Colonial origins and health system performance in the D.R.Congo

Samuel Lordemus, University of York (samuel.lordemus@york.ac.uk)
Supervisors: Arne Risa Hole and Rodrigo Moreno-Serra

Persistent inequalities in development and investment in health infrastructures are hampering health system performance in sub-Saharan Africa. As health facilities absorb more than half of total health domestic expenditures[1], exploring the root causes of inequalities in hospital performance is crucial to improve the allocation of health resources and achieve their highest impact. This paper attempts to bring a new perspective on this issue by investigating the historical legacy of a colonial regime on modern disparities in health system performance. Specifically, the objective is to explore to what extent colonial health investments have a causal effect on contemporary hospital input utilisation and output production.

I examine the long-term effects of colonial health investments on modern hospital performance by using archival data on the Belgian Congo between 1926 and 1956 along with contemporary data on the Democratic Republic of Congo (DRC). Focusing the analysis on the DRC brings two benefits. First, I obtain refined data from colonial archives on population health, public investments and disease prevalence in this second largest African country. The collected information offers the possibility to accurately estimate the effects of colonial health investments at the subnational level and has the advantage of precisely identifying sources of variation in factors pertaining to colonial settlement decisions. Furthermore, the troubled recent history of the DRC provides a unique setting for examining the persistence of the colonial legacy. From independence in 1960, followed by the Mobutu authoritative regime, to the collapse of the state and the outbreak of civil and regional wars three decades later, the presence of causal effects on modern facilities would be remarkable. It would suggest a high degree of persistence of initial health investments and the crucial role played by colonial medical missions in determining the performance of modern African health systems.

Data

Colonial settlements - I use two primary data sources. First, I exploit multiple colonial maps on health infrastructures between 1936 and 1953 to georeference the establishment of colonial health investments. These maps, produced by the Belgian Ministry of Colonies, provide information on the geographic distribution of all hospitals and dispensaries that reported health activities to the colonial government. Equipped with this information, I georeference and geolocalise all historical data: I first construct a geocoded dataset of all colonial medical missions between 1929 and 1953. I then compute the exact location of modern health facilities with colonial origins by matching the colonial health settlements with the list of modern health facilities in the DRC. The geo-location analysis was finally augmented with archival public health data from the Belgian Ministry of Colonies between 1926 and 1955.

Modern health facilities - The list of modern health facilities was obtained from the District Health Information System (DHIS2), a routine web platform managed by the Congolese Ministry of Health that provides financial and epidemiological information on modern health

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[1] World Health Organisation (2014).

facilities in the DRC. Monthly data was extracted between January 2017 and December 2018. The total sample data comprises 17,000 health facilities of which 4,449 have been geolocalised. The sub-sample contains 351 health facilities that were built during the colonial period. Since there exists high heterogeneity among health facilities in terms of size and capacity to deliver health services, I decide to focus the subsequent analysis on hospitals. Restricting the sub-sample of facilities on hospitals leads to 1,099 observations among which 208 have colonial origins.
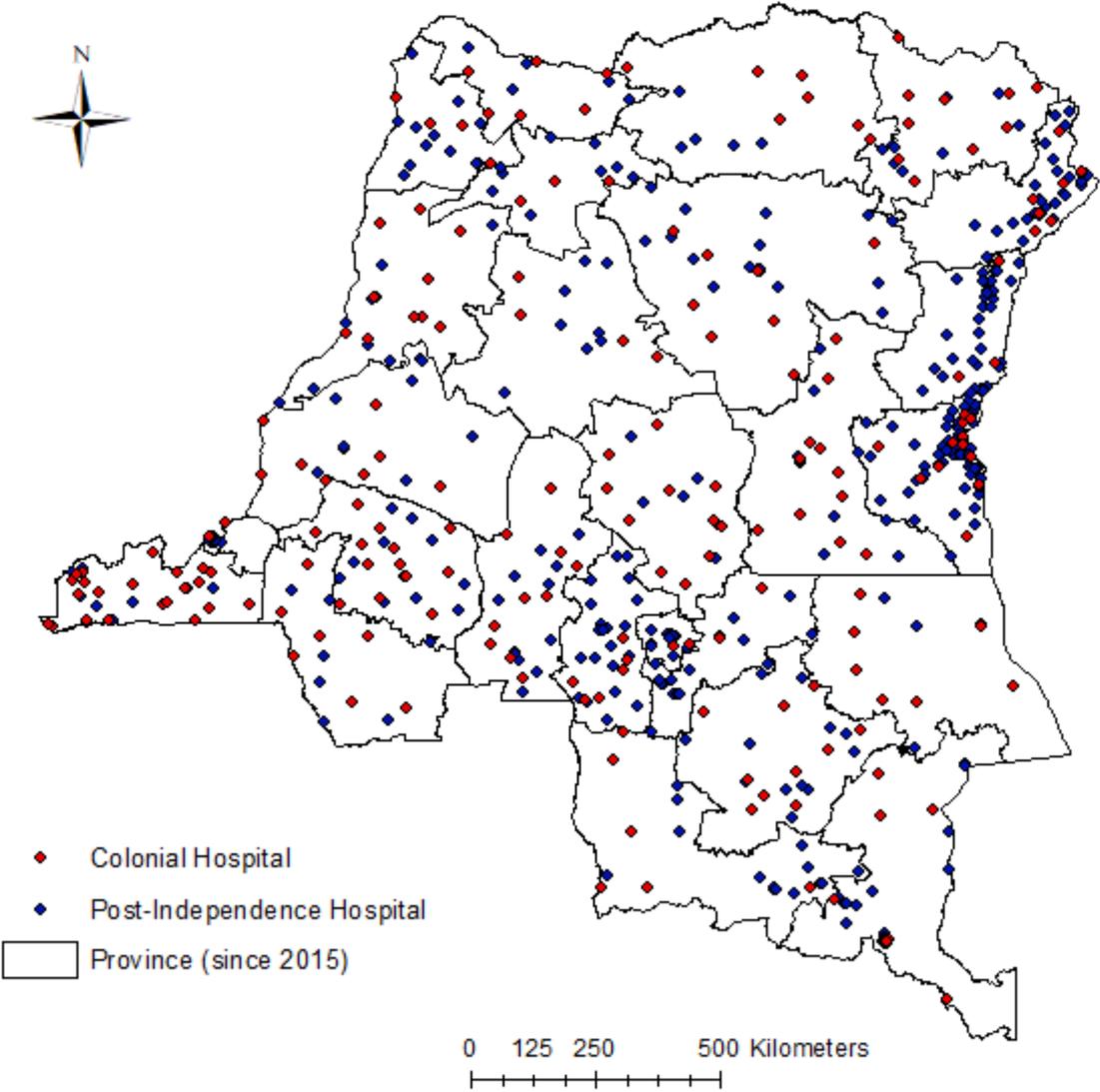

Figure 1*: Mapping of the full sample of colonial and post-independence*

Conceptual framework

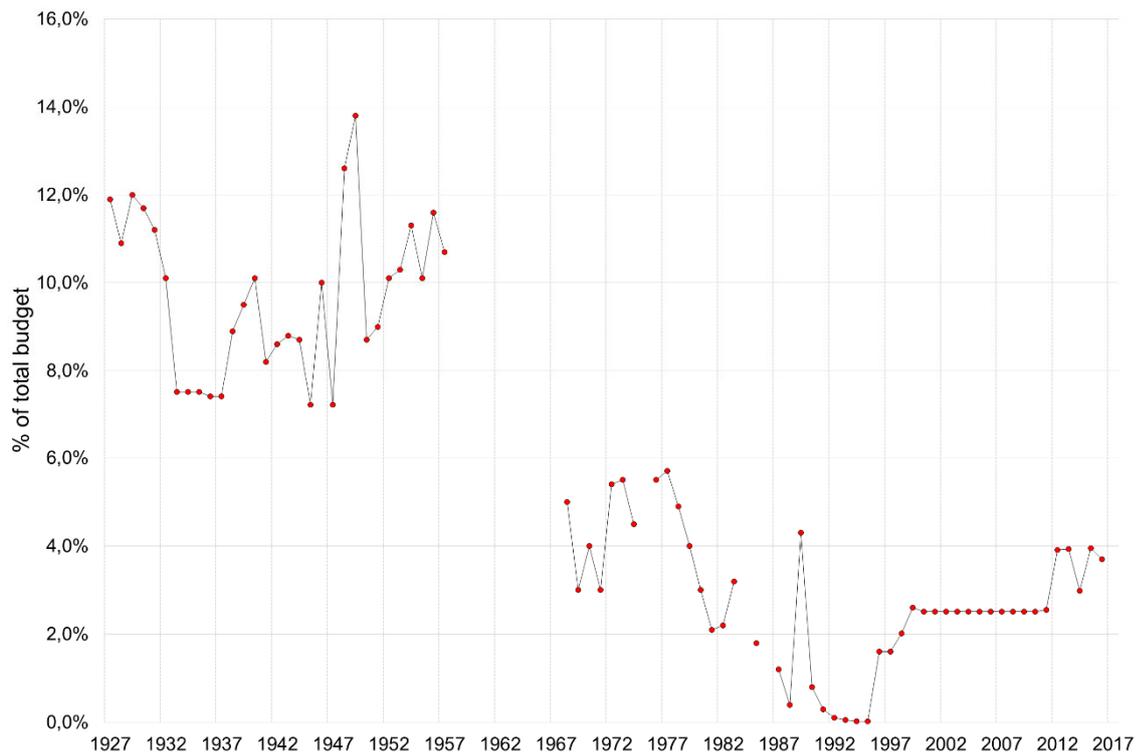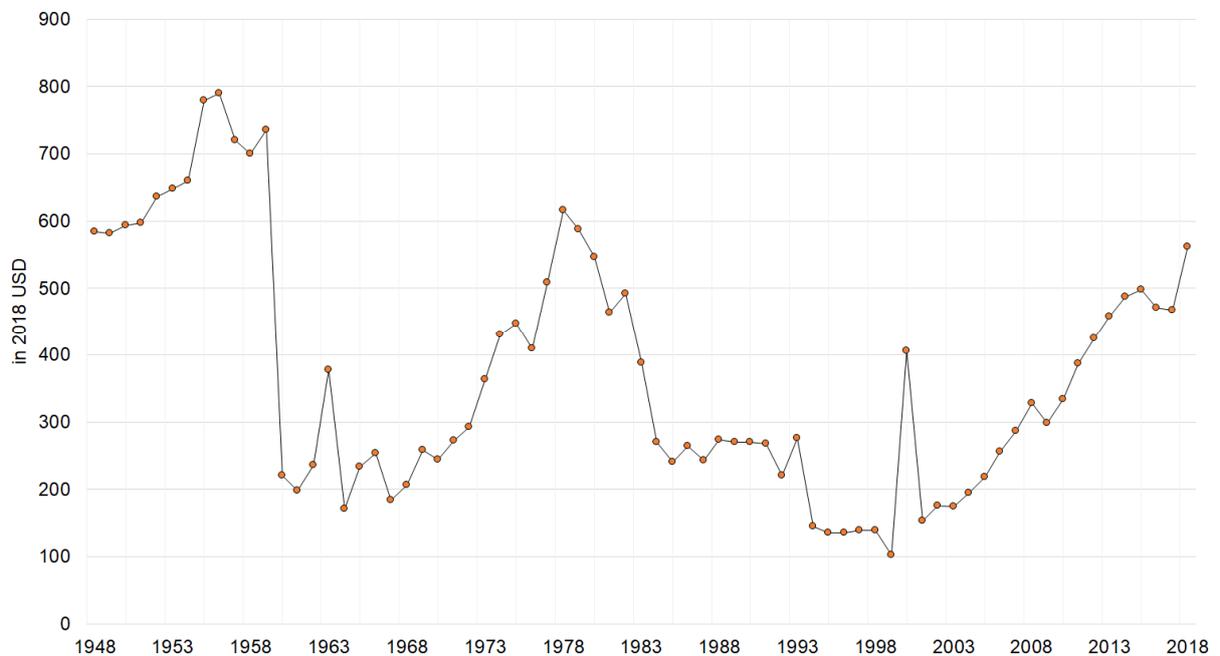Figure 2: *Share of domestic health spending in total budget, 1927-2016*

Figure 3: *DRC Gross National Income per capita in 2018 USD, 1948-2018*

Historical evidence suggests that under the colonial regime, the Belgian Congo had higher levels of public financing.[2] Figure 2 illustrates the evolution of the share of domestic health expenditures in the total budget between 1927 to 2016. While about 11 per cent of total

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[2] Vanthemsche (2012)

expenditures were devoted for health during the colonial era, this share significantly declined to a maximum of roughly 5 per cent during the post-independence period. Furthermore, the change in the government's participation in health care expenditure cannot not be solely attributed to a fall in public revenue as suggested in figure 3: the increase in Gross National Income (GNI) in the late seventies and since 2000 has not induced a similar increase in the share of domestic health spending.

How do initial investment decisions differ between facilities created before and after independence?

Although extractive, European colonialism also massively invested in infrastructure, roads and mechanised transport. The establishment of a tax system based on custom tariffs, tax on profits and revenues provided important revenues to the colony.[3] Colonial regimes were more susceptible to allocate higher resources to public hospitals than after independence: the simultaneous collapse of the state and the economy in Congo after independence and in the early 1970s significantly reduced the government's capacity to finance to health care.[4] In addition, the majority of (European) skilled workers fled the Congo following independence, leaving behind indigenous Congoleses with no formal training in business, administration or medicine. Altogether, independence can be interpreted as a negative external shock on the structural capacity of public investment in all sectors of the economy which should have affected all newly created (post-independence) health facilities.

<u>Proposition:</u> Optimal allocation of health resources implies that the central government transfers a higher health grant to colonial hospitals only when their effective stock of infrastructure capital is the highest.

I demonstrate this proposition by using a simple Cobb-Douglas production function with constant return to scale and different parameters between colonial and post-independence hospitals in the form

$$Y_t = (\Theta_t X_0)^\gamma K_t^\alpha L_t^{1-\alpha} \qquad (1)$$

Where Θ_t is the efficiency of structural investment at t, K_t and L_t denote physical and human capital respectively and X_0 is the initial infrastructure capital. Importantly, Θ_t is assumed to be significantly greater for colonial investments.

Matching estimation

I explore the effects of colonial health settlements with the matching estimation strategy. The matching procedure attempts to identify the true causal effect by using only colonial hospitals and their nearest post-independence neighbours from a predefined set of matching covariates. Specifically, the procedure consists of minimising the distance between covariate values of colonial and post-independence hospitals. The resulted matched sample is then used to obtain the colonial effects by estimating the differences in the outcome of interest between colonial and post-independence hospitals. Importantly, the underlying assumption of this strategy is the comparability of colonial and post-independence hospitals in the matched sample: the

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[3] Gardner (2013)
[4] Frankema and Buelens (2013)

outcome of a post-independence hospital is assumed to be as good as the counterfactual colonial outcome (the outcome of a "colonial" hospital if it would not have been funded during the colonial period but after independence).[5] I use three baseline covariates that are likely to be correlated with the outcome of interest: geographic location (longitude and latitude) and the size of the population served.

Results

Table 1: Matching estimates

Matching covariates	(1) geolocation	(2) geolocation & population	(3) geolocation	(4) geolocation & population
	Govt. Funding		Investment	
Colonial settlement	0.399**	0.361*	0.631**	0.279
	(0.190)	(0.191)	(0.247)	(0.250)
Obs.	441	439	423	419
	Beds		Medical staff	
Colonial settlement	0.399**	0.361*	0.631**	0.279
	(0.190)	(0.191)	(0.247)	(0.250)
Obs.	441	439	423	419
	Beds		Medical staff	
	Malaria treated		Emergency cases	
Colonial settlement	0.157*	0.182*	0.0999	0.122
	(0.0838)	(0.0935)	(0.150)	(0.123)
Obs.	617	609	590	582

Standard errors in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 1 reports the results of the matching estimations for three sets of dependent variables: financial characteristics (government funding and financing), ii) input used (bed occupancy and number of nurses) and iii) output produced (severe malaria cases treated and emergency cases). All dependent variables are divided by the number of medical staff. I find that public hospitals with colonial origins receive higher funding per medical staff from the central government and have higher bed capacity than their counterparts which were created after independence. The increased bed capacity among colonial hospitals supports the proposition made in the theoretical model that higher initial structural investment has a long-lasting impact on the physical capital of hospitals.[6]

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[5] Precisely, the identification and consistency of the estimate rely on two assumptions: i) random assignment of the treatment (the exposure to the treatment is independent of the outcome variable conditional on all relevant characteristics to the probability of treatment being observed) and ii) common support assumption, which stipulates the positive probability of being both a colonial or a post-independence hospital given a set of observable covariates.

[6] These results are robust to alternative estimation strategies: 1) using an OLS model that controls for a large set of geographical, epidemiological and demographical covariates at the local level, 2) addressing the potential

The large effects of colonial investments on modern government funding are more puzzling since the funding is mostly used to pay medical staff which is already controlled for. Why would modern hospitals with colonial origins receive a higher governmental grant?

Table 2: Matching estimates – ownership decomposition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Public	Private	Faith-based	HGR	Public	Private	Faith-based	HGR
	Govt. Funding				Investment			
Colonial	0.323*	-0.045	0.240	0.396*	0.038	1.010*	0.075	0.264
	(0.196)	(0.844)	(0.350)	(0.214)	(0.243)	(0.608)	(0.359)	(0.298)
Obs.	375	74	135	350	349	79	135	328
	Beds				Medical staff			
Colonial	8.040*	15.83	2.209	9.592*	0.0043	0.456**	0.276**	0.048
	(4.273)	(12.27)	(9.080)	(5.030)	(0.066)	(0.232)	(0.124)	(0.064)
Obs.	480	134	174	457	480	134	174	457
	Malaria treated				Emergency cases			
Colonial	0.132	0.488	0.0919	0.174*	-0.0239	-0.127	-0.0967	0.0990
	(0.090)	(0.508)	(0.163)	(0.090)	(0.123)	(0.496)	(0.274)	(0.126)
Obs.	479	139	174	453	460	125	168	442

Notes: The matching covariates are the geographic coordinates and population served. Robust Abadie–Imbens standard errors are reported in the parentheses. Government funding is divided by the number of medical staff. Government funding as well as the dependent variables in panel C have also medical staff as a matching covariate. All variables are taken in natural logarithm.Standard errors in parentheses. HGR: General Referral Hospital. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 2 attempts to elucidate this question by decomposing the colonial effects by hospital ownership: public, private, faith-based and general referral hospital (HGR). To do this, I perform a similar matching estimation as described in the baseline results, while adding an exact matching on hospital ownership.

The colonial effects on government funding are insignificant on all types of hospital ownership except for HGRs. This result is surprising since all HGRs are supposed to be fully subsidised by the central government, according to the national health policies.[7] Yet, many observers note that the limited budget allocated to health in the DRC adversely affects the subsidies transferred to hospitals, with infrequent and low disbursements.[8] The colonial effects on governmental grants could therefore underline the long-run relationship that some HGRs maintained with the central government to secure minimal funding. The historical connection of colonial hospitals with the central government might play a substantial role in attracting more attention from the political leaders. On the other hand, post-independence facilities, which tend to have lower structural capacity, might be less able to leverage government funding. Colonial investments would, therefore, provide a comparative advantage to colonial hospitals in competing with other health facilities to lay claim to limited public

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endogeneity of mission settlements by using the prevalence of sleeping sickness during the colonial era as an instrument for the settlements of colonial medical missions.

[7] Ministry of Health (2011).

[8] Ntembwa and Van Lerberghe (2014); Bertone et al. (2016).

resources. This argument echoes Banerjee et al. (2007) demonstrate that political considerations can be closely tied to the provision of public goods in resource-constrained settings.

As shown in theoretical model, the difference in initial infrastructure investments between colonial and post-independence hospitals can be a key determinant. Higher governmental funding to colonial hospitals might be the optimal solution to the central government if the effective stock of infrastructure capital is the highest in colonial hospitals. This effective stock is a product of an efficiency index of the infrastructure and the initial structural capital. I use the number of days per month without electricity to capture this index. I do not find evidence of a significant difference in the efficiency index between colonial and post-independence hospitals.

Alternative channels of persistence

I further explore whether the donor' support can be an additional channel of persistence of colonial effects. The three diseases that attract the highest share of Development Assistance for Health in the DRC are HIV, Tuberculosis and Malaria. Since domestic public health expenditures are extremely low in the DRC and insufficient to cover the population health needs, donors finance almost entirely these three disease programmes and are intensively involved in the provision, storage, and distribution of the related health products.[9] At the health facility level, donor's support can be directly observable by the availability of health products related to the three diseases. I estimate the following specification

$$Aid_f = \alpha_f + \beta Colonial_f + \mu Physician_f + \varepsilon_f \qquad (2)$$

where the dependent variable Aid_f is an indicator variable that equals 1 if the facility receives aid support and 0 otherwise. The variable $Physician$ controls for the number of physicians in health facility f that could positively affect the probability of aid support.

Table 3 reports the estimates of equation (2) using a linear probability model. The results reveal that donors' support increases by approximately 6 percentage points in hospitals with colonial origins. This quantitatively small effect becomes nonetheless statistically insignificant when the control variables are included. It is therefore not possible to conclude that donors support could be a major channel of persistence of the observed colonial effects.

Table 3: Aid support to hospitals

	Aid support			
	(1)	(2)	(3)	(4)
Colonial	0.075**	0.059	0.054	0.062
	(0.031)	(0.041)	(0.050)	(0.050)
Physician		0.022	-0.0078	-0.010
		(0.017)	(0.025)	(0.025)
Population				-0.047

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[9] Ministry of Health (2011).

				(0.036)
Obs.	1097	1052	628	620
Provincial FE	Yes	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes

Notes: The table reports the results from the estimation of equation (\ref{eq:donor}) with a linear probability model. Aid support is a binary variable equal to one if the hospital has stock of HIV or tuberculosis related drugs. All variables are taken in logarithm.* p<0.1, ** p<0.05, *** p<0.01

Conclusion

This study documents that colonial health settlements in the Belgian Congo established a network of health infrastructures with high structural capacity that persistently affected the contemporaneous performance of health facilities. I show that public hospitals with colonial origins receive higher funding from the central government than their counterparts which were created after independence. The effect persists even when the number of medical staff is controlled for. I further demonstrate that the persistence of colonial effects depends both on the type of the colonial funding source (State, religious and private firms) that established the health infrastructure and the targeted population during the colonial period (White European or Black Congolese). The long-run impacts of medical missions and their magnitude are remarkable in a country like DRC which suffered from decades of political and economic instability, civil wars and the complete collapse of the health system. Altogether, these findings highlight the importance of examining the historical roots of health facilities to assess their performance. It could help to understand the observed differences in the efficiency of health resources in improving population health at subnational levels.

Footnote references

Banerjee, A., Iyer, L., and Somanathan, R. (2007). *Public action for public goods*. Handbook of development economics, 4, pp. 3117-3154.

Bertone, M. P., Lurton, G., and Mutombo, P. B. (2016). *Investigating the remuneration of health workers in the DR Congo: implications for the health workforce and the health system in a fragile setting*. Health policy and planning, 31(9), pp. 1143-1151.

Frankema, E. and Buelens, F. (2013). *Colonial exploitation and economic development: The Belgian Congo and the Netherlands Indies compared*. Vol. 64. Routledge.

Gardner, L. (2013). *Fiscal policy in the Belgian Congo in comparative perspective*. In: Colonial Exploitation and Economic Development. Routledge, pp. 150-172.

Ministry of Health (2011). *Profil pharmaceutique de la République Démocratique du Congo*. Ministère de la Santé Publique.

Ntembwa, H. K. and Van Lerberghe, W. (2014). *Improving aid coordination in the health sector: Democratic Republic of the Congo case study*. World Health Organization.

Vanthemsche, G. (2012). *Belgium and the Congo, 1885-1980*. Cambridge University Press.

WHO (2014). *WHO global health expenditure atlas*. World Health Organization.