



The Regional Returns of Public Investment Policies in Mexico

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Summary. — This paper uses multiple regression analysis to determine the extent to which the regional distribution of public investment policies before and after the Mexican debt crisis and the opening of the country to trade have responded primarily to efficiency or redistribution criteria. The results highlight that the regional allocation of public investment funds in Mexico since 1970 seems to follow neither redistribution, nor efficiency criteria. In addition, there is no evidence that the allocation of funds has a positive effect on regional growth. The most likely explanation is that pork-barrel politics has played a key role in the regional distribution of funds, and probably has contributed to lowering their economic impact.

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1. INTRODUCTION

Since the early 1970s Mexico has experienced profound transformations in its economic model. It has moved from an almost closed-to-trade and public-led economy to one of the most open economies in Latin America. Mexico is currently much less guided by public sector forces than in times past (Aspe, 1993). In this context, the persistent economic disparities across Mexican states have become a grave problem. As the Zapatista revolt in Chiapas suggests, regional disparities in Mexico have become not only harmful to the national economy, also have created unrepresented demands for public services and infrastructure and bring political and social consequences.

Regional policies to tackle disparities in Mexico have, however, been almost absent, with successive governments concentrating on public investment policies aimed at achieving growth at the national level (Aguilar, 1989; Katz, 1998; OECD, 1997; Palacios, 1989). Yet,

many studies have pointed out that public investment in Mexico has not always achieved its aim of higher growth, nor has it generated greater territorial cohesion (Lächler & Asc-hauer, 1998; Nazmi & Ramirez, 1997; Palacios, 1989; Tijerina, 1995). Despite Mexico's federal structure, the regional allocation of investment has been centralized and has lacked clear mechanisms for distribution.¹

All public investment policies contain a efficiency and equity dimensions, which tend to follow different patterns and often represent a

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tradeoff (Molle, 1980; Richardson, 1978). The fundamental ethos on the efficiency side is that governments should pay more attention to those areas where the allocation of resources allows for higher returns (De la Fuente & Vives, 1995). The justification for an equity program is that it is socially, morally and politically unacceptable for different parts of the country—or, for that matter, for groups of individuals within the country—to experience great differences in standards of living. Inequality has also been proven to have some harmful effects on growth (Barro, 2000; Persson & Tabellini, 1994). Public investment policies, then, may not be considered only as a way to equalize conditions among areas in order to avoid the aforementioned problems, but also as a means to raise the overall level of development by creating conditions for higher productivity throughout Mexico.²

The role of governments, in general, and of central government, in particular, is thus key in determining the evolution of territorial disparities. Whether the main objective is to enhance the accumulation of productive factors and maximize national growth potential or to distribute economic activity more evenly across the country (and perhaps in this way also maximize growth potential), central government public policy decisions have important territorial implications.

There is, however, little theoretical consensus about the territorial impact of public policy intervention. From an endogenous growth or a new economic geography perspective, national public policies aimed at enhancing overall growth may lead, as a consequence of their impact on the distribution of human capital (Lucas, 1988, 1993), innovation (Grossman & Helpman, 1991; Romer, 1990) and infrastructure (Faini, 1984; Martin, 1999; Martin & Rogers, 1995), to increasing returns to scale, resulting in greater divergence across regions and favoring a center-periphery pattern (Krugman, 1991; Martin, 1998; Romer, 1990).

Neoclassical and other scholarly strands suggest, in contrast, that public investment may have an equalizing role, as it generates goods or activities which increase private productivity, especially in those areas with a lower initial stock of capital, resulting thus in constant or decreasing returns to scale. The empirical works of Aschauer (1989), and Munnell (1990a, 1990b), focusing on infrastructure public investment, or those of Barro (1990) have highlighted the positive returns of public

investment as a whole and their positive impact in backward areas. The role of central governments is, from this perspective, determinant in enhancing the accumulation of productive factors and growth potential in backward regions through public investment policies. If there are factors that have a positive effect on regional growth, there is scope for the implementation of supply-side policies (Martin, 1998).

Public investment in Mexico has been an important tool not only for providing infrastructure, but also for enhancing local capacities in general, and its use may help to explain the improvement in social indexes across the country (Lustig, 1998). Nevertheless, public investment has also been frequently used in a discretionary form, for example, to increase the government's presence in the economy through the acquisition of many enterprises, as was the case during the 1970s (Aspe & Beristain, 1984), leading to a skewed allocation of public funds in favor of the most developed states (Katz, 1998; Palacios, 1989; Rodríguez, 1997).

The question that we address in this paper is thus, to what extent have national investment policies, the main focus of which has been to generate greater economic activity, actually exacerbated (or, by contrast, prevented a further growth of) regional disparities in Mexico. More specifically, we intend to determine the extent to which such investment has been: allocated according to redistribution criteria; allocated according to efficiency criteria; and an important factor of regional growth. The paper is organized as follows. Section 2 introduces a brief review of the topic. Section 3 describes the structure and evolution of public investment in Mexico. Section 4 analyzes the redistributive factor and Section 5 focuses on the efficiency criteria. Section 6 discusses the impact of public investment on growth. The conclusions are presented in Section 7.

2. THE REGIONAL IMPACT OF PUBLIC INVESTMENT

Public investment policies try to fulfill several aims (Begg, 2003): greater competitiveness by correcting shortcomings on the supply-side of the economy and raising long-run productivity; generating equity, by making sure that economic activity is evenly distributed across a territory; solidaristic or palliative goals by alleviating poverty in the short-term and providing special assistance to disadvantaged

areas, especially in cases where inequality *per se* may be considered politically unacceptable.

Public investment policies, however, seldom have the capacity to tackle all these three aims at once. One of these aims tends to prevail and which of these prevails is determined by a combination of considerations of economic competence, social justice, political stability and/or political interest of those in government. Economic competence is generally guided by the aim of achieving high returns to investment. Social justice is advanced by an equitable sharing of economic and social gains among people living in all areas. Political stability may be improved by avoiding growing disparities among political groups, which lead to political tension and ultimately may affect national aggregate growth. Finally, political interest may be determined by factors ranging from the global good to pork-barrel politics.

The balance between these forces determines to a great extent how central government allocates public investment and which economic aim prevails. The regional allocation of public investment is, however, not a subject dealt with by many researchers. Hirschman (1958) stated that the regional allocation of public investment is the most evident method through which policy influences rates of growth in different parts of a country. In developing countries, Hirschman argues, there is a tendency to scatter funds among a large number of small projects dispersed throughout the country because of political aims, the belief that economic progress will affect all regions equally, or because there is a lack of planning talent.

In seeking a balance, Hirschman's proposal is divided into three phases. The first phase is investing in regions in which an economic boom triggers an increasing demand for resources. The second stage involves redirecting investment to less-developed regions as the demand for investment in developed regions has decreased. The third stage is equalizing investment across both kinds of regions. Nevertheless, Hirschman notes that investment in less-developed regions carries the danger of misguided investment. The less risky form of investment is to provide the less-developed regions with transport systems, electricity systems and other facilities already available in the more developed regions. Because of the weakness of the entrepreneurial sector of the society, however this might not be an efficient method (Rodríguez-Pose, 2002). Given that some investment in public utilities is necessary, the

main objective should be to provide the less developed regions with the means to generate endogenous economic activity.

Hansen (1965a, 1965b) suggests that in order to eliminate regional imbalances, public investment allocation should be differentiated among areas. In congested regions, that is, areas with a high concentration of population and economic activity, there should be investment in both categories in a first phase, then in economic capital in a second phase. For intermediate (areas with plentiful labor and raw materials) and lagging regions (areas of little interest to firms) there is a deficit of investment in both regions in a first phase, and in a second phase, economic capital should be allocated in intermediate regions and social capital in lagging regions. Nevertheless, the arguments of Hirschman and Hansen leave to planners when to switch the direction of public investment, opening also the door for political or electoral manipulation.

Using the New Economic Geography framework, Martin and Rogers (1995) and Martin (1999) analyze the impact of public infrastructure on industrial location. Assuming that trade integration leads firms to locate in regions with better domestic infrastructure, they propose that in areas with low industrial concentration, policies should be based on infrastructure that facilitates domestic rather than international trade. Furthermore, improving the access of poor regions to core regions will probably accelerate the process of divergence of industrial concentration.

Overall, there is agreement that public investment may generate positive benefits through economic growth, alleviation of poverty and the promotion of sustainability, intended to enhance the capacity of a region by increasing resources and enhancing the productivity of the resources. But, the generation of benefits occurs only when the services provided respond efficiently to effective demand (World Bank, 1994). As mentioned in the introduction, Aschauer (1989) and Munnell (1990a, 1990b) sparked a stream of work on public investment and productivity and growth. Such works have not however been free from controversy, especially those that report high output elasticities³ (Gramlich, 1994; Morrison & Schwartz, 1996). In addition, many of these studies suffer from endogeneity, as often efforts to test for test for causality are minimal (Button, 1998; Duffy-Deno & Eberts, 1991; Eisner, 1991; Gramlich, 1994; Holtz-Eakin, 1994).⁴

The issues of how public investment is allocated and to what extent it has a positive effect on growth are particularly relevant in a country such as Mexico, where investment decisions have traditionally been highly centralized and where the main objective of the federal government has been to foster national growth, in spite of the dimension of economic disparities among regions. This sets up the debate between efficiency and redistribution, and makes us wonder to what extent regional growth is fostered by such investment. In order to undertake such objectives in the remainder of the paper, it is first important to understand the territorial allocation of public investment in Mexico since 1970 which is presented in the next section.

3. PLANNING AND EVOLUTION OF PUBLIC INVESTMENT ALLOCATION

(a) *The populist period*

Mexican governments in the 1970s and beginning of the 1980s resorted to a widespread use of public investment in macroeconomic management (Figure 1), which often responded to the populism of the ruling elites. Four reasons are given for this extensive use of public investment: the erosion of political legitimacy; the emergence of guerrilla groups; the absence of institutional mechanisms to counter the presidential power; and the abundant access to international financial sources (Bazdresch & Levy, 1991).

The increase in public investment during this period was also tied to an upsurge of public intervention in the economy. This was mani-

festated, for example, in the fact that the number of public enterprises created in Mexico during 1971–76 matched the number of publicly owned firms created during 1952–70. As Aspe and Beristain (1984) noted, not all of these firms were necessarily related to the expansion of productive activities (see data in Table 1).

Some studies (e.g., Palacios, 1989; Scott, 1982) have concluded that the territorial allocation of public investment during this period fundamentally favored the more developed regions. There was little counterbalance. Given the lack of a coordinated and comprehensive regional policy, efforts by the federal government to redress regional disparities were often haphazard and piecemeal. These included efforts toward the development of housing, health and social security in rural areas and in the less developed areas (Navarrete, 1971), or efforts to increase funds for rural areas. As Bazdresch and Levy (1991), and Moore (1984) show that Mexico City was highly subsidized during this period (lower price of utilities, housing, etc), with resources being transferred from other states to the capital, therefore increasing the attraction of the city for migration.

The distribution of per capita public investment for each presidential period, and for 1971–85 and 1985–99 can be seen in Table 2. Mexico City (Distrito Federal) remains well above the national average in per capita allocation of public funds throughout the whole period of analysis.

With the discovery of large oil reserves and the oil boom in the 1970s, which brought what was then thought to be an unlimited horizon of high revenues for the country, the government

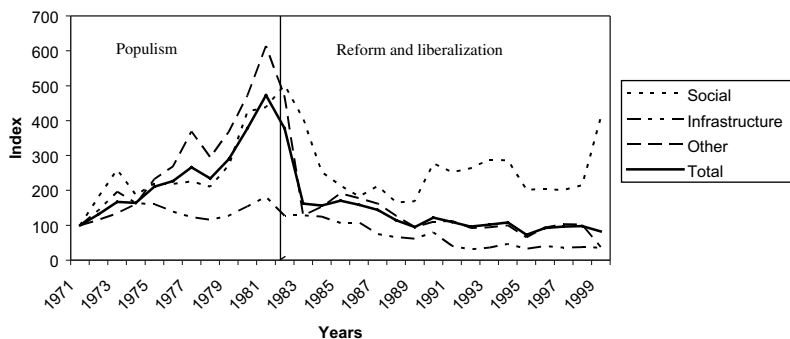


Figure 1. Per capita real public investment (1971 = 100). Source: Own calculation based on the *Statistical Annexes to the Presidential Address to the Nation (Poder Ejecutivo Federal, various years)*.

Table 1. *Sectoral composition of public investment in Mexico (as % of total public investment)^a*

Period	Agriculture	Social	Economic infrastructure	Industry, commerce and tourism	Other
1965–70	10.4	24.5	22.1	41.1	1.9
1971–76	15.6	20.4	22.3	41.9	1.4
1977–82	16.4	18.7	14.5	47.8	4.2
1983–90	9.8	28.2	15.9	41.9	4.1
1991–96	5.8	37.3	11.6	39.2	6.3
1991–99	6.3	36.1	10.8	41.3	6.1

Source: Palacios (1989), Lächler and Aschauer (1998) and own calculations.

^a Infrastructure comprises construction of roads, rails, airports, seaports and communication links. Social investment includes education, health, social security, labor, solidarity, welfare and similar concepts. The remaining investment is included under other. These categories are used throughout the paper.

Table 2. *Total public investment per capita (average = 100)*

State	1970–76	1976–82	1982–88	1988–94	1994–99	1971–85	1985–99
Aguascalientes	51	42	64	79	63	47	67
Baja California	118	100	93	62	52	106	68
Baja California Sur	288	257	196	208	149	253	179
Campeche	115	383	750	573	712	326	751
Coahuila	134	125	80	109	68	119	86
Colima	163	164	193	109	93	174	132
Chiapas	96	113	52	49	121	112	64
Chihuahua	64	55	52	50	48	56	49
Distrito Federal	144	142	232	345	173	159	253
Durango	58	48	52	56	59	51	53
Guanajuato	48	32	26	27	39	36	30
Guerrero	77	48	55	67	63	56	61
Hidalgo	118	64	74	104	107	84	94
Jalisco	42	29	35	32	25	33	31
México	42	23	26	32	28	28	28
Michoacán	86	58	132	61	43	78	78
Morelos	48	35	39	55	50	39	48
Nayarit	67	64	52	171	58	62	98
Nuevo León	61	61	58	41	60	65	47
Oaxaca	77	58	58	76	77	64	70
Puebla	29	23	29	26	33	25	28
Querétaro	64	64	64	53	65	67	53
Quintana Roo	339	187	145	108	95	221	105
San Luis Potosí	45	42	52	62	46	45	51
Sinaloa	77	77	64	77	58	77	66
Sonora	99	80	80	64	72	84	72
Tabasco	240	421	145	176	392	334	219
Tamaulipas	157	148	87	74	101	146	84
Tlaxcala	48	39	39	48	50	41	45
Veracruz	109	142	93	93	88	130	92
Yucatán	58	42	52	80	68	48	66
Zacatecas	38	35	32	34	45	37	35

Source: Own calculation using data from: Poder Ejecutivo Federal (various years).

started a so-called management of wealth approach at the end of the 1970s. One of the consequences of this approach was the reliance on debt in order to finance high government

expenditure. This excess of financial resources was used by the government to give huge subsidies to public enterprises and finance diverse programs without implementing any monitoring and control mechanisms to prevent deviation of funds. The objective of the governmental plan was to reduce the economic concentration in Mexico City, while leveling out differences in regional development. As seen in Table 2 the distribution of public investment did not meet the objectives of the Plan as Mexico City remained in a similar position to that of previous administrations, while investment in Campeche and Tabasco, the oil states, increased drastically.

(b) *Liberalization and reform*

The presidential terms after 1982 have been characterized by austerity measures implemented to alleviate the recurring crises, and thus the level of public spending has been reduced. The various National Development Plans implemented since the 1982 debt crisis have been aimed at improving the economic capacity of the states through an increase in the direct implementation of public works of local interest. The Plans have also established that federal investment should be concentrated in medium-sized cities and areas with adequate capacity, but without defining more accurate criteria.

There has been, however, a fundamental shift in the relationship between private and public investment and gross domestic output. The continued decline of public investment followed the new orientation toward a larger private-based sector and a market-friendly economy (Lächler & Aschauer, 1998). Two investment trends can be identified during this period (Cypher, 1990). The first is that, with public investment cut approximately by half, the private sector could not rely on the state to open up new areas of investment. Second, as output was falling faster than investment, it is likely that the existing capital stock was exhausted.

The role of public investment became to facilitate the provision of infrastructure to complement private investment and correct market failures. The privatization of public enterprises led to a natural decline in public investment. Public investment thus began to focus on sectors considered to have important externalities such as education, health and the environment (see the increase in the social col-

umn in Table 1), and on those areas traditionally underprovided by the private sector (Lächler & Aschauer, 1998).

At first glance it would seem that the allocation of public investment did not achieve the aims stated in the national plans, concentrating on, and therefore benefiting, few areas, in spite of government rhetoric. There is, however, always a tradeoff between redistribution and efficiency, which could mask the effects of allocation. It is therefore necessary to examine the extent to which the allocation of public investment has followed patterns of redistribution or patterns of efficiency. The next section will try to determine these patterns before analyzing the impact of this investment on growth, which will be undertaken in subsequent sections.

4. DETERMINANTS OF THE REGIONAL ALLOCATION OF PUBLIC INVESTMENT: THE REDISTRIBUTIVE FACTOR

Three criteria could be highlighted for the regional allocation of public investment (De la Fuente & Vives, 1995). First is the criterion of need, the target being to counterbalance the disadvantages of poor regions through public investment. Thus, regions with less income should receive more investment, but rich regions may call for more funds to meet their additional needs derived from population growth. The second consideration is efficiency, where the aim is to maximize national income. In this case, regions with a higher rate of return to investment should receive more investment, and redistribution should be *ex post* through taxation. Third, an intermediate position or neutral criterion is to ensure that public investment does not give any excessive advantage to any region, equalizing investment across regions. It should be born in mind however that this last criterion may not produce clear results as the objectives are diffused.

In order to determine the redistributive focus, it is possible to regress the allocated public investment versus a variable measuring the redistributive effect, controlling for additional variables, which may also be relevant. Here we set a model to some extent similar to the one presented by Kamada, Okuno, and Futagami (1998). The model is as follows:

$$RE_i = \beta_0 + \beta_1 Dis_i + \beta_2 Dens_i + \beta_3 Oil_i + \beta_4 Lag_i + \varepsilon_i \quad (1)$$

where β_j denotes the parameters ($j = 0-3$) to find, i represents the state, and ε is error term. The variables are defined as follows (a description of how variables were calculated and their sources can be found in Appendix A).

RE, the dependent variable, is the log of the per capita public investment allocated to each state in the given period.

As we are measuring the extent to which redistribution has been one of the main focuses when allocating public investment, we shall need a variable that accounts for this effect. *Dis* is a normalization of the per capita GDP in each state (see Appendix A for calculation). This variable accounts for the relative position of each state on the scale of the per capita GDP distribution, in which rich states have a positive sign, while the disadvantaged regions have a negative sign. Given that low-income regions have a negative sign, the expected sign of this coefficient is negative if the priority is one of equality. This variable may be subject to endogeneity because not only might the low-income regions determine how much investment to make, but also low investment in such areas may determine to some extent the low productivity and low income of those areas. We use the value for the beginning of the period to avoid problems of endogeneity.

Public investment may be directed to areas with large population bottlenecks needing more resources and public services. In order to account for this effect the model includes a variable known as *Dens*, which is the log of the population density in the initial year of analysis, measured as the population of the state divided by the corresponding area in square kilometers. As a location with a high population concentration requires more investment to satisfy its needs, the expected sign for the coefficient is positive. The value used here is also from the beginning of the period.

Oil is a dummy variable for the oil states, Campeche and Tabasco, which received high shares of public investment in order to exploit the oil fields.

The issue of switching the focus of public investment in some areas is subject to debate. The clearest distinction is the switch proposed by Hirschman and Hansen, which was previously discussed. In order to make some measurement of the switch in public investment

allocation, the model includes a variable *Lag*, which is the same as *RE* but for the previous period. This variable will help to determine the extent to which there is a switch in the allocation of public investment, a positive sign indicating persistence in the way allocation is made. In the *Lag* variable used in the regression for 1970–85, we apply the regional shares of national investment from Scott (1982) to the total federal investment during 1959–70.

The results of the analysis are reported in Tables 3 and 4 for 1970–85 and 1985–99 respectively, distinguishing between social and infrastructure investment, and after having performed the normal tests.⁵

Table 3 displays the results for the regional allocation of social public investment. The variable *Dis* is significant, although with positive sign, suggesting a regressive effect of this kind of investment; that is, the richer the state the greater the social investment. The regressiveness in the allocation of social investment underlines a likely delay in the local acquisition of social skills or in the development of entrepreneurship, as noted by Hirschman in lagging regions, given that all periods display a positive coefficient for the *Dis* variable, without change of sign over time, and a positive effect for the *Lag* variable.

Table 4 displays results for the allocation of public investment in infrastructure. Once again, the results of *Dis*, given its positive sign, indicate a regressive allocation of this kind of investment. The results for the variable *Lag* are also positive and significant. The combination of these coefficients shows this kind of investment has been consistently allocated in developed regions, conforming to the first stage of Hirschman's process. Why this preference for investment allocation in richer regions? Some explanations can be found in the literature. Martin and Rogers (1995) and Martin (1999) have noted that improving the access of poor regions to core areas would probably accelerate the process of divergence among regions, the central government facing the challenge of a tradeoff for regional policies between continuing to favor richer regions and investing more in lagging regions.⁶ This would also reinforce the theories of Hirschman and Hansen that social investment should come before infrastructure investment (in reference to less developed regions). Fujita, Krugman, and Venables (1999) have also noted that if infrastructure investment is made in less developed regions, industry will not locate in these places

Table 3. *OLS regression: cross-section of Mexican states social^a investment*

Variable	1971–85	1971–85 ^b	1985–99	1985–99
Constant	3.2954*** (0.8741)	5.1294*** (0.3016)	1.1315*** (0.5044)	4.9031*** (0.2399)
<i>Dis</i>	0.2063** (0.0981)	0.3396*** (0.1054)	0.0884 (0.0783)	0.3110*** (0.1286)
<i>Dens</i>	0.0108 (0.0575)	-0.0395 (0.0874)	0.0280 (0.0343)	0.0280 (0.060)
<i>Oil</i>	-0.0348 (0.3434)	0.2779** (0.1345)	0.3377 (0.3041)	-0.1800 (0.5239)
<i>Lag</i>	0.3552** (0.1652)	–	0.7453*** (0.0960)	–
R^2	0.4827	0.3941	0.7750	0.2728
$F > 0$	0.00	0.00	0.00	0.03
N	32	32	32	32

^aIncludes education, health, housing and similar concepts.

^bHubert/White/Sandwich standard errors in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 4. *OLS regression: cross-section of Mexican states infrastructure^a investment*

Variable	1971–85	1971–85	1985–99	1985–99
Constant	2.9111*** (0.7450) ^b	5.5612*** (0.1956)	1.0703** (0.5617)	4.4496*** (0.2028)
<i>Dis</i>	0.1240 (0.0836)	0.3167*** (0.0777)	0.1526** (0.0771)	0.3360*** (0.1088)
<i>Dens</i>	-0.0676 (0.0490)	-0.1405*** (0.0537)	0.0544 (0.0351)	-0.0103 (0.0512)
<i>Oil</i>	-0.3371 (0.2926)	0.1147 (0.3180)	-0.3781 (0.3019)	-0.8987** (0.4430)
<i>Lag</i>	0.5133*** (0.1408)	–	0.6092*** (0.0984)	–
R^2	0.6251	0.4406	0.6941	0.2597
$F > 0$	0.00	0.00	0.00	0.03
N	32	32	32	32

^aInvestment in communications and transport infrastructure.

^bStandard errors in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

due to a lack of forward and backward linkages.

Up to now we have put forward that the allocation of public investment may correspond to the first stage of Hirschman's and Hansen's allocation processes as: (a) there is a high concentration of public investment in few areas; (b) the high concentration is persistent; (c) there is an enduring regressive effect, which

suggests that, on average, high-income regions receive more investment. This investment is not necessarily aimed at addressing the needs of population bottlenecks, as the effect of density is negative and not significant in most instances as an alternative to the redistribution criterion. This evidence highlights the need to explore the criteria for efficiency. The extent to which efficiency criteria are prevalent in redistribution

decisions is the subject of analysis in the next section.

5. THE EFFICIENCY CRITERIA

The efficiency criterion is driven by rates of return, which indicate where it is more profitable to invest. The purpose of this section is to calculate the expected returns to public investment in order to compare these with the allocated investment in order to gain some insight on the extent to which efficiency has been the

key consideration in the allocation of public investment.

Following De la Fuente and Vives (1995) we use a standard Cobb-Douglas production function, in which the marginal productivity of each factor is proportional to its average, the ratio between the stock of the input and the output. This ratio is calculated using the average per capita public investment for the period as a proportion of the average per capita GDP in that period, and then normalizing with the average as 100. This acts as a proxy for the expected return of public investment (Table 5).

Table 5. *Expected returns, income per capita and allocated stock of economic public infrastructure^a*

State	(1) Expected return	(2) Rank of returns	(3) Pc* GDP needs	(4) Rank of GDP	(5) Mixed ranking	(6) Pc* federal public stock of capital	(7) Rank of stock
Nuevo León	211	1	171	29	13	81	16
Guanajuato	161	2	71	12	1	44	32
México	160	3	85	16	3	53	29
Quintana Roo	158	4	186	31	22	118	7
Jalisco	147	5	103	19	7	70	23
Puebla	141	6	66	8	2	46	31
Baja California Sur	141	7	130	26	18	92	12
Chihuahua	140	8	133	27	21	95	10
Aguascalientes	137	9	108	23	14	79	18
Morelos	129	10	99	18	11	77	20
Campeche	126	11	178	30	26	141	4
Yucatán	125	12	79	14	10	63	24
Coahuila	123	13	124	25	25	101	9
Durango	118	14	83	15	12	71	22
Tabasco	118	15	70	11	9	59	26
Zacatecas	108	16	57	5	5	53	28
Sinaloa	104	17	89	17	20	86	13
Guerrero	103	18	60	6	6	58	27
Sonora	96	19	118	24	28	124	6
Chiapas	95	20	47	1	4	49	30
Querétaro	92	21	108	22	27	118	8
Tlaxcala	89	22	55	3	8	61	25
Hidalgo	83	23	67	9	15	80	17
San Luis Potosí	81	24	75	13	24	93	11
Veracruz	80	25	63	7	17	78	19
Nayarit	79	26	68	10	23	86	14
Tamaulipas	75	27	104	20	29	139	5
Distrito Federal	70	28	256	32	32	366	1
Michoacán	68	29	56	4	19	82	15
Oaxaca	65	30	48	2	16	73	21
Baja California Sur	54	31	136	28	31	252	2
Colima	51	32	106	21	30	209	3

^a 1993 data. All columns, except rankings, are normalized (average = 100). The mixed ranking is made adding up the rankings in columns (2) and (4).

It should be noted that these results do not establish the optimum level of public investment but rather present a simple ranking for investment priority.

The expected return indicates that if the government wants to recover the investment made in the least possible time, it should then invest in areas where returns are higher. Caution is needed however when drawing conclusions from this analysis; as might be expected, the different productive inputs are complementary, and therefore productivity of public investment may be higher in those areas with larger endowments of other factors. In addition, if there are increasing returns in some regions, the return should then be higher than that calculated here. Therefore, efforts in other areas would also increase the returns on public investment, which still could play an important role in combination with other instruments of regional policy.

If the main criterion were efficiency, investment would be allocated according to the expected return ranking in column (2), while if the criterion were redistribution it would follow the per capita GDP ranking as in column (4). A mixed criterion would follow the ranking in column (5) (Table 5).

In the economic literature, returns are more closely related to the existence of a stock of capital. The data for the stock of economic public investment were provided by Rodríguez-Oreggia (2002) who built the stock for the regions using the Perpetual Inventory Method.

Care should be exercised in deriving implications from this stock of public economic capital. As Pritchett (1996) observed, public investment in economic infrastructure does not necessarily create the same proportion of capital, especially in developing countries where it is more difficult to distinguish between investment made in effectively productive enterprises and investment made in white elephants. Summer and Heston (1991) have already shown that capital goods tend to be relatively more expensive in developing countries than in developed ones.⁷ Tanzi and Davoodi (1997) noted that corruption plays an important role in the choice of projects and contractors, resulting in a highly distorted capital budget with some projects having no manifest use or output capacity below that expected.⁸ In these cases the stock of capital would not produce the expected results in terms of growth.

From the results presented in Table 5, Nuevo León appears as the state in which it would be

most profitable to invest in the stock of federal economic public infrastructure, followed by Chihuahua, Guanajuato, Mexico State and Quintana Roo. From column (7) it can be noted that states with a higher rate of return are ranked around the average in terms of allocated stock of infrastructure. Looking at the ranking of the stock in column (7) these states are ranked from the middle of the list to the bottom in terms of per capita stock of federal infrastructure. The table reinforces the findings in previous sections, as there is no a clear pattern for the allocation of the stock of federal public infrastructure, which follows neither a redistribution line nor an efficiency option.

We can conclude from this section that efficiency has not been the main criterion for the allocation of public investment. As shown earlier, however, neither has redistribution been the major driving force behind such allocation. What then are the criteria for the allocation of public investment? At least from the previous analyzes this is not possible to discern. Other factors may be considered as candidates such as political payoffs and lobbying.

The use of public investment for political purposes is not a new issue in the Mexican context. Bazdresch and Levy (1991) have pointed out that during the 1970s and the beginning of the 1980s the use of public investment had a clear link to political interests, with strategic planning considerations playing second fiddle.⁹ In addition, there is ample evidence that the federal government has used fiscal policy for political purposes, especially in the run-up to elections (González, 2002), with the bulk of investment going to areas loyal to the party in office (Molinar & Weldon, 1994; Rodríguez, 1997). Other political use of public funds has been to try to impose a federal agenda on state and local governments (Costa-Font, Rodríguez-Oreggia, & Luna, 2003).

If we accept the evidence that neither redistribution or efficiency play a decisive role in investment decisions, but that politics is decisive in the allocation of resources, we should then ask to what extent has public investment had any impact on regional economic growth? The next section examines this question.

6. PUBLIC INVESTMENT AND GROWTH IN THE MEXICAN REGIONS

A growth equation is estimated using the standard Barro type structure, which allows

testing for conditional convergence by adding a set of variables reflecting differences in endowments. The equation is set as follows:

$$Dy = f(y_0, oil, h_0, g) \quad (2)$$

The Appendix A contains a detailed description of these variables and their respective sources. The zero denotes the initial value of the variable in the period. Dy is the annual average rate of growth of real per capita GDP. y_0 is the log of the per capita GDP in the initial year of the period under analysis. A negative sign in the coefficient will highlight a process of conditional convergence.

Oil is a dummy variable for the oil states, Campeche and Tabasco. The reason for including this dummy is that these states recorded higher rates of growth during the 1970s and the beginning of 1980s due to the oil boom. Moreover, these states received high shares of public investment in order to exploit the oil fields, the dummy variable will then help to avoid overstate the coefficient of public investment.

The variable for the public stock of capital is denoted by g . We shall use the initial per capita stock of public economic infrastructure, denoted as g -stock. As capital would also include other concepts such as the social infrastructure, the model will also use a proxy with the social investment per capita averaged over the period, which will be denoted by g -social.

The works of Aschauer (1989) and Munnell (1990a) found a positive relationship between public investment and economic growth, however, empirical findings have not been clear-cut or have even stressed a negative relationship between public investment and growth (see, for example, Vanhoudt, Mathä, & Smid, 2000). We expect a positive textbook impact of public investment on the productive process. But, several studies have found only the stock of public economic infrastructure to be relevant for growth (for example, Martin, 1998; Mas, Maudos, Perez, & Uriel, 1996).

The equation adopts the following form:

$$Dy = \beta_0 + \beta_1 y_0 + \beta_2 oil + \beta_3 h_i + \beta_4 g_i + \varepsilon_i \quad (3)$$

β_j denotes the parameters to find, i represents the state and ε is error term.

(a) Results

The results for the regressions on economic growth are presented in two subperiods. The first is 1970–85, a period characterized by

populism and a closed and highly regulated national market, including a large share of state owned companies. The second subperiod is 1985–2000, in which deregulation of the economy free trade and regional economic integration within NAFTA are the main characteristics. This division will be the axis on which we shall base our analysis as it represents a fundamental change in economic policy, and has been statistically tested, among others, by Lächler and Aschauer (1998), who found a structural change in 1985–86.¹⁰

The regressions were estimated with an ordinary least squares (OLS) cross-section for the 32 states and normal tests were carried out as in Section 4. A problem worth highlighting is the endogenous component in public investment. Although this is a problem from the theory given the causal relationship between public investment and growth, technically, this problem can be avoided using instrumental variables (IV). The problem thus becomes identifying the ideal instruments and we will attempt to use this technique using lagged values.¹¹

(b) The period 1970–85

Table 6 reports the results for 1970–85. During this period y_0 is significant and negative, suggesting a process of conditional convergence. The coefficient, however, is sensitive to the inclusion of the variable for growth of public investment, although the sign remains negative.¹²

The variables for g -stock and g -social are not significant in any case. Why are they not significant in a period characterized by high use of such investment? One important question to consider is to what extent this investment was directed toward enhancing the productive capacity of the regions. In this period public investment was mainly directed toward the acquisition of enterprises (Aspe & Beristain, 1984; Lustig, 1998) and the pursuit of political interests (Bazdresch & Levy, 1991). Although these are not the only motives behind government intervention, they seriously dented its impact on economic growth. In addition, the productive public investment that remained was often targeted at addressing the needs of high population growth and fundamentally at trying to patch the accumulated scarcity in the fields of health and education (Villarreal, 1988). Therefore, in spite of the high levels of investment, the allocation of such investment failed to increase the productive capacity of regions as

Table 6. *Growth regression 1970–85^a*

Variable	OLS	OLS	OLS	IV	OLS	IV
Constant	0.0657** (0.0078)	0.0916*** (0.0244)	0.0476*** (0.0130)	0.11103*** (0.0509)	0.0435*** (0.0139)	0.0350** (0.0260)
y_0	-0.0291*** (0.0094)	-0.0217** (0.0152)	-0.031*** (0.0114)	-0.0243* (0.0133)	-0.013 (0.0141)	-0.0068 (0.0166)
h_0	0.0185 (0.0145)	0.0145 (0.0152)	0.0152 (0.0139)	0.0267 (0.0230)	0.0019 (0.0194)	-0.0044 (0.0219)
<i>Oil</i>	0.0886*** (0.0313)	0.0936*** (0.0302)	0.0873*** (0.0314)	0.0917*** (0.0334)	0.0767*** (0.0187)	0.0722*** (0.0148)
<i>g-stock</i>		-0.0054 (0.0051)				
<i>g-social</i>			0.0042 (0.0029)	-0.0128 (0.0145)		
<i>g-growth</i>					0.1913** (0.0909)	0.2641** (0.1345)
R^2	0.7737	0.7832	0.7814	0.6904	0.8495	0.8384
$F > 0$	0.00	0.00	0.00	0.00	0.00	0.00
N	32	32	32	32	32	32
Hausman				Accept		Accept

^aHuber/White/Sandwich. Std. errors in parentheses. Instruments are the lagged values for *g-social* and *g-growth*, and same variables for the others.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

reflected in per capita GDP growth. It is the growth of such investment, however, which has a positive and significant effect on growth, pointing more toward a Keynesian effect. According to the Hausman test, we cannot reject the null hypothesis of the OLS coefficients as consistent and efficient, preferring such coefficients to the IV.

Human capital is not relevant in this period. As there was a high level of public intervention in the economy, a large percentage of new employment was generated by the public sector, and therefore, as Griliches (1997) points out, its contribution to productivity is not properly reflected on national accounting records. This finding is also consistent with international evidence by López, Thomas, and Wang (1998) who find little impact of human capital on growth in periods where economic reforms were absent.

(c) *The period 1985–2000*

During 1985–2000 the presence of oil remains significant although with a negative sign (Table 7). The significant dummy variable for oil states means, again, that there is a different effect on growth in Campeche and Tabasco. The nega-

tive sign is however possibly due to the combination of three factors during this period. First comes the consistent decline of international oil prices. Given the low international prices, it was not profitable to invest more in the sector. The second factor is the opening to international trade, which led to the loss of the previous comparative advantage enjoyed by the oil-producing states in favor of northern states, especially those bordering the United States. Third are the efforts made by the government to compensate for the strong effect of oil on the economy, concentrating instead on other economic activities. Human capital is significant and positively associated with economic growth during this period, a result that is consistent with other studies on Mexican regional growth (Rodríguez-Oreggia, 2002; Rodríguez-Pose & Sánchez-Reaza, 2004) and with international evidence (López *et al.*, 1998) (Table 7).

None of the public stock or investment variables are significant in Table 7. As Ramírez (1994) suggests, this may be a result of the unsystematic cuts in the public budget, which may have had a negative impact on capital expenditure as changes in public investment precede changes in private capital. Budgetary cuts took off in the mid-1980s, after which the

Table 7. *Growth regression 1985–2000^a*

Variable	OLS	OLS	OLS	IV	OLS	IV
Constant	−0.0606*** (0.0227)	−0.1009*** (0.0381)	−0.0790*** (0.0297)	−0.0997*** (0.0327)	−0.0564** (0.0243)	−0.0966** (0.0433)
y_0	−0.0077 (0.0115)	−0.014 (0.0123)	−0.0118 (0.0123)	−0.0164 (0.0128)	−0.0089 (0.0118)	0.0023 (0.0182)
h_0	0.0524** (0.0217)	0.0506** (0.0215)	0.0533** (0.0217)	0.0543** (0.0222)	0.0501** (0.0224)	0.0726** (0.0347)
<i>Oil</i>	−0.062*** (0.0189)	−0.0550*** (0.0194)	−0.0608*** (0.0190)	−0.0593*** (0.0194)	−0.0610*** (0.0193)	−0.0704 (0.0276)
<i>g-stock</i>		0.008 (0.0061)				
<i>g-social</i>			0.0055 (0.0057)	0.0117 (0.0069)		
<i>g-growth</i>					−0.0613 (0.1162)	0.5278 (0.4271)
R^2	0.6923	0.7105	0.7023	0.6895	0.6954	0.4054
$F > 0$	0.00	0.00	0.00	0.00	0.00	0.00
N	32	32	32	32	32	32
Hausman				Accept		Accept

^aHuber/White/Sandwich. Std. errors in parentheses. Instruments are the lagged values for *g-social* and *g-growth*, and same variables for the others.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

capital variable also shows a decrease. These results are also compatible with those of Lächler and Aschauer (1998), who found a crowding out of private investment by public investment and a weakening of the relationship between public investment and growth during the 1990s in Mexico.

Table 6 reports a negative but not significant coefficient for the stock of federal public infrastructure during 1970–85. As Vanhoudt *et al.* (2000) have noted, a negative relationship is only likely to occur if the social rate of return is negative, for example, when resources are allocated in low-productivity areas, instead of high productivity ones, with no effect on overall productivity. In this sense, our previous findings have pointed toward a lack of direction, with neither efficiency, nor redistribution criteria dominating. This is relevant as this period experiences a convergence process, with poor regions growing faster than richer regions, but richer regions receiving more public investment.

To the extent that neither redistribution nor efficiency have been the main criterion for the allocation of funds, it might follow that political pay-offs and lobbying have undermined the positive effect on growth. During 1985–2000

the coefficient becomes positive, which is more reasonable considering that high-income states had higher rates of growth, while also receiving more public investment according to the findings in this paper.

7. CONCLUSIONS

The purpose of this paper has been to analyze the extent to which the allocation of public investment has followed either a pattern guided by redistribution or efficiency objectives, and the extent to which that allocation has had an impact on regional growth. The evidence shows that public investment in Mexico tends to be concentrated in just a few relatively well-off regions. Moreover, the analysis in this paper suggests that although the different national plans had as their stated goal the reduction of regional disparities through the allocation of public investment, that allocation has been regressive; that is, the richer states received more than their fair share of public investment throughout the period of analysis. The introduction of population density measurements into the analysis to test for bottlenecks caused by population concentration has proven, on the

whole, not to be a significant factor for the allocation of public investment.

We have also examined the question of efficiency in the allocation of public investment. The findings point out that, as in the case of redistribution, efficiency has not been a key concern in the allocation of public investment among regions. If public investment were efficiently allocated, then it would follow the rate of return criterion, which is not the case. It is likely that political interests and lobbying have played an important role in determining how investment is assigned. Powerful areas that have more resources for lobbying, and in areas with a high political pay-off seem to have reaped the lion's share of public investment. This has resulted not only in a decrease in the rate of return to investment, but also has contributed to reduce the impact of that investment on growth.

The effects of public investment in Mexico on regional growth are thus blurred. In the 1970–85 period the variables for public stock and investment show a lack of significance. One body of research has suggested that investment during this period was allocated according to political interests. In addition, that investment served to increase government intervention in the economy through the acquisition of enterprises. It is therefore likely that public investment had only a short-run Keynesian effect. This is supported by the fact that the only relationship found was between growth and the rate of growth of public investment, while testing for the investment accumulated in the period or the initial stock of infrastructure the results do not show any significance.

Budgetary cuts have contributed to reduce even further the association of public investment with growth after 1985. This lack of significance may be also due to lobbying and to the high political pay-offs in a period marked by increasing electoral competition, which may have affected the allocation of public investment and, therefore, limited further its effect on regional productivity. In addition, it seems that federal investment has been used as a tool to influence voting behavior in the states.

Contrary to the findings for the European regions, where, although it could be claimed that European public investment has not managed to deliver greater regional growth in peripheral areas and convergence, it has been an instrument for redistribution (Boldrin & Canova, 2001; Rodríguez-Pose & Fratesi, 2004; Vanhoudt *et al.*, 2000), in the Mexican regions public investment has not been effectively used either as instrument of redistribution or as engine for regional growth and convergence. The findings thus stress the presence of a possible pork-barrel effect in the use of public investment at the regional level in Mexico (Costa-Font *et al.*, 2003). Although the presence of pork barrel in public investment in Mexico does not completely rule out a possible impact of public investment on regional growth, especially in less-developed regions, it does suggest that there is still considerable room for maneuver in order to improve the focus and scope of public investment policies, if they are to become a real redistributive and/or growth enhancing policy.

NOTES

1. Some efforts were made through the existence of a federal fund distributing investment according to population, share of earnings from federal taxes made in the state, and a share received previously, but as of 2000 only 20% of the investment was allocated according to this formula.

2. Throughout the paper we make reference to public investment, although we are considering fixed capital formation as economic infrastructure investment; investment in education, health and similar issues is catalogued as social investment; and current spending in other entries such as other investment. This distinction becomes clearer later in the paper.

3. The high elasticities imply that government capital pays for itself in terms of higher output in a year or less.

4. There is a body of research on Latin America linking public and private investment to growth. Some works covering nations in the region have found complementarities between public and private investment and limited evidence of crowding out effects (Cardoso, 1993; Green & Villanueva, 1993; Serven & Solimano, 1993). Ramírez and Nazmi (2003) detect that for a short span of time (10 years), public and private investment have contributed to economic growth at the national level in nine countries of the area, while consumption expenditures have a negative impact. Cruz

and Teixeira (1999) found that, in the case of Brazil, public and private investment substitute each other in the short term but complement each other in the long run and have an impact on growth.

5. We use the Cook-Weisberg test for heteroskedasticity (Cook & Weisberg, 1983). Regressions where this problem is identified are displayed using standard errors with the method Huber/White/Sandwich robust variance estimates. Regressions have also been tested for multicollinearity with the Variance Inflation Factor (VIF—Chatterjee & Price, 1991).

6. In the case of roads, the evidence shows that links have been made in order to connect first the center of the country, namely Mexico City, and then northern areas, which are the more dynamic, with secondary or intra-regional networks being neglected (Besnainou & Davezies, 1998; Chias, 1995). Feltenstein and Ha (1999) point out that transport infrastructure in Mexico has led to a costs increase in sectoral production.

7. For example, the building of new road networks in Mexico was under concession since 1989 but pressures to achieve returns within the presidential term created a sense of urgency, which led to erroneous calculations for traffic and costs. Projects which proposed to return roads in the shortest time were favored by the government. As a result the costs were higher than planned (in some cases even by more than a factor of two) and the resulting tolls are up to ten times higher than for same distances in the United States. The consequence was that free roads were preferred and the government had to rescue the companies and absorb the debt in the public budget (World Bank, 1994).

8. Mexico has always been known for its high levels of corruption with frequent cases of collusion between

private investor groups and government officials (*Reforma*, 2001); in 2002 Mexico was ranked 57th in the Transparency International Corruption Perceptions Index (Transparency International, 2002).

9. An example is the construction of sugar mills by the government in areas where no natural conditions for sugar cane crops existed (García-Chávez, 1997).

10. We also performed a test for structural change with the pooled data, for 1970–85 and 1985–2000. We found the χ^2 to be significant at the 1% rejecting the null hypothesis of no structural change. Such break reflects the real change in policy by the Mexican government, undertaking economic reform and liberalization.

11. We have performed tests in order to check for the endogeneity of public investment in the growth regressions with a Durbin–Wu–Hausman test (Davidson & McKinnon, 1993). The F tests for 1970–85 are (p -value in parentheses): g -growth 14.18 (0.00); g -social 0.43 (0.51). For 1985–2000: g -growth 0.19 (0.66) and g -social 1.12 (0.29). But, since endogeneity arises from theoretical considerations about causality, it should also be addressed using Instrumental Variables.

12. A referee suggested complementing the analysis with the use of pooled cross-sectional time-series analysis. In our opinion, due to its length, such analysis exceeds the scope of this paper. Other studies such as Rodríguez-Oreggia (2003) and Gamboa and Messmacher (2003) use panel data to address similar issues, finding no impact of public investment on regional growth in Mexico. In addition, it has to be noted that the discussion about the use of panel data is still unfinished, see for example, Pritchett (2000).

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APPENDIX A. DEFINITION OF VARIABLES

Variable	Description	Source
<i>Dens</i>	Log of population per km ² . Initial year	a
<i>Dis</i>	Normalization of per capita GDP (y) by the standard deviation (S) as: $Dis_i = (y_i - y)/S$	a, b
<i>Dy</i>	Average annual rate of per capita GDP growth in a given period	a, b
<i>g-growth</i>	Average annual rate of growth of per capita public investment	a, b
<i>g-social</i>	Log of per capita social investment average in a given period	a
<i>g-stock</i>	Log of the per capita stock of economic infrastructure. Initial year	c
<i>h₀</i>	Log of average years of schooling of the population aged 15+ Initial year	a
<i>LAG</i>	Log of per capita public investment in a previous period	a, d
<i>Oil</i>	Dummy for Campeche and Tabasco	
<i>RE</i>	Per capita public investment in each state as percentage of the national	a
<i>y₀</i>	Log of per capita GDP. Initial year	a, b

a. Presidential Address to the Nation (Poder Ejecutivo Federal, various years).

b. Economic database of INEGI (www.inegi.gob.mx).

c. Rodríguez-Oreggia (2002).

d. Scott (1982) for data before 1970.