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**Financing Infrastructure in Developing Countries:
Lessons from the Railway Age**

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Abstract

This paper considers the role of infrastructure investment in the economic development of the regions of overseas European settlement in the 19th century. Its premise is that the pattern of investment in general, and the roles of public intervention and external finance in particular, were consequences of the structure of financial markets in countries in the early stages of economic development. Government intervention, external finance and debt-servicing difficulties were correlates of the financial-market imperfections that gave rise to informational asymmetries, moral hazard and adverse selection, while government policies to overcome asymmetric information encouraged management to engage in bankruptcy for profit. The tradeoff between credit rationing and bankruptcy for profit is at the heart of the paper.

I. Introduction

For low income countries, infrastructure investments have alluring benefits but also daunting costs. Where transportation, communication and power generation are inadequate, their provision can do much to boost productivity and growth. But where income and productivity are depressed by inadequate infrastructure, the financial resources needed to underwrite infrastructure investments are difficult to mobilize. With the lack of infrastructure limiting finance and the lack of finance limiting infrastructure, countries can find themselves in a low-level equilibrium trap from which it is difficult to break out.

Two potential escape routes are government subsidies and foreign borrowing. If infrastructure throws off externalities that raise productivity and profitability elsewhere in the economy but cannot be captured by those who finance the investment project, then the classic efficiency argument for subsidies applies. And even when the returns are appropriable, investment may still not pay if domestic funds are costly; investors may then seek finance abroad where it is cheaper. Not surprisingly, government guarantees and foreign borrowing are prominent features of infrastructure finance in many developing countries.

Increasingly these arguments for government intervention and foreign borrowing are regarded with skepticism. The "white elephants" subsidized by governments have underscored doubts about the efficiency of public finance. The debt-servicing difficulties of developing countries have raised questions about the efficacy of foreign borrowing. Both observations encourage proposals to commercialize and privatize infrastructure projects and to fund them by promoting the development of financial markets.

There is nothing new about either these arguments or these reservations. Infrastructure projects were privately financed and privately constructed in virtually all of the overseas regions of recent European settlement in the 19th century. At the same time, however, government subsidies and external finance were integral to the process of infrastructure development. While early U.S. railways, to take a prominent example, were private undertakings, land grants and government guarantees subsidized their construction. Finance was raised abroad, mainly on the London capital market. This history suggests that reliance on private initiative should not be viewed as obviating the need for government guarantees and foreign finance.

The goal of this paper is to elucidate these historical patterns of public intervention and external finance. Its premise is that observed patterns are consequences of the structure of financial markets in countries in the early stages of economic development. Government intervention, external finance and debt-servicing difficulties are correlates of the financial-market imperfections that give rise to informational asymmetries, moral hazard and adverse selection, while government policies to overcome asymmetric information can encourage management to engage in bankruptcy for profit (a problem which Akerlof and Romer (1993) refer to as "looting"). This tradeoff between credit rationing and bankruptcy-for-profit risk is at the heart of the present paper.

Section II reviews some theoretical considerations centering on the interaction of informational asymmetries, moral hazard and adverse selection. Section III introduces the financial and economic environment in which 19th century firms and governments operated and describes the financial arrangements that grew up in response. Section IV considers two devices used

to subsidize infrastructure investment and attract foreign finance: government guarantees and land grants. It describes how these relaxed credit constraints but at the same weakened the incentive for creditors to monitor management. Section V draws out the implications for developing countries today.

Though 19th century infrastructure investments included turnpikes, canals, docks, tramways, sanitation and telegraph systems, and the provision of electricity and lighting, railways command center stage. Railways were the most prominent and capital-intensive 19th century infrastructure investments. They forged unified national markets, linked domestic producers to the expanding world economy, facilitated the development of high-speed-throughput mass-production techniques, and incubated modern management practices.¹ The analysis therefore draws on the literature on 19th century railway investment and finance, most notably on recent contributions like Baskin (1988) and Carlos and Lewis (1992, 1993), where important insights about information asymmetries and capital market structure can be found.²

II. Theoretical Considerations

According to the Modigliani-Miller Theorem, investors should not care about the composition of firm finance. If a firm is highly leveraged, investors can offset this by adjusting the composition of their portfolios, rendering the structure of finance irrelevant.

In the real world there are several reasons why this strong result does not obtain. The relevant one here is informational asymmetries.³ Assume that the entrepreneur knows the probability of failure but that external investors do not. So long as all projects yield the same expected return and investors are risk neutral, entrepreneurs with riskier projects will be willing to pay

more for external funds.⁴ Since information is asymmetric, adverse selection arises: as the interest rate rises, entrepreneurs with safer projects drop out of the pool of potential borrowers.⁵ Moral hazard results, since by raising the interest rate the lender encourages the borrower to undertake risky investments. Raising the interest rate can therefore reduce the lender's expected return. Under these circumstances, lenders may ration credit.

In this model, credit rationing will be an increasing function of the riskiness of the underlying environment and of the severity of barriers to the dissemination of information. Moral hazard and adverse selection cannot arise in a world where all projects are the same, but the more costly it is to sort projects (the greater the informational asymmetries), the more serious are adverse-selection and moral-hazard problems. Many present-day developing countries fit these conditions: they are subject to terms of trade shocks and lack effective regulation requiring financial disclosure.

What pattern of finance should be observed when information is asymmetric and adverse selection and moral hazard arise? Entrepreneurs with risky but potentially profitable projects will be forced to commit their own wealth by subscribing shares. The greater are informational asymmetries, the more share capital will have to be subscribed by the promoters before external finance can be obtained.

De Menza and Webb (1987) show that the resulting level of investment will be socially suboptimal. In the first-best equilibrium with risk neutral investors, all projects with expected returns equal to the world rate of return will be undertaken. But when information is distributed asymmetrically, some such projects will not be financed. The first-best equilibrium can then be restored if the government provides an interest-rate

subsidy.

A subsidy or government guarantee which relaxes the credit constraint can create other problems, however. It weakens the incentive for investors to monitor management performance, since bondholders are guaranteed a return by the government. This may allow management to divert resources to nonproductive uses from which it benefits (Jensen and Meckling, 1976). In the extreme, promoters may engage in bankruptcy for profit (Akerlof and Romer, 1993). Since the promoters are interested in maximizing their own net worth, they will compare the returns they reap when they maximize the value of the firm with those they receive by taking out funds until they exhaust the resources available to them under the provisions of the interest guarantee and are forced to declare bankruptcy. They will inflate accounting rates of return relative to economic returns in order to appear solvent and acquire additional debt to be invested in activities that provide a high cash flow which the owners can tap. Since a government guarantee set the process in motion by weakening the incentive for investors to monitor management performance, the taxpayer will be left holding the bag. This problem is most prevalent where government guarantees are unconditional, where public oversight is lax (since effective public-sector surveillance and regulation should prevent promoters from inflating accounting returns relative to economic returns), and where promoters and their confederates attach the least value to reputational capital.

III. Investment and Informational Asymmetries in the Railway Age

I now analyze the structure of infrastructure finance in 19th century regions of overseas European settlement in order to illustrate these points.

I focus on railway construction and (primarily but not exclusively) on North America, because the railways were the most finance-intensive infrastructure projects of that era, and because their history in North America is particularly well documented. I focus on four factors conducive to informational asymmetries: the novelty of the technologies, the relatively long gestation period of the investments, the uncertain prospects for local market growth, and the dearth of reputable promoters.

Early North American infrastructure projects posed formidable information problems for outside investors. The technologies were unfamiliar. There were few places other than England from which investors could obtain information drawn from prior experience.⁶ Hence, a prominent project like the Erie Canal, so profitably built in the 1820s, could send a powerful signal to the capital market.⁷ And yet the costs of building the Erie Canal provided limited guidance to those seeking to estimate the costs of surmounting the higher mountains of Western Pennsylvania.⁸ It is not entirely surprising, then, that Pennsylvania and Maryland's canals turned out to be more expensive than anticipated.

Information problems were most severe in regions of recent European settlement. For areas like the American West that had only recently appeared on maps, not even geography could be taken for granted: at a dinner thrown by the Lord Mayor of London an English investor asked an American guest whether Cincinnati or Illinois was the larger city. Even if location was known, potential profitability was not: the amount of traffic a railway would generate was contingent on the economic development of the adjoining region, which depended on such unknowns as the fertility of the soil, the reliability of rainfall, and the extent of mineral reserves.⁹ Where the volume of traffic

ultimately depended on the extent of mineral deposits, uncertainty about reserves posed considerable risk; North American railways were built on the basis of quite crude forecasts of coal or silver deposits. Where land had to be settled and cleared before it could be farmed, many years might be required before the picture was clarified.¹⁰

Along with the economic prospects of the project, it was necessary to assess the reputability of the promoter. Recently settled, sparsely populated regions were prime locations for fly-by-night operators. Promoters could strike sweetheart deals with construction companies, siphoning off resources and saddling the project with insupportable debts.

These uncertainties were reduced by exploiting the informational advantage and signalling capacity of local investors. Where industrial and commercial development was precocious, it was possible to finance infrastructure investment through limited partnerships of local residents. Because early turnpikes, canals and railroads had modest capital requirements by the standards of the long-distance rail lines that followed, a local partnership could suffice to raise the requisite capital.

New England illustrates the point. The region was the center of American textile manufacturing and hence of American industry in the early 19th century. A growing number of small industrial towns provided a fertile market for short-haul railways (Chandler, 1954). New England was also the center of American commerce, shipping and whaling. From the China trade Boston merchants learned how to use entrepreneurial and managerial techniques to overcome long spans of time and distance (Johnson and Supple, 1967). Much New England railway finance was raised the same way that the region financed its textile mills, by relying on family, friends and contacts. Where contract

enforcement was problematic and information was difficult to verify independently, the markets made heavy use of such links. Friends and associates vested their confidence in individual financiers with reputations for honest dealing who signalled their commitment by putting their own funds at risk.¹¹ The majority of early New England railway shares were subscribed by local manufacturers, farmers, landowners, bankers, merchants and contractors. Not only did such individuals have favored access to information, but they stood to benefit from the externalities thrown off by transportation links. At the head of many early syndicates were textile producers seeking roads that would serve their mills and Boston merchants looking to railroads as a link with the hinterland market and the Great Lakes (Platt, 1984).

Thus, early New England railways were largely financed with local capital.¹² That these projects were relatively modest -- they only connected Boston with Portsmouth or Providence -- facilitated the local mobilization of capital. Even a more ambitious railroad built in the late 'thirties and early 'forties, the Western Rail-Road linking Boston with Albany, raised most of its finance locally.¹³

Underdeveloped markets could, however, impede the mobilization of local finance. One example of the difficulties presented by imperfect commodity and capital markets was the attempt to market bonds for the St. Lawrence and Atlantic Railway in Canada in the 1840s: farmers lacking cash, subscriptions were paid in the form of pork and eggs for the sustenance of construction gangs. Some early U.S. railways similarly took subscriptions in the form of labor and materials.¹⁴

This model of local finance was difficult to generalize, however, since

the capital requirements of early railways were more modest than those which followed and the funds available in New England exceeded those of other regions. Elsewhere it was necessary to seek external finance.¹⁵ External finance was not a substitute for local finance; it was still necessary for locals to invest in order to indicate their willingness to put their money where their mouths were. If locals put up funds, external investors could have confidence that those in the best position to assess the needs of the project and monitor its progress and the actions of its promoters would do so.

Personal contacts remained important as a partial solution to information problems. When in the 1840s Boston began to invest in the roads of the U.S. South and West, this was done through personal ties. Railroad men coming to Boston contacted merchants who had invested previously in New England railways. The promoters invested their own money in the project, signalling their commitment, "and talked friends and close business acquaintances into taking shares in it."¹⁶ Long-term relations between Western promoters and Boston merchants and between the merchants and their contacts provided a conduit for information about investment projects and promoters.

Railway securities tended to be traded in distant markets before such trade developed in the liabilities of manufacturing and commercial concerns. Manufacturing used more exotic technologies, and commercial undertakings had less tangible assets (knowledge of customer requirements, for example). Investing in industry and commerce therefore had to surmount even higher information hurdles. The railways were consequently among the first enterprises to access external finance on a significant scale (Baskin, 1988). As early as the 1830s, a number of lines around Philadelphia and several in

Virginia and North Carolina were able to market securities in London (Adler, 1970). The pattern persisted: as late as 1914 railway securities accounted for perhaps half of all outstanding foreign investments in the United States.¹⁷

Accessing foreign investors entailed the intermediation of specialized institutions that had grown up in the principal European financial centers to deal with information problems: issue houses, private banks, bill brokers and financial investment companies.¹⁸ (The importance of these institutions, in the case of Britain, is illustrated by Table 1.) British investment houses typically retained American agents familiar with the American economy and railway projects. They specialized in recommending high quality foreign bonds. To signal their confidence in their advice, they often bought the same bonds for their own portfolios. Typically, these were the bonds of railroads that were well known and long established or were backed by the credit of a state government. Most British investors followed their advice, limiting their purchases to a few large Eastern companies for which information problems were least severe (Adler, 1970).

Financial institutions were not the only mechanism for surmounting information problems. The immigrant community was a conduit for information, as were specialized publications like The American Railroad Journal and Poor's Manual of the Railroads of the United States. From the 1860s, British investors organized themselves as the Council of Foreign Bondholders and the English Association of American Bond and Shareholders to collect information on arrears and negotiate with debtors.¹⁹ Some foreign investors traded in the securities of small or obscure railways, which were obtained from jobbers and dealers who purchased blocks in the U.S. for sale in Europe. But the vast

Table 1
THE PROPORTION OF OVERSEAS NEW ISSUES INTRODUCED BY
THE MAIN TYPES OF ISSUING HOUSES 1870-1914

	Official and semi- official agencies	Private banks ^a	Joint- stock banks	Overseas banks & agencies	Companies via their bankers	Other media ^b	Total Amount Issued
1870-74	1.8	53.0	4.4	9.6	18.2	13.0	390.6
1875-79	14.5	36.5	0.8	24.7	13.0	10.5	149.2
1880-84	6.7	38.5	3.3	14.1	26.7	10.7	355.3
1885-89	9.9	43.7	5.3	7.5	26.1	7.5	479.2
1890-94	10.4	46.4	9.0	8.8	19.6	5.8	349.6
1895-99	8.7	25.1	11.2	20.3	25.2	9.5	359.6
1900-04	27.4	19.2	17.8	14.4	16.7	4.5	258.2
1905-09	10.3	32.7	12.2	22.4	18.7	3.7	609.9
1910-14	8.3	35.2	17.4	18.8	17.5	2.8	783.8
1870-1914 Total	9.8	37.2	10.3	15.4	20.5	6.8	--
Amount Issued (£m)	355	1,354	371	562	746	248	3,636

Notes:

^a i.e. merchant bankers.

^b Comprising: a. investment trust, £23m; b. finance, land and property companies, £18m; c. special purpose syndicates, £41m; d. issue house with stock exchange connections, £22m; e. companies as their own issuers, £13m, and f. miscellaneous issuers, £131m.

Sources: Based on a table prepared by W. A. Brown published in *The Economist* (20 November 1937) and reprinted in T. Balogh, *Studies in Financial Organization* (Cambridge, 1947), p. 233.

majority of investors concentrated on first-class securities issued by the London offices of prominent American railways and endorsed by British issue houses or banks.

The financial instruments that were preferred varied with economic and geographical distance. Nearby lenders, like New Englanders lending to the Midwest, purchased common stock, since personal and business contacts insured a reliable flow of information. The short, inexpensively-built lines of Central New York were able to supplement local subscriptions with sales of equity in New York City.²⁰ A substantial block of shares in Canada's Welland Canal, built in the late 1820s and 1830s to circumvent Niagara Falls and open Montreal to the western trade, was purchased by a group of investors in New York State.²¹ British investors in American railways, whose economic distance was reduced by institutions like investment houses and stock brokers, sometimes purchased common stock as well.²²

Other investors purchased bonds, which, as primary claims, were perceived as less risky.²³ Ambitious infrastructure projects, including long-haul railways, relied primarily on bonded debt. A very few railways, like certain early Southern lines, were able to issue stock, but these relied on the municipal guarantees of cities like Charleston and Savannah.²⁴

Normally, the regulations and surveillance of an organized stock market help to attenuate the moral hazard and adverse selection problems caused by asymmetric information. These functions were carried out only to a limited extent by the institutions of the London market, however. The ability of the London Exchange to restrict trading in particular securities was limited by competition from provincial exchanges and outside brokers and bucket shops.²⁵

²⁵Before 1914 the Stock Exchange made no attempt to restrict or control in any

way the right to deal in any security, whether British or foreign...it was in general more concerned with arrangements to ensure a reasonably free market in the securities than with the intrinsic merits of the company or with the adequacy or accuracy of the information provided."²⁶

The problem with relying on mainly on bonds, as foreign investors did in the second half of the 19th century, was that, in the prevailing environment of imperfect information, adverse selection and moral hazard could be severe. The portfolio of projects contemplating debt finance grew riskier as the interest rate rose. Promoters had an incentive to take on excessive debt (to water their stock), since they stood to make huge profits through leverage if they succeeded but could lose no more than their equity stake if they failed.

Contemporaries consequently complained that many worthwhile investment projects could not raise external funds. This credit rationing created an obvious argument for government intervention.

IV. Government Subsidies and Guarantees

"When great schemes of public utility are brought before the country," wrote The Economist in 1858, "it is natural that the Government should extend its aid to such enterprises."²⁷ In the case of infrastructure investments, government aid took the form taken by subsidies and aid in kind (often financed by the issue of bonds designated for the purpose or the earmarking of revenues) and of guarantees of interest on bonded debt. Canadian governments borrowed \$20 million for canal purposes in the 1840s.²⁸ In the United States, of the \$195 million allocated to canal construction between 1815 and 1860, \$121 million was spent by state governments, only \$74 million by private companies.²⁹ State and local governments were also key subscribers to the

securities of the early American railroads. Prior to 1840 nearly all east-west projects -- both railways and canals -- were financed by public bonds. In the 1830s, the Commonwealth of Massachusetts took a one third partnership in the Western Railroad Corporation of Massachusetts, which it financed by floating state paper in London.³⁰ The State of Ohio subscribed one share in its state's railroads for every two shares purchased by private investors.³¹ Only the early north-south railways and the Pennsylvania coal roads were paid for largely by bonds of private corporations; these lines were shorter and cheaper to build and more certain of regular traffic.

The classic efficiency argument for subsidization rests on externalities: that a project's social returns exceed its private returns. The historical literature supports the proposition that the railways were a source of positive externalities. Fogel's (1960) study of the Union Pacific Railroad in the United States, for example, estimated that the social return averaged 30 per cent per annum, two and a half times the private return. Yet it is not clear that private entrepreneurs were always unable to capture these returns. Adjoining lands whose productivity and value were enhanced by investment in a turnpike, canal or railway could be purchased by the promoter of the infrastructure project. Textile mills and mercantile enterprises whose profits were boosted by infrastructure investments that provided a steady supply of raw materials to the factory and finished products to the market could and often were owned by those who organized infrastructure projects. This scope for internalizing externalities weakened the case for subsidization.³²

Another justification for government intervention is as a means of offsetting the capital market imperfections that result from informational

asymmetries. Even if social returns could otherwise be captured by investors, incomplete information which leads to credit rationing may prevent them from doing so.

A third -- and very different -- explanation for government intervention is in terms of rent seeking by those who stood to benefit disproportionately from government subsidies and guarantees. Lewis and McKinnon (1987) argue that the Canadian Northern Railway may have been socially as well as privately unprofitable but those who stood to benefit from its construction succeeded in enlisting government subsidization in their support. While this is certainly true, one need not dismiss rent seeking as unimportant in order to acknowledge that at least some government intervention was motivated on other grounds.

This prevalence of capital market imperfections provides an ready explanation for the form of many 19th century infrastructure subsidies: interest guarantees on government bonds. This device was prevalent wherever canal and railway construction took place. In India, it was referred to as "the guarantee." If an Indian railway company did not attain a minimum rate of return of, say, 5 per cent, it received compensation for the difference from the Government of India. The interest clause in the bond covenant was backed by the full powers of taxation of the Indian Government. All of India's early railways were built under the terms of the guarantee.

Government guarantees were particularly important for attracting foreign investors, for whom distance was an obstacle to the acquisition of information. Without the guarantee, it is said, infrastructure projects were impossible to finance.³³ Once the guarantee was provided, however, Indian railways had no difficulty in raising funds abroad. "The motives of the British investors can be explained almost entirely in terms of the 5 per cent

guarantee of interest offered by the Indian Government," in the words of one historian.³⁴ Indian bonds were regarded as perfectly safe; investors included widows, barristers, clergymen, spinsters, bankers and retired army officers.

In Canada, canal projects in the first half of the 19th century received government guarantees under the aegis of the British Colonial Office. Before 1849, attempts to build railways in Canada had foundered on the difficulty of raising capital. That year an act was adopted for government guarantees of interest at a rate not over 6 per cent on half the bonds of any railway over 75 miles in length, provided that half the railway was already built.³⁵ Only when the guarantee was secured were Canadian railways able to attract significant amounts of foreign finance (see Tables 2 and 3).³⁶

Guarantees and subsidies played a role in the construction of all of Canada's important railways.³⁷ Funds for the Grand Trunk were raised from individuals, municipalities and contractors, but roughly half of its bonds were guaranteed by the Provincial Government and heavily subscribed by British investors.³⁸ The Canadian Pacific and the Grand Trunk Pacific also enjoyed public support.³⁹ Glazebrook (1938) concludes that not one of these lines could have been built without government guarantees.

While guarantees helped railway promoters surmount credit-rationing problems, they also weakened the incentive for investors to monitor management. Investors no longer stood to lose -- or to lose as much -- if promoters and their confederates diverted resources from productive uses, since the government promised to bail them out. In the extreme, this might encourage the construction of railway lines where there was no hope of generating sufficient traffic to service the debt that was incurred. More generally, it gave promoters an incentive to negotiate sweetheart deals with

Table 2
 DISTRIBUTION OF TOTAL FLOW OF CAPITAL TO CANADA, 1900-14
 (millions of dollars)

	All Countries	Great Britain	United States	Other Countries
Dominion and provincial governments	179	175	4	—
Municipal governments	260	200	60	—
Railroads	767	670	50	47
Industrial	630	420	180	30
Land and timber	305	80	145	80
Mining	125	65	60	—
Insurance	82	32	50	—
Other	198	111	81	6
TOTALS	2,546	1,753	630	163

Source: Buckley (1955), p. 90.

Table 3
GROSS CONSTRUCTION OUTLAYS IN MAJOR TRANSPORT FIELDS
Canada, 1901-30

A. Values (millions of dollars)				
	Railways	Highways	Canals and Harbours	Total
1901-5	124.3	3.3	32.1	159.7
1906-10	380.7	11.7	48.0	440.4
1911-15	537.4	38.5	93.7	669.6
1916-20	252.5	39.4	59.7	351.6
1921-25	253.2	100.4	109.8	463.4
1926-30	389.4	172.4	138.2	700.0

B. Percentage Distribution				
	Railways	Highways	Canals and Harbours	Total
1901-5	77.8	2.1	20.1	100.0
1906-10	86.4	2.7	10.1	100.0
1911-15	80.3	5.7	14.0	100.0
1916-20	71.8	11.2	16.9	100.0
1921-25	54.6	21.7	23.7	100.0
1926-30	55.5	24.6	19.7	100.0

Source: Buckley (1955), p. 32.

contractors and channel cash into their own pockets. Infrastructure projects being one of a kind, such practices were difficult to detect. Reasonable costs for idiosyncratic projects like railways and canals are intrinsically difficult to ascertain. And the fact that railway construction generated an abundant current cash flow made the diversion of the enterprise's resources into the pockets of the promoters relatively easy to arrange. Since many partnerships were temporary, promoters had little reason to be deterred by reputational considerations. Only those ultimately responsible for the financial liability -- or more precisely, their elected representatives -- had an incentive to engage in monitoring.

Thus, there was potential scope for looting. Since the rate of return on debt was guaranteed by the government, bondholders had little incentive to expend resources on determining whether promoters had identified a project capable of an adequate net revenue performance, or whether contractors were diverting the project's resources into their own pockets. Only if government authorities monitored the actions of promoters and contractors and threatened them with legal sanctions did the latter have reason to be deterred.

The prevalence of looting is difficult to quantify, given the problem of establishing minimum construction costs.⁴⁰ Yet the qualitative evidence is suggestive. Of the Great Western of Canada, Leland Jenks wrote that its directors, enjoying a government guarantee, sought not to minimize construction costs but to finance the contractor and share in his profits.⁴¹ Canada's Grand Trunk Railway provides additional gory detail. Almost immediately upon floating government guaranteed bonds, the Company found itself unable to pay the interest. To a large degree its problems reflected "unanticipated costs of construction."⁴² Contractors pressed for the

construction of new links to the railways of New York and Michigan rather than the use of existing lines. In 1851 Gzowski and Company, a contracting firm run by former directors of railways with connections to the Grand Trunk, received the contracts for the construction of these lines. The contractors received their pay in the form of cash, "and the individual members of the firm realized sizable fortunes."⁴³ The British group of Peto, Brassey, Betts and Jackson, itself deeply involved in Canadian politics, was "helped...over every difficulty" by "a complaisant legislature and a winning governor-general. "Construction costs proved higher than expected."⁴⁴ Existing lines were added to the network for "inflated" purchase prices. Operating expenses in the first ten years ranged from 58 to 85 per cent of gross receipts instead of the 40 per cent that had been forecast and was typical of other railways. All this is consistent with the predictions of the Akerlof-Romer model -- that government guarantees extended to relax credit-rationing constraints weaken the effectiveness of corporate control if they are not accompanied by effective public-sector oversight and regulation. Currie's (1957, p.9) summary of the situation resonates with this framework: "As the Government would guarantee bonds up to one-half the cost of the road, hard-pressed promoters were tempted to inflate their costs, effectively force the Government to assume responsibility for more than its proper share of the actual expenditure, and reduce the real value of the assets against which, under the Guarantee Act, the Government held a first mortgage."

In India, there were several layers of principal-agent problems: the Indian taxpayer underwrote the guarantee, but the Indian Government that extended it was responsible not to him but to the British Crown; Jenks portrays projects like the Madras Canal, which was completed but could not be

filled with water, as a direct consequence. Of the railways, one Indian finance minister testified, "All the money came from the English capitalist, and so long as he was guaranteed 5 per cent. on the revenues of India, it was immaterial to him whether the funds that he lent were thrown into the Hooghly or converted into brick and mortar."⁴⁵

Along with interest guarantees, land grants were a prevalent form of government subsidization.⁴⁶ They were attractive to governments for which financial subsidies and interest guarantees implied the imposition of highly distortionary taxes, and the extension of a land grant might meet with less political resistance than the taxes required for a financial subsidy or guarantee. Arguably, ceding adjoining land to railways and canals also allowed promoters to internalize at least some of the externalities thrown off by their investments.

Land grants served to correct capital market imperfections by providing collateral. Compared to other bonds, those backed by mortgages on land had minimal bankruptcy costs, for interest and principal due the primary creditors could be paid off through land sales if the project failed. The loan was fully collateralized, mitigating the moral hazard and adverse selection problems that otherwise give rise to credit rationing.⁴⁷ This role of land grants is reflected in the fact that only American railroads receiving land grants were able to issue regular bonds as opposed to convertible issues (Adler, 1970). These securities were issued separately from other bonded debt. Alternatively, receipts from the sales of land could be mortgaged, as in the case of the Atchison, Topeka and Santa Fe, which issued "land income" bonds. The presence of this backing was attractive to foreign investors for whom monitoring and information gathering was least practical.

In principle, the land grants offered railways in North America and elsewhere were sufficient to collateralize only a portion of an enterprise's bonded debt. Compared to an unlimited guarantee, this should have done less to discourage monitoring by outside investors. But railways which ran into difficulties were often extended additional guarantees and subsidies subsequently. In practice, it is questionable that the negative side-effects of land grants were less pronounced than those of bond guarantees.

One land-grant policy, that of the United States, has been studied in detail. Fishlow (1965) estimates that the land subsidy amounted to roughly 5 per cent of total 1850-1880 U.S. railroad investment. Other authors (e.g. Mercer, 1969, 1972) arrive at smaller numbers. The small size of these estimates suggests that land grants incompletely collateralized the railways' liabilities. Land grants were not uniformly distributed, however; they were concentrated in the period 1865-70 and received disproportionately by certain roads. Included in these were the first transcontinental lines, the kind of risky investments that might have otherwise found it difficult to secure adequate funding.

Mercer concludes that many land grants were wasted -- that they were given to railroads that would have been built in any case. He bases his view on the finding that the private rate of return exceeded the return on alternative uses of funds -- that, in other words, the railways still would have wished to borrow at the prevailing rate. An asymmetric information perspective casts doubt on this conclusion, since it implies that without land grants some railways might not have been able to access external finance at any price.

VII. Conclusions and Policy Implications

Recent suggestions for reforming the provision and finance of infrastructure in developing countries include encouraging private provision as a way of avoiding the inefficiencies of public administration and tapping local savings as a way of avoiding excessive reliance on external borrowing. These suggestions have a back-to-the-future quality: private provision and local finance were characteristic of infrastructure investments in many countries -- notably the North American case considered here -- for much of the 19th century. Consequently, the historical record is a potentially rich source of information on the circumstances under which these approaches are workable and on their limitations.

What the record reveals is that private provision and local finance did not obviate the need for government intervention and foreign borrowing. Although most infrastructure projects were privately financed and constructed in the overseas regions of recent European settlement during the 19th century, government subsidies and external finance were still integral to the process. The informational asymmetries characteristic of markets in the early stages of development hindered efforts to rely on private finance. Funds adequate to underwrite the construction of canals, railways and ports could not be mobilized through the operation of domestic financial markets alone, owing to problems of asymmetric information which gave rise to adverse selection and moral hazard and which discouraged private investors. Financial institutions specializing in project assessment and in the monitoring of management helped to attenuate these information problems and to encourage private investment, but these were typically foreign institutions with foreign clienteles. Foreign intermediaries had a head start as a result of having grown up in

response to the earlier economic and financial development of the more advanced regions. Their intervention attenuated information problems but did not eliminate them. Reliance on private provision and finance consequently did not obviate the need for either government intervention, such as the provision of bond guarantees designed to relax credit constraints, or external borrowing.

Often, however, such government intervention simply replaced one set of problems with another. Investors, having been guaranteed a return by government, had little incentive to monitor management performance. Management, freed of investor scrutiny and having gained capital-market access courtesy of government, could seal sweetheart deals with construction companies that left taxpayers holding the bag. Guarantees might render irrelevant the information problems that hindered investors' efforts to evaluate the commercial prospects of infrastructure projects but without providing mechanisms to monitor the uses of external funds and protect the public interest.

The implication is that exploiting nontraditional approaches to financing infrastructure investment requires two further initiatives on the part of policymakers. First, the effectiveness of public administration must be enhanced. Effective public oversight is needed insure the accountability of enterprises, since private investors will have little interest in that accountability if they enjoy government guarantees. The agencies concerned will have to monitor management decision-making and firm financial performance and credibly threaten legal sanctions against managers tempted by bankruptcy for profit. Second, policymakers need to encourage the development of financial institutions such as investment banks, mutual funds and bond-rating

agencies capable of surmounting information problems in order to free the government of the need to provide subsidies and interest guarantees.⁴⁸

These are no mean feats for governments in any setting. Proposals for privatizing the provision and finance of infrastructure investments notwithstanding, it seems likely therefore that the traditional role for government -- and the traditional problems associated with government intervention -- will necessarily remain.

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Footnotes

1. Any attempt to argue the importance of railways must confront Fogel's (1964) conclusion that the social savings due to railway construction in the U.S. were small. Given differences across countries in geography and topography, subsequent studies have yielded much larger estimates for other parts of the world. Nor do social savings calculations attempt to quantify the dynamic effects emphasized by authors as diverse as Jenks (1944), Chandler (1990) and Williamson (1974).
2. Space requires treating the long 19th century (ending in 1914) as a unit. A fuller treatment could trace changes in the structure of financial markets, in the transmission of information (due, for example, to the Transatlantic cable and the telegraph), and in spillover effects affecting households and firms.
3. Additional reasons are tax effects and bankruptch costs. See Keeton (1979) and Stiglitz and Weiss (1981).
4. Since all projects yield the same expected return, riskier projects (which yield nothing in the event of failure) yield a higher return in the event of success. Hence, in the event of success entrepreneurs with riskier projects can afford to pay a higher interest rate.
5. Put another way, entrepreneurs will prefer to finance the lowest risk projects themselves, leaving only higher risk projects for outside investors, and the higher the interest rate, the larger the share of low risk projects that entrepreneurs will find it attractive to self finance.
6. Foreign investors could also be put off by political uncertainty. The disruption to U.S. foreign market access caused by its Civil War, for example, lingered into the 1870s, well after the conclusion of the American Civil War. The unfortunate name given the 1857 rebellion in India ("The Mutiny") similarly posed a persistent obstacle to borrowing. MacPherson (1955), p.180.
7. The Canal was completed in 1825 at a total cost of \$11 million, \$3 million of which came from current sources and \$8 million of which came from long-term loans. It was able to meet current interest payments on the debt in its first year of operation and was fully paid off within ten years. The Erie's success set off a canal-building boom that engulfed the mid-Atlantic and New England coasts.
8. In the same way, information gleaned from experience with canal building was of limited use to aspiring railway builders. It was similarly problematic to extrapolate from experience with gas-burning lamps to the costs and benefits of electrification.

9. The same was true, of course, outside North America. Thus, "want of local knowledge" was cited in 1852 by the chairman of the Madras Company as an obstacle to attracting external finance for railroad building in India. MacPherson (1955), p.180.

10. For example, Canadian railway building peaked in the final decades of the 19th century but significantly stimulated wheat production and rail traffic only in the second decade of the 20th. Ankli (1980), p.260 and passim. The problem was similar elsewhere. Thus, at mid-century, an Indian official cited the long gestation period before profits could be expected as a particular impediment to railway investment. MacPherson (1980), pp.180-181.

11. Baskin (1988), p.210. See also Lamoreaux (1986). As Johnson and Supple (1967, p.338) put it, "investment tended to be a cumulative social process in an environment lacking an impersonal, national money market." The danger of looting by fly-by-night operators was correspondingly reduced.

12. Johnson and Supple (1967), p.36.

13. While it had more than 2,000 shareholders, most were located in Boston. Only 17 per cent had 100 or more shares as of 1841. To continue the road from the state line to Albany, the city of Albany subscribed the entire capital stock, paying for it with city bonds. Johnson and Supple (1967), p.43. Another example is the early Spanish railways, which were financed domestically from the 1840s. Although foreign financiers, entrepreneurs and engineers took part, the major share of the capital was Spanish. Wais (1974), p.159.

14. Cleveland and Powell (1912), p.30.

15. I refer to "external" rather than "foreign" finance for two reasons. First, entities like Canada and India which were not fully independent relied on external finance from the imperial center, Great Britain. Second, late developing regions in continental economies, such as the Western United States, relied on external finance from earlier developing regions, like New England.

16. Nicholas Biddle and other merchants and bankers played a similar role in Philadelphia. Chandler (1954), p.259.

17. The railways' access to external funds benefitted from the fact that knowledge useful for evaluating the riskiness of projects was transferable across space. The experience that British investors had already gained helped them to evaluate the prospects of American lines, in other words. Baskin (1988), p.212.

18. Besides personal contacts and specialized investment brokers, foreign investors relied on the signal of third-country management. A substantial share of late 19th century British investment in Latin America was in U.S.- and Canadian-controlled and managed enterprises. North American investors

faced the same risks as their British counterparts but, especially in the cases of Mexico and Panama (still officially Colombia), had advantages of proximity. Prior U.S. and Canadian borrowing had established links with the London market which could now be used to channel information from Latin America back to Britain. The involvement of Americans and Canadians with whom British investors had long-term relationships maximized information capital and prevented British foreign investments from being looted. British investors took shares in Canadian controlled public utilities, tramways and railways throughout the Western Hemisphere. On the eve of World War I, Canadian-controlled enterprises represented more than half of all British portfolio investment in private industry in Latin America and nearly 50 per cent of all British public utility capital invested there. Stone (1977), p.715.

19. Protective organizations were established in France, Germany and Holland as well. On the operations of the Council of Foreign Bondholders, see Eichengreen and Portes (1989). Wilkins (1989) notes that the newspaper files of the Council include 25 volumes devoted to American railways.

20. Trading in these shares played a central role in early development of the New York Stock Exchange. Chandler (1954), p.254.

21. This was the only Canadian canal which attracted significant foreign investment; proximity to New York and the latter's experience with the Erie Canal played a facilitating role. Ultimately, revenues proved insufficient to pay for maintenance. In 1837 the provincial government took effective control of the canal and formal ownership passed to it in 1841.

22. Estimates for years around the end of the prewar period nonetheless suggest that the majority of British investments in American rails took the form of bonds. See for example Lewis (1938), who suggests that the value of British holdings in bonds, circa 1914, was 2 1/2 times the value of shares. Other contemporary estimates put the ratio as high as nine to one. See Wilkins (1989), p.725.

23. Chandler (1954), p.248. As a prominent banker put the point in 1913, "stocks go wrong more frequently than bonds." Cited in Wilkins (1989), p.725. Railway bonds could run 30, 40, 50 or even 100 years to maturity and were secured by mortgages on the railroad's property or enjoyed a government guarantee. Many lines issued bonds that were convertible into stock at the holder's option. With time, this "long-term convertible mortgage bond" became the standard instrument for railway finance. (Chandler, 1954). According to Adler (1970, p.53), all but one of the American railway issues that found favor in London before 1852 were convertible bonds.

24. Chandler (1954), pp.250-251. In the case of Spain, foreign investors avoided stock, despite the fact this was widely traded in Barcelona. Common stock represented only 40 per cent of Spanish railway capital as of 1864.

25. From the mid-'eighties The Economist began to publish quotations for American rails not listed on the London Exchange but nonetheless extensively traded. Adler (1970), p.158. Trading on other European exchanges was active as well. As early as 1875 63 U.S. railway issues were listed on the Amsterdam Exchange. Wilkins (1989), p.202. U.S. railway shares were also actively traded in Berlin, Paris, Geneva, Zurich, Basle, Brussels and Antwerp.
26. Paish (1951), p.4.
27. Cited in MacPherson (1955), p.181.
28. Jenks (1938), p.204.
29. Cranmer (1960), p.558.
30. Platt (1984), p.156.
31. The costs of these projects were said to be too great and their profits too uncertain to attract adequate private capital. Chandler (1954), p.249.
32. Given that many different landowners and merchants typically benefitted from the construction of a single railway line, large-number problems might still impede efforts to internalize the externalities, leaving a rationale for subsidization.
33. Because the North Bengal Company was refused a guarantee, it was unable to begin construction and all deposits were returned to shareholders.
34. MacPherson (1955), p.180.
35. Easterbrook and Aitken (1961), p.298. In 1851 the guarantee was restricted to railroads which formed part of a main, or trunk, line. This legislation was passed partly in response to pressure from the Provincial Government's British bankers, Baring Brothers and Glyn, Mills and Company, who worried that an unlimited guarantee would encourage excessive building and saddle the Provincial Government with an unsupportable debt. Another Act, in 1852, liberalized this condition somewhat, allowing individual municipalities to borrow from a Provincial fund to help establish branch and feeder lines. Currie (1957), p.9.
36. An exception was the Great Western, although this was essentially "a link between Buffalo and Detroit over foreign soil" (Jenks, 1938, p.205). It obtained its initial capital from merchants in Detroit and from New York investors who had financed the New York Central. Completing construction required a flotation in London in 1852, however. Other major railways initiated following the passage of the Guarantee Act relied almost entirely on British finance (Carlos and Lewis, 1994). For additional details, see below.

37. In Canada, principal as well as interest was often guaranteed.
38. The Province of Canada was the name given the colonies of Upper and Lower Canada when these were merged in 1841. Upon Confederation, they were renamed Ontario and Quebec.
39. Grand Trunk Pacific Securities were guaranteed mainly by the Grand Trunk and thus received government support indirectly. Public support for the Canadian Pacific took the form mainly of direct subsidies rather than interest guarantees.
40. This valuation problem is precisely the feature of construction-related activities that gives rise to scope for looting (Akerlof and Romer, 1993).
41. Jenks (1938), p.205.
42. Easterbrook and Aitken (1956), p.309 and passim.
43. Easterbrook and Aitken (1956), p.310.
44. Jenks (1938), p.204.
45. Cited in Jenks (1938), pp.221-222.
46. Approximately 150 million acres of land was granted to Western U.S. railways between 1850 and 1870. The policy was discontinued in 1871. Among other things, the settlement of the West having increased the difficulty of assembling land for right-of-ways and adjoining land grants. In Canada, legislation authorizing the government to use land grants was adopted in 1852 as part of an Act that restricted the Guarantee Act of 1849, although the land-grant aspect of the legislation was not used until the 1870s, when railroads were extended into the unsettled Western Prairies. (Here too, the fact that the Prairies were unsettled and the land remained in government hands obviated problems of assembling land for right-of-ways and land grants.) Initially, land was granted in alternating blocks 20 miles deep and 6 to 12 miles wide, one going to the railroad, the next reserved for the government.
47. At least this was true of early mortgage bonds. Subsequently some promoters issued "collateral trust mortgage bonds" that were secured not by real property but by the stocks and bonds of other companies. See Bryant (1971) for details.
48. The case for subsidization may only be reduced, rather than eliminated, even when informational asymmetries in financial markets are overcome insofar as infrastructure investments continue to throw off positive externalities that private agents are incapable of fully internalizing. This is what distinguishes the case of infrastructure from general problems of financing enterprise in developing countries.

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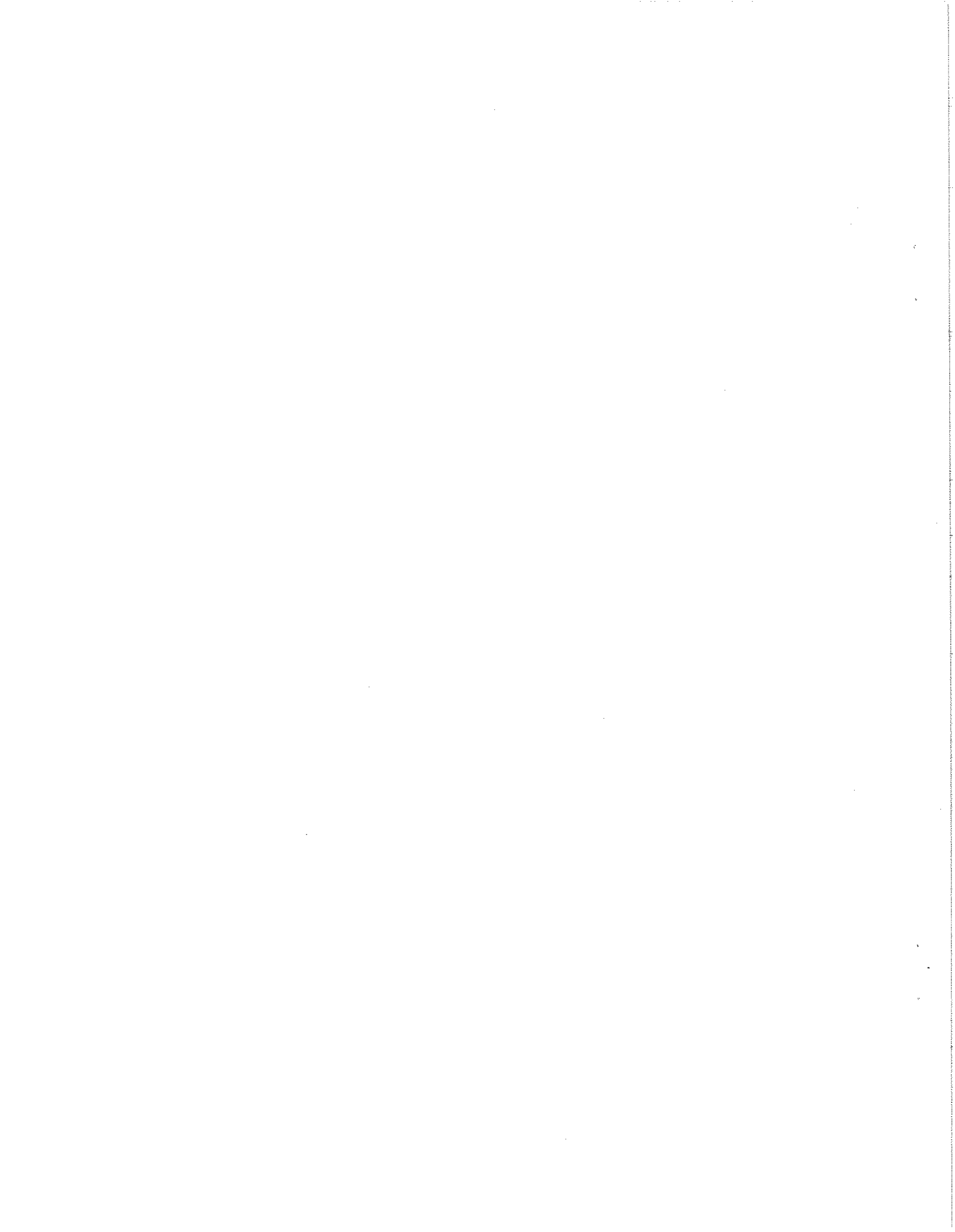
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