

Explaining Rwanda's prioritisation of rural electrification over rural clean drinking water through institutional path dependency

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ABSTRACT

The Tennessee Valley Authority and Rural Electrification Administration became the World Bank's template of choice for development projects. They remained so due to both institutional inertia within the World Bank and path dependent thinking of electrification as a means to economic growth. Consequently, electrification took the front seat for development projects worldwide, extending to rural areas, while water remains perceived as an amenity, rather than as economic infrastructure. This explains in part why the Government of Rwanda has prioritised rural electrification over rural clean drinking water in spite of recent evidence showing that rural electrification does not deliver growth in the Rwandan context.

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1. Issue of study: Prioritisation of rural electrification in Rwanda over access to potable water as a result of path dependence in development thinking

A substantial portion of Rwanda's rural population is without either electricity¹ or access to drinking water free of faecal contamination. The latter has had a human cost: the incidence of repeated infection with diarrhoea among children aged 12–23 months was 22% and 49% of 18–23 month olds showed stunted growth in 2014–15 (Government of Rwanda - National Institute of Statistics of Rwanda et al 2016, p.137).

Both electrification and access to potable water have been regarded as public goods that should be provided by governments in a developing country context because of failure by the market to provide them when such infrastructure has involved lumpy, indivisible and irreversible investments that have relied upon long investment recovery periods and uncertain returns (World Bank, 1993, p. 28; Frischmann, 2012). Disruptive tech-

nologies (Schumpeter, 1943, p. 83) have done away with these barriers to private investment in the case of rural electricity, resulting in privately offered off-grid electricity and the leap-frog (Christensen, 2001, p. 11) of a cost-effective and appropriately scaled infrastructure for poor rural households (Ahmed, 2017b).

As Alexander Gerschenkron would have predicted, this has to an extent resulted in some amount of adaption by the Government of Rwanda in encouraging further private investment in off-grid electricity (Ahmed, 2017b), resulting in 14% of Rwandans having access to electricity through off-grid solutions (Government of Rwanda - Ministry of Infrastructure, 2019), because of the Government of Rwanda's flexibility and originality as the administrator of a country lacking certain 'prerequisites' to development. The Government is able to solve its specific development problems along a path that will allow it to keep down costs while increasing welfare (Gerschenkron, 1962).

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¹ 49% of Rwandan households do not have access to electricity (Government of Rwanda - Ministry of Infrastructure, 2019).

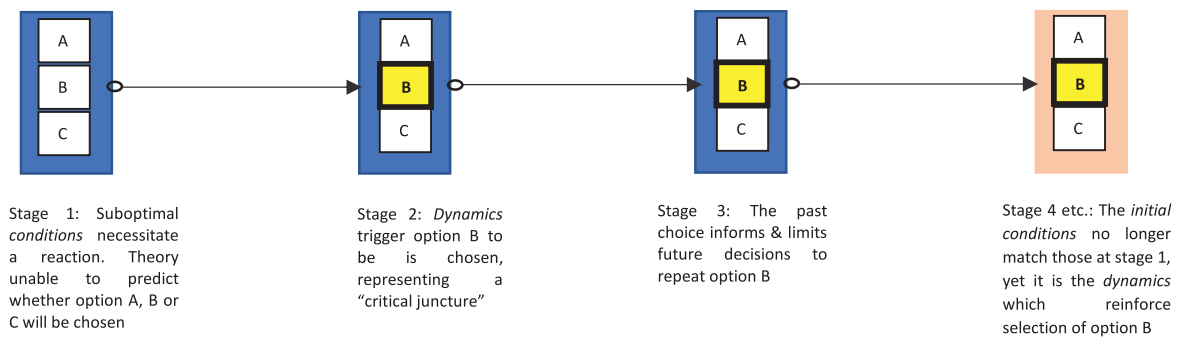


Fig. 1. Path dependence illustrated. I have built upon Mahoney's original illustration. This paper argues that the institutional norms of prioritisation of rural electrification since the establishment of the Tennessee Valley Authority (TVA) and Rural Electrification Administration in 1933 became ossified and were repeated in the very different context of developing Rwanda, until the 2016 Sustainable Development Goals explicitly emphasised quality of water as a political international development objective, in spite of researchers' findings that the poor themselves would prioritise clean drinking water over access to electricity.⁴⁶

However, the extent of adaption has been limited², with the Government of Rwanda investing heavily in rural electrification without first having even provided universal access to drinking water in Rwanda's main towns, where doing so would be more economical than in rural areas.

While both electrification and potable water deliver better welfare for current consumption, and both are a potential means to making rural Rwandans more productive, assisting in achieving William Baumol's convergence of national productivity levels (Baumol, 1986),³ water would intuitively be the first type of infrastructure required, since it would provide for a healthier population whose functionalities are then expanded⁴. Indeed, in non-serviced Indian slums, dwellers stated that the first type of infrastructure they would want is water, with electricity ranked fourth of ten types of aspiration (Parikh, Chaturvedi and George, 2012, Fig. 3). This was anticipated by World Bank Vice President Burke Knapp in 1960, and rejected: "Water is the first thing that the people want, but we have to distinguish between [...] amenities which raise the standard of living, and [...] projects which will benefit the economy [...] Our emphasis should be on the latter" (Kapur, Lewis and Webb, 1997, p. 167). The social benefits of home electrification would warmly be recounted by US President Johnson (Johnson, 1965). By contrast, the lack of access to water supply was remembered by Robert Garner, Vice President at the World Bank⁵ for its first nine years. "Why should such and such a coun-

² In 2016, 24% of households had access to electricity (Government of Rwanda - Ministry of Infrastructure, 2016c). At that time, a government consultant said (phone interview, 14 April, 2017) that the cost of connecting an additional rural house to the grid ranged from USD 600-1,000. Because these households were low-consumption users and unable to pay the cost-recovery tariffs to cover the cost of connection, many went into default, and ended up not using the electricity to which they had 'access'. Solar home systems were a more appropriate solution for low-consumption users, for whom the low cost-recovery monthly lease payments amounted to less than the cost of using kerosene and candles (Ahmed, 2017b). But because the World Bank was subsidising connections, the Ministry of Infrastructure continued to finance cost-inefficient on-grid connections for villages. Now, 37% of households in Rwanda are connected to the grid (Government of Rwanda - Ministry of Infrastructure, 2019).

³ Before the advent of affordable mobile phones, Nagaraj, Varoudakis and Veganzones (2000) found that both health conditions and power capacity have a strong impact on growth in Indian states, but that the reduction of mortality had a greater impact (a -0.38 elasticity versus elasticities of 0.14, 0.12 and 0.16 for per capita electrical consumption, per capita industrial consumption of electricity and percentage of villages electrified).

⁴ The nexus between health and growth can be explained by Amartya Sen's theory of capability and functioning, where the capability of a person reflects the combination of functions a person can achieve, and a day lost due to illness represents a person's reduction in functioning (Sen, 1995; Parikh, Chaturvedi and George, 2012).

⁵ Officially then the International Bank of Reconstruction and Development.

Figure 4 Urban populations have better access to safe drinking water than rural populations.

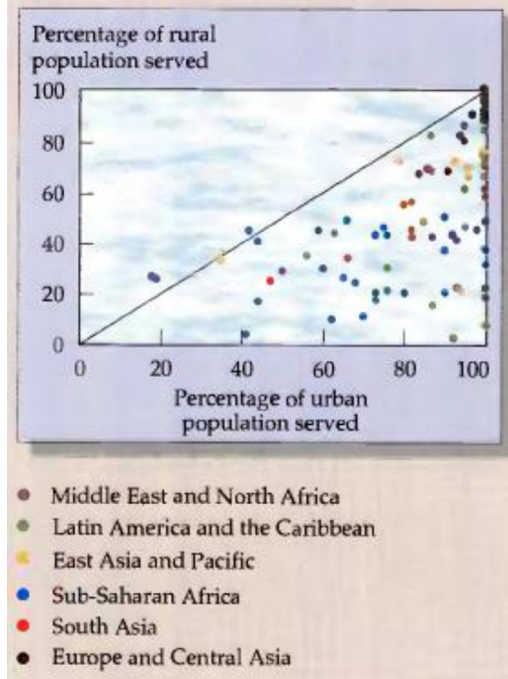


Fig. 2. Rural safe water supply access lags urban safe water supply (World Bank, 1994, p. 6).

try have a water supply system in its town? When I was brought up in Mississippi [...] we didn't have any water in our house" (Kapur, Lewis and Webb, 1997, p110).

Water's marginalisation to electrification can in large part be explained by the application of the historical institutionalist framework of path-dependence to the development model propounded by the World Bank, Rwanda's largest donor (Government of Rwanda - Ministry of Finance and Economic Development 2017b, p. 13). Douglass North wrote that organisations are created to take advantage of the opportunities that institutions determine. "The resultant path of institutional change is shaped by the lock-in that comes from the symbiotic relationship between institutions and organisations that have evolved as a consequence of the incentive structure provided by those institutions and the feedback process by

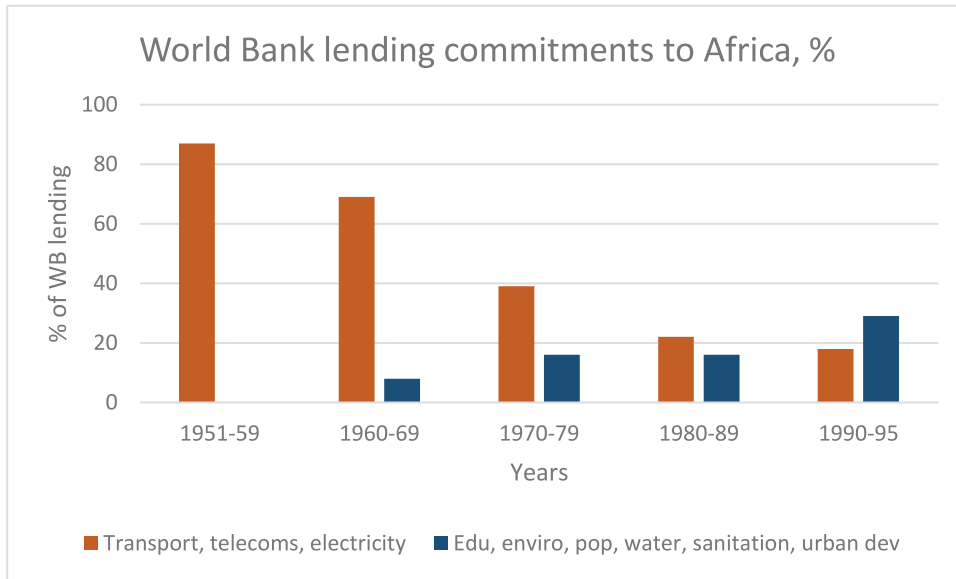


Fig. 3. Investment levels for social infrastructure started at 0 but converged with the Bank’s traditional infrastructure by 1995 (Kapur, Lewis and Webb, 1997, p. 6), and in Africa, started exceeding it (Kapur, Lewis and Webb, 1997, p. 696).

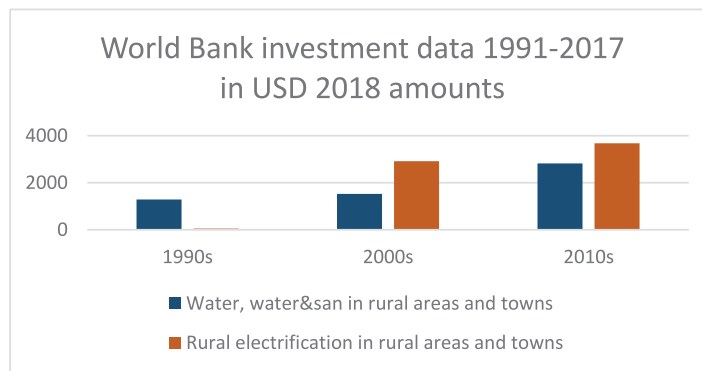


Fig. 4. World Bank investments in rural water vs rural energy 1990s, 2000s, 2010s (BLS, 2018; World Bank, 2018d, 2018e, 2018c, 2018f).

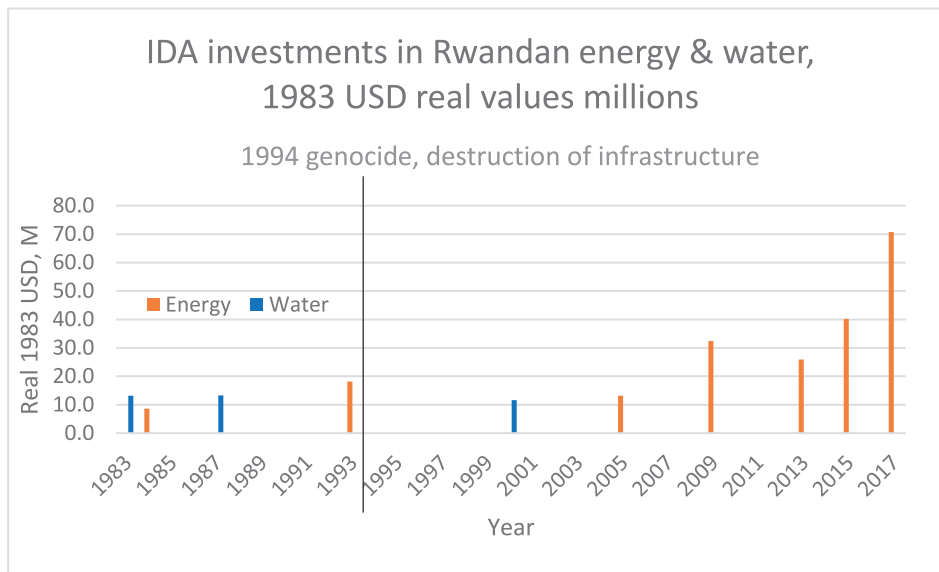


Fig. 5. World Bank investments into Rwandan energy & water (BLS, 2018; World Bank, 2018g).

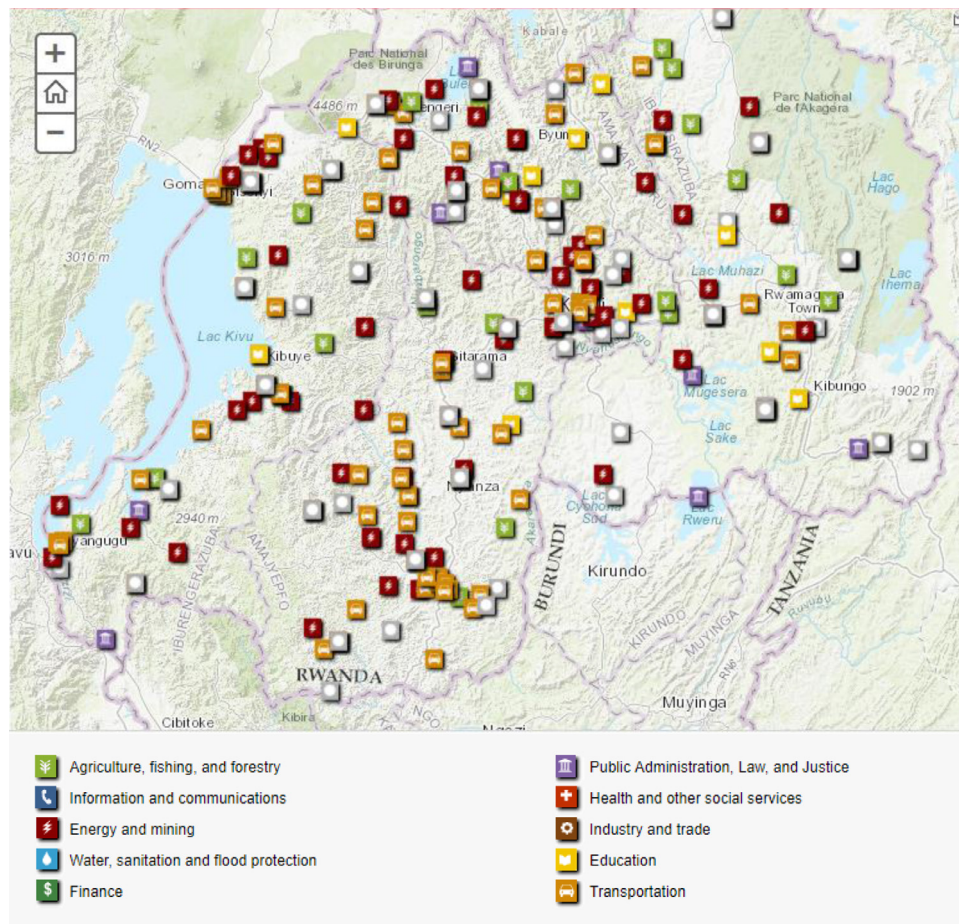


Fig. 6. Map of the World Bank's investments in Rwanda. Water is invisible (World Bank, 2018a).

which human beings perceive and react to changes in the opportunity set' (North, 1990, 5%). Colignon (1997, p. 39) summarises path dependency as the 'notion that, for any given sequence of practices and events, past choices and temporally remote events can help explain subsequent paths of institutionalised practices and contemporary outcomes'. Institutionalisation occurs, Colignon proceeds, 'when organisational structure and practices – which maintain relationships and upon which policies are derived, rest upon, and sustained – are themselves, maintained through embeddedness in path-dependent relations.'

Failure by President Herbert Hoover's administration to alleviate the effects of the Great Depression in the USA gave its successor Roosevelt administration a license to try something new. In the way Henry Ford gave the US market the mass produced and affordable automobile, Roosevelt gave the US market mass produced and affordable electricity. His intervention worked. The economy grew, unemployment fell, and Roosevelt was elected for an unprecedented four terms. The rise of totalitarianism as a result of bad economic conditions motivated his administration to create the Bretton Woods organisations to help maintain peace after the Second World War (Mason and Asher, 1973, p. 15; Sharma, 2010, p. 33, 2017, p. 7) by providing international public goods in the form of monetary stability, free flow of capital and free trade (Gilpin, 2001). The Soviet Union threatened this stability, and so, the World Bank was used as a political instrument to export the economic success of the Tennessee Valley Authority's electrification programme to developing countries that would fall under the influence of the United States. Supporting this intervention were the economic theories of British and American *Erfahrungswis-*

*senschaftler*⁶ of the day whose work had been informed by the experience of the Tennessee Valley Authority – Keynes, Rosenstein-Rodan, Hirschman, Rostow.

Water infrastructure, meanwhile, was and continues to be marginalised as a non-economic, welfare asset. Further, the World Bank has stood against correcting this notion since the time of Albert Hirschman⁷ by not attempting to measure the full economic impacts of water investment.⁸

More recent development literature from the 1980s to the early 2010s has provided evidence of positive benefits arising from rural electrification. But the applicability of that literature has not been assessed for the context of Rwanda, where the same advantages have not been derived, as borne out by the evidence (Lenz *et al.*, 2017).

⁶ Experiential scientists.

⁷ Hirschman (1967, pp. 165–166) objected to even attempting to use ex-post evaluations to rank infrastructure projects, citing the impossibility of using a single scale to amalgamate all the varied dimensions.

⁸ Were staff in favour of water projects afraid that the benefits would be less than their cost, and so did not attempt to capture the productivity gains, hoping instead to rely on rhetoric appealing to what they felt was right, as Pritchett's model (Pritchett, 2002) of why it pays to be ignorant predicts? This explanation does not accord with the Bank's 1994 World Development Report's Table 1.2 showed that Bank water supply projects returned on aggregate an 8% financial rate of return for 1974–82 and a 6% rate of return for 1983–92 (World Bank, 1994, table 1.2); productivity gains would have only added to an already positive financial rate of return to yield an even greater economic rate of return. Water and sanitation and sewerage had their performances accounted for with a financial rate of return, while other sectors were given the benefit of economic rates of return (though to what extent benefits beyond financial returns were calculated is not made clear).

Table 1

When it started offering electricity, the Tennessee Valley Authority offered it at rates 40% of the national average, until electricity prices started converging so that in 1941, its rates were 55% of the national average. Excerpted from [Finer, 1972, p.205](#).

[1944] 1972, p. 205

Electric system	Average rate per kWh/cents					
	1933	1937	1938	1939	1940	1941
Tennessee Valley Authority		1.83	1.95	2.16	2.06	2.05
US entire industry	5.49	4.39	4.14	4	3.84	3.73

Table 2

The Bank's credit rating affected its ability to raise funds. Its Wall Street leadership & project lending won it AAA credit rating by the mid-1950s ([Mason and Asher, 1973, p. 132](#)).

Year	Bank credit rating
1947	AA – Fitch A – S&P
1950	A – Moody's AA – Fitch A1 – S&P
'soon after 1950'	AA – Moody's
'since the mid-1950s'	AAA – Moody's, Fitch, S&P

Achieving the UN's 'Sustainable Energy for All' and Sustainable Development Goals for universal electricity access by 2030 would consume 45% of Africa's annual development assistance ([Grimm et al., 2020](#)), representing a substantial opportunity cost to water and other rural infrastructure for the provision of better health, education, and transport. Given how on-grid does not add great value to productivity in spite of its high investment costs ([Lenz et al., 2017](#)), off-grid electrification would be the more cost-effective tool for mass electrification ([Grimm et al., 2020](#)).

Fortunately, the 2016 SDGs also stipulate more clearly than the Millennium Development Goals did their aspiration for access to clean drinking water, representing a further critical juncture. This seems to have had the desired effect of increasing the Government of Rwanda's attention to rural access to potable water.

1.1. Theoretical framework: Historical institutional path-dependence

'It is sometimes not possible to uncover the [...] illogic of the world [...] except by understanding how it got that way,' wrote Paul David (1985). His study of non-typebar English keyboards demonstrated the relevance to the field of economics the historical institutionalist theoretical framework of path dependence.

Path dependence refers to institutional norms that become ossified at a point in time – a critical juncture – through positive feedback. [Mahoney explains \(2000, pp. 513–14\)](#) that in a path-dependent pattern, selection will happen in an otherwise unpredictable manner other than what has been tried and tested before.

Adapting and expanding on Mahoney's explanation⁹, at Stage 1, there exists a set of suboptimal initial conditions at which point a universe of interventions A, B and C could be adopted. Theory is unable to predict which will be chosen (2000, p. 538). Option B is chosen at Stage 2. Stage 2 is described as a "critical juncture" – a particular point in time where a decision is made. At Stage 3, the past choice triggers the feedback mechanism that informs and hence limits future decisions to repeat the same decision taken at Stage 4 and beyond.

At Stage 4, [Pierson and Skocpol \(2002, p700, with reference to Stinchcombe, 1968\)](#) would argue that it is the dynamics triggered at the critical juncture, rather than the initial conditions themselves, that cause reproduction of those same dynamics. Selection

⁹ In his illustration of contingency of a self-reinforcing sequence, [Mahoney \(2000, Fig. 1\)](#) shows three distinct times, as opposed to stages. He does not give reflection of Time 2 its own distinct time period, as I do.

of Options A and C becomes increasingly unlikely, although not impossible.

The paper shows how biases from America's experience with the TVA became institutionalised within the US-dominated World Bank, Rwanda's largest donor for infrastructure investments, and continue to persist, with the OECD regarding electrification as "economic infrastructure" but water as "social infrastructure" ([OECD, 2019](#)). The development literature on rural electrification of the 1980s–2010s, discussed above, reemphasised this.

The World Bank could have initiated ex-post studies comparing the productivity gains from investment in rural electrification with the returns on investment in rural clean drinking water, but it has not.

The Millennium Development Goals of 2000 only aimed at improving access to "improved" sources of drinking water. In this way, the Government of Rwanda, more concerned about the appearance of poverty, rather than the experience of poverty ([Ansoms, 2009](#)) was able to abrogate from its duty to deliver clean drinking water, allowing it to claim that it had achieved for 93% of rural households access within 500 metres of an improved water source ([Government of Rwanda - Ministry of Infrastructure, 2016b](#)), even while its own statistics showed that as of 2015, 89% of households were without water on premises, while 49% of households were more than 30 minutes away from drinking water ([Government of Rwanda - National Institute of Statistics of Rwanda et al 2016, p.21](#)); that 22% of 12–23 months suffered from repeated diarrhoea and 49% of 18–23 month olds showed stunted growth ([Government of Rwanda - National Institute of Statistics of Rwanda et al 2016, p. 137](#)), giving credence to [Kirby et al's \(2016\)](#) estimation that 75% of drinking water in Rwanda is contaminated by faecal matter.

1.1.1. Stage 1: The initial conditions set by the Great Depression

In the case of Rwanda's story of path-dependent prioritisation of rural electrification, Stage 1 is the Great Depression in the United States. Unemployment in the USA hit 25% (U.S. [Census Bureau, 1999](#)). The populations of industrialised economies suffered decreases in welfare as global GDP fell 15% between 1929–32 ([Lowenstein, 2015](#)). Having tried and tested the *laissez-faire* option, US President Herbert Hoover was elected out of office and replaced by Franklin Delano Roosevelt.

The initial conditions for choosing option B – the mass production of electricity – were entirely different from those that existed in Rwanda in 2009 when the World Bank approved USD 80 million for an electricity access scale-up project ([World Bank, 2020a](#)). In Rostovian stages of economic development (adopted in development thinking for reasons explained below), Rwanda was at the first traditional stage because more than 75% of its population worked in subsistence agriculture ([Rostow, 1960; World Bank, 2020b](#)). By contrast, the United States, with about a fifth of its work force in agriculture ([Rostow, 1960, p. 71; U.S. Census Bureau, 1999, table 1430](#)), was at the mature fourth stage and approaching the fifth and final stage of high-mass consump-

Table 3

Water and sewerage are the worst sector for project cancellations, representing a third of value. Percentages recalculated. Source: PPIAF, 2016, p33– IMAGE.

recalculated. Source: PPIAF, 2016, p33

Sector	Projects reaching financial close		Cancelled projects		Cancelled projects as % of sector total	
	Number	Investment commitments (US\$M)	Number	Investment commitments (US\$M)	By number	By investment commitments
Energy	2,460	655,434	51	19,195	2.1%	2.9%
Transport	1,456	448,530	79	31,533	5.4%	7.0%
Water and sewerage	806	61,767	49	24,399	6.1%	39.5%

Table 4

Post-genocide, the difference between the World Bank's investment in energy over water has been 16x (IMF, 1998; BLS, 2018; World Bank, 2018g)– IMAGE.

World Bank projects USD (1983), millions					
	Pre-genocide	Post-genocide	All WB investments	All WB investments less approx rehabilitation	
Energy	26.8	182.2	209.0		197.8
Water	26.5	11.6	38.1		38.1
Difference, x	1.0x	15.7x	5.5x		5.2x

Table 5

The African Development Bank has somewhat reduced the imbalance in investment between investment in energy and water in Rwanda from 16x to 5x (AfDB, 2018; BLS, 2018; World Bank, 2018g)– IMAGE.

WB & AfDB energy & water projects post 2000

	1983, USD M
Energy	201.9
Water	44.0
Difference	4.6x

tion. Further, it was industrialised, so could capture the benefits of increased demand for electric appliances.

1.1.2. Stage 2: Selecting option B – electricity for the masses

Roosevelt experimented with Keynes' 'heterodox' option of deficit spending to institute the New Deal, heavy government investment in federal programmes and public projects (Garner, 1972; Currie, 2004; Alacevich, 2009; Baumol, 2014). Included in the New Deal were the Rural Electrification Administration and Tennessee Valley Authority, a federal hydropower agency that would by 1946 comprise nine 'huge' dams along a stretch of 600 miles of Tennessee River, and a further eleven dams on the tributaries. As well regulating the flow of water, the dams had the capacity to generate 2–2.5 million kilowatts of power, ranking the TVA second among US electric systems (Huxley, 1946, pp. 12–13). As it started delivering electricity in 1937, the Tennessee Valley Authority offered electricity prices that were almost 60% lower than the national average (Finer, 1972, p. 205). Whether or not prices converged as a result of competitive pressure, that fell to 45% by 1941 (1972, p. 205).

Through the TVA, Roosevelt's administration took Henry Ford's model of mass production and applied it to electrification for 'a politically defined vision' (Tobey, 1996, pp. 93–96) to stimulate aggregate demand (Barber, 1996, pp. 128–131). Where electric utilities had targeted one-fifth of households already modernised, Roosevelt focused on the four-fifths of households that utilities claimed were incapable of modernisation.

1.1.3. Stage 3: Feedback mechanism of the Tennessee Valley's material successes – cheaper and increased electricity, increased consumerism, greater growth, increased wages, political success and new economic theory

The results showed that Roosevelt's vision had been met. Prior to the New Deal, the average household consumed 30kWh monthly in the USA, just more than lights (11kWh/month) and a radio (7kWh/month). By the 1950s, that had increased by

five times. Refrigerators – which spent on average 22kWh/month – went from being a luxury-appliance to a mass appliance (Tobey, 1996, pp. 157–162). Greater demand from the middle-class market meant that their unit cost of production fell in addition to the cost of running them thanks to the TVA. Within three years of connecting to the TVA's Wilson Dam, Tupelo, a town of 10,000 people in Mississippi, saw eight stores sell USD 500,000 worth of appliances. More broadly, between 1933–39, nominal retail and service receipts increased by 87% in the power area of the Tennessee Valley Authority according to census of business data (Finer, 1972, p. 213). A 1935 edition of *Electrical World* noted that the rise in sales of appliances was stimulated by the TVA's lower electricity rates (Tobey, 1996, p. 122). Electric cooking (123kWh/month) and water heating (168kWh/month) were the next items on the USA's energy ladder (Tobey, 1996, pp. 157–162).

Greater aggregate demand led to greater output and output per capita, and this was particularly pronounced in the TVA's catchment area. Per capita increased by 84% from 1933–40 in Alabama, Mississippi and Tennessee, compared with 57% for the USA (Finer, 1972, p. 212).

The increase in sales explains the increase of 17,000 jobs in the trade sector in the TVA power area from 1930 to 1940 (Finer, 1972, p. 211). The greater prosperity in this sector explains the expansion of other sectors. Value-added by manufacturing increased by 39% from 1935–1939 in the TVA public power area (compared with 31% across the United States), and manufacturing wages increased by 35% (compared with 25% across the United States) (Finer, 1972, p. 211). The textiles, food products and chemicals manufacturing sectors increased employment by 17,000 from 1930 to 1940 (Finer, 1972, p. 211). In turn, the expansion of these sectors explains the increase in employment of the construction industry by 16,000 for the same period. All this despite the inference we draw that the TVA power area imported its manufactured electrical appliances from outside the area.

Additionally, electrification's intended aim to curtail urbanisation was somewhat successful. The rural non-farm population of the TVA power area increased by 22% from 1930 to 1940, compared with a 17% increase for the urban population (Finer, 1972, p. 211).

Politically, the New Deal translated into a landslide second term for Roosevelt, who won 523 out of 531 electoral votes and more than 60% of the popular vote, because voters attributed the New Deal to alleviating the Depression (Brinkley, 1996, p. 17).

More broadly, Roosevelt's New Deal intervention and mass electrification to stimulate the economy and reduce unemployment redefined the role of government by defying and rewriting textbook teaching (Barber, 1996, p. 1). The New Deal provided the

template for the Keynesian multiplier linking consumption and output in a cyclical relationship. It further gave rise to balanced growth theory, as propounded by Paul Rosenstein-Rodan who became the IBRD's Economic Department Assistant Director and to unbalanced theory, as propounded by Albert Hirschman, who also consulted for the IBRD.

The TVA power area's growth showed the importance of complementary knock-on effects between sectors of the economy. Taken alone, Rosenstein-Rodan argued (Rosenstein-Rodan, 1943, pp. 205–206), a shoe factory employing 20,000 formerly agrarian workers in a more-or-less closed and self-sufficient domestic economy would be useless. The employees would require more than the shoes they were able to buy with their wages. 'If, instead, one million unemployed workers were taken from the land and put, not into one industry, but into a whole series of industries which produce the bulk of the goods on which the workers would spend their wages, what was not true in the case of one shoe factory would become true in the case of a whole system of industries: it would create its own additional market [...] The industries producing the bulk of the wage goods can therefore be said to be complementary'.

By contrast, Hirschman argued that developing countries had an insufficient endowment of resources to enable them to invest simultaneously in all sectors to achieve balanced growth and take-off (Hirschman, 1959; Ncube, Lufumpa and Kararach, 2017). According to his unbalanced theory of growth, therefore, governments had to invest strategically in infrastructure to raise the productivity of selected industries – though not to the broad extent that Rosenstein-Rodan had imagined – to multiply new investment opportunities (Hirschman, 1959; Ncube, Lufumpa and Kararach, 2017). Availability of reliable power (à la TVA) and transportation facilities were therefore prerequisites for economic development (Hirschman, 1959; Ncube, Lufumpa and Kararach, 2017).

Perhaps the most neglected underlying theoretical commonality between the mainstream Anglo-American economists Keynes, Rosenstein-Rodan and Hirschman of the 1930s, '40s and '50s (the latter two of whom have latterly become known as development economists) was that their economic modelling based on the TVA experience was what Reinert (Reinert, 2019) characterises as 'Erfahrungswissenschaft' – a science based on experience.¹⁰

1.1.4. Stage 4: Rinse and repeat – internationalisation of Option B

Multiple strategic goals motivated Cold War US governments to export the successes of the Tennessee Valley Authority (TVA) and Rural Electrification Administration (REA) abroad: a desire to create shared prosperity to prevent a repeat of the conditions that resulted in the Second World War (Mason and Asher, 1973, p. 15; Sharma, 2010, p. 33, 2017, p. 7), as well as to sustain the growth of the US economy growth by having bigger markets to which it could export; and a desire to limit the influence of the Soviet Union during the Cold War,¹¹ both as a political end in itself (Craig and Porter, 2006) as well as a means to protect the USA's potential export markets.

The speeches of US Presidents Roosevelt in 1945,¹² Johnson in 1965¹³ and the 1966 speech of US Secretary of Defence Robert McNamara,¹⁴ who two years later would preside over the World Bank for the following 13 years, illustrate the US governments' sense of self-interested promotion of prosperity for all through infrastructure investment abroad. Prosperity the world over meant deeper markets with which the US could trade, and fewer security threats.

As for intertwining development logic with the Truman Doctrine of containing Soviet expansion and influence, nowhere is this more explicit than in Walt Whitman Rostow's "The Stages of Economic Growth: A Non-Communist Manifesto", published in 1960. Acknowledging that the 'Keynesian revolution' (Rostow, 1960, p. 155) had allowed Western governments to address unemployment in times of economic depression, and thus thwart Marxism, he set about merging a dynamic version of classical production theory with Keynesian income analysis. Since underdeveloped nations were 'the main focus of Communist hopes', their take-off would be the 'most important single item on the Western agenda' (1960, p. 134).

Rostow's theory of production focused on the composition of investment and on developments within particular sectors of the economy at particular stages (1960, pp. 13–14) – at a traditional stage; at a stage where it was getting ready for take-off and where 75% of the working force was in subsistence agriculture; at the stage of taking-off, by which end 40% of the work force might in agriculture; at a mature stage, where 20% of the work force would be in agriculture; and finally at a stage of high mass-consumption (1960, p. 71).

Given the varying elasticities of demand with each stage of growth, Rostow prescribed a 'sequence of optimum patterns of investment' (1960, p. 14). Investment to increase societal productivity would thus start in agriculture; then in 'social overhead capital'.¹⁵ Together, agricultural and infrastructure investment provided a 'viable base' (1960, p. 25) for modern industry.

Amongst the items of mass consumption Rostow considered, durable household electronics featured prominently (1960, pp. 79, 103, 105). To maintain industrialised economies' growth, they should look towards 'underdeveloped' markets (1960, p. 156). Herein lies the contradiction in the Rostovian development model: if industrialised nations are to continue growing by exporting to underdeveloped markets, how will underdeveloped markets advance to the stage of mass high-consumption? Do they too not need to industrialise?

¹² In 1945, President Roosevelt shared with Congress a post-World War II vision of establishing the International Bank of Reconstruction and Development (IBRD, which would become known as the World Bank) as well as the International Monetary Fund in terms that accorded with his legacy of electrification: "expanded production, employment, exchange and consumption" to "ensure our own prosperity [...] as well as for a peace that will endure". (Roosevelt, 1945).

¹³ US president Lyndon Johnson referred to the Tennessee Valley Authority (TVA) and Rural Electrification Administration (REA) as a template for development: "Electrification of the countryside – [...] is impressive [...] In the countryside where I was born, and where I live, I have seen the night illuminated, and the kitchens warmed, and the homes heated, where once the cheerless night and the ceaseless cold held sway. And all this happened because electricity came to our area along the humming wires of the REA." Vietnam's Mekong River could provide food, water and power, he told his audience, on a scale that would "dwarf even our own TVA" (Johnson, 1965).

¹⁴ As the US Secretary of Defence, McNamara had described the nexus between violence and 'economic backwardness'. Propelling developing nations from poverty was key to security (McNamara, 1966).

¹⁵ This was following Hirschman's use of the term in 1958 (p.63) which Hirschman said included 'all public services from law and order through education and public health to transportation, communications, power and water supply, as well as such agricultural overhead capital as irrigation and drainage systems. The hard core of the concept can probably be restricted to transportation and power'. For his part, Rostow emphasised transportation.

¹⁰ Reinert is therefore not even-handed when he states that 'German economics is above all an Erfahrungswissenschaft' (Reinert, 2019), nor when he writes, 'since the 1890s, Anglo-Saxon economics has produced theories of growth and trade which imply even growth' (Reinert, 2019).

¹¹ Ignoring the fact that Vladimir Lenin had said in 1920 that 'Communism is Soviet power plus the electrification of the whole country'.

Promoting infrastructure investment in electricity for industry made sense. But if household electrification were accompanied by the import of mass-produced durable electronics before a domestic industrial base had been established, the benefits from promotion of increased household electronics consumption would not be captured domestically, as was the case in the Tennessee power area and as Rosenstein-Rodan predicted more generally. Instead, they would be captured by foreign firms, workers and economies, whose existing high fixed-cost investments to efficiently mass-produce durable household goods would preclude the entry of new, inexperienced, inefficient domestic competitors.¹⁶ Illustrating the self-interested logic of investing in electrification in underdeveloped markets is the case of Chile, which after seeing its installed capacity of electricity increase, saw a substantial rise in manufactured US imports from 1938–1960.

Data collected from the UN (1962, p. 20) and from the World Bank (2016, p. 4) show an 86% correlation between the value of Chile's manufactured imports and its increase in installed energy capacity between 1938 and 1960. 89% of Chilean merchandise imports were from high-income countries in 1960 (World Bank, 2019, l. 216). There is an 89% correlation between the indexed value of Chilean manufactured imports and US manufactured exports from 1938–60. As Chile's imports increased, the USA's exports increased. By contrast, the correlation between Chile's manufactured imports and its largest neighbours' manufactured exports Argentina and Brazil for the same period is 11% and -4% respectively (United Nations, 1962, pp. 9, 17, 20, 52).

Thus pushing for electrification through the World Bank could be said to be politically motivated under the global hegemon model, where the hegemon 'created a liberal international economy primarily to promote its own interests' (Gilpin, 2001, p. 99). It was left to the newly established regional development banks – the Inter-American Development Bank established in 1959, the African Development Bank in 1964, and the Asian Development Bank in 1966 – to focus on poverty lending and water investments (Bakker, 2013, p. 288).

World Bank poverty-oriented investments overtook energy investments for the first time during the presidency of Robert McNamara (Sharma, 2017, p. 67), the former US Secretary of Defence, who had the broader idea that to promote America's interests meant attacking poverty to make the world a safer place (McNamara, 1966). Repositioning the World Bank as an 'effective tool for promoting free market reforms in developing countries' – promoting US export markets – however, returned under Ronald Reagan's presidency of the United States (Sharma, 2017, p. 152). It took cover under the logic that open markets lead to growth, lead to poverty reduction; a return to the 'trickle-down' arguments of the 1950s promoted by a big push (Kanbur and Vines, 2000, p. 91). Supporting this logic was that growth could convincingly be shown empirically to reduce poverty (Ravallion and Chen, 1997; Kanbur and Vines, 2000).

That the Tennessee Valley Authority template was to be used as a universal supply-driven solution (Scott, 1998, p. 6; Staples, 2006, p. 12) further illustrates that on balance, export of the TVA was more driven by politics than by the particular problems faced by different underdeveloped regions. This is borne out in the early World Bank country reports requesting for water and sanitation investments and being rejected, crescendoing into the outcry by 1960 by developing countries that resulted in the creation of the International Development Association.

¹⁶ These factors rather undermine Hirschman's justification for imports with respect to industrialisation. Hirschman had written: 'Imports [...] reconnoiter [sic] the country's demand; they remove uncertainty [...], thereby bringing perceptibly closer the point at which domestic production can economically be started' (Hirschman, 1959, p. 121).

1.1.5. Beyond Stage 4: Rinse and repeat – establishing path dependence within the early years of the World Bank

In its third annual report published in 1948 (IBRD, 1948), the International Bank of Reconstruction and Development (also known then, though not yet officially, as the 'World Bank') announced its first development (as opposed to reconstruction) loan. Of a universe of options presented in its second annual report, the Bank opted, in step with the clamouring in the United States for the 'weaponisation'¹⁷ of the Tennessee Valley Authority, to start with USD 13.5 million for hydroelectric projects in Chile (IBRD, 1947; Olivier, 1961b, p. 5; World Bank, 2016). Power supply was deemed insufficient in Chile, and hydro was favoured over coal and liquid fuels because they were high in cost and insufficient in supply (IBRD, 1948, p. 22). This investment was followed, in line with Rostovian alertness for the need to establish export markets in underdeveloped markets, with a loan to Chile of USD 2.5 million for the importing of agricultural machinery (World Bank, 2016, p. 4).

By 1951, the Bank had extended 32 loans in 13 developing countries¹⁸. Energy accounted for 60% of the Bank's development finance portfolio (IBRD, 1951b, pp. 54–56).¹⁹

In 1956, the Bank initiated the Economic Development Institute (Mason and Asher, 1973, p. 326) that would train future finance and prime ministers. The institute took students on outings. The Tennessee Valley Authority's network of dams, power plants, irrigation systems and fertiliser plant proved to be 'particularly popular [...] as many Third World countries [sic], as well as the World Bankers, saw it as a model of the type of large-scale economic development that could be produced by large infusions of outside development capital under close governmental supervision'.

The Bank's mission report for Colombia, the first survey mission to be published (IBRD, 1950, p. 5, 1951b, p. 7)²⁰, is a trove of rationale. Here, electricity investment was again to take precedence. Power plants were to be the second and third investments made by the Bank in Chile, after agricultural machinery. After investment in Colombia's highways, the fourth investment made by the Bank, power would rank as second among sectors for most invested in sector by the Bank by 1951.

Lauchlin Currie, a former New Deal economic advisor to Roosevelt and self-professed Keynesian (Currie, 2004), headed the Bank's commission for Colombia. His mission reported: 'Electric power is perhaps the most single element in modern economic development' (1950a, p. 514). What is more, the report did not sim-

¹⁷ In 1949, New Republic carried an article that called the Tennessee Valley Authority the finest 'American 'know-how' available for export' and the USA's 'best-known, most highly appreciated institution' (Cooke, 1949; Ekbladh, 2002, p. 350). The historian Arthur Schlesinger called the Tennessee Valley Authority 'a weapon which, if properly employed, might outbid all the social ruthlessness of the Communists' (Schlesinger, 1949; Ekbladh, 2002, p. 350). Even a member of the judiciary was recorded making overtly political statements about the Tennessee Valley Authority. 'The word "Tennessee" is well known all the way across from the Mediterranean to the Pacific,' said US Supreme Court Justice William Douglas in 1951. 'They know about Tennessee because they have heard of the Tennessee Valley Authority [...] that fits their needs and will solve many of their basic problems. The TVA can also be utilized as one of the major influences to turn back the tide of communism which today threatens to engulf Asia' (Douglas, 1951; Ekbladh, 2002, p. 335).

¹⁸ I have counted as developing countries Brazil, Chile, Colombia, El Salvador, Ethiopia, India, Iraq, Mexico, Nicaragua, South Africa, Thailand, Turkey, Uruguay, and excluded Australia, Belgium, Denmark, Finland, France, Iceland, Luxembourg, Netherlands, Yugoslavia.

¹⁹ Using nominal values for 1948–51 loan agreements, electric power accounted for 61.5%, transport for 21.8%, agriculture for 9%, foreign exchange for finance for 4.6%, flood control for 2.8% and telecommunications for 0.3%.

²⁰ According to the IBRD's sixth annual report (1950, p7), by year end 1951, the report of a similar mission to Turkey was presented to the Turkish government, the reports for Guatemala and Cuba were scheduled for transmittal, for Iraq was being drafted and survey missions for Ceylon and Surinam were being organised.

ply argue for electrification's role in industrialisation, it argued for electrification in terms of the benefit to rural areas.

While the report did mention that electricity would be used for handicrafts (*Report of a Mission headed by Lauchlin Currie, 1950a*, p. 514), a rural industry that accounted for almost 5% of national income in 1939 and for 3.5% in 1947 (1950a, p. 30), economic benefit was not the only rationale cited for electrification. The summary report said that '[t]he difference in living standards between the most and the least developed countries [ould] be expressed largely in terms of differences in the facilities available for modern community living – electric power, sanitary facilities, and similar public services.

Living standards incorporated comfort and convenience, as well as industrial development, efficiency of labour and the general rate of scientific, technical and social advance (*Report of a Mission headed by Lauchlin Currie, 1950b*, p. 49). The Bank's first development mission report considered rural electrification good because it not only made life more comfortable, but also contributed to labour efficiency and the handicraft industry.

With respect to rural water, the mission report noted that 'unquestionably a large proportion of the wells, springs and streams upon which [rural households] rely are polluted or otherwise unsatisfactory' (*Report of a Mission headed by Lauchlin Currie, 1950a*, p. 514), but did not propose government intervention to address this. Rather, it ignored the problem of pollution and called on individuals to dig themselves wells (*Report of a Mission headed by Lauchlin Currie, 1950a*, pp. 524–525)²¹.

Contrasting with the Colombia mission report's emphasis on energy were mission reports to Cuba and Nicaragua. The Cuba mission reported that were a water crisis allowed to occur, 'all employment in all industries would cease' (*IBRD, 1951a*, p. 328). The Nicaragua report called investments in sanitation, education and public health 'without question' the first priority to combat high disease rates and low nutrition inhibiting productivity (*IBRD, 1953*, p. 22). However, no loans were made to Cuba in the 1950s where requests were made for water projects (*Alacevich, 2009*, p. 129). Of the eleven loans to Nicaragua between 1951 and 1960, none was for water, sanitation, health or education (*Kapur, Lewis and Webb, 1997*, p. 111). With Paraguay, it was a similar story. Having accepted a US Eximbank loan in 1954 for a water supply system, the Bank 'arguing that the project was an unproductive amenity, and moved as well by its rivalry with the Eximbank, dropped plans for lending to that country, an interruption that lasted until 1962' (*Kapur, Lewis and Webb, 1997*, p. 111).

In rejecting a Currie-supported investment for urban water in Colombia, Bank vice president Robert Garner responded that the Bank would only consider municipal projects if 'tangible evidence was provided that the projects were closely connected with the development of productive facilities' (*Garner, 1952; Alacevich, 2009*, p. 114). Rejecting the project once again a year later in 1953 following a resubmission for the application of a loan for the municipality, Garner argued that the 'Bank should concentrate its efforts on projects which will yield the greatest and quickest increase in output and productivity'. Out of these new sources of income would come the means for member countries 'provide out of their own resources better municipal services, better housing, better health and education' (*Garner, 1953; Alacevich, 2009*, p. 117).²² Garner's

sentiment would be reiterated by his successor almost a decade later. As World Bank vice president Burke Knapp (Olivier, 1961, p. 33) explained in 1961, "We can lean a little in the direction of taking those things which have come to be known as social projects rather than directly productive economic projects. My own definition of these is things that are less investment in future productivity and more satisfaction of current welfare requirements, like housing, water supply, other municipal services. Our sort of doctrine in the main in the past has been that those things were the fruits of economic development and that we would rather invest in the means of economic development and let countries develop the taxable capacity and the productivity that would enable these amenities to be provided."

Lower marginal productivity could not, however, be the reasoning for denying investment in water in Cuba and Nicaragua where clean water was seen as a prerequisite for productivity and industry. In truth, Garner's opposition to investing in water was probably more grounded in personal, emotive biases stemming from experience. Flippantly, in an interview in 1985, he said "Why should such and such a country have a water supply system in its town? When I was brought up in Mississippi [...] we didn't have any water in our house" (*Kapur, Lewis and Webb, 1997*, p. 110). Kapur, Lewis and Webb remark that 'one is left wondering [. . .] had Garner been born in a town with piped water in each home, he might have agreed to lend for municipal water services' (1997, p. 125).

Regarding the positive experience associated with hydropower, Mason and Asher have commented that 'in no sector has the Bank Group had a greater impact than in electric power' (1973, p. 713). The Tennessee Valley Authority was a template that would allow 'the relative ease of transferring the technology of power generation from more developed to less developed countries' (1973, p. 713). The Bank took pride in reorganising power companies to which it loaned so that they ran on sound financial lines (*Mason and Asher, 1973*, p. 716). Constrained by reliance on private funding by selling bonds on the private market, the Bank focused on establishing its creditworthiness in its early years (*Sharma, 2017*, p. 15). This resulted in an appraisal methodology in the mid-1950s of assessing the need for power using market rather than shadow economic demand, in using market prices, and weighing the case for power in financial rather than economic terms (*Mason and Asher, 1973*, p. 716). Its early appraisals of hydropower 'rarely' investigated the 'possibility of a thermal alternative' (*Mason and Asher, 1973*, p. 237), showing just how path dependent the Bank's institutions had become, as Mahoney, Pierson and Skocpol's model of path dependency predicts.

That the Bank went from strength to strength in its bond ratings, finally achieving a AAA rating in 1959 (*Sharma, 2017*, p. 15), reinforced for management that its conservative approach of sticking to lending what it knew was working. 'The first loans granted by the Bank [...] proved to be successful, and in fact they were completely repaid,' notes Alacevich. 'According to those who urged and considered it inappropriate for the Bank to venture into higher-risk loans in an environment where it was difficult to raise funds, there was no reason to change policy. The success of the first loans validated this position against alternative models of "impact" and "social loans" and contributed to perpetuating the model' (*Alacevich, 2009*, p. 136); the bank had not as of 1971 suffered a financial loss (*Mason and Asher, 1973*, p. 258). Thus, as predicted by the path dependency framework, it became difficult to justify diversion from the path already known.

In relation to the rejected water investments, *Currie (1979; Alacevich, 2009*, p. 129) complained that the Bank "had the strange

²¹ 'The cost of building a well is normally quite small – the requirement is labor, which would generally be furnished by the property-owner himself, or by his family, his neighbors or his regular farm workers – but considerable education by public agencies as to the importance of a satisfactory water source, and some simple technical aid, will be necessary' (*Report of a Mission headed by Lauchlin Currie, 1950a*, pp. 524–525).

²² In 1953, to circumvent the Bank's opposition to funds for potable water, the government office in charge of contacts with the Bank suggested applying

for Bogota only loans for its electricity company. The total requested, however, would actually cover the funds needed for both the electricity and water projects (*Alacevich, 2009*, p. 80).

belief that water was social, not economic.” The categorisation of water remains as such, with water and sanitation listed under ‘Social Infrastructure and Services’ and energy listed under ‘Economic Infrastructure and Services’ on the OECD’s website (2019).

It was not until a political uprising from developing members that the Bank made its first urban water supply loans in 1960 with the creation of the International Development Association, and even then, investments mainly privileged the urban middle-classes.

1.2. Rebellion against the path-dependence: The politics that brought about Bank (urban, self-liquidating) water supply lending

The Bank’s move into water lending came about due to yet another critical juncture – a political uprising of the world’s developing countries demanding for a fund to be housed at the UN.

Concentrating on urban electrical power and transportation the Bank’s loans of the 1950s had not improved the well-being of the poorest people. Unemployment rates in many countries had risen, and benefits from growth proved to be iniquitous (Alacevich, 2009, p. 149). The Bank’s unwillingness during the 1950s to lend for education, water supply, housing, and non-self-liquidating ventures built pressure (Mason and Asher, 1973, p. 415) among less developed countries for a Special United Nations Fund for Economic Development (Mason and Asher, 1973, p. 383). The UN agency would provide grants and long-term, low-interest loans for economic and social development (1973, p. 380). Because it would be housed at the UN, the principle of one-country-one-vote would prevail (Peet, 2009, p. 62).

Housing such a fund at the UN would have lost the United States its hegemonic financial dominance; at the UN, every Member had one vote, whereas at the Bank, the number of votes was determined by invested capital. The response, as the hegemonic model framed by Gilpin (Gilpin, 2001) would have predicted, was the creation of the International Development Association (IDA) attached to the Bank as a ‘soft loan window’ charging no interest but a nominal annual fee, separated from the IBRD so as not to affect its AAA credit-rating and so not to invite amendments to the Bank’s charter (Olivier, 1961a, p. 34). Votes would continue to be weighted by paid-in share capital, thus maintaining American dominance, and the top leadership would remain the same as the IBRD’s, headed by an American president.

Article V1b of the IDA’s *Articles of Agreement (1960b)*(IDA 1960b) state that the Association would finance projects of high developmental priority, and the Executive Directors’ report remarked that this would be so whether or not a whether the project was revenue-producing or directly productive, and ‘thus’ made water supply, sanitation and pilot housing eligible for financing (IDA 1960a, p. 23).

With the effective embargo on water projects lifted (Kapur, Lewis and Webb, 1997, p. 166), the IDA almost immediately started issuing loans for urban water supply, with loans made in 1961 in Taipei, Taiwan and Amman, Jordan (IDA, 1962, pp. 10, 14).

Two forces propelled the growth of investments in water. The first was commercial.²³ The second force propelling growth in water investments was Robert McNamara’s pro-poor presidency, beginning in 1968 and ending in 1981.²⁴ The World Bank’s first water

investment in Rwanda would be made in the wake of his legacy, two years after his presidency ended.

Despite the growth in water supply investments, it was only in 1991, three decades before the IDA’s first water supply project, that the words ‘rural’ and ‘water supply’ appeared in a project title, for investments in Pakistan (World Bank, 2018c, 2018f).²⁵ As opposed to having explicitly supported rural electrification, Mason and Asher (1973, pp. 718–721) remarked that as of mid-1971, the Bank had not supported any rural water project. Rural water supply would have been perceived as a riskier investment. Rural water consumers would have had less cash with which to pay (Bakker, 2013, p. 289), and the associated capital and operating costs to recover on both an absolute and on a per capita basis would have been higher.^{26 27}

Two years earlier, Richard Demuth had turned down a proposal to develop rural water supplies throughout Latin America (Kapur, Lewis and Webb, 1997, p. 201). Such projects instead were invested in heavily by the Inter-American Development Bank (1997, p. 201).²⁸ The new regional development banks – the Inter-American Development Bank, established in 1959, the African Development Bank, established in 1964, and the Asian Development Bank, established in 1966 – had become both competitors in markets where poverty-focused lending was the best growth opportunity (Bakker, 2013) as well as supplements to the World Bank’s neglect of public goods for the poorest.

1.3. But persistence in rural water investments by the Bank lagging rural electrification worldwide

As of March 2018, the IDA and IBRD had only invested in 61 projects with ‘rural’ and ‘water supply’ in their titles for a total of USD 5.6 billion in real adjusted 2018 USD terms for each project (BLS, 2018; World Bank, 2018c, 2018f). To give a sense of scale, this real figure is just 1% of the nominal IBRD and IDA’s cumulative commitments for 1990–2013. This is also USD 1 billion in real adjusted terms less than what the Bank has invested in for projects with project titles that explicitly state that they are for rural electrification or electricity access (also excluding joined up projects which invest across sectors for rural development, see Annex 1). Though the first rural electrification project²⁹ was documented eight years after the first water supply project, the number of rural electrification and electricity access projects are now 50% more than the number of rural water projects.

opening nations from poverty was key to security (McNamara, 1966). He therefore oversaw both the Bank’s rapid expansion of loans in absolute terms as well as a proportionate rise in spending on ‘social’ infrastructure. With respect to water, the IDA’s 1971 annual report noted the ‘huge backlog’ of underinvestment in municipal water supply in developing countries as a result of reluctance to charge consumers a cost-recovery tariff (p. 23). Addressing this underinvestment, four of the first years of McNamara’s presidency (1969–1973) saw a nominal increase of 4.5x of water supply and sewerage investment over the seven years preceding (1961–1968) (Sharma, 2010, p. 120). Poverty-oriented water supply and sewerage investments increased from 1.6% of IBRD and IDA lending commitments at the start of McNamara’s presidency by four times to 6.7% by the end of his presidency (Sharma, 2017, p. 67).

²⁵ Investments in rural water supply were found to be made in Brazil in 1986, but water supply was a small component of the overall project. It is also possible that investments in rural water supply were made prior to 1986 as smaller components of overall projects.

²⁶ Rural infrastructure costs more than infrastructure, both on an absolute as well as on a per capita basis when delivered as an on-grid solution. On an absolute basis because it involves higher distribution costs. On a per capita basis because there are fewer people to divide the higher distribution costs by.

²⁷ In trying to soften the bias towards secondary cities and towns, World Bank vice president Burke Knapp (1965; Kapur, Lewis and Webb, 1997, p. 201) said, ‘I am not saying we should go for the villages and the hamlets’.

²⁸ Similarly, the African Development Bank redresses the imbalance of World Bank investments in Rwanda by investing more in water than in energy in recent decades – this will be shown below.

²⁹ In Argentina.

²³ Seeing that water supply could be self-liquidating in low-income countries, it made sense to meet the same demand in middle-income countries as the IBRD’s pipeline of traditional projects was running thin (Squire, 1960; Bakker, 2013). Though the IDA had made the Bank’s first water supply investment in 1961, by 1969, IBRD lending commitments for water supply and sanitation exceeded IDA commitments by 150% (Kapur, Lewis and Webb, 1997, p. 141).

²⁴ As the former US Secretary of Defence, McNamara had described the nexus between violence and ‘economic backwardness’ (McNamara, 1966). Propelling devel-

The figure below from the Bank's World Development Report for 1994 'Infrastructure for Development' illustrates how far rural water lagged urban water as of 1994.

'Evidence strongly suggests that much of the potable water is consumed by the wealthier sections of urban societies', observed the Bank's report on the performance of its water projects from 1967–89 (World Bank, 1992, p. 52), in spite of McNamara's efforts to tackle poverty.

Consequently, both institutions intent on making commercial returns as well as making social returns will target first the cities, then the peri-urban areas before targeting rural areas when they consider only on-grid solutions to providing electricity and cleaner water. On a commercial basis, the costs will be lower in urban areas. On an impact basis, the population reached will be greater in urban areas. Projects had to hit a hurdle rate of 10% Economic Rate of Return³⁰ at the ex-ante appraisal stage (World Bank, 1992, pp. 52–53). For water and sewerage services, however, Economic Rate of Return was the same as Financial Rate of Return, as the regulated revenues were taken as a proxy for water's benefit (World Bank, 1992, pp. 52–53). Because these revenues were often below the costs, 66% of projects failed to meet the 10% ERR criterion on an ex-post basis (World Bank, 1992, pp. 52–53). The Bank by 1971 had readily admitted in its annual report (IDA, 1971, p. 23) that 'the financial returns accruing to water and sewerage authorities considerably understate the true benefits to the community, by no means all of which are readily apparent or easily quantifiable'.

The World Bank's investments in what it categorised as 'social' infrastructure (which includes water supply) lagged what it historically called 'infrastructure' (which includes electricity), including for Africa until the 1990s.

The 1990s were the first time that the Bank's commitments to 'economic' infrastructure were exceeded by 'social' infrastructure. The 1990s also saw investment in water and water sanitation in rural areas and towns exceeding investment in electrification in rural areas and towns worldwide. This, however, reversed in the 2000s and 2010s.

What had not changed in the 1990s was the framework for thinking of water versus energy. This excerpt from the 1994 World Development Report, whose theme was 'Infrastructure for Development' (World Bank, 1994, p. cover page) harks back to the economic thinking of previous decades: 'Infrastructure is an umbrella term for many activities referred to as "social overhead capital" by such development economists as Paul Rosenstein-Rodan, Ragnar Nurkse, and Albert Hirschman. Neither term is precisely defined, but both encompass activities that share technical features (such as economies of scale) and economic features (such as spillovers from users to nonusers)' (World Bank, 1994, p. 2).

While on the one hand acknowledging the challenge that almost one billion people still lacked access to clean water (1994, p. 1), the report concluded that coping with such infrastructure challenges was 'much more than plotting needed investments', but about tackling inefficiency and waste (1994, p. 1). Its recommendation was to manage infrastructure like a business, to liberalise entry into infrastructure that had no technological barriers, to facilitate public-private partnerships (PPPs) and for governments to have a changed role from monopolistic service providers to regulators to support private involvement in the provision of infrastructure services (1994, p. 2).³¹

³⁰ Defined by the Bank as the discount rate at which the present value of benefits of an investment over its economic life are equal to the present value of capital and operating costs, excluding duties and taxes (World Bank, 1992, p. 52).

³¹ The discussion would no doubt have been informed by the World Bank's Water Resources Management policy paper of 1993, which acknowledged the conclusions of several water conferences that water has an economic value and that wide access to potable water was required (World Bank, 1993, p. 24) saw the problem of

The problems with these recommendations would become apparent. The World Bank's Public-Private Infrastructure Advisory Facility's findings for 1990–2014 (Of, 2013, p. 33) showed that ten times as many energy PPPs reached financial close as did water and sewerage PPPs. It wasn't difficult to see why: 28% of water and sewerage PPPs were cancelled (Of, 2013, p. 33). The problem of approaching water as something that the private sector could provide was the politics: publics and public authorities were suspicious of investors profiteering from an essential human need, particularly when it resulted in higher water tariffs, as it did in the case of Aguas del Tunari illustrates.³²

Neither meeting the narrowly defined economic rate of return because of the Bank's historically lazy approach of not attempting to capture the productivity returns of investing in healthier communities, nor able to attract the financial investment in the way that it had envisioned in the World Development Report of 1994, it is little wonder why the Bank returned to its old bias of investment in rural electrification over access to potable water from 2000 onwards. The development literature prior to Lenz et al (2017) of the 1980s to the early 2010s did nothing to disprove the economic benefits arising from rural electrification for contexts such as Rwanda's.

A passive recount of the development literature could have suggested economic returns to rural Rwanda. Mobile phones allowed farmers in Niger to get price information for their produce, lowering transaction costs; accounting for lower dispersion in grain prices (Aker, 2017). Variation in mobile phone ownership helped explain an increase in household real consumption by 11%, reduced poverty incidence by 8% and decreased extreme poverty by 5.4% in rural Peru (Beuermann, Mckelvey and Vakis, 2012). Even before the proliferation of mobile phones, the literature found that rural electrification was correlated with transitions out of poverty (Brenneman and Kerf, 2002) with various mechanisms for increasing economic productivity: increased irrigation and electric pumps for agricultural production; better storage through refrigeration allows farmers to wait to sell their produce until better prices are available; better lighting, allowing for more and higher quality work hours for homebased income generating activities; its association with increased start-ups and electricity using firms, which require greater capital investment, employ more workers); improvement in health through refrigeration of vaccines and food; improvement in respiratory health through substitution away from traditional smoke-emitting biomass sources of energy; decreased time wasted in collecting firewood, and increased time to devote to self-employment; improvement in study time, school enrolment, school attendance and education outcomes; reducing fertility rates; and even reduced domestic violence against women and female babies (Jensen and Oster, 2009). Solar home systems can save end-consumers money they would spend on burning candles (Ahmed, 2017b).

But rural electrification's negligible benefits in Rwanda were not unforeseeable even prior to Lenz et al's findings. First, mobile phones were already widely used before widespread household electrification, so electrification seems to only have increased their use from 60% of potential users to more than 70% (Lenz et al., 2017). Second, the relevance of mobile phone use to decrease in-

underprovision of water as a market failure which could be corrected through government policies and incentives, and (almost as an after-thought), through public sector provision when 'other problems' such as public goods and inadequate investments arose (p. 27).

³² The Bolivian government cancelled the award of a 40-year concession to Aguas del Tunari to supply water and sanitation services to the city of Cochabamba within six months, amid violent protests that claimed a protestor's life. The protests came as a result of increased tariffs used to pay for new investment, and as a result of a law that precluded people from using self-constructed wells to tap water for free (Sawant, 2010, pp. 120–122).

formation asymmetries for farmers would be limited by the extent to which government agricultural ministries or 'party-statal' fix farmgate prices for crops that they insist farmers cultivate, as the Horizon Group does with pyrethrum (Huggins, 2017, pp. 138–139). Similarly, both houses with and without electricity connections cite radio as their main source of information (Lenz *et al.*, 2017); electricity connections are not required to operate battery-run or dynamo radios.

The use of irrigation would be limited by Rwanda's hilly geography. The cost of purchasing or running a refrigerator is prohibitively expensive for many Rwandan farmers, who mostly use electricity for lighting, entertainment devices and mobile phones (Lenz *et al.*, 2017), so the commercial benefits accrued from refrigerated crops (for selling when prices are more favourable) and health benefits accrued from food not going bad are not realised. The benefits of better lighting and reduced time in accumulating biomass for homebased income generating activities would be negated by the distance and cost that traders would need to travel from marketplaces to newly electrified areas. The City of Kigali's ban on hawking in 2016 would also not help (Nsabimana, 2019). In fact, Lenz *et al.* did not observe much evidence for a change in income generation patterns (2017). As for education, school attendance in Rwanda would be regulated by the state and community, and indeed Lenz *et al.* found that electrification did not alter school attendance. They also found that it did not greatly impact the amount of time studied, rather just shift study time from day-time to night-time (2017).

1.4. The World Bank as the path-defining actor in Rwanda's history of infrastructure investment

When it received its first World Bank investment in 1970, Rwanda was neither the United States in the 1930s when the Tennessee Valley Authority was introduced, nor Chile in 1948 when investment was approved for hydroelectric energy. As observed in section 2.1.1, a fifth of the USA's workforce in the 1930s was in agriculture and at Rostow's final stage of mass consumption. In 1948, 32% of Chile's workforce was employed in agriculture and fishing (Díaz, Lüders and Wagner, 2016, p. 666), rendering it at Rostow's "take-off stage" of development, or alternatively, ripe for flooding with US manufactured exports. Rwanda in 1970, meanwhile, was an agrarian economy. World Bank employment statistics for Rwanda go as far back as 1991 when 88% of the population was employed in agriculture (World Bank, 2020b). In 1973, 95% of the population was rural (Verwimp, 2013, p. 34). Rwanda was, according to Rostow's five stages of economic development, at the first 'traditional' stage of development.

While the USA benefited from creating an export market for manufactured goods in Chile by investing in Chile's energy infrastructure, it should be remembered that the official reason for investing in energy in Latin America in the 1950s rather than in water was because the former was economic infrastructure whereas the latter was an amenity that could be paid for by the taxes on increased economic activity. And so it was thus that the model of preferring investment in 'economic infrastructure and services' over 'social welfare infrastructure' was perpetuated in the World Bank's first investments in Rwanda. Between 1970 and 1983, the Bank funded 19 'economic infrastructure and services' projects and just one project falling within the domain of 'social infrastructure and services' (World Bank, 2018g).³³ Water supply would be the 21st project the IDA would fund in Rwanda, in 1983, and power would be the 22nd (World Bank, 2018g).

Prior to investment from the World Bank, Rwanda as of 1980 bucked the worldwide trend of having greater urban access to safe drinking water than rural access (World Bank, 1994, p. 146). By 1990, however, following the Bank's 1983 and 1987 investments in water supply, access to safe drinking water in urban areas was higher than in rural areas (World Bank, 1994, p. 146).

Prior to the war of 1994, IDA funds for energy and water roughly matched. After the war, the IDA funded energy disproportionately more than it did water.

Domestic electricity supply fell from 92 million kWh in 1993 to 24 million kWh in 1994 and was still not 60% of the pre-war level in 1995 (IMF, 1998, p. 12). Meanwhile, post-war production and consumption of water in 1995 was the same as that in 1993 (IMF, 1998). It would be safe to conclude that the 1994 war destroyed energy infrastructure, while it did not destroy water infrastructure. Interestingly, the number of electricity subscribers did not greatly vary from 1993 to 1994 to 1995. It did hugely expand, however, in 1996, by a factor of 6.7x, leapfrogging the number of water subscribers, while the number of water subscribers returned in 1996 to a similar number as to what it was in 1993.

Domestic production of 92.46 million kWh of energy fell from 1993 to 53.6 million kWh domestic production in 1995 (IMF, 1998), so if it can be assumed that the 1994 war destroyed 42% of Rwanda's electricity infrastructure, the cost of repair to pre-war levels can be approximated by working out 42% of pre-war investment in energy. The following table adjusts for this reinvestment:

However, the list of World Bank investments in Rwanda does not show that it invested in energy rehabilitation (or for that matter, any energy projects) until 2005, well after 1997 when energy supply and distribution levels had returned to pre-war levels. The list does show, however, that the IDA invested just once in rural water supply and sanitation between 1994–2018, a commitment of USD 20 million (nominal 2000 USD) in 2000, when the drinking water service rate was just 54% according to the IMF (IMF, 2005, p. 61).³⁴ By contrast, for the same period 1994–2018, the IDA committed 16 times that amount in real terms in energy projects. In just the Electricity Access Scale-up and Sector Wide Approach, it invested 5 times the amount invested in rural water supply and sanitation in real terms.

A map on the World Bank's website for its projects in Rwanda shows that its water and sanitation projects are invisible.

In its six energy and water investments reported on its portfolio for investments since 2000 (though the first of these six investments was made in 2010), the Africa Development Bank, Rwanda's second largest infrastructure funder, has, as its regional counterpart IADB was noted as doing by Kapur *et al.* (1997, p. 201), picked up looked-over water projects, investing 1.6x more in water than in energy.

Rwanda's Ministry of Finance has taken its cue from the developmental thinking in the early days of the World Bank, stating, 'We also recognise that transportation, energy, and information technology infrastructure are the backbone of effective and efficient service delivery and economic growth' (Government of Rwanda - Ministry of Finance and Economic Development 2010b, p. 14). Accordingly, from what could be ascertained by various Ministry of Finance reports, it had expended at least RWF 86 billion in 2014 real terms on rural electrification compared to RWF (2014) 11 billion on rural water and sanitation for 2009–14. For Fiscal Year 2011/2012, of Economic Development and Poverty Reduction Sectors, the Citizen's Guide shows RWF 0.3 billion allocated for water supply, whereas RWF 97.6 billion was allocated for fuel and energy. (Government of Rwanda - Ministry of Finance and Economic De-

³³ To use the OECD's classifications (OECD, 2019): more roads, several agricultural projects, a project to set-up Rwanda's first bank, a telecommunications project before it funded an education project.

³⁴ This service rate probably meant, as it does now, that the rural population was within 0.5km of an "improved water source" and that the urban population was within 0.2km.

velopment, 2009, 2010a, 2011, 2012, 2013a, Government of Rwanda - Ministry of Finance and Economic Development 2013b 2013b, 2015; Central Bank of Rwanda, 2017).

2. Discussion

As a least developing country, the Government of Rwanda's budget is constrained. The question then arises as to which type of infrastructure should be given priority to best reduce poverty, an ostensible target of Rwanda's biggest donor, the World Bank (World Bank, no date), an aim which largely aligns with the aims of the political party governing Rwanda (Chemouni, 2014), even if it is more preoccupied with the appearance of poverty, rather than the experience of poverty (Ansoms, 2009).

According to one school of thought, basic health needs (such as access to potable water) should be met first; after that, needs that would allow people to live an even higher standard of living should be met after (Parikh, Chaturvedi and George, 2012), i.e. electrification that would allow farmers to more frequently and cheaply (Lenz *et al.*, 2017) charge mobile phones that allow them to negotiate better prices for their crops and predict weather patterns better. A study of Indian slum dwellers' aspirations supports this thinking, with slum-dwellers in non-serviced slums prioritising the provision of water before all other types of infrastructure, while slum dwellers in serviced slums prioritise the provision of 'higher-order' aspirations such as housing, land and employment (Parikh, Chaturvedi and George, 2012). A peasant in a Ministry of Finance cartoon (2010, p. 25) echoes this line of thinking: "Clean water is our priority, not the market place."

Opposing this perspective were the early World Bank vice presidents: the Bank should reject the first non-productive amenities that people ask for and rather invest in projects benefitting the economy, whose generated taxes would then pay for the welfare amenities. Thinking of water as 'social infrastructure' persists today (OECD, 2019), while thinking of rural electricity as an engine for growth has been espoused by the development literature over the past three decades (Brenneman and Kerf, 2002), when in fact it has not been a panacea for growth in all contexts (Lenz *et al.*, 2017).

To resolve debate on the productivity of various infrastructure assets, the World Bank could have initiated ex-post studies that compare the returns on investments in rural electrification between on and off-grid solutions and the returns on off and on-grid investments in rural water and sanitation on a like-for-like basis.³⁵ It has not so far³⁶, so the question as to which type of investment yields the greater benefit (inclusive of productivity gains caused by a healthier population) net of cost cannot be answered.

Rural distribution of on-grid water would cost more than on-grid electricity both on a capital and operational cost basis, given that the costs would include digging costs, given that the materials used for pipes are greater than the costs of cables and poles used for electricity, and given the costs of electric pumping water up

Rwanda's myriad hills. In addition to the higher last mile costs are the additional capital and operating costs associated with creating extra capacity to treat water. In the case of power generation, rural energy would use minimal capacity from existing power plants primarily built for urban domestic and industrial demand.

Changes in technology should, however, change the choices that face developing country governments. Off-grid solutions provide appropriate levels of electricity (Ahmed, 2017b)³⁷, cleaning of water (Rosa *et al.*, 2014) and could do so with the provision of water (Ahmed, 2017a). The former can be offered by the private sector, the second can be provided for by the government at low cost and the latter can be piloted and demonstrated by the government and then implemented at low cost by the rural poor themselves.

For electricity, the private sector fulfils low consumption household demand with micro investments in solar home systems whose costs can be recouped within 28 months³⁸ and can be removed easily if end-users default. Solar home systems now account for 27% of electrified households in Rwanda (Government of Rwanda - Ministry of Infrastructure, 2019). This percentage, however, could have been much higher.

Water filters, meanwhile, a technology which have long been around, are undersupplied by the private sector. Only 3.5% of Rwandan households used them (Government of Rwanda - National Institute of Statistics of Rwanda *et al.* 2016, p.21), and these were distributed for free³⁹ by a social enterprise in partnership with the Government of Rwanda⁴⁰. Half of the households that had them use them at least every other day 12–24 months after they had been received, and consequently households that had received them had 50% lower odds of reported diarrhoea incidence among children under 5 than children in households in the control arm of a matched cohort study (Kirby *et al.*, 2017).

The programme which distributed these filters for free envisioned distributing them to 30% of the population, i.e. to reach 3 million people (DelAgua 2020). For internal business reasons, the social enterprise was unable to fulfil on scaling up the vision⁴¹.

In terms of increasing access to water, public provision through pipes is not the only way. Water condensation is almost free, has a realistic chance of working in Rwanda's humid hills and one that could be at first piloted and then advocated by the Government of Rwanda for rural citizens to use (Ahmed, 2017a).

Reviewing the Rwandan Ministry of Finance's budget plans and reports for 2009–2014 suggest that the Government of Rwanda had been investing exponentially more in rural electrification than in access to potable water. Talking with district officials, Chemouni observed⁴² that 'priority [is] given to electrification in the planning of the districts in 2013/14' (2014, p. 252). The World Bank had been working with the Rwanda Energy Group and Rwandan Ministry of Finance since 2009 to implement a (nominal) USD 122 million electricity access project (World Bank, 2018b). Its objective was to connect 768,000 households to the national grid. By contrast, an Africa Development Bank report revealed how it, the Africa Growing Together Fund, European Investment Bank and Government of

³⁵ One way of doing this would be to conduct randomised control trials of comparable villages – some with on-grid electricity, some with off-grid electricity, some with on-grid potable water, some with off-grid potable water, some without any form of electricity and some without any form of water, and all the combinations thereof. Proxies for income could be then measured at the time of the introduction of the interventions (where applicable), and then over time. Short of implementing costly RCTs, impact could also be assessed using regression analysis on synthesised counterfactual results using in the way that Abadie and Gardeazabal did (Abadie and Gardeazabal, 2003), or in combination with the matching method.

³⁶ IBRD project appraisals had primarily been concerned with financial objectives (Mason and Asher, 1973, pp. 239, 242) which did not catch 'hard-to-measure indirect benefits or public health externalities' (Kapur, Lewis and Webb, 1997, p. 211). Influential World Bank economist Albert Hirschman (1967, pp. 165–166) objected to even attempting to use ex-post evaluations to rank infrastructure projects, citing the impossibility of using a single scale to amalgamate all the varied dimensions.

³⁷ They provide a lower difference between the cost of electricity provision and internalised benefits for 16 rural communities in Rwanda (Grimm *et al.*, 2020) as measured by willingness to pay surveys than on-grid electricity provision in Kenya (Lee, Miguel and Wolfram, 2016).

³⁸ Confirmed by WhatsApp with a former finance director at a solar home system vendor on 18 April, 2019.

³⁹ Confirmed in an email by a former DelAgua project manager on 18 April, 2019.

⁴⁰ Roughly 100,000 households received water filters through a partnership between the Government of Rwanda Ministry of Health and UK social enterprise DeAgua (Nagel *et al.*, 2016). This would equate roughly to the 3.5% of the population figure caught in the Demographic Health Survey.

⁴¹ Phone interview with a former DelAgua project manager, 20 November, 2017.

⁴² Per an email exchange with Chemouni on 30 October, 2017, he writes that this information was obtained by chatting with district officials.

Rwanda would invest almost USD 250 million to reach universal water supply coverage not across Rwanda but in the capital city Kigali and six other satellite cities (up from 73% as of the time of the report), as well as 15% access to sewage (up from 0% from the time of the report) (African Development Bank, 2017). That a rural electricity roll-out programme was underway at the same time as an urban water supply programme shows how relatively advanced electrification was, and how much electrification has historically been prioritised.

Publication of the 2016 Sustainable Development Goals represents an inflection point in the prioritisation of Rwanda's rural infrastructure as it makes visible the experience of poverty by emphasising water quality, as opposed to the Millennium Development Goals' type of water source, which allowed for the appearance of poverty to take precedence. The Ministry of Infrastructure swiftly mentioned water quality in its policy papers (Government of Rwanda - Ministry of Infrastructure, 2016a, 2016b) and in July 2017 issued a Terms of Reference for a consultant to assess the national quality of water (Government of Rwanda - Rwanda Utilities Regulatory Authority, 2017). The document explicitly links international expectations from the Sustainable Development Goals of 2016 with this new interest, while citing its success in achieving the Millennium Development Goal of 2000 for access to improved water. The Ministry of Finance accordingly budgeted investment in rural water more than it did for rural electrification for 2016–2020.⁴³

3. Conclusion

Rwanda's prioritisation of rural electrification over access to potable water can only have been informed by ex-ante assessment of on-grid costs, as opposed to assessment of net benefits of both on and off-grid solutions. It is the result of a false taxonomy of water as social infrastructure and electricity as economic infrastructure. Lenz et al's (2017) recent study suggests that rural electrification in the Rwandan context is at the least wrongly categorised, being more an amenity than an economic asset.

The lack of adaptive thinking needed at the donor and government level to efficiently alleviate poverty is due, as was found by studying the formative periods of the World Bank⁴⁴, to a flawed *Er-fahrungswissenschaft*,⁴⁵ in this case perverse path-dependence with respect to the way that potable water was thought of as amenity, and which precluded disproving the hypothesis that the provision of potable water is not an economic infrastructure asset. The initial conditions for the introduction of mass electrification in the United States were long forgotten. The United States was at stage five in Rostow's five stages of economic growth, whereas Rwanda is still at stage one, without the industrial base to capitalise on the demand for electrical appliances. Instead, rural electrification has been pursued for its own sake as the provision of an amenity rather than an economic asset, regardless that it has come at the expense of rural water that should be provided both for the welfare gains it would provide, as well as for the productivity gains. Thanks to the Sustainable Development Goals' emphasis on water quality, the Government of Rwanda and the World Bank will be motivated to develop potable water infrastructure, even if they are not yet fully convinced of its economic utility.

⁴³ For 2016–2020, it had budgeted RWF (2014) 439 billion for rural electrification, compared to RWF (2014) 316 billion for rural water and sanitation. (Government of Rwanda - Ministry of Finance and Economic Development 2016, 2017a; Central Bank of Rwanda, 2017).

⁴⁴ Alacevich writes (2009, p. 9) that it is by studying the formative periods of an institution that a researcher is in the best position to identify possible options of its evolution.

⁴⁵ A flawed experienced-based science.

Off-grid electrification would be a more cost-effective tool for meeting the modest electricity consumption levels demonstrated even in grid-connected areas of rural Rwanda, and for achieving electrification's slight productivity gains in the Rwandan context until grid electrification no longer poses the substantial budgetary constraint it currently does to the delivery of potable water and the better provision of rural health, education and transport services. Further investment in water, health, education and transport should facilitate rural citizens' ability to afford the consumption of more electricity by making citizens more productive and hence then justify greater public investment in on-grid electrification. When Rwandans are able to afford more and better electricity, we may then see gains in productivity as a result of higher electricity consumption more in line with other parts of the world.

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None.

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References

- Abadie, A., Gardeazabal, J., 2003. 'The Economic Costs of Conflict: A Case Study of the Basque Country. The American Economic Review, March 113–132. doi:10.1257/000282803321455188.
- AfDB, 2018. AfDB Project Portfolio in Rwanda. AfDB website.
- African Development Bank (2017) Rwanda Sustainable Water Supply and Sanitation Program Appraisal Report.
- Ahmed, I., 2017a. After off-grid electricity, what chance off-grid water? Financial Times 31 July. Available at <https://www.ft.com/content/e2c9ef62-72b9-11e7-aca6-c6bd07df1a3c>.
- Ahmed, I. (2017b) 'Leapfrogging into the light', Financial Times, 27 March. Available at: <https://www.ft.com/content/41524878-108f-11e7-b030-768954394623>.
- Aker, J.C., 2017. 'Information from Markets Near and Far: Mobile Phones and Agricultural Markets in Niger. American Economic Journal: Applied Economics 2 (3), 46–59 doi: 144.82.238.225.
- Alacevich, M., 2009. The Political Economy of the World Bank - the Early Years. World Bank, Washington, D.C.
- Ansoms, A., 2009. 'Re-Engineering Rural Society: The Visions and Ambitions of the Rwandan Elite. The Royal African Society 2 108 (431), 289–309. doi:10.1093/afrafadpOoi.
- Bakker, K., 2013. 'Constructing "public" water: the World Bank, urban water supply, and the biopolitics of development. Environment and Planning D: Society and Space 31, 280–300. doi:10.1068/d5111.
- Barber, W.J., 1996. Designs within Disorder. Franklin D. Roosevelt, the Economists, and the Shaping of American Economic Policy. Cambridge University Press, Cambridge, pp. 1933–1945.
- Baumol, W.J., 1986. 'Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show. American Economic Association 76 (5), 1072–1085.

- Baumol, W.J., 2014. 'Stimulating growth amid recession : Entrepreneurship, innovation, and the Keynesian revolution. *Journal of Policy Modeling*. The Society for Policy Modeling 36, 629–635. doi:10.1016/j.jpolmod.2014.03.004.
- Beuermann, D.W., Mckelvey, C., Vakis, R., 2012. 'Mobile Phones and Economic Development in Rural Peru. *The Journal of Development Studies* 48 (11), 1617–1628. doi:10.1080/00220388.2012.709615.
- BLS, 2018. Historical Consumer Price Index for All Urban Consumers (CPI-U). U. S. city average, all items, Washington, D.C.
- Breneman, A. and Kerf, M. (2002) Infrastructure & Poverty Linkages A Literature Review. Available at: https://www.ilo.org/wcmsp5/groups/public/-ed_emp/-emp_policy/-invest/documents/publication/wcms_asist_8281.pdf.
- Brinkley, A., 1996. *The End of Reform: New Deal Liberalism in Recession and War*. Vintage Books, New York.
- Central Bank of Rwanda, 2017. Consumer Price Index. Kigali.
- Chemouni, B., 2014. 'Explaining the design of the Rwandan decentralization: elite vulnerability and the territorial repartition of power. *Journal of Eastern African Studies* 8 (2), 246–262. doi:10.1080/17531055.2014.891800.
- Christensen, C., 2001. 'Making friends with disruptive technology - an interview with Clayton M. Christensen'. *Strategy & Leadership* 29 (2), 10–15. <https://doi.org/10.1108/10878570110695110>.
- Colignon, R.A., 1997. *Power Plays: Critical Events in the Institutionalization of the Tennessee Valley Authority*. State University of New York Press, Albany.
- Cooke, M.L., 1949. 'Down to Earth with Point Four'. *New Republic*, pp. 18–21 11 July.
- Craig, D., Porter, D., 2006. *Development beyond neoliberalism? Governance, poverty reduction and political economy*. Routledge, Abingdon.
- Currie, L., 2004. Memorandum on full employment March 18, 1940. *Journal of Economic Studies*. Washington, D.C. 31 (3/4), 366–368.
- Currie, L.B., 1979. A Talk by Lauchlin Currie: Hotel Tequendama. Mimeo August 31.
- David, P.A., 1985. Clio and the Economics of QWERTY. *The American Economic Review* 75 (2), 332–337. <http://www.jstor.org/stable/1805621>.
- DelAgua, 2020. Project Rwanda no date. DelAgua website Available at <http://www.delagua.org/projects/rwanda>.
- Diáz, J., Lüders, R., Wagner, G., 2016. Chile 1810–2010 : La República En Cifras: Historical Statistics. First. Ediciones Universidad Católica de Chile, Santiago Available at <https://www.jstor.org/stable/j.ctt1h9cvqj>.
- Douglas, W.O., 1951. Address before the General Assembly of the State of Tennessee. In: *Appendix to the Congressional Record*, 82nd Congress, 1 sess, p. 22 February.
- Ekladh, D., 2002. "Mr. TVA": Grass-Roots Development, David Lilienthal, and the Rise and Fall of the Tennessee Valley Authority as a Symbol for U.S. Overseas Development, 1933–1973. *Diplomatic History* 26 (3), 335–374. <https://doi.org/10.1111/1467-7709.00315>.
- Finer, H., 1972. *The T.V.A.: Lessons for International Application*. Da Capo Press, New York.
- Frischmann, B.M., 2012. *Infrastructure: The Social Value of Shared Resources*. Oxford University Press, Oxford.
- Garner, R.L., 1952. Letter to Rafael Delgado. LBCP, Washington, D.C.
- Garner, R.L., 1953. Letter to Emilio Toro. LBCP, Washington, D.C.
- Garner, R.L., 1972. *This is the Way it Was with Robert L. Garner*. Chevy Chase. Chevy Chase Printing, Maryland.
- Gerschenkron, A., 1962. *Economic Backwardness in Historical Perspective – A book of Essays*. Cambridge, MA and London: Harvard University Press.
- Gilpin, R. (2001) *Global political economy: understanding the international economic order*. Princeton: Princeton University Press.
- Government of Rwanda - Ministry of Finance and Economic Development, 2009. *A Public Guide to the 2009–2010 Budget*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2010a. *Budget Execution Report for the Fiscal year 2009/10*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2010b. *The Budget of Rwanda - a Citizen's Guide 2010–2011*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2011. *The National Budget - a Citizen's Guide 2011–2012*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2012. *Budget Framework Paper 2012/13–2014/15*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2013a. *Budget Execution Report for the FY 2012/2013*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2013b. *Budget Framework Paper 2013/14–2015/16*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2015. *Budget Execution Report for July–December 2014 Period*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2016. *Budget Framework Paper 2016/2017–2018/2019*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2017a. *Budget Framework Paper 2017/2018–2019/2020*. Kigali.
- Government of Rwanda - Ministry of Finance and Economic Development, 2017b. *Rwanda Official Development Assistance Report - An extended review 2015/2016 fiscal year*. Kigali Available at http://www.devpartners.gov.rw/fileadmin/user_upload/ODA_report_201516_2_.pdf.
- Government of Rwanda - Ministry of Infrastructure, 2016a. *National Water Supply Policy*. Kigali.
- Government of Rwanda - Ministry of Infrastructure, 2016b. *National Water Supply Policy Implementation Strategy*. Kigali.
- Government of Rwanda - Ministry of Infrastructure, 2016c. *Rural Electrification Strategy*. Kigali.
- Government of Rwanda - Ministry of Infrastructure, 2019. *Electricity Access. Ministry of Infrastructure website Available at <http://mininfra.gov.rw/index.php?id=312>*.
- Government of Rwanda - National Institute of Statistics of Rwanda, 2016. *Rwanda Demographic and Health Survey*. NISR, MOH, ICF International, Rwanda. Rockville, Maryland doi: March, 2016.
- Government of Rwanda - Rwanda Utilities Regulatory Authority, 2017. *Terms of Reference for the Recruitment of a consultancy to provide technical assistance for the successful implementation of the National Water Quality study*. Kigali: Government of Rwanda - Rwanda Utilities Regulatory Authority.
- Grimm, M., Lenz, L., Peters, J., Sievert, M., 2020. Demand for Off-Grid Solar Electricity: Experimental Evidence from Rwanda. *Journal of the Association of Environmental and Resource Economists* 7 (3), 417–454. doi:10.1086/707384.
- Hirschman, A.O., 1959. *The Strategy of Economic Development*. Yale University Press, New Haven.
- Hirschman, A.O., 1967. *Development Projects Observed*. Brookings Institution, Washington, D.C..
- Huggins, C., 2017. *Agricultural Reform in Rwanda: Authoritarianism, Markets and Zones of Governance*, 1st edn. Zed Books Ltd, London.
- Huxley, J., 1946. *TVA – adventure in planning*. Kingston-upon-Thames. The Architectural Press.
- IBRD (1947) *Second Annual Report 1946–1947*. Washington, D.C.
- IBRD (1948) *Third Annual Report, 1947–1948*. Washington, D.C. doi: 10.1007/978-1-349-26356-1_7.
- IBRD (1950) *Fifth Annual Report 1949–1950*. Washington, D.C.
- IBRD (1951a) *Report on Cuba - Findings and Recommendations of an Economic and Technical Mission*. Washington, D.C. doi: 10.2307/2509624.
- IBRD (1951b) *Sixth Annual Report 1950–1951*. Washington, D.C.
- IBRD, 1953. *The Economic Development of Nicaragua*. Baltimore.
- IDA (1960a) *Articles of Agreement and Report of the Executive Directors of the International Bank for Reconstruction and Development on the Articles of Agreement*. Washington, D.C.
- IDA, 1960b. *International Development Association Articles of Agreement*. World Bank, Washington, D.C.
- IDA (1962) *Annual Report 1962*. Washington, D.C.
- IDA (1971) *Annual Report 1971*. Washington, D.C.
- IMF (1998) *Rwanda: Statistical Appendix*. Washington, D.C.
- IMF (2005) *Rwanda: Poverty Reduction Strategy Paper Annual Progress Report*. Washington, D.C.
- Jensen, R., Oster, E., 2009. *The Power of TV: Cable Television and Women's Status in India*. *The Quarterly Journal of Economics* 124 (3), 1057–1094 doi: 144.82.108.120.
- Johnson, L.B., 1965. *Peace without conquest. C-SPAN*, Baltimore, United States <https://www.c-span.org/video/?153274-1/reel-america-president-lyndon-johnson-vietnam-war-1965>.
- Kanbur, R., Vines, D., 2000. 'The World Bank and poverty reduction : past, present and future. In: Gilbert, C.L., Vines, D. (Eds.), *The World Bank - Structure and Politics*. Cambridge University Press, Cambridge, pp. 87–107.
- Kapur, D., Lewis, J.P., Webb, R.C., 1997. *The World Bank: its first half century*. Brookings Institution Press, Washington, D.C. Available at <http://documents.worldbank.org/curated/en/313081468322727631/History>.
- Kirby, M.A., et al., 2016. *Faecal contamination of household drinking water in Rwanda : A national cross-sectional study*. *Science of the Total Environment* 571, 426–434.
- Kirby, M.A., et al., 2017. *International Journal of Hygiene and Use, microbiological effectiveness and health impact of a household water filter intervention in rural Rwanda – A matched cohort study* 220, 1020–1029.
- Knapp, J. B. (1965) 'Selection of Water Supply and Sewer Projects'. Washington, D.C., p. July 6.
- Lee, K., Miguel, E. and Wolfram, C. (2016) *Experimental Evidence on the Demand for and Costs of Rural Electrification*. 22292. Cambridge, MA. doi: 10.3386/w22292.
- Lenz, L., et al., 2017. *Does Large-Scale Infrastructure Investment Alleviate Poverty? Impacts of Rwanda's Electricity Access Roll-Out Program*. *World Development* 89, 88–110. <http://dx.doi.org/10.1016/j.worlddev.2016.08.003>.
- Lowenstein, R., 2015. *History Repeating*. *Wall Street Journal*, 14 January A13.
- Mahoney, J., 2000. 'Path Dependence in Historical Sociology. *Theory and Society* 29 (4), 507–548. Available at <http://www.jstor.org/stable/3108585> .
- Mason, E.S., Asher, R.E., 1973. *The World Bank since Bretton Woods*. The Brookings Institution, Washington, D.C.
- McNamara, R.S., 1966. 'Security in the Contemporary World. Montreal: Address of the US Secretary of Defense to the American Society of Newspaper Editors p. May 18.
- Nagel, C.L., et al., 2016. In: *Study design of a cluster-randomized controlled trial to evaluate a large-scale distribution of cook stoves and water filters in Western Province, Rwanda*, 4. *Contemporary Clinical Trials Communications*, pp. 124–135.
- Ncube, M., Lufumpa, C.L., Kararach, G., 2017. *Introduction: Infrastructure in African development*. In: Ncube, M., Lufumpa, C.L. (Eds.), *Infrastructure in Africa – Lessons for Future Development*. Policy Press, Bristol.
- North, D.C., 1990. *Institutions, Institutional Change and Economic Performance – Political Economy of Institutions and Decisions*. University of Cambridge Press, Kindle. Cambridge.
- Nsabimana, E., 2019. *How effective has the ban on hawkers been?*. *New Times* 19 February. Available at <https://www.newtimes.co.rw/news/hawkers-ban-effective>.
- OECD, 2019. *Aid (ODA) by sector and donor*. OECD website.
- Of, T. H. E. S. (2013) 'The state of', (June).
- Olivier, R. (1961a) Transcript of interview with Burke Knapp.
- Olivier, R., 1961b. Transcript of Interview with Richard H. Demuth. World Bank.

- Pariikh, P., Chaturvedi, S., George, G., 2012. 'Empowering change: The effects of energy provision on individual aspirations in slum communities. Energy Policy. <http://dx.doi.org/10.1016/j.enpol.2012.07.046>.
- Peet, R., 2009. *Unholy Trinity: The IMF, World Bank and WTO*, Second Edi. Zed Books Ltd, London.
- Pierson, P., Skocpol, T., 2002. 'Historical Institutionalism in Contemporary Political Science. In: Katznelson, I., Milner, H. (Eds.), *Political Science - State of the Discipline*. American Political Science Association and WW Norton & Company, D.C. and New York, pp. 693–721.
- PPIAF, 2016. *The State of PPPs Infrastructure Public-Private Partnerships in Emerging Markets & Developing Countries*. World Bank. <https://ppiaf.org/documents/3551/download>.
- Pritchett, L., 2002. 'It pays to be ignorant: A simple political economy of rigorous program evaluation. *The Journal of Policy Reform* 5 (4), 251–269. doi:10.1080/1384128032000096832.
- Ravallion, M., Chen, S., 1997. 'What Can New Survey Data Tell Us about Recent Changes in Distribution and Poverty? *The World Bank Economic Review* 11 (2), 357–382 doi: 144.82.238.225.
- Reinert, E.S., 2019. 'German Economics as Development Economics: From the Thirty Years' War to World War II'. In: Kattel, R. (Ed.), *The Visionary Realism of German Economics: From the Thirty Years' War to the Cold War*. Anthem Press, London, pp. 15–36. doi:10.2307/j.ctvc5979.
- Report of a Mission headed by Lauchlin Currie (1950a) *The Basis of a Development Program for Colombia*. Washington, D.C. doi: 10.2105/ajph.40.12.1567-a.
- Report of a Mission headed by Lauchlin Currie (1950b) *The Basis of a Development Program for Colombia - The Summary*. Washington, D.C.
- Roosevelt, F.D., 1945. 'Message to Congress on the Bretton Woods Agreements'. D.C.: The American Presidency Project 12. February. Available at <https://www.presidency.ucsb.edu/node/210026>.
- Rosa, G. et al. (2014) 'Assessing the Impact of Water Filters and Improved Cook Stoves on Drinking Water Quality and Household Air Pollution : A Randomised Controlled Trial in Rwanda', 9(3), pp. 1–9. doi: 10.1371/journal.pone.0091011.
- Rosenstein-Rodan, P.N., 1943. 'Problems of Industrialisation of Eastern and South-Eastern Europe. *The Economic Journal* 53 (210/211), 202–211. Available at <http://www.jstor.org/stable/2226317>.
- Rostow, W.W., 1960. *The stages of economic growth: A non-communist manifesto*, 3rd edn. Cambridge University Press, Cambridge.
- Sawant, R.J., 2010. *Infrastructure Investing: Managing Risks & Rewards for Pensions*. Insurance Companies & Endowments. John Wiley & Sons, Inc., Hoboken.
- Schlesinger, A.J., 1949. *The Vital Center: The Politics of Freedom*. Houghton Mifflin, Boston.
- Schumpeter, J.A., 1943. *Capitalism, Socialism & Democracy*, Sixth edit Routledge, London New York.
- Scott, J.C., 1998. *Seeing Like a State - How Certain Schemes to Improve the Human Condition Have Failed*. Yale University Press.
- Sen, A., 1995. 'Capability and Well-Being. In: Nussbaum, M., Sen, A. (Eds.), *The Quality of Life*. Clarendon Press, Oxford doi:10.1093/0198287976.001.0001.
- Sharma (2010) Note to users. doi: 10.1177/001088048102200214.
- Sharma, P.A., 2017. *Robert McNamara's Other War - The World Bank and International Development*. University of Pennsylvania Press, Philadelphia.
- Squire, P. (1960) 'World Bank internal memo to R. Sadove'.
- Staples, A.L.S., 2006. *The birth of development: how the World Bank. In: Food and Agriculture Organisation and World Health Organisation changed the world*. The Kent State University Press, Kent, Ohio, pp. 1945–1965.
- Stinchcombe, A.L., 1968. *Constructing Social Theories*. University of Chicago Press, Chicago.
- Tobey, R.C., 1996. *Technology as freedom: The New Deal and the electrical modernization of the American home*. University of California Press, Berkeley, California.
- Census Bureau, U.S., 1999. Table No. 1430. *Employment Status of the Civilian Population: 1929 to 1998*. Statistical Abstract of the United States. U.S. Census Bureau, Washington, D.C. Available at <https://www.census.gov/prod/99pubs/99statab/sec31.pdf>.
- United Nations, 1962. *International Trade Statistics 1900 – 1960*. UN Trade Statistics Available at <https://unstats.un.org/unsd/trade/data/tables.asp>.
- Verwimp, P. (2013) *Peasants in Power: The Political Economy of Development and Genocide in Rwanda*. Second. Dordrecht Heidelberg New York London: Springer. doi: 10.1007/978-94-007-6434-7.
- World Bank (1992) 'Water supply and sanitation projects : the Bank's experience, 1967-1989', (10789), pp. 1–149. Available at: <http://documents.worldbank.org/curated/en/1992/06/736481/water-supply-sanitation-projects-banks-experience-1967-1989>.
- World Bank (1993) *Improving Water Resources Management, Water Resources Management*. Available at: <http://onlinelibrary.wiley.com/doi/10.1002/047147844X.wr241/full>.
- World Bank, 1994. *World Development Report 1994*. The World Bank, Washington, D.C. doi:10.1596/978-0-1952-0992-1.
- World Bank (2016) 'World Bank's First Development Loans to Chile, 1948', (057), pp. 1–5. Available at: <http://documents.worldbank.org/curated/en/308691468185347709/pdf/104690-WP-PUBLIC-2007-01-World-Banks-First-Development-Loans-to-Chile.pdf>.
- World Bank, 2018a. *Map of World Bank projects in Rwanda*. World Bank website Available at, http://projects.worldbank.org/search?lang=en&searchTerm=&countrycode_exact=RW.
- World Bank (2018b) *Rwanda Electricity Access Scale-up and Sector Wide Approach (SWAp) Development Project (P111567)*.
- World Bank, 2018c. *World Bank Projects & Operations by Sector - Water/Sanitation/Waste /Water Supply*. World Bank website.
- World Bank, 2018d. *World Bank Projects & Operations by Sector / Energy & Extractives / Energy Transmission and Distribution*. World Bank website.
- World Bank, 2018e. *World Bank Projects & Operations by Sector / Energy & Extractives / Renewable Energy Solar*. World Bank website.
- World Bank, 2018f. *World Bank Projects and Operations by Sector - Water/Sanitation/Waste/ Other Water Supply, Sanitation and Waste Management*. World Bank website.
- World Bank, 2018g. *World Bank Projects in Rwanda*. World Bank Available at, http://projects.worldbank.org/search?lang=en&searchTerm=&countrycode_exact=RW.
- World Bank (2019) *World Development Indicators - Chile*. Available at: <https://data.worldbank.org/country/chile>.
- World Bank, 2020a. *Rwanda Electricity Access Scale-up and Sector Wide Approach (SWAp) Development Project*. World Bank Projects & Operations. Available at <https://projects.worldbank.org/en/projects-operations/project-detail/P111567>. Accessed: 22 March 2020.
- World Bank (2020b) 'Rwanda World Bank Indicators'. World Bank. Available at: <https://data.worldbank.org/country/rwanda>.
- World Bank (no date) *What is IDA?*, International Development Association website. Available at: <http://ida.worldbank.org/about/what-is-ida> (Accessed: 18 April 2019).