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**What Roosevelt Took:
The Economic Impact of
the Panama Canal, 1903-37**

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Abstract

The Panama Canal was one of the largest public investments of its time. In the first decade of its operation, the Canal produced significant social returns for the United States. Most of these returns were due to the transportation of petroleum from California to the East Coast. Few of these returns, however, accrued to the Panamanian population or government. U.S. policy operated to minimize the effects of the Canal on the Panamanian economy. The major exception to this policy was the American anti-malarial campaign, which improved health conditions in the port cities.

“I took the Isthmus.” –*President Theodore Roosevelt, 1904.*

“Why, it’s ours, we stole it fair and square.” –*Senator Samuel Hayakawa, 1977.*

Modern economic historians have been skeptical of the Canal’s economic benefits to the United States. Stanley Lebergott, for example, noted that the Canal “gave equal advantage to any nation that chose to use the Canal,” and the benefits for coast-to-coast shipping accrued “in the same proportion as American railroads were injured.”¹ Early boosters of the Panama Canal, however, had no such doubts. For example, a 1903 estimate delivered to Congress concluded that a canal would produce benefits which when capitalized would be worth \$1.2 billion, or 4.7 percent of U.S. GDP.²

On the other hand, most observers concur that the Canal strongly stimulated Panamanian economic growth between 1915 and 1930.³ Contemporaries certainly expected the Canal to benefit the Panamanian economy. The Panamanian ambassador to Washington waxed enthusiastic in 1913, as he traveled the U.S. trying to drum up investment: “Our country has the Canal within its own territory, and therefore enjoys the greatest advantage ... The market for the products consumed by ships passing from one ocean to the other, or arriving at the Canal’s terminal ports,

¹ Lebergott, “The Returns,” p. 240.

² 58th Congress, Second Session, S.D. 51.

³ See Federal Research Division, *A Country Study*, Chapter 3, Leonard, “The Commissary Issue,” Langley, “Negotiating New Treaties,” particularly p. 2.

is a market that naturally belongs to Panama, and no other country can handle our competition.”⁴ In 1917, the authors of the Blue Book of Panama asserted that, “The Republic of Panama should shortly become one of the business centers of the universe.” Its authors went on to assert that “the administration and upkeep [of the Panama Canal] have brought large sums of money into the country.”⁵

We argue that the boosters of an Isthmian Canal had it right: the Panama Canal produced substantial benefits for the consumers of transportation during its first quarter-century of operation. Our minimum estimate of the social rate of return is well in excess of the returns from U.S. government bonds. We also argue that the lion’s share of the social returns from the Canal accrued to the United States. In fact, the lion’s share of the benefits originated from the transportation of petroleum products from California to the East Coast.

We also argue, however, that those who predicted that the Canal would bring great economic benefits to Panama had it wrong. The Canal’s direct benefits to Panama were relatively small. The United States used its military leverage to force newly-independent Panama into accepting a payment for the use of its territory that was far smaller than the previous agreement which had been freely negotiated between Colombia and the French-owned Panama Canal Company. In fact, it was smaller than the American offer Colombia had previously rejected.

American policy then acted to deliberately *minimize* the spillovers from the Canal. The Canal Zone deliberately avoided employing Panamanian labor. The U.S. also explicitly prohibited Panamanian businesses from providing services to the Canal Zone or ships transiting through the Zone. The Canal Zone administration did construct sanitary works in both Colón and Panama City, but it charged the Panamanian government the full cost of construction and operation, including interest. Lastly, despite the fact that the United States explicitly exercised a protectorate over Panama, including a fiscal agent in Panama City, the American imprimatur did not translate into lowered borrowing costs for the Republic of Panama.

The major exception to the lack of spillovers from the Panama Canal was the great American anti-malarial campaign in 1906-09. These efforts greatly reduced deaths from malaria and yellow fever in Panama City and Colón, at no expense to the Republic of Panama. Few contemporaries, however, ever mentioned the great reduction in the prevalence of disease as a benefit of the Panama Canal. Ironically, the great benefits for Panama that contemporaries expected did not materialize, while the greatest benefit proved to be the precocious and unexpected arrival of new public health technology on the Isthmus.

⁴ Eusebio Morales, *Ensayos*, p.119.

⁵ William Scoullar, *The Blue Book of Panama*, preface and p. 62.

The Panama Canal And World Commerce

The direct commercial benefits produced by the Panama Canal depend upon three variables. The first is the cost of constructing and operating the Panama Canal. The second is the reduction in the cost of transportation induced by the opening of the Canal. The third is the sensitivity of shippers to the cost of transportation. We take each of these three factors in turn.

The Costs of the Panama Canal

The Panama Canal was the most expensive public works project in American history until that time. Between 1903 and 1914, the United States spent \$302 million on construction. In 2004 dollars, adjusted with the U.S. GDP deflator, the Panama Canal cost \$4.4 billion.

The Canal exceeded its estimated construction cost by a considerable margin. A 1902 congressional committee authorized the purchase of the New Company's assets based on a projection of construction costs of \$144 million. The committee approved a bond issue of \$130 million in order to finance construction.⁶ As early as 1905, however, the *New York Times* complained that the Isthmian Canal Commission would have spent \$66 million by the end of the year, with "no dirt flying." The *Times* blamed the part of cost overruns on inflated salaries for Canal personnel.⁷ By the time initial construction finished in 1914 – work would continue for four more years as a result of unexpected landslides – the direct construction costs surpassed initial estimates by a factor of 2.1. The scale of Panama Canal cost overruns, therefore, was significantly higher than on comparable projects like the Erie Canal (1.5), Hoover Dam (1.1), or the Bay Area Rapid Transport system (1.6), although Panama Canal cost overruns did compare favorably to the Big Dig (5.2+ and counting).⁸

Direct construction costs, however, were not the only costs of the canal. The U.S. also spent \$40 million to purchase the assets of the New Panama Canal Company and \$10 million for the Panamanian government. In addition, the U.S. incurred an implicit interest cost over the construction decade. Lastly, the U.S. needed to defend the Canal, which necessitated the construction of barracks, shore defense batteries, and naval support facilities.

We calculated implicit interest costs using the yield on long-term U.S. federal bonds. For each year between 1903 and 1914, we calculated the cumulative amount spent on construction. We then multiplied that amount by the interest rate in order

⁶ *New York Times*, 20 January 1902.

⁷ "Hot Time in Prospect for Canal Commission," *New York Times*, 22 November 1905.

⁸ Data on cost overruns on the Erie Canal, Hoover Dam, and Big Dig from Engerman and Sokoloff, "Digging the Dirt," p. 38. BART overruns from <http://www.sfcityscape.com/transit/BART.html>. The recent BART airport extension exceeded its initial cost projection by a factor of 1.5, slightly less than the overruns on the rest of the BART project.

to determine the financing cost. Lastly, we converted the total cost, into 1925 dollars using the U.S. GDP deflator. The total cost of the Canal construction, including interest, came to \$763.7 million in 1925 dollars.

The initial Canal proposal envisioned no special expenditures for Canal defense. The Isthmian Canal Commission believed that the Canal was essentially indefensible, since “a small party of resolute men, armed with a few sticks of dynamite, could temporarily disable it without great difficulty.” In addition, if an enemy fleet dominated the Caribbean, then the Canal would be essentially worthless to the United States. Rather than liberate the U.S. from the need to build a two-ocean Navy, Canal defense would require even more ships, for doubtful security gains.⁹

The Taft Administration, however, rejected neutralization and established the Panama Fortification Board in 1909. A landslide in 1916, meanwhile, prompted Congress to decide to build the two-ocean fleet which the Canal was intended to obviate.¹⁰ Military needs expanded to include a large permanent garrison, coastal defense batteries, and, eventually, air defense. We obtained the cost of defense-related construction from various copies of the *Annual Report of the Governor of the Panama Canal*. Using the same procedure outlined above, we calculated the total cost of defense-related construction to be \$157.9 million in 1925 dollars, including implicit interest expenses.

The total cost of the Panama Canal, therefore, came to \$921.7 million in 1925 dollars. \$921.7 million in 1925 dollars is the equivalent of \$8.3 billion in 2004 dollars, but a better sense of the project’s scale is to ask how much the Panama Canal would cost today as a constant share of U.S. GDP. The answer to that question is \$119.4 billion.

Transportation Cost Savings of the Panama Canal

The Panama Canal’s chief benefit to world trade came from shortening distance. Without it, trade between the east and west coasts of North America, or between the west coast of North America and Europe, had to either travel along the transcontinental railroad, around the southern tip of South America, or via the Tehuantepec or Panama railroads. Sending cargoes by the Isthmian railroads could cut distance, but at an additional cost of \$3.00 per ton at Panama and \$3.50 per ton at Tehuantepec.¹¹ The Canal had little impact on shipping distances between Europe and Asia or Europe and the Antipodes, which could travel alternate routes.

⁹ Hains, “An Isthmian Canal,” p. 4, and the *Report of the Isthmian Canal Commission, 1899-1901*, p. 253.

¹⁰ Braisted, *The United States Navy*, pp. 186-90.

¹¹ Huebner, “Economic Aspects,” p. 819. The additional cost of \$3.00–\$3.50 per ton would obviate most of the cost savings from the shorter route.

TABLE 1 AROUND HERE

How large were the transportation costs savings engendered by the Panama Canal? Saif Mohammed and Jeffrey Williamson have compiled a series of shipping costs between Portland, Oregon, and the United Kingdom. Their data on shipping costs are reproduced in Table 2. In 1922, the first year in which the Panama Canal was fully open to civilian traffic, shipping costs dropped 31 percent. Since the Canal reduced the distance between Portland and Liverpool by 42 percent, it seems likely that the Canal's opening caused most of the fall in freight rates.

TABLE 2 AROUND HERE

Part of the cost of transporting a ton of cargo, however, does not change with distance: loading and unloading, warehousing, insurance, docking fees, etcetera. We estimated the fixed cost of shipping by solving the following pair of simultaneous equations with two unknowns:

$$\begin{aligned} (\text{fixed cost}) + (\text{distance before canal}) \times (\text{per-mile cost}) &= (\text{total cost per ton before canal}) \\ (\text{fixed cost}) + (\text{distance after canal}) \times (\text{per-mile cost}) &= (\text{total cost per ton after canal}) \end{aligned}$$

Subtracting the fixed cost of shipping from the total cost of shipping one ton from the West Coast to Europe produced an estimate of the fixed cost per ton of \$3.12 in 1925 dollars.¹² The variable cost of transporting a ton of cargo one mile, therefore, was approximately 0.07¢ (U.S.) in 1921-22.

TABLES 3 AND 4 AROUND HERE

We then estimated shipping costs per ton-mile for the rest of the 1920s by subtracting our estimate of fixed costs from the total cost per ton-mile. Since the U.S. required that all transcontinental shipping be carried by U.S.-flagged vessels, it cost significantly more per-mile than international shipping. We therefore calculated per-mile costs separately for transcontinental and international routes.

We calculated the transportation cost savings generated by the opening of the Canal under three assumptions. First, we assumed that the opening of the Panama Canal had no effect on the fixed cost of shipping. Inasmuch as the Canal reduced insurance costs, our estimates bias downwards the cost savings it generated, although contemporary observers claimed when writing about the choice of ships about whether to use the Panama Canal or travel around Cape Horn, "Insurance rates are not likely to be different on the various alternative routes."¹³

¹² Canal tolls increased the fixed cost of shipping. We account for this by subtracting the Canal's cost of operations from our overall social savings estimates.

¹³ Hutchinson, "Voyage Costs," p. 577.

Second, we assumed that all of the reduction in per-mile shipping costs in the late 1920s came from improvements in shipping technology or drops in the cost of inputs such as fuel and labor. We do not attribute them to the opening of the Canal. This assumption biases downwards our estimates of the Panama Canal's transportation cost savings.

Third, we assumed that the same amount of cargo would be shipped between the same ports in the absence of the Panama Canal. Following Rockwell, we assumed that intercoastal cargoes would be shipped via the transcontinental railroad. Since we do not have data on the value of the cargoes transiting the Canal, we do not take into account savings in inventory costs due to lowered time in transit. Table 5 presents the basic estimates of the cost savings produced by the Panama Canal, broken down by route and year.

TABLE 5 AROUND HERE

Price Sensitivity

We believe estimates of cost savings in Table 5 are close to an upper-bound on the Panama Canal's benefits to world commerce, even though they do not include savings in insurance and inventory cost. We believe the estimates are close to an upper-bound because it is not at all clear that, were the Canal closed and transportation costs commensurately higher, the cargoes originally shipped through the Canal would even have been shipped.

For example, the lion's share of the cargo passing through the Canal by the late 1920s consisted of petroleum from southern California and lumber from the Pacific Northwest. However, both products had relatively accessible substitutes that did not pass through the canal: Venezuelan oil and Southern pine lumber. Much the same can be said of many of the international cargoes, like Philippine cane sugar or copra, both of which faced competition from alternate sources and domestic substitutes. Thus, inasmuch as consumers are sensitive to price, therefore, then the benefits from the Canal will be lower than our basic cost-savings estimates.

We therefore adjusted our calculations for various estimates of the price elasticity of demand for sea transportation. Doing so allows us to account for the availability of substitutes to ocean transport, should its price rise due to the lack of the Panama Canal. We calculated the ratio between the social savings at a given price elasticity and the social savings when the price elasticity is different from zero using the following two equations, where ϕ is the ratio between the cost of ocean transport without the use of the Panama Canal and the cost of ocean transport using the Panama Canal and ε is equal to the price elasticity of demand. Since the proportional cost savings of the canal were different for every route, we calculated the change in

the cost savings for various demand elasticities separately for every route and then aggregated upwards. The results are presented in Table 6.

$$(1) \frac{S_{\varepsilon}}{S_0} = \frac{\phi^{1-\varepsilon} - 1}{(1-\varepsilon)(\phi-1)} \text{ for } \varepsilon \neq -1.$$

$$(2) \frac{S_{\varepsilon}}{S_0} = \frac{\ln \phi}{\phi-1} \text{ for } \varepsilon = -1.$$

Social Rate of Return on the Panama Canal

Did the transportation cost savings produced by the Panama Canal justify the high construction cost? In order to answer this question, we divided the transportation cost savings estimated above by the canal's construction cost in order to produce a "social rate of return." The social rate of return, as we have defined it, measures the flow of benefits to the users of the Canal's services. If those returns are lower than the opportunity cost of capital, then the Panama Canal did not add value to the world economy.

INSERT TABLE 6 AROUND HERE

Even at the extreme assumption of a demand elasticity of -2.0 , the average social savings generated by the Canal, as a percentage of the Canal's total construction cost, remains well in excess of the 4.2 percent real return on federal government bonds during the period. In short, inasmuch as the rate of return on U.S. government bonds proxies the opportunity cost of capital, then the Panama Canal generated significant savings for the world economy during the 1920s.

An alternative way to compare the social returns generated by the Panama Canal with the returns that could be generated by buying back government debt is to calculate the "internal rate of return," or IRR, for the Panama Canal project. The IRR is the discount rate at which the net present value of a series of cash flows is equal to zero. It can be used to compare the returns available from different projects with different patterns of investment outlays and cash revenues.

Table 6 calculates the inflation-adjusted IRR for the Panama Canal, counting social returns as a "cash flow." It also calculates the IRR that would result from investing the same amount (over the same time period) in federal government bonds instead. Even at a demand elasticity for transportation of -2.0 , the IRR for the Panama Canal is more than 50 percent higher than the IRR for government bonds.

Men, Plans, Canals, Panama

The German scientist-explorer Alexander von Humboldt first proposed an Isthmian canal in 1811. However, the disease environment and insufficient technical ability prevented any serious efforts towards the goal until the 1850s, when a group of American investors constructed a railroad across Panama, then a province of Colombia. As a witness told a Senate committee in 1849, the railroad was meant to pave the way for a canal “by showing to the world how immense this business is.” The railroad proved to be phenomenally profitable.¹⁴

Nevertheless, no concrete efforts to construct a canal began until the engineer Ferdinand de Lesseps, fresh from his triumph at Suez, turned his attention to Central America. In 1878, De Lesseps sent Lieutenant Lucien Wyse, on leave from the French Navy, to scout out potential canal routes in Panama and Nicaragua. Wyse negotiated an agreement to build a canal in Panama with the Colombian government. The Wyse Concession promised Colombia an annual payment of \$250,000, in addition to the \$250,000 annuity already provided by the Panama Railroad Company. The Wyse Concession also promised the Colombians 5 percent of the canal’s gross revenues for the first 25 years, 6 percent for the subsequent quarter-century, 7 percent for the third quarter-century, and 8 percent for the final 24 years of the concession. At the end of 99 years, the Canal was to revert to Colombian control. Wyse then traveled to New York, where he secured the agreement of the Panama Railroad Company to sell its shares to De Lesseps’ company for twice their market value.¹⁵

De Lesseps calculated that he would be able to build a sea-level canal across Panama for \$240 million, including interest costs. He also forecasted maritime traffic of 60 million tons a year, which would generate \$18 million in toll revenue and \$8 million in profit. De Lesseps used these estimates to raise \$60 million in capital, of which \$6.4 million went to pay for underwriting fees, “remuneration to banks,” and publicity. Another \$17 million purchased the Panama Railroad, and the canal venture took over the Railroad’s \$6 million in outstanding debt.¹⁶

Such an inauspicious financial start boded ill for the entire project. The French engineers proved unable to construct a sea-level canal across Panama. Mudslides ensured that the walls of the canal had to be dug at a 22.5° angle rather than the planned 45°. That, of course, magnified the amount of earth that had to be moved. Unfortunately, the French method of simply dumping the spill in nearby valleys had the twin side effects of exacerbating mudslides during the rainy season—since the fill blocked natural watercourses—and creating malarial swamps that retarded the

¹⁴ Between 1856 and 1870, the Panama Railroad’s net margin averaged 53%. *Memoria de Hacienda*, p. 9.

¹⁵ McCullough, *The Path*, p. 66-67.

¹⁶ McCullough, *The Path*, pp. 73, 83, 125, and 128-129.

French enterprise's efforts to reduce mortality rates among its employees. In 1887 the French gave up trying to build a sea-level canal, and redesigned their project around a series of locks designed by Alexandre Gustave Eiffel.¹⁷

Unfortunately, the admission that a sea-level canal was impossible came too late to save the French effort. The public failed to take up new bond issues in the required amounts. The French legislature subsequently refused to suspend the company's debts, and in 1889 the company went bankrupt.¹⁸ The assets were reorganized under the name of the New Panama Canal Company. The New Company continued some spotty construction efforts and operated the Panama Railroad, but the canal project remained essentially dead.

American governments long desired the construction of a canal across the Central American isthmus because of the economic benefits it would bring. In 1878, the same year Wyse gained his concession from the Colombian government, a prominent Wall Street analyst estimated that an Isthmian canal would save world shipping \$48 million per year, of which \$36 million would accrue to the United States.¹⁹ Two years later, President Rutherford Hayes declared, "The policy of this country is a Canal under American control. Our commercial interest is greater than that of any other country."²⁰ The failure of the French to successfully finish a canal in Panama did little to change American opinions about the value of an Isthmian canal.

The Spanish-American War in 1898 reignited American interest in an Isthmian canal. In 1901 the U.S. signed the Hay-Pauncefote Treaty with Great Britain, which removed British opposition. The Isthmian Canal Commission then recommended a Nicaraguan route. The reason was neither technical nor political – rather, the New Company demanded too much (\$109 million) for its properties.²¹

Philippe Bunau-Varilla, an engineer under De Lesseps and the owner of a substantial interest in the New Company, convinced the company's management in Paris to reduce its price to \$40 million. His chief argument was that the New Company's concession from the Colombian government was slated to expire in 1904, after which its shareholders would receive nothing for their investments. Bunau-Varilla then informed Senator Mark Hanna (R-Ohio) of the lower offer. Senator Hanna, in return, blocked in committee a bill that would have approved construction along the Nicaragua route. Two weeks later, on January 28, 1902, Senator John Spooner (R-Wisconsin) introduced a bill that authorized the President to purchase the assets of

¹⁷ McCullough, *The Path*, pp. 93-94.

¹⁸ McCullough, *The Path*, p. 203.

¹⁹ McCullough, p. 39.

²⁰ Cited in Calvo Ospina, "Panama's Home Waters."

²¹ *Report of the Isthmian Canal Commission, 1899-1901*, p. 175, and *New York Exchange Telegraph*, November 17, 1901. \$109 million in 1903 dollars is the equivalent of \$1.9 billion in 2004 dollars, or \$50.2 billion when adjusted for relative share of GDP.

the New Company for \$40 million as long as a satisfactory agreement could be arranged with Colombia.²²

The Colombians realized that they were in a good position. The French concession expired in 1904, when it would revert to Colombia. If Colombia could simply delay an agreement with the United States until then, the Colombian government would be able to receive some or all of the \$40 million promised the New Company for its properties.

Colombia ran two risks with this strategy. The first was that the United States might decide to build a canal in Nicaragua in the meantime. The second was that the U.S. might choose to intervene militarily. The civil war of 1899-1902 was winding down, but the violence had not stopped, and the U.S. had in fact briefly occupied part of Panama in 1901.²³

As part of its proposal, the U.S. demanded the cession of a ten-mile wide band around the canal, including the cities of Colón and Panama City. Ambassador Carlos Martínez rejected the proposal, but wrote Bogotá insisting that Colombia would have to accept a lease of “at least 200 years” for a six-mile wide zone. Martínez also urged that Bogotá focus on retaining Panama City and Colón and getting a good financial deal, rather than symbolic negotiations over sovereignty and legal jurisdiction.²⁴

In February 1902, the Colombian government replaced Martínez with José Vicente Concha. Concha arrived prepared to accede to most of the Americans’ demands, with two exceptions. First, Concha insisted that “neither national, local, departmental, nor any other sort of tax on the canal be prevented.” Second, Concha insisted upon an up-front payment of \$7 million and an annual rent of \$600,000, although his instructions allowed him to defer rent negotiations until later, and he was prepared to forego the initial payments in return for a share in the Canal equal to or higher than those provided by the Wyse Concession. Concha believed that U.S. threats to build in Nicaragua were hollow.²⁵ The Nicaraguan route would run along the Costa Rican border, and the Costa Rican government showed little sign of agreeing to an American presence.²⁶

²² Miner, *The Fight*, pp. 124-25.

²³ Grimmett, “Instances of Uses,” p. 12.

²⁴ Uribe Vargas, *Los últimos derechos*, chapter 10.

²⁵ Uribe Vargas, *Los últimos derechos*, chapter 11, and *Libro Azul*, pp. 116-117.

²⁶ Hill, “The Nicaraguan Canal,” pp. 203, 207-08. A protocol signed in 1887 granted both Nicaragua and Costa Rica a 6 percent interest in any canal constructed along the San Juan River. An arbitration commission headed by President Grover Cleveland negated Costa Rica’s right to a share of canal revenues, but agreed that Costa Rica had a veto over construction and the right to demand compensation. An 1899 contract granted Nicaragua an up-front payment of \$500,000 and an 8 percent share in the canal, but no agreement had been reached with Costa Rica as of 1903.

The United States, however, showed little signs of compromising on either issue. On September 17, 1902, in response to unrest on the isthmus, the U.S. sent Marines to guard all trains crossing Panama and stationed ships off both terminals. Under pressure to concede the Americans' points, Concha stormed out of the negotiations and returned to Colombia. "In no case," wrote Concha, "for any human reason, will I sign any treaty with the government of the United States while its troops continue to occupy Colombian territory against every principle of justice and in violation of a public promise."²⁷

The Colombian chargé d'affaires, Tomás Herrán, was left in charge of the negotiations. Herrán was out of his league, under pressure both from Bogotá and the Americans. On January 3rd, 1903, Herrán received a cable from his government insisting that he obtain a final offer from the U.S. Secretary of State, John Hay, as soon as possible. After receiving a subsequent message from Hay implying that his refusal would cause the Americans to build in Nicaragua instead, Herrán signed a treaty in Hay's home in the presence of William Cromwell, a lawyer for the New Panama Canal Company.²⁸ Cromwell and Bunau-Varilla had, in fact, helped draft the agreement.²⁹

The Hay-Herrán Treaty essentially granted all the Americans' demands. The U.S. received a six-mile zone within which it could deploy troops with Colombia's consent, construct a canal, and control public health. Colombia also renounced its rights to a share of the revenues under the Wyse Convention and the \$250,000 annuity paid by the Panama Railroad, in return for \$10 million and a new annual payment of \$250,000 that would begin in 1912.

The treaty's terms did not go down well in Bogotá. The Colombian senate rejected it in a unanimous vote. President Roosevelt erupted at the news. "They are mad to get hold of the \$40 million of the Frenchmen, and they want to make us a party to the gouge."³⁰ He went on to call the Colombians "blackmailers," "homicidal corruptionists," and "cut-throats," ending with, "You could no more make an agreement with the Colombian rulers than you could nail currant jelly to a wall."³¹

The Colombian vote convinced Roosevelt to intervene.³² In addition to the possible Costa Rican complications along the Nicaraguan route, Roosevelt doubted the technical feasibility of dredging the San Juan River. A law professor from Columbia University, John Moore, provided a legal justification for the intervention by sug-

²⁷ Uribe Vargas, *Los últimos derechos*, chapter 11.

²⁸ Domm, *La crisis de Panamá*, p. 47.

²⁹ Mabry, "Acquisition of the Panama Canal."

³⁰ Major, *Prize Possession*, p. 31.

³¹ Zimmerman, *The First Great Triumph*, p. 431.

³² Zimmerman, *The First Great Triumph*, pp. 432-33.

gesting that the Bidlack Treaty, which committed the United States to protect Colombian sovereignty in Panama, made the U.S. the “responsible sovereign” on the Isthmus. Secretary Hay then began to spread the message that should a revolt break out in Panama, the U.S. Navy would prevent the landing of Colombian troops.³³

Bunau-Varilla received Hay’s message. On September 23rd, 1903, Bunau-Varilla met with Manuel Amador, a leader of the Panamanian independence movement, in Room 1162 of the Waldorf-Astoria in New York. Bunau-Varilla wrote Amador a personal check for \$100,000 in order to organize a new revolt. In return, Amador promised to appoint Bunau-Varilla the new republic’s foreign minister. On October 9th, Bunau-Varilla met with Roosevelt and left convinced that he would support an uprising.³⁴ When Bunau-Varilla informed the State Department that the revolution was scheduled for November 3rd, Roosevelt dispatched American gunboats.³⁵

On November 3rd, 1903, Amador declared independence. Colombia landed 400 soldiers at Colón, but the *U.S.S. Nashville* dispatched a contingent of Marines to dissuade the Colombians from fighting. The Colombians withdrew – although a Colombian gunboat did kill one bystander when it fired shells at Panama City. President Roosevelt declared, “No one connected with the American Government had any part in preparing, inciting, or encouraging the revolution.”³⁶

Bunau-Varilla quickly signed a canal treaty that provided a one-time payment of \$10 million for perpetual rights to a twenty-mile wide Canal Zone (minus Panama City and Colón), four offshore islands, and any other lands that the U.S. might find “necessary and convenient for the construction, maintenance, operation, sanitation and protection of the said Canal or of any auxiliary canals or other works necessary and convenient.” Panama abandoned its right to impose any taxes or “contributions or charges of a personal character” upon the Canal, its subsidiary companies (including the Panama Railroad), or its employees. In return, the U.S. agreed to replace the \$250,000 annuity formerly paid by the Panama Railroad, beginning in 1913.

Construction lasted until 1914. The U.S. organized the Canal Zone as an “unorganized possession,” outside of the reach of most federal laws, including the Constitution. The Panama Canal Act of 1912 formalized the regime under a governor appointed by the president every four years. The franchise was not extended to residents, and until 1928 the Zone governor in effect ran U.S. relations with Panama.³⁷

³³ Zimmerman, *The First Great Triumph*, p 432.

³⁴ Bunau-Varilla, *The Great Adventure*, pp. 180-81.

³⁵ Zimmerman, *The First Great Triumph*, p. 433.

³⁶ Roosevelt, *Theodore Roosevelt*, Ch. XIV.

³⁷ Congressional Research Service, *Background Documents*, pp. 597, 600, 605-06, and Records of the Panama Canal [hereafter RPC], McIlvaine/Walker, 19 November 1927, National Archives at College Park [hereafter NACP], Record Group 185.7.

The American politicians who backed the creation of the Panama Canal did not do so in order to benefit global commerce. In fact, the Panama Canal Act mandated that the Canal would charge no tolls on intra-U.S. traffic. The British protested that this provision of the Panama Canal Act violated the Hay-Pauncefote Treaty. President Taft responded that “the United States owned the canal.”³⁸ And during the 1912 presidential campaign, Woodrow Wilson declared his support for the Act.³⁹

However, President Wilson changed his mind, after meeting with Senator Elihu Root of New York.⁴⁰ Wilson changed his mind for three reasons. First, Wilson decided that the Act did in fact violate the Hay-Pauncefote Treaty. Second, and closely related, Wilson worried about subsequent relations with Great Britain. The British might refuse to renew the Arbitration Convention, which required Britain to take disputes between itself and the U.S. to a special court in the Hague. The British also might interfere with American policy in Mexico. Third, the transcontinental trade was “handled by comparatively few companies,” which would reap most of the benefits from toll-free Canal traffic. Wilson did not want to subsidize those companies.⁴¹ After a very contentious Congressional vote, Wilson succeeded in getting the act repealed on June 15, 1914.

Although the first ship transited the Canal on January 7th, 1914, Canal traffic remained low until 1920. World War I increased the profitability of American trade with Europe. Ships that had previously plied the transcontinental route transferred to trans-Atlantic routes during the War.⁴² At the same time, a series of landslides and other problems necessitated periodic Canal closures. After the War ended, however, traffic levels rose and the teething problems were solved. The Canal officially opened to the free passage of civilian ships on July 12th, 1920.⁴³

The Panama Canal and the United States

What benefits from the Canal accrued to the United States? As the controversy over the Panama Canal Act demonstrates, few American politicians supported the Canal in order to benefit world commerce. Rather, they cared about benefits for Americans and American trade.

Table 7 shows the basic estimate of the social savings generated by the Canal for the United States. Toll expenditures include only tolls paid on these routes, while the total profits generated by the Canal and transferred to the U.S. Treasury are

³⁸ Link, *Wilson*, p. 304.

³⁹ *New York Times*, 3 July 1912.

⁴⁰ Link, p. 306.

⁴¹ *Commoner*, April 1914.

⁴² Crumbaker, “The Panama Canal,” p. 151.

⁴³ Rockwell, “The Lumber Trade,” p. 447.

added back into the estimate. In theory, the returns from the Canal financed public expenditures that benefited all Americans. Foreign traffic, therefore, implicitly subsidized traffic bound to or from American ports.

INSERT TABLE 7 AROUND HERE

The estimates in Table 7 assume that Americans benefited from the cost savings generated by the Canal regardless of the origin or destination of the cargo. If markets were perfectly competitive, then one would expect foreign exporters to the United States to pass on cost savings to American consumers. On the other hand, if markets were monopolistic, then American exporters would reap the benefits from the drop in transportation costs. Table 7 implicitly assumes that *both* conditions held: U.S. import markets were competitive, while Americans enjoyed market power in the markets to which they exported. This assumption is clearly unrealistic.

Table 8 presents estimates of the social rate of return from the Canal for the United States, broken down by assumptions about how cost-savings are distributed between importers and exporters and the elasticity of demand. The lowest estimates in Table 8 are still well above the rate of return on U.S. government bonds. Thus, as a practical matter, it matters little how the benefits from the Canal's social savings are divided between exporters and importers.

INSERT TABLE 8 AROUND HERE

Were there defense-related savings from the Panama Canal? In 1916, the U.S. committed itself to building a two-ocean navy regardless of the Canal.⁴⁴ Congress failed to follow through on that commitment, but the reason was political, not strategic. Navy strategists continued to maintain that the U.S. needed to maintain a larger force in the Pacific.⁴⁵ One reason for the Navy's insistence was that the Canal's locks could handle neither the newest class of battleship nor aircraft carriers. The Washington Treaty of 1922 obviated the need to build either large battleships (later aircraft carriers) or a two-ocean fleet -- at least until the treaty expired in 1936, when Japan announced its withdrawal from its terms. Meanwhile, the U.S. incurred significant costs in garrisoning and defending the Canal Zone.

Of course, given that the Panama Canal encouraged the U.S. to sign the Washington Treaty and thereby limit its military expense, the Canal may have provided additional savings to the American economy. Whether such savings were prudent considering subsequent events is, of course, a entirely different question.

⁴⁴ Braisted, *The United States Navy*, pp. 186-90.

⁴⁵ Wheeler, "The United States Navy," p. 63.

The Panama Canal And Panama, Direct Effects

One might have expected the Panama Canal to have had a huge direct impact on the Panamanian economy. Toll revenues averaged \$44 per person per year in 1921-29. Canal employment averaged 12,852 people in 1921-37, or 7 percent of Panama's economically active population. In addition, 4,671 ships transited the Canal every year, and these ships required repairs and provisioning.

However, these expectations would have been incorrect. American policy served to insulate the Panamanian economy from the Canal. Direct transfer payments were held to a minimum. Employment preference went to West Indians over native Panamanians. The sale of goods or services to transiting vessels by Panamanians was banned.

Transfer Payments: The Factual

The 1903 payment of \$10 million for the Canal came to roughly three times the government's annual tax intake. In per capita terms, it came to \$36 per person. (\$642 in 2004 dollars.) Article 138 of the Panamanian constitution guaranteed that at least \$6 million of the \$10 million payment would be invested in fixed-income securities. Despite this constitutional article, the United States refused to turn the money over to the Panamanian government directly. Rather, the U.S. gave the \$10 million to J.P. Morgan, with the understanding that most of it would be invested on Panama's behalf. J.P. Morgan placed \$6 million in Manhattan real estate and \$2.8 million in various New York banks. The target rate of return earned on the portfolio was 3.9 percent, roughly 0.2 percentage points below the rate on long-term corporate bonds.⁴⁶

Upon gaining power, the provisional government in Panama City under Manuel Amador instructed Philippe Bunau-Varilla to obtain four main concessions from the U.S. government: a share of the proceeds from the sale of the New Company's concession properties to the United States, the reversion to Panama of all lands leased to the New Company or the Panama Railroad, the replacement of U.S. courts in the Canal Zone with joint tribunals, and the retention of Panama's right to levy excise taxes in the Zone. The Panamanian government also asked for U.S. protection from foreign threats.⁴⁷

Bunau-Varilla ignored instructions from Panama City. The only one of Panama City's requests that he obtained was a United States guarantee of Panamanian inde-

⁴⁶ Bunau-Varilla Collection [hereafter BVD], Bunau-Varilla/Hay, 6 March 1904, Library of Congress Manuscript Division [hereafter LCMD], and Congressional Research Service, *Background Documents*, pp. 520-22. See also, "Panama Gold For New York: \$6,000,000 of Canal Payment for Investment in Mortgages," *New York Times*, 22 May 1905. The average rate of return on 15-to-20 year corporate bonds was 4.1 percent in 1903.

⁴⁷ BVD, De la Espriella/Bunau-Varilla, 14 November 1903, LCMD.

pendence. In fact, the new treaty gave the U.S. full sovereignty over the zone and required Panama to pay the full capital and operating costs “of any works of sanitation, such as the collection and disposition of sewage and the distribution of water in the said cities of Panama and Colon.” Bunau-Varilla neglected to inform Panama City of these changes, referring only to “very slight modifications.”⁴⁸

When Manuel Amador arrived in Washington, he disavowed the treaty and said that he would need to take it back to Panama City to consult with the rest of the provisional government. Bunau-Varilla warned the Panamanians that the U.S. would pull out its troops and come to terms with Colombia if they did not ratify the treaty as soon as a copy reached Colón. Secretary Hay warned of “grave consequences” if Panama did not ratify quickly. The U.S. landed 2000 marines in Panama to underscore the point. The Panamanians ratified, despite the lack of a Spanish translation of the treaty.⁴⁹

In short, the U.S. used its military leverage over the new government to extort a better deal from the Panamanian government than it could have obtained through open negotiations.

Transfer Payments: Some Counterfactuals

How did the Hay-Bunau-Varilla treaty compare to a deal that Panama might have negotiated voluntarily? There are four plausible counterfactuals. The first is the deal that Colombia *did* negotiate voluntarily with the French: the Wyse Concession. The second is the proposal that Ambassador Concha offered the Americans before U.S. troops occupied Colombian territory in Panama. The third is the guidelines prepared by the Colombian Senate after it rejected the Hay-Herrán Treaty. The fourth is the Hay-Herrán Treaty itself, signed by the United States but rejected by the Colombian senate rejected.

INSERT TABLE 9 AROUND HERE

Which treaty offered the best deal to Panama? Table 10 computes the 1904 net present value of each offer. The NPV of the Hay-Bunau-Varilla Treaty is substantially less than the value of any of the other options. Unlike the other treaties, (even Hay-Herrán), Hay-Bunau-Varilla did not provide for the eventual reversion of the Canal and required Panama to bear the full cost (including interest) of any sanitary works completed in the course of construction. The NPV of the Wyse Concession is most likely an underestimate, since it assumes that a privately-run for-profit Canal would have charged the same \$1 per ton toll as the U.S. government. Given that

⁴⁸ BVD, Bunau-Varilla/ De la Espriella, 21 November 1903, LCMD.

⁴⁹ Castellero, *Panamá y los Estados Unidos*, pp. 42-59. See also “Gen. Reyes to Confer with other Envoys” and “Colombian Generals’ Offer,” *New York Times*, 29 November 1903.

Congress considered the Canal toll to be a subsidy to American shipping, rather than a revenue-maximizing price, this assumption appears unlikely. Our estimates the social returns from the Panama Canal imply that there was plenty of surplus to be appropriated.

INSERT TABLE 10 AROUND HERE

Employment and its Discontents

The labor force used to construct the Panama Canal did not come from Panama. Rather, the majority of the workers came from the British West Indies. Panamanian labor was too scarce and too expensive. In 1886, for example, unskilled workers on the Panama Railroad earned between 18¢ and 28¢ (U.S.) per hour – at a time when the average manufacturing worker in the United States earned 19¢ per hour.⁵⁰ Panamanian skilled labor cost even more. Skilled workers on the Panama Railroad earned 50¢ per hour in the 1880s, while cigarette rollers earned a piece rate of 30¢ per 100 cigarettes, three times higher than the nominal rates paid to American workers for the same amount.⁵¹

West Indians were not the Americans' first choice; rather, the U.S. authorities attempted to contract Chinese contract laborers. The Chinese government, however, refused to cooperate with the United States. The Americans then decided to create a three-tiered work force. Skilled Americans went on what became known as the "Gold Roll." Spaniards and West Indians went on the "Silver Roll." Unskilled labor earned 10¢ an hour for a 10 hour day. Carpenters and barbers earned 13¢ to 16¢ an hour. Machine operators earned 25¢, and machinists and boilermakers topped at 50¢ an hour. In 1908, the Canal administration gave Spaniards and other Europeans an unofficial wage floor of 20¢ an hour, while capping West Indian wages at 50¢. The next year, President Taft officially closed the Gold Roll to non-Americans, with the exception of Panamanian nationals. Under pressure from U.S. unions, however, the Canal only hired 16 Panamanians for Gold Roll jobs.⁵²

INSERT TABLE 11 AROUND HERE

In 1920, the West Indians went on strike in the face of declining real wages and large-scale layoffs. Between 1914 and 1920, the cost-of-living rose 80 percent, while average monthly wages rose only 55 percent, to \$40.⁵³ Governor Chester Harding threatened to occupy Panama City and Colón unless the Panamanian government

⁵⁰ Mack, *La tierra dividida*, p. 73. U.S. manufacturing wages from *Historical Statistics*, Vol. 2, p. 267.

⁵¹ *La Estrella de Panamá*, 22 April 1880, p. 4. U.S. labor costs in unmechanized cigarette manufacturing for 1876, from Porter, "Origins," p. 69.

⁵² Conniff, *Black Labor*, pp. 31 and 86, and Major, *Prize Possession*, pp. 83-84.

⁵³ Conniff, *Black Labor*, pp. 50.

broke the strike. Panama obliged by banning strike meetings.⁵⁴ Neither Harding nor his successor, Jay Morrow, however, agreed to hire more Panamanians on either the Gold or Silver rolls. Panama banned the immigration of non-Spanish-speaking blacks in 1926.⁵⁵

The American policy of recruiting immigrant labor (while arguably necessary in a country with a population as small and as rural as Panama's) meant that the increase in labor demand engendered by the Canal translated into an increase in the Panamanian labor force rather than an increase in real wages. In addition, the U.S. decision to restrict the Gold Roll to white Americans limited the ability of either native Panamanians or the new immigrants to benefit from on-the-job training and move up the skills ladder.

A skeptical reader might argue that the Silver Roll employees, even if primarily of West Indian origin, would still have spent their wages in Panama. That, however, was not the case. Canal workers received access to a special chain of subsidized government-run stores in the Canal Zone colloquially known as the "Commissary." These stores sold goods (including basic foodstuffs) imported from the United States and were open to all Canal employees, contractors, and transiting passengers. The Commissary remained a thorn in the side of U.S.-Panamanian relations until 1936.

Invisible Exports

The post-1903 influx of Canal workers caused shortages of food and retail goods.⁵⁶ In response, in 1905 the U.S. government established a series of commissaries in the Canal Zone in order to feed and provision the work force.⁵⁷ In 1913, the operation expanded to building housing for the workers, inside and outside the Canal Zone.⁵⁸ By 1920, the government-run Commissary operated 13 "plantations" producing fruit and vegetables for local consumption, and imports of beef and pork into the Zone had been curtailed.⁵⁹ Once the Canal opened to commercial ship traffic, the Commissary expanded to include supplying "coal and other materials, labor, repairs, and supplies ... at reasonable prices to passing vessels."⁶⁰ Governor George Goethals justified the policy by saying, "The ships would be dependent upon a precarious local supply at prices that would probably be extortionate, and the conditions of such would make the canal route unattractive."⁶¹

⁵⁴ Major, *Prize Possession*, p. 91.

⁵⁵ Major, *Prize Possession*, p. 95.

⁵⁶ "Pay Klondike Prices for Food in Panama; Native Laborers Suffer," *New York Times*, 24 September 1905.

⁵⁷ *Annual Report of the Isthmian Canal Commission, 1904-05*, p. 8.

⁵⁸ Conniff, *Black Labor*, p. 30.

⁵⁹ Brown, "Five Years," p. 198.

⁶⁰ Section 6 of the Panama Canal Act of 1912.

⁶¹ Leonard, "The Commissary Issue," p. 92.

What gave the Commissary an advantage over local merchants? In addition to its exemption from Panamanian import duties (and all taxes, Panamanian or American) the Commissary received subsidized rates on the Panama Railroad. The Commissary paid a flat rate of \$2.25 per ton, while Panamanians paid between \$6.80 and \$10.00 per ton, depending on the class of service.⁶²

Panamanian merchants protested that the Panama Railroad had “not [been created] with the idea that it was to be utilized as a weapon to kill local business.”⁶³ As a result of the protest, the U.S. granted 16 local firms access to port facilities. Governor Goethals, however, declared that none of the Panamanian firms were capable of provisioning passing ships. The Canal Zone authorities, therefore, continued to ban Panamanian companies from soliciting business on board passing vessels.⁶⁴ The Panamanians later complained that the Commissary sold luxury items to passing vessels as well as basic supplies. Governor Meriwether Walker, however, refused to end the sales simply “in order to throw business to Panama merchants.” In 1931, Walker’s successor, Harry Burgess, also refused to end the subsidized sales of luxury items, although he did raise the prices the Commissary charged.⁶⁵ The transit trade was not opened to Panamanians until the Hull-Álfaro Agreement of 1936.

The Commissary also effectively insulated the Panamanian economy from the increased demand engendered by the Canal Zone’s workforce. Table 11 presents data on Commissary sales and sales per employee. With approximate average annual wages per employee of \$500, and average annual Commissary sales per employee of \$400, the typical Canal Zone worker had little need to source any of his or her basic needs from Panamanian merchants.

INSERT TABLE 12 AROUND HERE

Did the Canal Zone provide a source of invisible exports for the Panamanian economy? There are many possible channels. Silver Roll workers often lived outside the Canal Zone, and spent some of their wages on housing and services. Panamanian citizens worked within the Zone, primarily as domestic servants for Gold Roll employees. American soldiers purchased goods and services in Panama that were prohibited inside the Canal Zone.⁶⁶ The increase in maritime traffic might have produced an increase in Panama’s revenues from tourism and the re-export trade.

⁶² Leonard, “The Commissary Issue,” p. 95.

⁶³ Leonard, “The Commissary Issue,” p. 96.

⁶⁴ Leonard, “The Commissary Issue,” p. 93.

⁶⁵ Leonard, “The Commissary Issue,” p. 97.

⁶⁶ In 1918, the United States banned the importation of drugs, alcohol, or prostitutes into the Canal Zone. Major, *Prize Possession*, p. 150.

The available trade data, however, indicate that Panama's invisible exports were not any greater in the 1920s than they had been before 1903. A crude indicator of the size of Panama's invisible earnings is the country's trade deficit minus net its financial inflows. Unfortunately, we do not have data on net financial inflows for Panama until 1945. We do, however, have trade data from the pre-1903 period. Since the Darien Gap prevented overland commerce with the rest of Colombia, it is possible to use data from Panama's port customs officials (who recorded the value of all imports, including those from the rest of Colombia) to estimate Panama's trade balance for selected years before 1903. Table 13 presents those estimates.

INSERT TABLE 13 AROUND HERE

Panama's net imports, in real terms, were only slightly larger in the 1920s than it had been in the 1890s. In per capita terms, Panama's real net imports were *smaller* in the 1920s than they had been in the 1890s. In fact, Panama's real per capita trade deficit was little higher in the 1920s than it had been in the 1850s.

In order to square these figures with the hypothesis that Panama's invisible earnings rose after the opening of the Canal, one would have to believe that Panama's net financial inflows were significantly higher in the 1890s, immediately after the 1889 collapse of the French canal effort, than they were during the 1920s.

The Panama Canal And Panama, Indirect Effects

Did the Canal have a sizeable *indirect* impact on Panama? We conjecture three possible channels. First, Panama was a protectorate of the United States. Panama's protected status might have reduced its government's cost of capital and allowed it to borrow more on international capital markets. Second, the U.S. constructed water and sewage systems in Panama City and Colón; inasmuch as U.S. taxpayers financed their construction, then the water and sewage systems would have comprised an indirect benefit for Panama. Third, the U.S. made a sizeable investment in public health as part of the Canal construction effort, separate from its investments in physical capital in the port cities. Those efforts might have indirectly subsidized the well-being of the Panamanian people.

The first channel for indirect benefits does not seem to have functioned. Panama neither borrowed more nor at lower rates than other Central American countries. The second indirect channel also seems not to have operated. The United States did construct sanitary works in Panama, lowering death rates, but the U.S. government charged the Panamanians the full cost of their construction and operation, including interest. Only through the third channel, via its anti-malarial campaign, did the U.S. provide Panama an indirect benefit through its interest in the Canal.

Sovereign Risk

The United States created Panama as a formal protectorate, although American officials shunned the use of the term. At the urging of the U.S. minister to Panama, William Buchanan, Article 136 of the Panamanian constitution granted the United States the right to “intervene in any part of Panama, to reestablish public peace and constitutional order.”⁶⁷

The U.S. exercised its right to intervene on multiple occasions. In November 1904, President Roosevelt deployed the United States Marine Corps to forestall an attempted coup. The coup leader soon resigned his commission, and Panama abolished its army soon thereafter.⁶⁸ In 1912, the U.S. again deployed Marines in order to supervise a contested election.⁶⁹ In 1918, President Ramón Valdes died unexpectedly, and factions within the Panamanian government declared the indefinite postponement of the legislative election due on July 7th.⁷⁰ The U.S. Army was deployed outside the Zone to insure that the election took place. Panama elected a new legislature under American supervision, and the legislature proceeded to install Belisario Porras as president. In 1920, the U.S. Army rescued Porras from an angry mob in Panama City. In 1921 the U.S. had cause to regret its decision to protect Porras, when it deployed a battalion of Marines in order to eject a Panamanian “expedition” from the contested Costa Rican village of Coto.⁷¹ In 1925, the U.S. Army quelled rent riots in Panama City.⁷²

The U.S. also supervised Panamanian finances. Article 138 of the Panamanian constitution mandated that \$6 million in proceeds from the Hay-Bunau-Varilla Treaty remain invested in New York. When the government attempted in 1911 to use the money to finance a railroad from Panama City to Chiriquí Province, the State Department announced that any diversion would be a violation of the constitution and activate the U.S. obligation to intervene under Article 136. In 1914, the U.S. approved a \$3 million railroad loan secured by the Canal Zone annuity. American officials defended their control over Panamanian finances by insisting that it was “notorious that Latin American officials are apt to be anything but cautious in entering financial obligations.”⁷³ American worries did not prove unfounded. In 1918, after

⁶⁷ Peterson, *Diplomat of the Americas*, pp. 238-60.

⁶⁸ The Panamanian National Police would remain the country's *de facto* military until 1953, when President José Antonio Remón, a colonel in the National Police, created the National Guard. Under the terms of the Mutual Security Act, the U.S. aided Panama in turning its paramilitary police into a full-fledged army. Manuel Noriega renamed the National Guard the Panama Defense Forces in 1984. In 1990, the year after the American invasion, Panama once again abolished its military. The Panamanian congress enshrined the decision in the Constitution in 1994.

⁶⁹ Grimmer, “Instances of Uses,” p. 13 and 15.

⁷⁰ Major, *Prize Possession*, p. 138.

⁷¹ Major, *Prize Possession*, pp. 141-42.

⁷² Grimmer, “Instances of Uses,” p. 16.

⁷³ Major, *Prize Possession*, pp. 129-30.

Panama used some of the railroad loan to meet current expenses, the State Department pressured Panama into appointing a “fiscal agent” who would have “control and charge of the national treasury.” Addison Ruan, the former American financial agent in Haiti, received the job.⁷⁴

Panama took out four major foreign loans during the period of the financial protectorate. The first was a \$3 million loan in 1914 to finance the Chiriquí Railroad. National City Bank purchased all the bonds at an effective interest rate of 5.2 percent.⁷⁵ The next year, Panama issued a further \$4.5 million in debt, secured by the income on the \$6 million invested in New York real estate. The effective interest rate was 5.6%.⁷⁶ In 1926, Panama took out a \$2.6 million loan for further work on the Chiriquí Railroad and the construction of a wharf at Armuelles. The loan was secured by revenue from Panama’s export duties and the stamp tax. The effective interest rate was 6.3%.⁷⁷ Finally, in 1928 the country refinanced its outstanding loan principal of \$6.2 million, and took out an additional \$10 million in new debt, for an effective interest rate of 5.2%.⁷⁸

INSERT TABLE 14 AROUND HERE

Did American intervention lower the cost of capital faced by the Panamanian government? Table 14 presents estimates of sovereign borrowing costs for representative nations in the western hemisphere. Panama’s borrowing costs were not systematically lower than countries that were not American protectorates, such as Argentina, Costa Rica, and Venezuela. Nor did the cost of Panama’s new debt issues change systematically after the installation of the American fiscal agent in 1918.

The historical record explains why American protection did little to reduce Panama’s borrowing costs. Panama systematically refused to heed the fiscal agent’s advice, and developed ways to circumvent the agent’s control. In 1923, Addison Ruan resigned in frustration. His replacement, Walter Warwick, in the words of U.S. minister to Panama, John South, “sat back and allowed the [Panamanian] government to do practically as it has seen fit, even to the extent of purchasing new, expensive automobiles for the use of the President and his cabinet, including one for the Fiscal Agent himself.” South made an extensive list of Panamanian misuse of borrowed funds. In 1928, when Panama began planning a \$16 million bond issue, Assistant Secretary of State Francis White explicitly and publicly stated that while the United States had arranged to “protect” the finances of Cuba, Haiti, Santo Domingo, and Nicaragua, “such a relationship does not exist with Panama.” The As-

⁷⁴ Major, *Prize Possession*, pp. 139–40.

⁷⁵ Calculated from data in *Wall Street Journal*, 3 December 1914.

⁷⁶ Calculated from data in *Wall Street Journal*, 25 May 1915.

⁷⁷ Calculated from data in *Wall Street Journal*, 15 June 1926.

⁷⁸ Calculated from data in *Wall Street Journal*, 25 May 1928.

sistant Secretary's announcement appears to have come as no surprise to the markets. As Table 14 illustrates, the financial markets already rated Panamanian securities not only as riskier than Cuba, which did enjoy American financial "protection," but riskier than Costa Rica, which did not.⁷⁹

Sanitary Works

The Panama Canal brought important improvements to the health of the Panamanian population. Death rates in the city of Colón fell from an average of 52 per 1,000 in the decade before Canal construction began to 17 per 1,000 by the beginning of the 1920s. Death rates in Panama City and among Canal employees fell commensurately. The improvement in death rates had two causes. The first was the construction of water and sewage works in the cities of Panama and Colón. The second was the anti-malarial campaign in the Canal Zone.

The U.S. supplied Panama City with water through a 16-inch pipe from the Ancon reservoir. The system's capacity was 1.8 million gallons per day. By 1906 the U.S. had finished the water and sewage system, although only 432 houses were hooked up, the rest receiving water from public hydrants. In Colón (which although not officially part of the Canal Zone was entirely owned by the Panama Railroad, which was in turn owned by the United States), railroad employees already enjoyed access to piped water from the Mount Hope reservoir. The U.S., however, placed street hydrants every 700 feet in 1906 in order to insure wider access, and expanded the sewer system to include the entire city. In 1915, the U.S. finished the water works with a pair of filtration plants.⁸⁰

The U.S. charged the Panamanians the full \$4.8 million cost of the waterworks. In fact, the U.S. charged a 6% interest rate, roughly equal to Panama's cost of capital on the private market.⁸¹ When the U.S. turned the waterworks over to Panama in 1946 (as part of a 1942 wartime agreement), the remaining unamortized debt came to only \$669,226.⁸² In that sense, the health benefit from the waterworks could only be considered a spillover inasmuch as the presence of the Canal Zone accelerated the construction of the works compared to what a fully independent Panamanian would have achieved: the Americans did not subsidize the cost.

Public Health

The anti-malaria campaign, on the other hand, was a pure spillover from the Canal construction. High death rates from malaria worried the Isthmian Canal Com-

⁷⁹ Major, *Prize Possession*, pp. 145-46 and 149.

⁸⁰ "Canal Ends Half Century's Association with Municipal Services in Panama, Colon," *The Panama Canal Review*, 3 July 1953.

⁸¹ "Canal Ends Half Century's Association with Municipal Services in Panama, Colon," *The Panama Canal Review*, 3 July 1953.

⁸² "Canal Ends Half Century's Association with Municipal Services in Panama, Colon," *The Panama Canal Review*, 3 July 1953.

mission, which began an anti-malaria campaign on June 30, 1904, under Colonel William Gorgas, who had supervised the disease control and sanitary efforts in occupied Cuba.

Colonel Gorgas was a thorough man. Under his orders, all pools within 100 yards of individual houses were drained; when not possible, oil was used to kill mosquito larvae. When oiling failed, Gorgas liberally applied the world's first insecticide, created by Joseph LePrince, the Canal Zone's chief sanitary inspector. The Sanitary Department used 700,000 gallons of oil and 124,000 gallons of insecticide every year.⁸³

Malarial death rates for Canal employees fell from 11.6 per 1000 in 1906 to 1.2 per 1000 in 1909. In the entire area covered by the campaign (the Canal Zone, Panama City, and Colón), malarial death rates decreased from 16.2 per 1,000 in 1906 to 2.6 per 1,000 in 1909.⁸⁴ The decline in the incidence of malaria accounted for approximately 37 to 40 percent of the total mortality decline in Panama City and Colón between 1900-04 and 1910-14.

The anti-malaria campaign confined its immediate benefits to Canal employees and the residents of the two port cities. Table 15 presents overall mortality rates for Panama City, Colón, and the rest of the country. It also presents the death rate for Canal employees during both the French and American periods. Mortality rates outside the Zone and the port cities remained fairly constant.

Table 15 presents a simple counterfactual of what Panama's mortality rates would have been in the absence of the American anti-malarial program. This counterfactual assumes that death rates in the port cities decline 10.4 percentage points less than they actually did. It further assumes that net migration to the cities remains constant. In such a counterfactual, Panamanian mortality actually *rises*. Although mortality in the cities drops, it is not enough to offset the increase in the cities' share of the overall Panamanian population.

INSERT TABLE 15 AROUND HERE

In short, it appears that the Panama Canal produced one major spillover for the Panamanian population: the near-eradication of malaria and yellow fever. Nevertheless, it should be noted that Panama's mortality rates appear to have been somewhat lower than countries with similar disease environments before the arrival of the Americans. In 1900-04, for example, mortality rates in Panama were 11 percent lower than Cuba (where the U.S. spent a great deal on disease control in 1898-1902), 13 percent lower than Costa Rica, and 28 percent lower than Venezuela.

⁸³ Bennett, *History Of The Panama Canal*, chapter 20.

⁸⁴ www.cdc.gov/malaria/history/panama_canal.htm

Conclusion

The Panama Canal is one of the first great works of twentieth century engineering. It dramatically cut transportation costs and produced significant savings for world commerce. The lion's share of these savings were captured by the United States, because most of the ships passing through the Canal carried cargoes coming from or destined to the United States – or in the case of the intercoastal traffic, both – and because the Canal produced significant direct transfers to the U.S. Treasury. Despite the large cost overruns during its construction, and the prolonged construction time, the Canal was a good investment of public money.

On the other hand, the Canal produced relatively few spillovers for Panama. Although the lack of spillovers was the direct result of American policy, it could be argued that the U.S. had little choice, given the state of the Panamanian economy in 1903. The country did not have an easily mobilized (or English-speaking) labor force for work on the Canal, and it is questionable whether Panamanian suppliers could have met a significant percentage of the needs of passing ships even had the Americans allowed them to compete. Nor did Panama benefit from its “special relationship” with the United States when borrowing on world capital markets. The benefits were almost entirely limited to the direct payments made by the U.S. for the Canal Zone and the great reduction in the incidence of malaria in the country's two major cities.

Panama's experience with the Canal, therefore, holds warnings for modern underdeveloped countries that seek to rapidly develop through the construction of large infrastructure projects, be they pipelines (as in Central Asia and Africa) or “land bridges” (as in Central America). The spillovers from such projects may prove disappointing. Nor is it clear that greater international oversight is an efficient way to insure greater local benefits from such projects: the United States, with a clear willingness to intervene and an American fiscal agent installed in the presidential palace, proved unable to control Panamanian finances or to convince international capital markets that the country was a better-than-average risk.⁸⁵ Meanwhile, the greatest spillover to Panama from the Canal, the reduction in the prevalence of malaria and yellow fever, has little parallel in the modern world: modern-day De Lesseps and Goethals do not need to wipe out tropical diseases in the areas in which they operate in order to build their works quickly and cheaply. Panama eventually developed the human and institutional capital needed to benefit from the presence of the Canal on its soil, but it was a slow process that took almost a century, and required multiple costly interventions by the United States. It is not clear how long it will take Bolivia, Chad, or Uzbekistan to do the same.

⁸⁵ The current experience of the attempt of the international community to govern the finances of the Chadian government's revenues from oil extraction is in line with the American experience in Panama a century ago.

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TABLE 1: DISTANCES

	Panama Canal route	Shortest alternative
<i>Selected U.S. routes</i>		
New York to Valparaíso	5,515	8,512
New York to Los Angeles	5,812	12,949
New York to Portland	6,756	13,907
New York to Vancouver	6,925	14,054
San Francisco to Liverpool	7,825	13,841
New York to Sydney	10,573	12,762
New York to Shanghai	11,471	16,746
<i>Selected non-U.S. routes</i>		
Tampico to Valparaíso	4,785	9,088
Liverpool to Valparaíso	7,192	11,841
Liverpool to Vancouver	8,602	13,251
Liverpool to Sydney	12,250	11,514
Liverpool to Shanghai	13,148	10,465

Source: www.distances.com

TABLE 2: TRANSPORTATION RATES PER TON

	Water shipping				Rail shipping	
	Portland OR to Liverpool UK		Portland OR to New York NY		Portland OR to New York NY	
	<i>Current dollars</i>	<i>1925 dollars</i>	<i>Current dollars</i>	<i>1925 dollars</i>	<i>Current dollars</i>	<i>1925 dollars</i>
1907	\$8.66	\$15.08				
1908	\$6.42	\$11.25				
1909	\$7.31	\$12.80				
1910	\$6.90	\$11.78				
1911	\$7.18	\$12.36				
1912	\$7.47	\$12.33				
1913	\$16.69	\$27.37				
1914	\$25.91	\$41.97				
1915	\$35.12	\$55.14				
1916						
1917						
1918					\$15.50	\$15.05
1919	\$21.47	\$20.39			\$16.00	\$15.24
1920	\$17.23	\$14.30	\$24.00	\$20.00	\$17.33	\$14.44
1921	\$12.99	\$12.69	\$13.24	\$12.93	\$21.30	\$20.80
1922	\$8.42	\$8.70	\$9.82	\$10.14	\$18.00	\$18.60
1923	\$8.19	\$8.23	\$8.93	\$8.97	\$18.00	\$18.09
1924	\$7.87	\$8.01	\$9.00	\$9.16	\$18.00	\$18.32
1925	\$8.39	\$8.39	\$9.69	\$9.69	\$18.00	\$18.00
1926	\$8.69	\$8.65	\$9.15	\$9.11	\$18.00	\$17.92
1927	\$8.44	\$8.61	\$9.51	\$9.69	\$18.00	\$18.35
1928	\$7.70	\$7.79	\$9.14	\$9.25	\$18.00	\$18.22
1929	\$6.93	\$6.99	\$8.18	\$8.25	\$18.00	\$18.15
1930	\$5.10	\$4.87	\$6.79	\$6.48	\$18.00	\$17.18
1931	\$5.31	\$4.54	\$6.58	\$5.63	\$18.00	\$15.41
1932	\$3.75	\$2.83	\$6.75	\$5.10	\$18.00	\$13.59
1933	\$4.19	\$3.06	\$7.08	\$5.17	\$18.00	\$13.16
1934	\$4.95	\$3.84	\$8.15	\$6.32	\$18.00	\$13.96
1935	\$4.56	\$3.61	\$8.23	\$6.51	\$14.40	\$11.40
1936	\$6.24	\$5.00	\$8.54	\$6.84	\$14.40	\$11.53
1937	\$9.20	\$7.69	\$9.31	\$7.78	\$15.60	\$13.03
1907-21 average	\$14.45	\$20.62	\$18.62	\$16.46	\$17.53	\$16.38
1922-29 average	\$8.08	\$8.17	\$9.18	\$9.28	\$18.00	\$18.21
1930-37 average	\$5.41	\$4.43	\$7.68	\$6.23	\$16.80	\$13.66

Source: Pre-1915 water rates from Mohammed and Williamson, Table 2. 1920 water rates from Portland to New York from Rockwell, p. 149. 1921-37 water rates from Portland to New York from Rockwell, Appendix VIII, assuming a conversion factor of 679,000 board-feet per ton. Railroad freight rates from Rockwell, Appendix VII.

TABLE 3: FIXED AND VARIABLE SHIPPING COST ESTIMATES, PORTLAND, OREGON-UNITED KINGDOM, 1925 DOLLARS

(1)	Average shipping cost, 1921	\$12.69
(2)	Average shipping cost, 1922	\$8.70
(3)	Line (2) ÷ line (1)	69%
(4)	Distance, pre-Canal, miles	14,471
(5)	Distance, post-Canal, miles	8,435
(6)	Total cost per ton-mile, 1907-1910	0.09¢
(7)	Total cost per ton-mile, 1921-1929	0.10¢
(8)	Estimate of fixed cost	\$3.12
(9)	Estimated variable shipping cost, 1921 = line (1) - line (8)	\$9.57
(10)	Estimated variable shipping cost, 1922 = line (2) - line (8)	\$5.58
(11)	Implicit variable cost per ton-mile	0.07¢

Source: Table 2 and Table 3.

TABLE 4: ESTIMATED SHIPPING COST PER TON-MILE IN 1925 DOLLARS

	(a) International	(b) U.S. intercostal	(c) (a) ÷ (b)
1907	0.08¢		
1908	0.06¢		
1909	0.07¢		
1910	0.06¢		
1921	0.07¢	0.15¢	46%
1922	0.07¢	0.10¢	64%
1923	0.06¢	0.09¢	70%
1924	0.06¢	0.09¢	65%
1925	0.06¢	0.10¢	64%
1926	0.07¢	0.09¢	74%
1927	0.07¢	0.10¢	67%
1928	0.06¢	0.09¢	61%
1929	0.05¢	0.08¢	60%

Source: Tables 3 and 4, Rockwell (1971)

TABLE 5: BASIC GLOBAL SOCIAL SAVINGS ESTIMATES, BY ROUTE, IN MILLIONS OF 1925 DOLLARS

	1921	1922	1923	1924	1925	1926	1927	1928	1929
US Intercontinental									
US East - SouthAm West	\$3.78	\$1.57	\$3.73	\$4.70	\$5.70	\$6.37	\$5.72	\$5.35	\$4.73
US East - Asia	\$5.73	\$7.09	\$6.10	\$5.51	\$4.95	\$6.07	\$6.81	\$6.04	\$6.23
US East - Australasia	\$1.11	\$0.48	\$0.71	\$0.81	\$0.95	\$1.09	\$1.18	\$0.78	\$0.67
US West - Europe	\$5.17	\$5.92	\$5.09	\$5.79	\$5.62	\$6.53	\$7.92	\$7.82	\$7.93
Non-US intercontinental									
Europe-Canada West	\$0.00	\$1.75	\$3.14	\$3.92	\$5.15	\$6.28	\$7.45	\$9.46	\$6.75
Europe to SouthAm West	\$3.75	\$2.91	\$4.93	\$5.41	\$7.23	\$7.30	\$5.90	\$7.49	\$7.03
Mexico East to SouthAm West	\$1.86	\$0.73	\$0.67	\$0.65	\$0.32	\$0.00	\$0.00	\$0.00	\$0.00
Transcontinental	\$10.80	\$23.76	\$78.27	\$128.42	\$84.57	\$96.16	\$99.49	\$96.89	\$106.26
<i>Minus tolls</i>	(6.22)	(11.56)	(17.60)	(24.72)	(21.37)	(22.82)	(24.69)	(27.27)	(27.36)
TOTAL	\$25.99	\$32.66	\$85.05	\$130.49	\$93.10	\$106.98	\$109.79	\$106.56	\$112.24
Social rate of return	2.8%	3.5%	9.2%	14.2%	10.1%	11.6%	11.9%	11.6%	12.2%
% of total savings from transcontinental traffic	34%	54%	76%	83%	74%	74%	74%	72%	76%
% from all U.S. routes	83%	88%	91%	94%	89%	90%	90%	87%	90%

	1930	1931	1932	1933	1934	1935	1936	1937
US Intercontinental								
US East - SouthAm West	\$4.43	\$3.68	\$1.26	\$0.47	\$2.83	\$2.14	\$4.49	\$8.40
US East - Asia	\$6.40	\$6.11	\$5.08	\$5.89	\$9.60	\$8.92	\$12.89	\$28.54
US East - Australasia	\$0.61	\$0.42	\$0.22	\$0.19	\$0.35	\$0.44	\$0.80	\$1.32
US West - Europe	\$10.15	\$9.89	\$4.89	\$5.46	\$6.04	\$5.00	\$10.28	\$12.94
Non-US intercontinental								
Europe-Canada West	\$2.99	\$4.91	\$3.80	\$6.18	\$5.28	\$5.27	\$8.17	\$13.07
Europe to SouthAm West	\$5.50	\$5.59	\$3.03	\$3.32	\$6.67	\$6.43	\$9.01	\$15.85
Mexico East to SouthAm West	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Transcontinental	\$121.92	\$103.75	\$76.41	\$72.46	\$90.79	\$50.68	\$46.56	\$42.30
<i>Minus tolls</i>	(27.08)	(24.64)	(20.71)	(19.62)	(24.07)	(23.34)	(23.51)	(23.15)
TOTAL	\$124.93	\$109.70	\$ 73.99	\$ 74.35	\$ 97.49	\$ 55.55	\$ 68.69	\$ 99.27
Social rate of return	13.6%	11.9%	8.0%	8.1%	10.6%	6.0%	7.5%	10.8%
% of total savings from transcontinental traffic	80%	77%	81%	77%	75%	64%	51%	35%
% from all U.S. routes	94%	92%	93%	90%	90%	85%	81%	76%

Source: See Tables 1, 2, 3, and 4.

TABLE 6: GLOBAL SOCIAL RATES OF RETURN FROM THE PANAMA CANAL FOR ALTERNATIVE VALUES OF THE PRICE ELASTICITY OF DEMAND FOR FREIGHT SERVICES VIA THE CANAL

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
$\epsilon = 0.0$	2.8%	3.5%	9.2%	14.2%	10.1%	11.6%	11.9%	11.6%	12.2%	13.6%
$\epsilon = -0.5$	2.4%	3.0%	7.6%	11.7%	8.4%	9.6%	9.9%	9.6%	10.1%	11.2%
$\epsilon = -1.0$	2.1%	2.6%	6.4%	9.7%	7.0%	8.1%	8.3%	8.1%	8.5%	9.3%
$\epsilon = -1.5$	1.9%	2.2%	5.4%	8.2%	6.0%	6.9%	7.1%	6.9%	7.2%	7.9%
$\epsilon = -2.0$	1.6%	1.9%	4.7%	7.0%	5.1%	5.9%	6.1%	5.9%	6.2%	6.7%
Yield on long-term government bonds	4.5%	4.3%	4.4%	4.0%	3.8%	3.6%	3.2%	3.5%	3.4%	3.2%

	1931	1932	1933	1934	1935	1936	1937	Average	Average, 1923-29
$\epsilon = 0.0$	11.9%	8.0%	8.1%	10.6%	6.0%	7.5%	10.8%	9.7%	11.5%
$\epsilon = -0.5$	9.9%	6.6%	6.7%	8.8%	5.1%	6.3%	9.3%	8.0%	9.6%
$\epsilon = -1.0$	8.2%	5.5%	5.6%	7.4%	4.3%	5.4%	8.1%	6.8%	8.0%
$\epsilon = -1.5$	7.0%	4.7%	4.7%	6.3%	3.7%	4.7%	7.1%	5.7%	6.8%
$\epsilon = -2.0$	6.0%	4.0%	4.1%	5.4%	3.2%	4.1%	6.3%	4.9%	5.8%
Yield on long-term government bonds	3.9%	3.4%	3.5%	3.0%	2.8%	2.5%	2.7%	3.8%	3.7%

	Internal rate of return	
	Panama canal	Gov't bonds
$\epsilon = 0.0$	9.6%	4.0%
$\epsilon = -0.5$	8.9%	4.0%
$\epsilon = -1.0$	8.0%	4.0%
$\epsilon = -1.5$	7.3%	4.0%
$\epsilon = -2.0$	6.6%	4.0%

Source: See Tables 1, 2, 3, and 4.

TABLE 7: BASIC AMERICAN SOCIAL SAVINGS ESTIMATES, BY ROUTE, IN MILLIONS OF 1925 DOLLARS

	1921	1922	1923	1924	1925	1926	1927	1928
U.S. Intercontinental								
U.S. East – South America West	\$3.78	\$1.57	\$3.73	\$4.70	\$5.70	\$6.37	\$5.72	\$5.35
U.S. East - Asia	\$5.73	\$7.09	\$6.10	\$5.51	\$4.95	\$6.07	\$6.81	\$6.04
U.S. East - Australasia	\$1.11	\$0.48	\$0.71	\$0.81	\$0.95	\$1.09	\$1.18	\$0.78
U.S. West - Europe*	\$5.17	\$5.92	\$5.09	\$5.79	\$5.62	\$6.53	\$7.92	\$7.82
Transcontinental	\$10.80	\$23.76	\$78.27	\$128.42	\$84.57	\$96.16	\$99.49	\$96.89
<i>Minus tolls paid by ships on U.S. routes</i>	(4.42)	(8.65)	(13.90)	(20.30)	(16.23)	(17.50)	(19.23)	(19.38)
<i>Plus profits remitted to U.S. Treasury</i>	\$1.07	\$3.35	\$10.65	\$16.96	\$13.68	\$15.37	\$16.25	\$18.63
TOTAL	\$23.25	\$33.53	\$90.64	\$141.89	\$99.23	\$114.08	\$118.15	\$116.14
Social rate of return	2.5%	3.6%	9.8%	15.4%	10.8%	12.4%	12.8%	12.6%
Yield on long-term government bonds	4.5%	4.3%	4.4%	4.0%	3.8%	3.6%	3.2%	3.5%
		1929	1930	1931	1932	1933	1934	1935
U.S. Intercontinental								
U.S. East – South America West		\$4.70	\$4.43	\$3.68	\$1.26	\$0.47	\$2.83	\$2.14
U.S. East - Asia		\$5.51	\$6.40	\$6.11	\$5.08	\$5.89	\$9.60	\$8.92
U.S. East - Australasia		\$0.81	\$0.61	\$0.42	\$0.22	\$0.19	\$0.35	\$0.44
U.S. West - Europe*		\$5.79	\$10.15	\$9.89	\$4.89	\$5.46	\$6.04	\$5.00
Transcontinental		\$106.26	\$121.92	\$103.75	\$76.41	\$72.46	\$90.79	\$50.68
<i>Minus tolls paid by ships on U.S. routes</i>		(21.84)	(21.62)	(18.71)	(15.24)	(13.74)	(17.96)	(16.61)
<i>Plus profits remitted to U.S. Treasury</i>		\$18.07	\$18.29	\$14.86	\$11.35	\$11.51	\$17.78	\$15.14
TOTAL		\$119.30	\$140.19	\$120.00	\$83.97	\$82.24	\$109.42	\$65.71
Social rate of return		12.9%	15.2%	13.0%	9.1%	8.9%	11.9%	7.1%
Yield on long-term government bonds		3.4%	3.2%	3.9%	3.4%	3.5%	3.0%	2.8%
		1936	1937	Average				
U.S. Intercontinental								
U.S. East – South America West		\$4.49	\$8.40	\$ 4.08				
U.S. East - Asia		\$12.89	\$28.54	\$ 8.07				
U.S. East - Australasia		\$0.80	\$1.32	\$ 0.72				
U.S. West - Europe*		\$10.28	\$12.94	\$ 7.08				
Transcontinental		\$46.56	\$42.30	\$ 78.21				
<i>Minus tolls paid by ships on U.S. routes</i>		(17.02)	(16.44)	\$ (16.40)				
<i>Plus profits remitted to U.S. Treasury</i>		\$15.05	\$14.05	\$ 13.65				
TOTAL		\$73.05	\$91.11	\$ 95.41				
Social rate of return		7.9%	9.9%	10.4%				
Yield on long-term government bonds		2.5%	2.7%	3.5%				

* In 1929, Canadian-European traffic was included in the estimates for U.S.-European traffic. In order to avoid overestimating the social savings accruing to the U.S., we assigned the 1929 traffic to Canada at its historic ratio.

Source: See Tables 1, 2, 3, and 4.

TABLE 8: AMERICAN SOCIAL RATES OF RETURN FROM THE PANAMA CANAL FOR ALTERNATIVE VALUES OF THE PRICE ELASTICITY OF DEMAND FOR FREIGHT SERVICES VIA THE CANAL

ASSUMING THAT ONLY U.S. IMPORTERS BENEFIT

	1921	1922	1923	1924	1925	1926	1927	1928	1929
$\epsilon = 0.0$	1.4%	2.5%	9.1%	14.6%	10.0%	11.4%	11.6%	11.6%	11.6%
$\epsilon = -0.5$	1.2%	2.0%	7.4%	11.9%	8.2%	9.3%	9.4%	9.5%	9.5%
$\epsilon = -1.0$	1.0%	1.7%	6.1%	9.8%	6.8%	7.7%	7.8%	7.8%	7.8%
$\epsilon = -1.5$	0.8%	1.4%	5.1%	8.2%	5.6%	6.4%	6.5%	6.5%	6.5%
$\epsilon = -2.0$	0.7%	1.2%	4.3%	6.9%	4.8%	5.5%	5.5%	5.5%	5.5%

	1930	1931	1932	1933	1934	1935	1936	1937	Average
$\epsilon = 0.0$	14.5%	12.3%	8.7%	8.4%	11.2%	6.4%	6.7%	7.0%	9.3%
$\epsilon = -0.5$	12.3%	11.6%	9.3%	9.2%	11.5%	6.4%	6.6%	6.7%	8.4%
$\epsilon = -1.0$	10.2%	9.5%	7.6%	7.6%	9.5%	5.3%	5.5%	5.6%	6.9%
$\epsilon = -1.5$	8.5%	8.0%	6.4%	6.3%	7.9%	4.5%	4.6%	4.8%	5.8%
$\epsilon = -2.0$	7.2%	6.7%	5.4%	5.3%	6.7%	3.8%	4.0%	4.1%	4.9%

ASSUMING THAT ONLY U.S. EXPORTERS BENEFIT

	1921	1922	1923	1924	1925	1926	1927	1928	1929
$\epsilon = 0.0$	2.3%	3.8%	9.5%	15.1%	10.3%	11.9%	12.5%	12.3%	12.3%
$\epsilon = -0.5$	2.0%	3.2%	7.8%	12.3%	8.5%	9.8%	10.3%	10.1%	10.1%
$\epsilon = -1.0$	1.7%	2.7%	6.5%	10.2%	7.0%	8.1%	8.5%	8.4%	8.4%
$\epsilon = -1.5$	1.5%	2.3%	5.4%	8.5%	5.9%	6.8%	7.2%	7.0%	7.0%
$\epsilon = -2.0$	1.3%	2.0%	4.6%	7.2%	5.0%	5.8%	6.1%	6.0%	6.0%

	1930	1931	1932	1933	1934	1935	1936	1937	Average
$\epsilon = 0.0$	14.7%	12.5%	9.0%	8.7%	11.2%	6.8%	6.9%	8.1%	9.9%
$\epsilon = -0.5$	12.6%	11.8%	9.6%	9.5%	11.5%	6.8%	6.8%	7.7%	8.8%
$\epsilon = -1.0$	10.4%	9.7%	7.9%	7.8%	9.5%	5.7%	5.7%	6.5%	7.3%
$\epsilon = -1.5$	8.7%	8.2%	6.6%	6.6%	8.0%	4.8%	4.8%	5.6%	6.2%
$\epsilon = -2.0$	7.4%	6.9%	5.6%	5.5%	6.8%	4.1%	4.1%	4.9%	5.3%

	Internal rate of return	
	Panama canal	Gov't bonds
$\epsilon = 0.0$	9.4%	4.0%
$\epsilon = -0.5$	8.7%	4.0%
$\epsilon = -1.0$	7.7%	4.0%
$\epsilon = -1.5$	6.9%	4.0%
$\epsilon = -2.0$	6.2%	4.0%

Source: See Tables 1, 2, 3, and 4.

TABLE 9: ALTERNATE PANAMA CANAL AGREEMENTS

	Hay-Bunau-Varilla	Hay-Herrán	Wyse Concession	Concha offer	Colombian Senate
Initial payment from U.S.	\$10,000,000	\$10,000,000	\$0	\$7,000,000	\$20,000,000
Payment from New Panama Canal Company	\$0	\$0	\$0	\$0	\$10,000,000
Continues \$250,000 annual rent from Panama railroad?	No	No	Yes	Yes	Yes
<i>Annual rent from Canal:</i>					
First nine years	\$0	\$0	5% of revenues	\$600,000	\$150,000
Next 16 years	\$250,000	\$250,000	5% of revenues	\$600,000	\$150,000
Next 25 years	\$250,000	\$250,000	6% of revenues	\$600,000	\$150,000
Next 25 years	\$250,000	\$250,000	7% of revenues	\$600,000	\$150,000
Final 24 years	\$250,000	\$250,000	8% of revenues	\$600,000	\$150,000
Reversion to host country?	Never	99 years	99 years	99 years	99 years
Financial responsibility for sanitary works?	Host nation	U.S.	U.S.	U.S.	U.S.

Source: Hay-Bunau Varilla and Hay-Herrán from treaty texts. Wyse Concession from McCullough, pp. 66-67. Concha proposal from Uribe Vargas, *Los últimos derechos*, chapter 11, and *Libro Azul*, pp. 116-117. Colombian Senate proposal from Miner, *Panama Route*, pp. 327-28.

Note: The Wyse Concession included a \$250,000 annual rent in addition to the revenue share.

TABLE 10: NET PRESENT VALUE OF ALTERNATE PANAMA CANAL AGREEMENTS

	Initial payments	NPV of rents from the Canal	NPV of canal reversion	NPV of rents from Panama Railroad	Value of sanitary works	Total (1903 dollars)	Total (2004 dollars)
Hay-Bunau-Varilla	\$10,000,000	\$4,247,169	\$0	\$0	\$0	\$14,247,169	\$249,325,465
Hay-Herrán	\$10,000,000	\$4,133,004	\$14,299,610	\$0	\$4,800,000	\$33,232,614	\$581,570,741
Wyse Concession	\$0	\$20,152,913	\$14,299,610	\$5,612,540	\$0	\$40,065,063	\$701,138,610
Concha Proposal	\$7,000,000	\$7,735,523	\$14,299,610	\$5,612,540	\$4,800,000	\$39,447,673	\$690,334,272
Senate Proposal	\$30,000,000	\$2,750,292	\$14,112,379	\$5,612,540	\$4,800,000	\$57,275,211	\$1,002,316,200

Source: See Table 9.

Note: For the purposes of valuing the 2002 reversion of the Panama Canal to Panama, the value of the Canal was calculated at its nominal construction cost, discounted back to 1904, on the assumption that the U.S. would leave the Canal in good condition. The 2002 nominal value of the canal reversion under the Colombian senate proposal was discounted by the \$10 million that would have been paid to Colombia in 1904 by the New Panama Canal Company.

TABLE 11: SILVER ROLL HIRES BY THE ISTHMIAN CANAL COMMISSION BY COUNTRY-OF-ORIGIN, VARIOUS YEARS

	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913
Spain			1,174	5,293	1,831					
Cuba			500							
Italy			909	1,032						
Greece				1,101						
France			19							
Armenia			14							
Total Europeans	0	0	2,616	7,426	1,831	0	0	0	0	0
Fortune Island			361							
Barbados	404	3,019	6,510	3,242	2,592	3,605				528
Guadeloupe				2,039					14	
Martinique		2,733	585	2,224						
Jamaica		47								
Trinidad			1,079				205		143	
Curacao			23							
St. Kitts			933						9	
St. Lucia									55	
St. Vincent									296	
Grenada									93	
British Guiana									332	
Total West Indies	404	5,799	9,491	7,505	2,592	3,605	205	0	942	528
Costa Rica		244								
Colombia		1,077	416							
Panama		334	10	13						
Not classified			69							
Grand Total	404	7,454	12,602	14,944	4,423	3,605	205	0	942	528

Source: 1914 *Report of the Isthmian Canal Commission*, p. 294.

TABLE 12: COMMISSARY SALES

	(1000s of dollars)						Dollars		Commissary sales as % of wages
	U.S. government	Panama Canal Company	Steamships	Panama Railroad Company	Independent companies	Employees	Sales per employee	Average annual wages	
1922	\$1,220	\$939	\$360	\$216	\$323	\$4,001	\$393	\$831	47%
1923	\$1,084	\$696	\$344	\$170	\$602	\$3,797	\$345	\$811	43%
1924	\$1,002	\$767	\$468	\$230	\$599	\$4,419	\$384	\$884	43%
1925	\$1,063	\$744	\$605	\$192	\$732	\$4,409	\$359	\$868	41%
1926	\$1,371	\$686	\$767	\$265	\$660	\$5,477	\$427	\$855	50%
1927	\$1,322	\$697	\$794	\$265	\$698	\$5,751	\$429	\$870	49%
1928	\$1,431	\$728	\$981	\$411	\$682	\$5,857	\$421	\$852	49%
1929	\$1,515	\$852	\$1,135	\$287	\$713	\$6,431	\$409		
1930	\$1,435	\$811	\$1,099	\$373	\$653	\$6,870	\$454		
1931	\$1,455	\$701	\$789	\$300	\$685	\$6,546	\$471		
1932	\$1,070	\$627	\$237	\$528	\$459	\$5,768	\$470		
1933	\$964	\$563	\$294	\$180	\$493	\$5,107	\$405	\$901	45%
1934	\$665	\$496	\$331	\$234	\$407	\$4,654	\$387		
1935	\$705	\$730	\$356	\$301	\$247	\$5,114	\$411		
1936	\$942	\$732	\$305	\$259	\$312	\$5,372	\$416		

Source: Leonard, Table 2.

TABLE 13: PANAMA'S AVERAGE NET IMPORTS

	Current dollars	1925 dollars	Real net imports per capita
1856-58	\$1,647,600	\$3,320,105	\$21.02
1891-97	\$4,166,099	\$9,015,963	\$36.15
1921-29	\$10,864,015	\$10,944,145	\$23.99

Source: *Gaceta de Panamá* and *Estadística Panameña*, various.

Note: The Panama Railroad opened for business in 1855.

TABLE 14: BORROWING COSTS, ADJUSTED FOR MATURITY

	Dec-1914	May-1915	Jun-1926	May-1928
United States	3.6%	3.6%	3.6%	3.5%
Venezuela	5.5%	5.5%	3.6%	3.5%
Costa Rica	6.8%	na	4.1%	3.7%
Cuba	na	na	4.9%	4.6%
Panama	5.2%	5.6%	6.3%	5.2%
Dominican Republic	na	na	5.6%	5.5%
Argentina	5.1%	5.1%	6.1%	6.0%
Colombia	6.0%	6.0%	6.5%	6.3%
Chile	5.0%	4.9%	6.9%	6.8%
Brazil	5.0%	5.0%	6.6%	7.1%

Source: *Financial Times* and *Wall Street Journal*, various editions.

TABLE 15: MORTALITY RATES PER 1000

	Panama City	Colón	Rest of Panama	Panama total	Canal workers	Costa Rica	Vene- zuela	Cuba	Counterfactual mortality rate
1885-89		96.5			56.7				
1890-94		40.3			30.2				
1895-99		45.6			25.9				
1900-04	65.8	62.3	16.1	21.0	27.6	24.0	29.1	23.7	21.0
1905-09	41.1	37.8	16.2	19.7	23.5	25.5	29.8	23.3	24.0
1910-14	31.7	25.3	16.9	19.0	9.3	23.7	28.3	21.4	23.2
1915-19	25.6	24.4	15.3	17.3	6.8	25.1	29.7	22.2	22.1
1920-24	21.8	19.3	16.4	17.3	8.7	22.8	26.0	19.3	23.1

Source: Costa Rica, *International Historical Statistics: The Americas 1750-2000*, p 68. Venezuela and Cuba, *International Historical Statistics: The Americas 1750-2000*, pp 84-85.