

Open data appetite: How nations' hunger for open government data varies with their economic complexity

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***Abstract.** There are significant cross-national differences in government data openness. The research takes an economic complexity perspective to help explain this phenomenon. It theoretically explores the notion that data openness is more valuable to complex economies, and that a nation's economic complexity is thereby an incentive to “open up” and exploit government data. Empirical data from ninety-four countries is used to test the relationship between economic complexity and government data openness. The tests indicate a moderate to strong link.*

Introduction

Studies such as Koski (2011), Vickery (2011) and Shakespeare (2013) indicate enormous unexploited value in open government data.¹ It is of no surprise then, that many governments are pursuing open data policies (Stott, 2014, p.4), and that almost every month a national government launches a new open government data portal (Davies, 2014, p.1).

However, the comprehensiveness of such initiatives varies significantly (Chui, Farrell & Jackson, 2014, p.8), and more generally, there are large differences in the extent to which countries' government data has been opened up (Open Knowledge, 2014).

This is puzzling, at least from an economic perspective. Given the economic value to be generated, why aren't nations more *comprehensively* and more *equally* advancing open government data? Why are they irrationally neglecting their economic self-interest?

Or perhaps they are not.

Stott (2014, p.5) notes four distinct drivers for governments' open data programmes: economic growth, enhancing civic engagement, increasing transparency and accountability, and improving the operations and efficiency of public services. Ubaldi (2013, p.12-16) and Granickas K (2013, p.14-24) provide a similar overview. However, these policy objectives for implementing open government data do not necessarily explain the differences in the *extent* of that implementation.

Scholars have noted many impediments to the potential opening of government data – see for instance, Janssen, Charalabidis & Zuiderwijk, 2012, p.261-263; Zuiderwijk & ors, 2012; Martin & ors, 2013; Barry & Bannister, 2014; Martin, 2014, p.226. In general terms, the commonly cited impediments can be grouped as: financial; skills and infrastructural capacity; institutional/bureaucratic resistance; technical complications; and legal/policy framework. Some of these have national level relevance and so may be relevant in partially explaining the differences between countries in government data openness.

Other factors have been advanced from the specific perspective of national level differences in government data openness. These appear less frequently in scholarly literature. They include transparency/corruption (Hogge, 2010, p.28; Weinstein & Goldstein 2012, p.40; Jetzek, 2013, p.11), democracy (Hoxha, Brahaj & Vrandecic 2011, p.237; Al Nazi & Chatfield, 2012, p.1; Lakomaa & Kallberg 2013, par. 6), and economic size (Nugruho, 2013, p.68).

It is beyond the scope of this paper to critically assess the many factors already proposed. Instead, it introduces a potential new explanatory factor – that open government data might simply be more economically valuable to some countries than to others, affecting their appetite for it. Specifically, the paper intends to answer the question: “is the open availability and exploitability of a country's government data linked to its economic complexity?”

¹ The reader is assumed to be familiar with the concept of open data, and specifically open government data. For an authoritative and broadly accepted definition of open data, and principles of open government data, see <http://opendefinition.org> and <http://opengovdata.org> respectively.

The question is addressed by leveraging from existing literature, and is then tested empirically. Specifically, the correlation between a pair of proxy data sets is assessed. To add to the robustness of the empirical analysis, an alternative proxy is also used. The correlation in both cases is significant, and offers support for the theoretical case.

The intended contribution of the paper is twofold – to help explain the seemingly irrational behaviour of governments “lagging” others in their adoption of open data initiatives, and to provide an alternative perspective for interpreting the rankings of government data openness indices.

Data as an ingredient of innovation

Various scholars have highlighted the link between innovation and economic value – for instance Solow (1957), Romer (1986; 1990), Lucas (1988) and Malecki (1997).

The process of innovation depends heavily on knowledge (Gloet & Terziowski, 2004, p.402), which in turn depends on the progressively lower order resources of information and *data* (Cleveland, 1982, p.34; Zeleny, 1987; Ackoff, 1998).

It is now recognised that “data are a core asset that can create a significant competitive advantage and drive innovation” (OECD, 2013, p.4), so, as will be elaborated later in the paper, a fundamental appeal of open government data is its potential as an input to innovation and therefore economic value.

Open government data as a public good

Applying a pair of economic distinctions, open government data is *non-depleting* (Samuelson, 1954), as it is undiminished by consumption, and *non-excludable* (Musgrave, 1983), as its consumption is available to all. Or put another way, one's use of open government data does not leave less of that data for others, nor does it prevent others from using it. These are the two essential characteristics of a public good.

This has two important implications. Firstly, public goods can create positive externalities – in the form of spill-over benefits to other parties – that cannot be captured as revenue by the party generating the public good (Meade, 1952). As Doctorow (2013) puts it, “just because something has value doesn't mean it has a price”.

By “opening” their otherwise retained data, governments make it free and easy to use data that would otherwise have been withheld, or provided on a restricted basis. They thus transform it from being *excludable* (or *partially excludable* (Romer, 1990)), to *non-excludable*. In doing so they render the data a true public good, thus unlocking the potential for the positive spill-over. This is analogous to the knowledge spill-over identified by Arrow (1962), and can be very valuable. Not surprisingly, The Economist (2010) asserts: “public access to government figures is certain to release economic value and encourage entrepreneurship”.

The second implication is that because public goods lack a price mechanism, there is no efficient private market for them. This is generally regarded as a justification, or an imperative, for government intervention. For instance, Stiglitz, Orszag & Orszag (2000) counsel that providing data is not only a proper role of government, but that it should “seek to make as much public information and data available on-line as possible” (p.53). Gruen (2015) promotes the opening up of government data as a “public private partnership in building the public goods of the information age” (p.3). Linking the need for intervention with its core purpose – the spill-over – Stiglitz (2014) points out that “neither [the influential Harvard economist and political scientist] Schumpeter, nor others arguing for the virtues of markets on the basis of their innovativeness, was able to show that markets were efficient in innovation” and therefore reasons that the government must intervene to stimulate knowledge, learning and innovation (p.19). Similarly, parliamentarian Turnbull (in Gruen, 2015, p.2) notes: “one of the most obvious ways governments can encourage innovation is by making their stores of information available, in machine readable form, to everyone”.

Complex economies

Hidalgo & Hausmann (2009) introduced a *complexity* approach to explain the economic performance of a country using its network structure (rather than aggregates) of economic output. A complex national economy – one that relative to other countries exports a diverse mix of products, especially uncommon

products – is shown to have much better growth prospects relative to current income than a country with a less sophisticated export basket (Hidalgo & Hausmann, 2009; Hausmann & Hidalgo, 2011).

This approach shows that “poorly diversified countries make products that most other countries make, while highly diversified countries make those products plus the products that few other countries make” (Hausmann & Hidalgo, 2011, p.311). It also indicates “the number of new products that a country can make increases with the number of [its] capabilities” (Hausmann & Hidalgo, 2011, p.336). They further explain this (at p.339):-

Countries with few capabilities will be able to make few products and will have scant benefits from accumulating any individual additional capability. This is because the likelihood that a new capability will be able to synergize with existing capabilities and become useful for the production of a new product is low in the absence of the other requisite capabilities. Therefore, the demand for any randomly selected additional capability is likely to be zero in countries with few capabilities. By contrast, countries with many capabilities would be able to produce many new products by combining any new capability with different subsets of the capabilities they already possess.

Accordingly, government data will be of low/no utility in a country of low product diversity, as their endeavouring to convert that data into a capability of applied knowledge would probably be wasteful, given the low potential application for that knowledge. Or as Hausmann & ors (2014) more succinctly put it, “accumulating bits of productive knowledge will make little sense in places where the industries that require it are not present” (p.7).

Conversely, “complex economies...weave vast quantities of relevant knowledge together, across large networks of people, to generate a diverse mix of knowledge-intensive products” (Hausmann & ors (2014, p.18). In that context, data spill-over is a valuable. Not only does it have productive potential, it is *required* to fuel innovation in the country's existing products and help create new products. Accordingly, in complex economies, there is likely to be strong “appetite” for data, including government data. In considering why government data is opened up more widely in some countries than others, Janssen (2011) speculates, among other things, that “[m]aybe the government or the public bodies do not realize the value of their data for others” (p.452). This seems plausible, but perhaps risks implying that governments are entirely pro-active in opening their data – that is, government open data is merely an outcome of “push” (supply), absent of any “pull” (demand). Yang & Kankanhalli (2013, p.645) note that the demand side of open government data receives little research attention. Yet clearly such demand exists and is expressed to government. For instance, Stott (2004) observes that: “innovators and entrepreneurs were more likely to act as a result of spotting a market opportunity, and then seek the data needed to build a service to address it, rather than observe the availability of data and try and invent ways of using it” (p.9). Huijboom & Van den Broek (2011) note that “the drivers [of open government data] lie predominantly outside government, the barriers are within government” (p.9). Bates (2012) found that the open data movement, (at least in their study country of the United Kingdom), had little political traction until business actively campaigned for it.

Correlation testing

The empirical analysis uses data of proxies to test the correlation between government data openness and the economic complexity of countries. The countries included in the sample are all those for which a corresponding pair can be drawn from the respective proxy datasets.

The proxy selected for data openness is the World Wide Web Foundation's Open Data Barometer (Davies, Sharif & Alonso, 2015), specifically the sub-indexes Readiness, and Implementation, the scores of which have been aggregated for analysis purposes. The Readiness sub-index scores the extent to which a country has readied itself to implement an open data initiative successfully. It is based on an expert survey, complemented by secondary data from the World Economic Forum, United Nations e-Government Survey and Freedom House. The Implementation sub-index is based on a peer reviewed expert survey and a detailed dataset survey. It scores the extent to which a country has made significant data sets available as open data. The Open Data Barometer includes a third dimension – the Impact sub-index – but this has low relevance to the current analysis, so has not been included.

For comparison, an alternative proxy is also used – the Global Open Data Index by Open Knowledge (2014). Unlike its counterpart, the multi-dimensional Open Data Barometer, the Global Open Data Index purely measures the degree to which governments have opened specific, key datasets. That is, its scope is narrower by design.

The proxy used to represent economic complexity is the Atlas of Economic Complexity (Hausmann R & Hurn 2014), specifically its Economic Complexity Index. The index sorts countries based on the amount of productive knowledge implied in their basket of exports.

The assembled data is shown in the table below.

Table – input data used for empirical analysis

COUNTRY/ (TERRITORY)	ECONOMIC COMPLEXITY INDEX 2014 (Year 2013 data)	OPEN DATA BAROMETER (Year 2014 data)			GLOBAL OPEN DATA INDEX (Year 2014 data)
		Sub-indices "Readiness" + "Implementation"	Sub-index "Readiness"	Sub-index "Implementation"	
Argentina	-0.1795602	85	48	37	42
Australia	-0.4263481	161	92	69	72
Austria	1.7741020	125	83	42	59
Bangladesh	-1.0892750	36	24	12	34
Belgium	1.2110320	116	86	30	39
Botswana	-0.6290607	33	26	7	19
Brazil	0.1029131	129	66	63	54
Bulgaria	0.6141351	–	–	–	41
Cambodia	-0.8625131	–	–	–	27
Cameroon	-1.4476120	14	11	3	23
Canada	0.5880209	165	90	75	59
Chile	-0.2068380	144	69	75	61
China (ex. Hong Kong)	1.1134810	76	52	24	37
Colombia	0.0366673	84	54	30	66
Costa Rica	0.0146312	89	56	33	38
Croatia	0.8723580	–	–	–	41
Czech Republic	1.7601930	125	64	61	66
Denmark	1.1772090	148	94	54	83
Ecuador	-0.9520293	85	42	43	44
Egypt	-0.1674301	43	27	16	25
El Salvador	-0.0121301	–	–	–	37
Estonia	0.8757979	135	84	51	–
Ethiopia	-1.4153180	25	16	9	–
Finland	1.7958410	147	93	54	73
France	1.4863730	166	91	75	80
Georgia	-0.1137857	–	–	–	50
Germany	2.0355900	152	85	67	69
Ghana	-0.9569041	71	35	36	24
Greece	0.1727422	103	60	43	38
Guatemala	-0.3854875	–	–	–	33
Guinea	-2.0767160	–	–	–	10
Hong Kong	0.8635684	–	–	–	38
Hungary	1.5365280	86	48	38	48
India	0.2574860	93	56	37	68
Indonesia	-0.1392084	87	46	41	43
Ireland	1.3333100	113	74	39	48
Israel	1.1148420	121	70	51	46
Italy	1.4196730	109	55	54	55
Jamaica	-0.2392239	69	42	27	43
Japan	2.3481820	134	81	53	61
Jordan	0.1332699	54	40	14	–
Kazakhstan	-0.6999299	70	40	30	–
Kenya	-0.4333492	65	42	23	22
Korea (South)	1.9296800	133	79	54	53
Latvia	0.5683572	–	–	–	51
Lebanon	0.2759996	–	–	–	22
Lithuania	0.6975712	–	–	–	32
Macedonia, the FYR	-0.1414956	–	–	–	35
Malawi	-0.8655115	39	26	13	–
Malaysia	0.7874141	81	44	37	–
Mauritius	-0.1023210	60	35	25	–
Mexico	1.0791530	121	67	54	53
Moldova	-0.0730508	–	–	–	44

Table continued...

COUNTRY/ (TERRITORY)	ECONOMIC COMPLEXITY INDEX 2014 (Year 2013 data)	OPEN DATA BAROMETER (Year 2014 data)			GLOBAL OPEN DATA INDEX (Year 2014 data)
		Sub-indices "Readiness" + "Implementation"	Sub-index "Readiness"	Sub-index "Implementation"	
Morocco	-0.5323563	62	47	15	25
Mozambique	-1.2104280	43	21	22	–
Namibia	-0.4434603	34	25	9	–
Netherlands	1.0168730	171	95	76	64
New Zealand	0.0150814	169	81	88	72
Nigeria	-1.8869250	45	39	6	29
Norway	0.7056139	161	88	73	71
Oman	-0.4220883	–	–	–	18
Pakistan	-0.8305064	43	32	11	45
Panama	0.3535757	–	–	–	25
Paraguay	-0.6529082	–	–	–	45
Peru	-0.7803960	93	44	49	–
Philippines	0.3212904	76	58	18	31
Poland	1.0702040	92	46	46	42
Portugal	0.6482422	120	70	50	47
Qatar	-0.4919712	55	46	9	–
Romania	0.8936864	–	–	–	64
Russia	0.4005627	102	54	48	43
Saudi Arabia	-0.0448647	53	38	15	28
Senegal	-0.6577639	42	34	8	34
Serbia	0.5579252	–	–	–	42
Singapore	1.6137480	110	71	39	34
Slovakia	1.6619780	–	–	–	35
Slovenia	1.5670920	–	–	–	54
South Africa	-0.0899121	79	48	31	48
Spain	0.9562754	138	78	60	52
Sweden	1.8172560	176	100	76	66
Switzerland	2.3313620	119	81	38	58
Tanzania	-0.9497769	32	17	15	21
Thailand	0.9931926	54	33	21	36
Tunisia	0.1689951	77	58	19	34
Turkey	0.4372690	82	47	35	53
UAE	-0.0362714	75	53	22	–
UK	1.7059250	198	98	100	97
Ukraine	0.4653941	60	37	23	–
Uruguay	0.0487153	117	66	51	66
US	1.5470810	184	96	88	70
Venezuela	-0.8336459	36	20	16	–
Vietnam	-0.1860898	42	16	26	–
Yemen	-1.4836950	19	12	7	–
Zambia	-0.4236829	27	19	8	27
Zimbabwe	-0.8495688	30	20	10	24

In each case, data from the most recently published year of the index is used. This provides for the comparison of seventy-five countries in the first correlation test (using the Open Data Barometer as proxy), and seventy-eight countries for the second test (using the alternative proxy), plus the Hong Kong Special Administrative Region of the People's Republic of China.² The correlation plots of this data are shown below.

² Hong Kong Hong Kong is itemised separately from China only because that is how it has been treated in the indices.

Chart 1 – ECONOMIC COMPLEXITY vs GOVERNMENT DATA OPENNESS
(Scenario: Open Data Barometer)

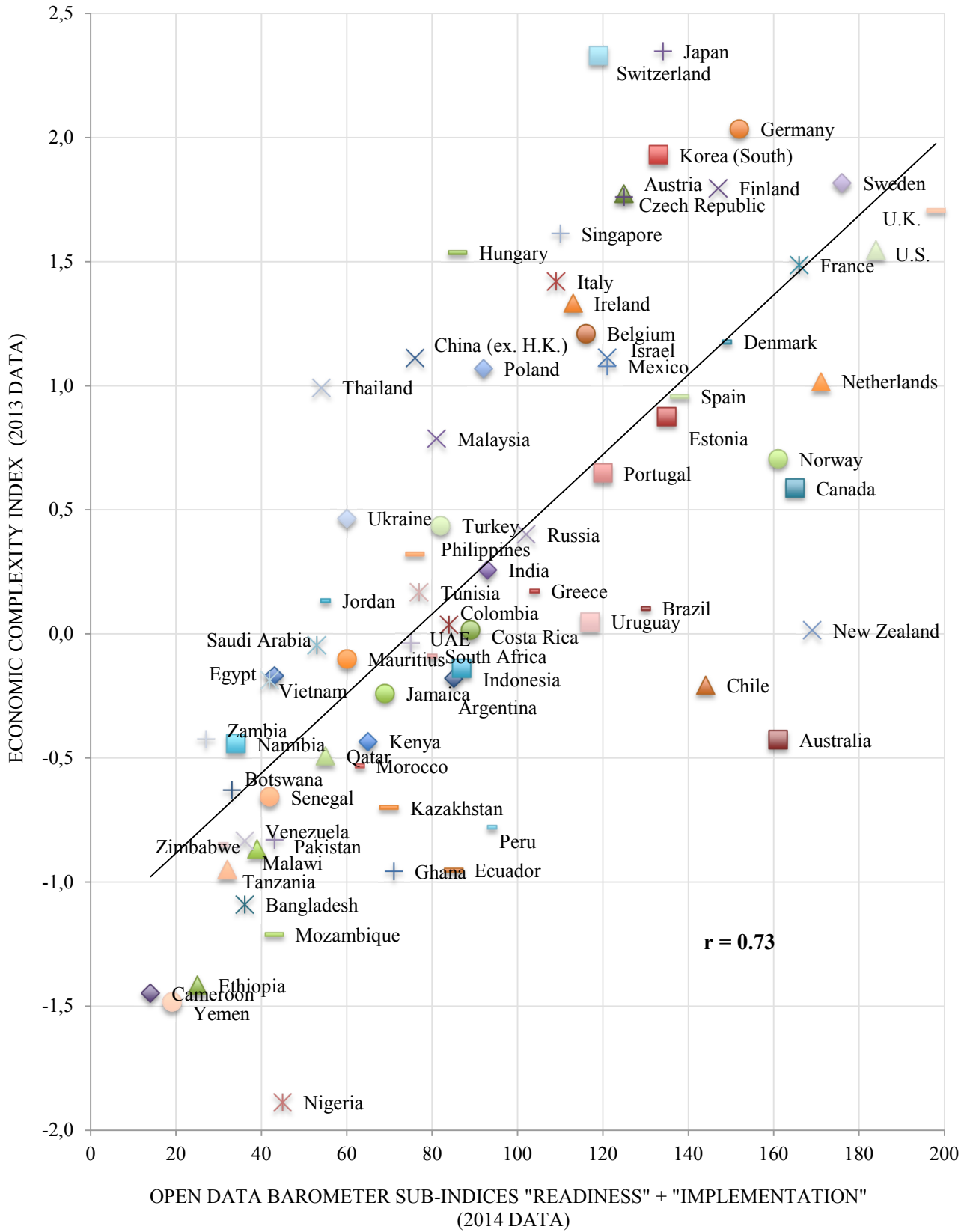
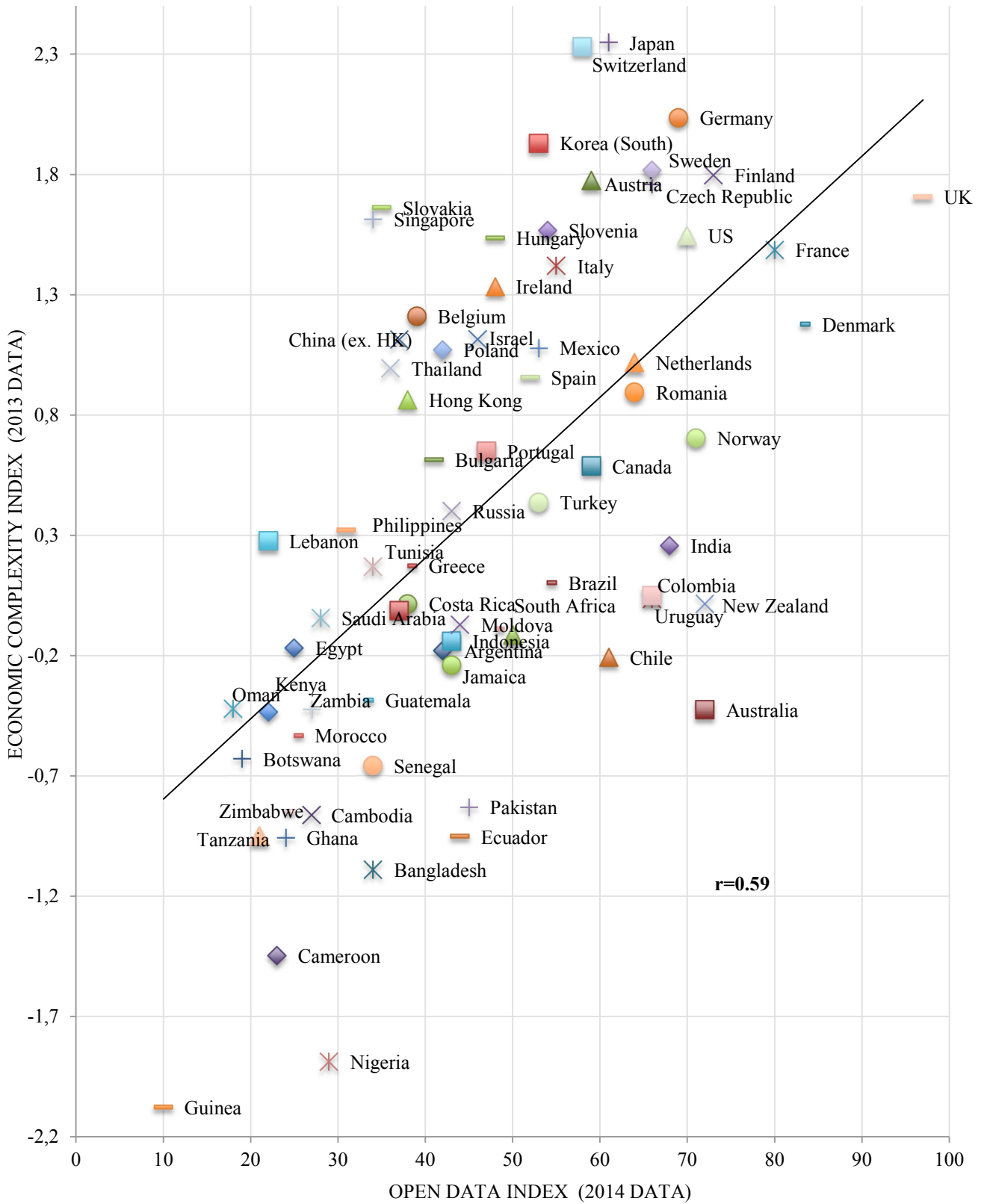


Chart 2 – ECONOMIC COMPLEXITY vs GOVERNMENT DATA OPENESS
Scenario: Open Data Index



In terms of the overall pattern, the position of specific countries, and the correlation, the outcomes in both scenarios are broadly similar.

Discussion and conclusions

The empirical analysis indicates moderate to strong correlation between the proxy datasets, which supports the theoretical hypothesis of a link between a nation's economic complexity and its data openness. That is, open government data is more present in economically complex countries.

It is interesting to note that many of the countries that rank highly in the indices of government open data openness – for instance the United Kingdom – fall behind or merely hug the trend-line. Their level of government data openness is no more than what the scope and ubiquity of their exports would suggest would be the case. Once economic complexity is taken into account, the entire Group of Eight Industrialised Nations is “lagging” in government data openness when compared with countries such as Australia, New Zealand and Chile. Given that country rankings risk stimulating self-congratulation, complacency and even condescension, perhaps the economic complexity perspective provides a partial antidote in this case, should one be required.

Although “interest in open data has been increasing for many years” (Chui, Farrell & Jackson, 2014, p.8), the phenomenon of opening government data is relatively new (Janssen, Charalabidis & Zuiderwijk, 2012, p.259; Stott, 2014, p.5), at least its current form (Berners-Lee & Shadbolt, 2011, para. 6; Janssen, 2012, para. 2-3). Both of the open data indices used are only in their second year of publication. The indices are at this stage probably capturing not just broad differences in demand for and commitment to open government data, but also the more short-term differences in progress of initial roll-outs. It seems plausible that correlation would increase slightly as open data initiatives underway become more fully established. It may be useful to repeat the test in subsequent years to consider the change in correlation over time, and as more countries are added to the indices.

The proxies used for government data openness are not intended to be direct substitutes for each other, and they comprise different (but overlapping) country sets. There is nonetheless a significant difference in the correlation results between the two scenarios. This is considered to be largely attributable to the more narrow focus of the Open Data Index. In addition to the assessing the *availability* of open data, the Open Data Barometer better reflects its *exploitability* (through its Readiness sub-index), by considering whether the supporting context is in place to facilitate the further release and use of open government data. For instance, it considers the strength of a country's data protection laws and regulation (Davies, Sharif & Alonso, 2015, p.12 & p.20) in respect to their ability to help prevent inappropriate release of private data with open public data. It also considers: the degree of dialogue between the government, civil society and information technology professionals regarding government open data; the degree the government supports a culture of innovation with open data; a country's “right-to-information” framework; and the resourcing of open government data initiatives (Davies, Sharif & Alonso, 2015, p.12 & p.19-20). Although arguably somewhat complicating the interpretation of results, the inclusion of these additional factors does not weaken the suitability of the proxy. On the contrary, it helps fully address the research question. Further, it intuitively makes sense that the inclusion of such factors would increase the correlation, as if it is the case that a complex country is inherently “hungry” for open government data, it should also be hungry for a framework to ensure that the release and use of such data is successful. As shown in Chart 1 above, the co-efficient of correlation is 0.73 when the data openness proxy is two sub-indexes aggregated. Although not shown as charts, correlation tests were also undertaken on the sub-indexes separately. The Readiness sub-index delivered a correlation of 0.77, the Implementation sub-index a correlation of 0.62. The latter correlation much more closely reflects the correlation co-efficient of 0.59 in Chart 2. This is not unexpected, as those particular two proxies are closer in nature.

It might be valuable to at some later stage consider more deeply and probe the causes underlying the correlations derived. In the mean time, this preliminary and exploratory research raises some interesting considerations.

For instance, it encourages speculation as to why some countries appear to be implementing open government data to a degree well beyond that implied by their economic complexity. The theory considered suggests that in terms of creating economic value from innovation, it may be a waste – at least in direct terms for the local economy. On the other hand, open data is not merely a public good, but a *global* public good, so the data producing country may still indirectly benefit from the value created by the exploitation of their open data by other countries, especially if the producer's is an open economy. It perhaps also suggests that the governments of these countries are acting relatively more proactively to deliver the other economic value realisable from open government data (– for instance, internal efficiency), as well as social value. Although this research has taken an economic perspective, if anything, it supports the case that government data openness is driven by economic as well as social factors.

In terms of policy implications, considering economic complexity may help assess more critically the intended purpose open government data policy. For instance, if a purpose of foreign development aid for open government data projects is to foster innovation, does the economic complexity context of the recipient country support this?

As mentioned in the introduction, a variety of factors have been advanced by others to explain the differences in government data openness between countries. Unfortunately, little research has been undertaken on their explanatory power. As a most basic starting point, it may be productive extension research test the correlation of government data openness with for instance: transparency, using proxy data from say, the Corruption Perceptions Index (Transparency International, 2014); or democracy – using the Democracy Index (Economist Intelligence Unit, 2014).

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