiency. Extensive train networks in European countries or China, into the most rural areas, attest to that. Fourth, national governments may build large prestige projects that do not necessarily meet strict transport-economic criteria. Examples include the large European integration projects like Øresund, or German post-re-unification projects intended to reunite the country (although they did conduct cost-benefit analyses for these projects). The second and the fourth motivations, in particular, may be susceptible to the ideological opposition indicated in the data.

[36] The Concept of the Regions stipulates cooperation and integration of European countries through cultural, economic and funding frameworks benefitting border-crossing regional projects.

above. The other side of the coin is that ideological opposition is stronger in Anglo-Saxon counties, which are less centralized.

6.2. Location, Opposition, Transparency

Inner-City Projects: Altshuler and Luberoff argue that inner-city projects draw project opposition – at least since the 1970s in the U.S.[37] Hence we would expect decision-making to vary between inner-city projects and outside-city projects. There are three insights.

1) The data systematically confirmed stronger opposition for inner-city projects – a variable to be taken into account when making urban decisions. 2) More cost-benefit analyses are being conducted for inner-city projects. 3) The data indicates that the presence of local decision-makers diminishes project transparency. This is not contradictory: inner-city projects are often very costly– primarily because urban space is highly contested (and requires underground infrastructure like water pipes and electricity cables). Because of the lack of space, they either need to be built underground, require expensive permits or the purchase of expensive property. Moreover, local residents must be recruited for support. On the other hand, local decision-makers may not guarantee more extensive public documentation because of political and business-related interests that potentially operate behind the scenes.

Diminished transparency and increased risk of opposition suggest that project decision-making is much more complicated for inner-city projects than for larger-scale ones.

Opposition: There are five main findings.

1) Projects with national level decision-makers and government grant funding face weaker opposition than other projects. 2) Project opposition and cost-overrun are associated. 3) As noted above, opposition increases in dense inner cities. 4) Opposition decreases with respect to projects that are being built as additions to existing networks. 5) Project opposition, bond funding, and transparency associations were repeatedly significant. Bond funding is associated with certain types of project opposition. Though the correlation is significant between these factors – with respect to opposition and project transparency – the data is largely inconclusive as to which is cause and which is effect.

Transparency:

1) Project transparency (or the availability of cost benefit analyses) is not related to project success measures, which challenges some of the theoretical explanations about reasons for project efficiency.[38] 2) Although the degree of transparency of a project is only indirectly related to macro-political structures, the wealthier the countries, the more transparent the decision-making. 3) Transparency (as an independent variable) causes project opposition. Of course it does not directly, but there are issues with the directionality of the association, as discussed in the concluding part of Section 4. We held that it is problematic to determine whether transparency is a cause or an effect. For instance, project opposition may occur either before or after the study has been done.

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[37] Altshuler, Alan, and David Luberoff. *Megaprojects: The Changing Politics of Urban Public Investment*. Washington, D.C.: Brookings Institution Press, 2003.

[38] Flyvbjerg, Bent, Nils Bruzelius, and Werner Rothengatter. *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge/ New York: Cambridge University Press, 2003.

With respect to cost-benefit studies the main finding is that barely half of the project decisions were based on a cost-benefit study. Moreover, the data suggests that the availability of cost-benefit studies impacts the degree of project opposition. That suggests that opposition, in fact, could be either the *catalyst* for project studies or the result of their absence. In this sense, the transparency results are inconclusive.

6.3. Project Funding

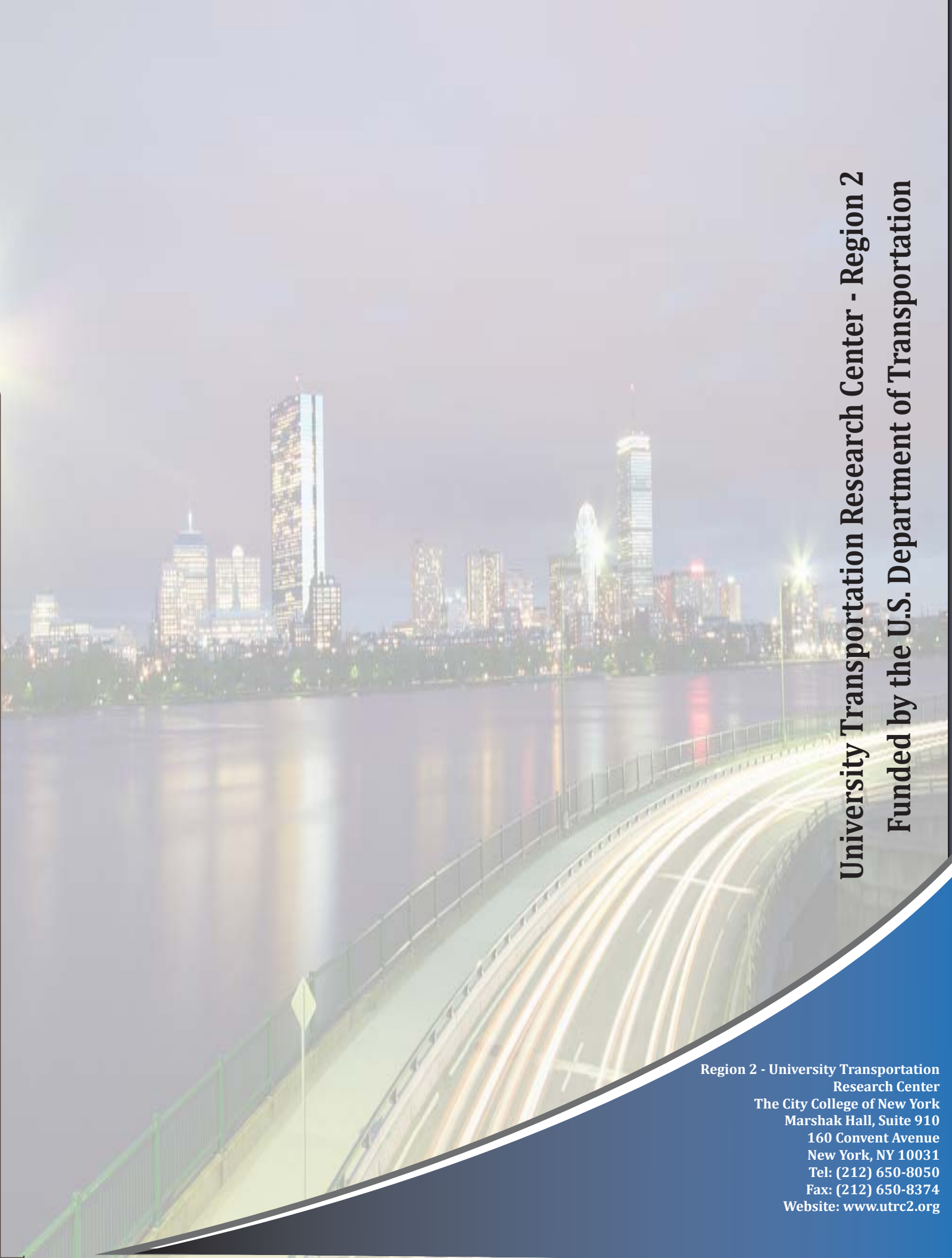
The data show that the importance of local funding sources increases over time and across countries, as does funding complexity (measured by the number of funding sources for each project). This indirectly confirms the fragmentation and devolution thesis,[39] which held that project decisions get more complicated with the number of potential veto points.

Bond funding plays a stronger role in centralized countries.

Other than that, project funding seems easier in Europe: European projects are grant-funded to a larger degree than projects anywhere else, so some of the political struggles may be dodged. In any event, European infrastructure investment proliferated in the past 30 years, because the European Union, to further the ongoing European integration process, provided billions of Euros for integrative infrastructure development.

With respect to the efficiency debate in the literature, the results are inconclusive. Privately funded projects (or projects involving private funding) are not associated with fewer cost overruns or more efficiency in general. However, as a funding type, equity funding is associated with shorter construction times – but also with cancelled projects.

[39] Giuliano, Genevieve. "The Changing Landscape of Transportation Decision-Making." edited by Thomas B. Deen Distinguished Lecture, 5-12, 2007.



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Region 2 - University Transportation
Research Center
The City College of New York
Marshak Hall, Suite 910
160 Convent Avenue
New York, NY 10031
Tel: (212) 650-8050
Fax: (212) 650-8374
Website: www.utrc2.org