

The importance of cloud policies to promote economic development in Sub-Saharan Africa

Dr. Raul L. Katz



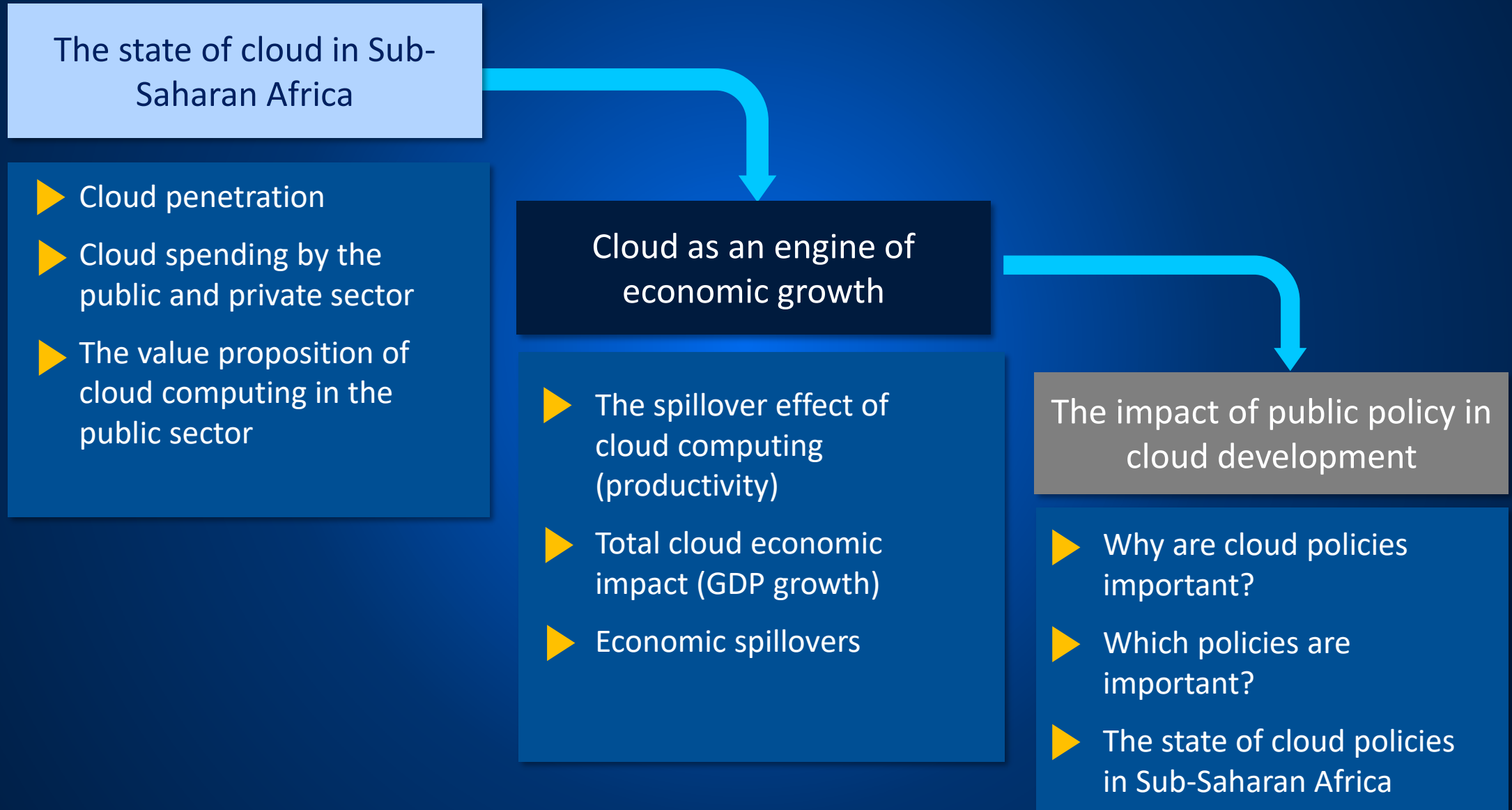
October 17, 2023



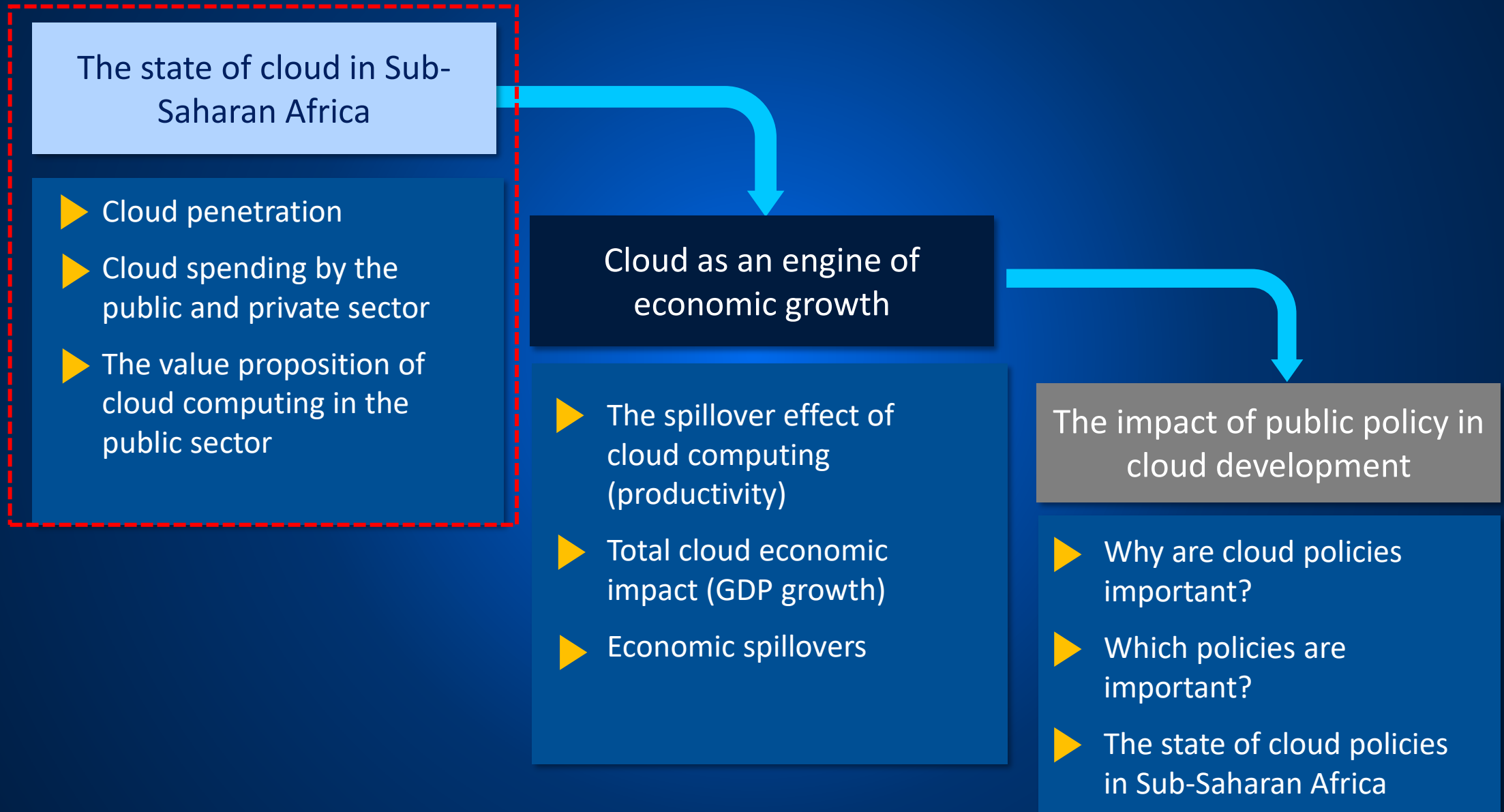
Telecom Advisory Services LLC

New York — Buenos Aires — Madrid — Bogotá — Quito

THIS RESEARCH ADDRESSES THE ECONOMIC CONTRIBUTION OF CLOUD ADOPTION IN SUB-SAHARAN AFRICA, AND THE IMPACT OF PUBLIC POLICIES ON OVERALL INDUSTRY GROWTH

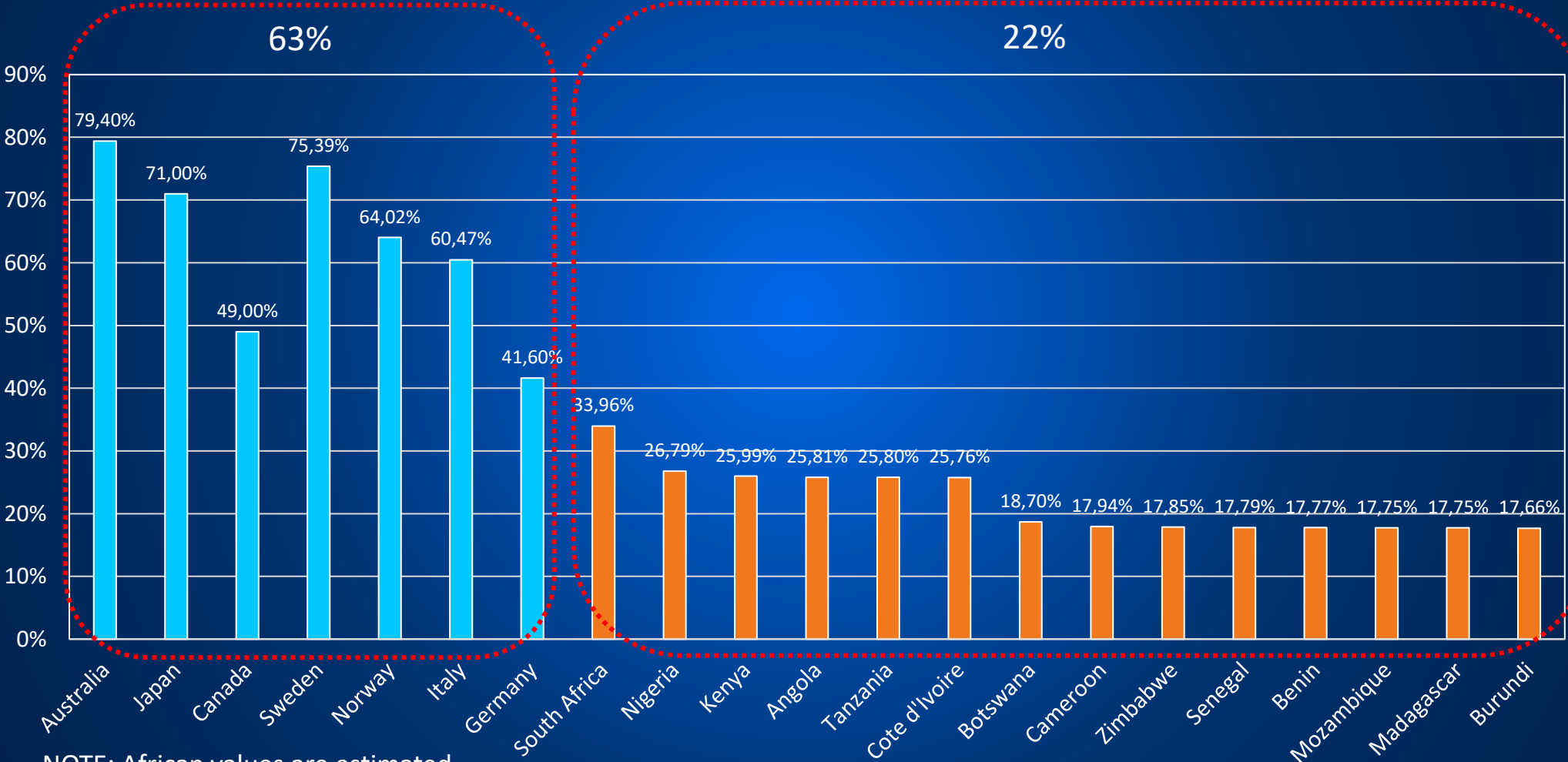


WE FIRST ASSESS THE DEVELOPMENT OF CLOUD COMPUTING IN THE REGION



CLOUD ADOPTION IN SUB-SAHARAN AFRICA AVERAGES 22%, RANGING BETWEEN 34% AND 18% OF ENTERPRISES – THE AVERAGE IN ADVANCED ECONOMIES IS 63%

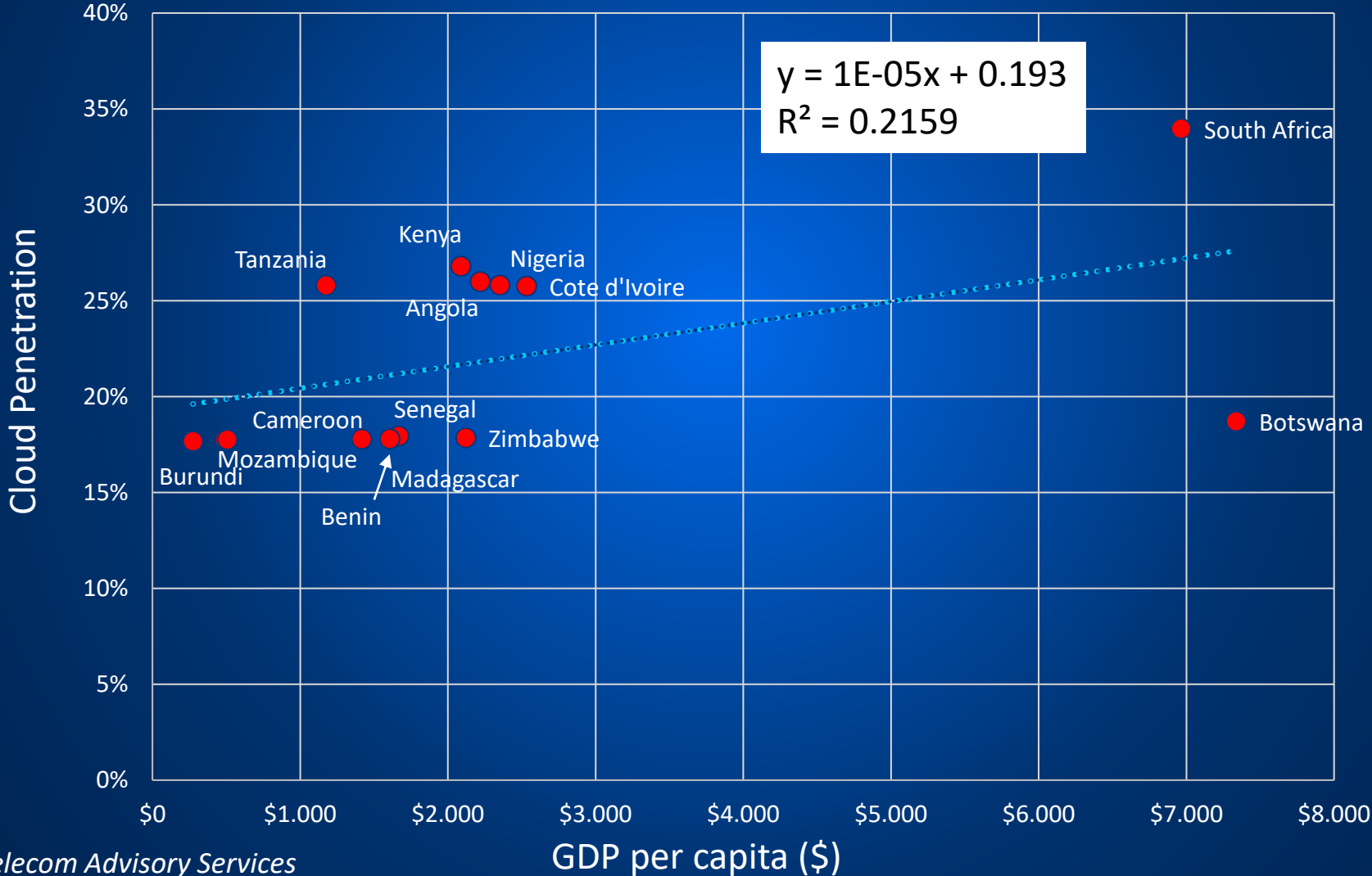
CLOUD PENETRATION (2021)



NOTE: African values are estimated
 Sources: OECD Stat; Telecom Advisory Services analysis

AS EXPECTED, CLOUD ADOPTION IS ASSOCIATED WITH ECONOMIC DEVELOPMENT – HOWEVER, OTHER VARIABLES APPEAR TO BE AT WORK

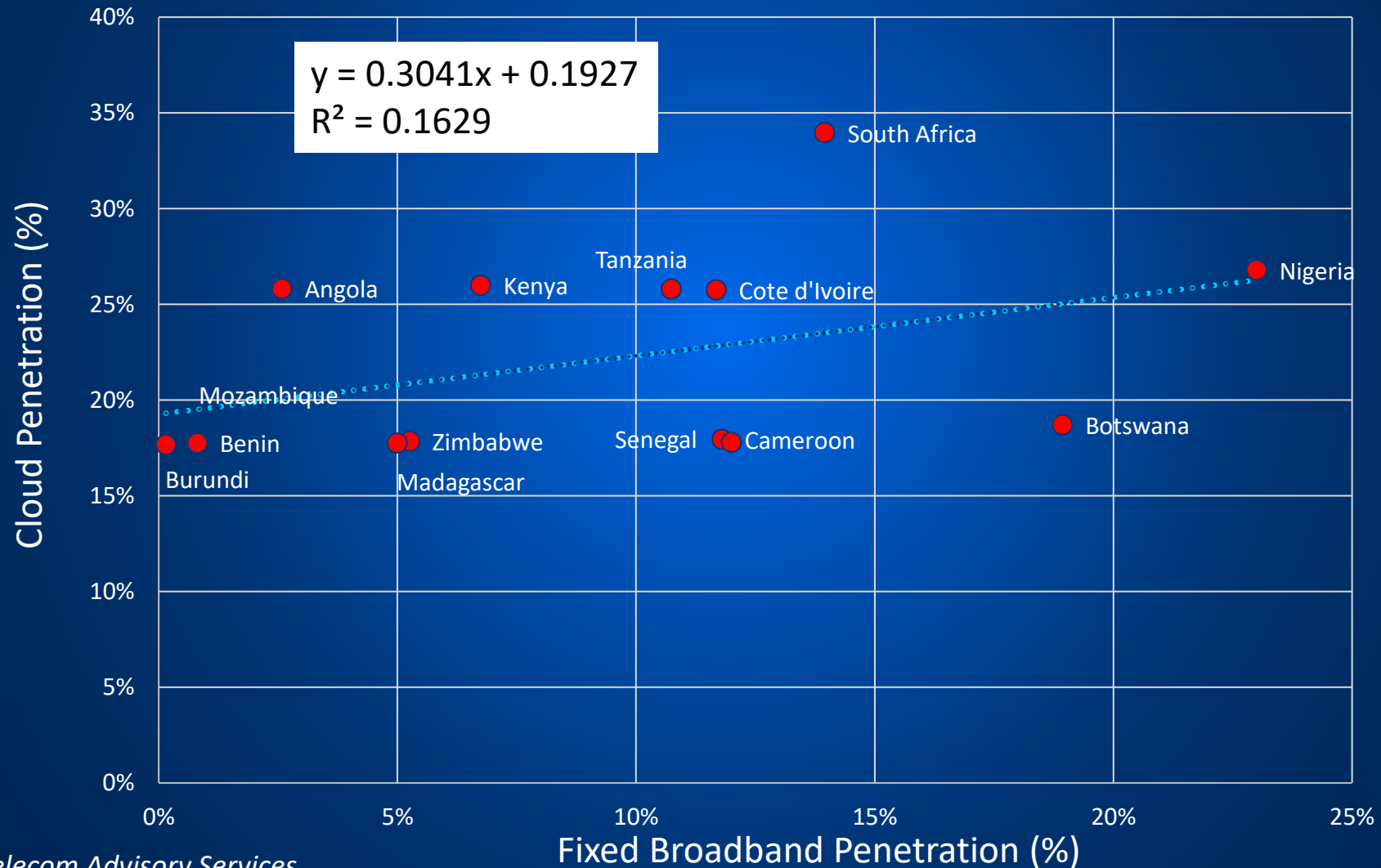
GDP PER CAPITA vs. CLOUD PENETRATION



Sources: IMF; Telecom Advisory Services

FIXED BROADBAND, AS A COMPLEMENTARY TECHNOLOGY, IS ALSO A FACTOR AFFECTING CLOUD ADOPTION

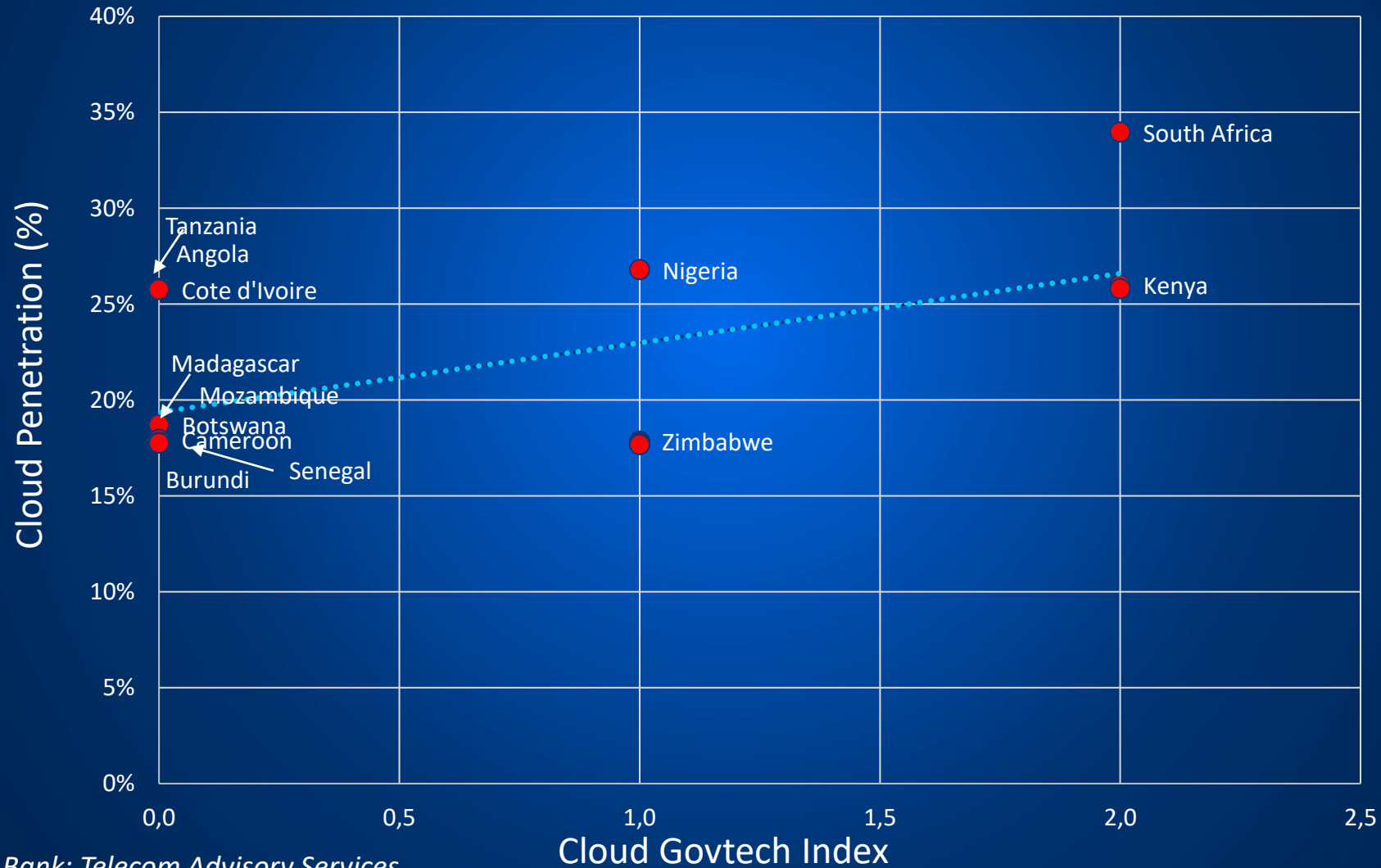
CLOUD ENTERPRISE PENETRATION vs. FIXED BROADBAND ADOPTION (2021)



Sources: ITU; Telecom Advisory Services

YET, ANOTHER FACTOR INFLUENCING CLOUD ADOPTION IS CLOUD POLICY

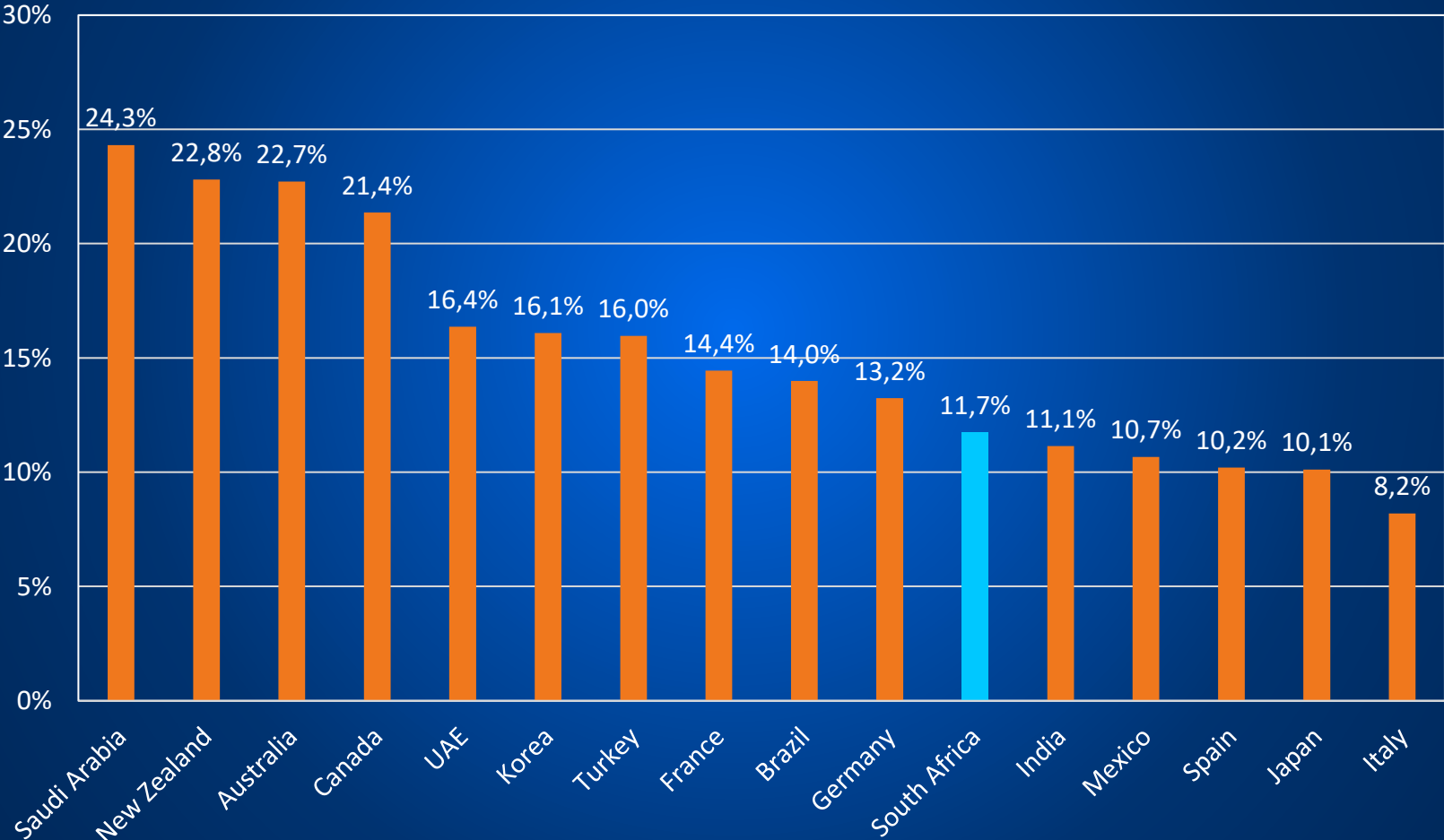
CLOUD GOVTECH POLICY INDEX (2022) vs. CLOUD PENETRATION (2021)



Sources: World Bank; Telecom Advisory Services

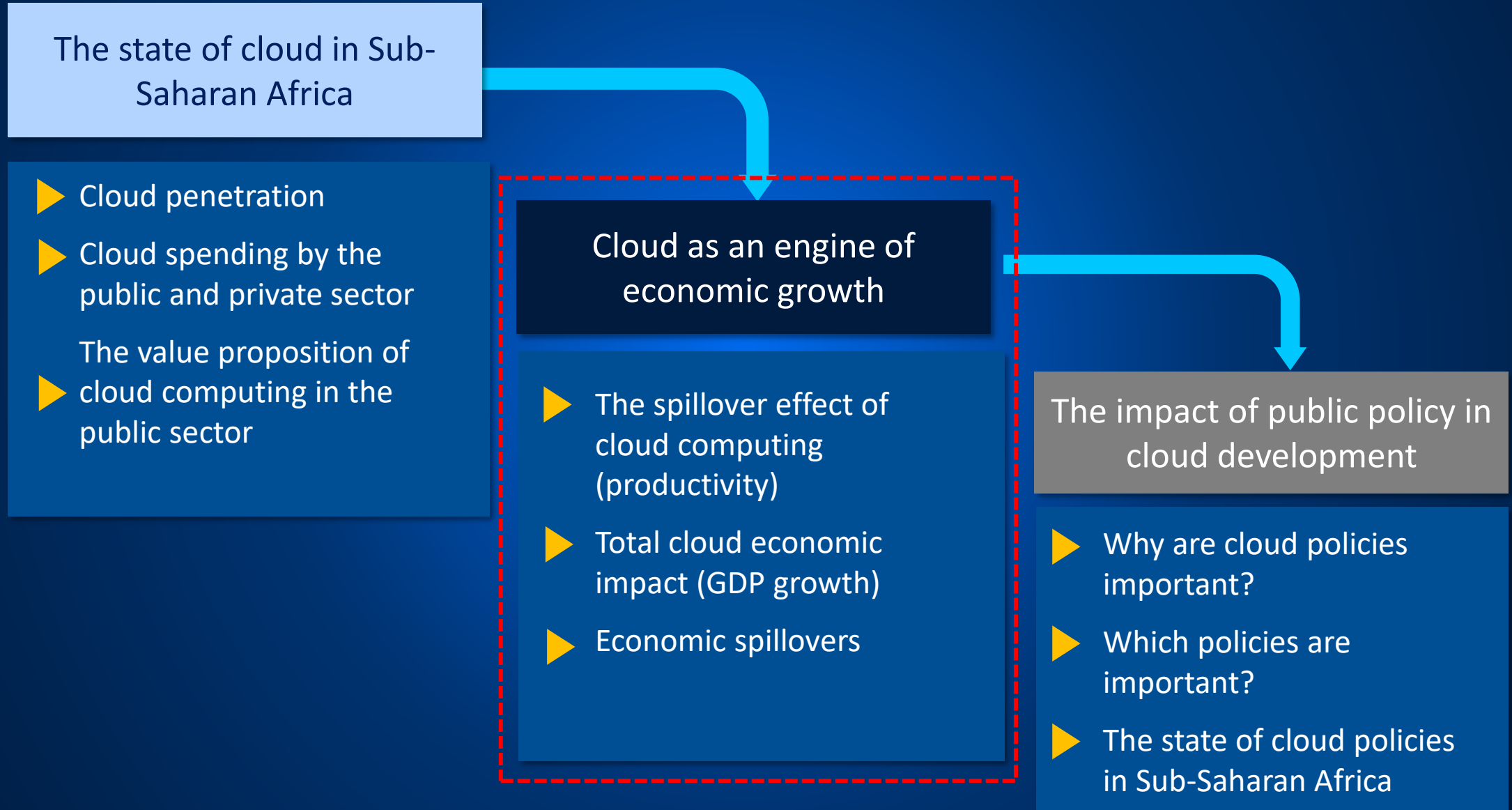
FINALLY, CLOUD USE BY THE PUBLIC SECTOR IS ANOTHER FACTOR DRIVING CLOUD DEVELOPMENT SINCE GOVERNMENTS ARE PRIMARY USERS

PUBLIC SECTOR CLOUD SPENDING AS PERCENT OF TOTAL SPENDING (2021)



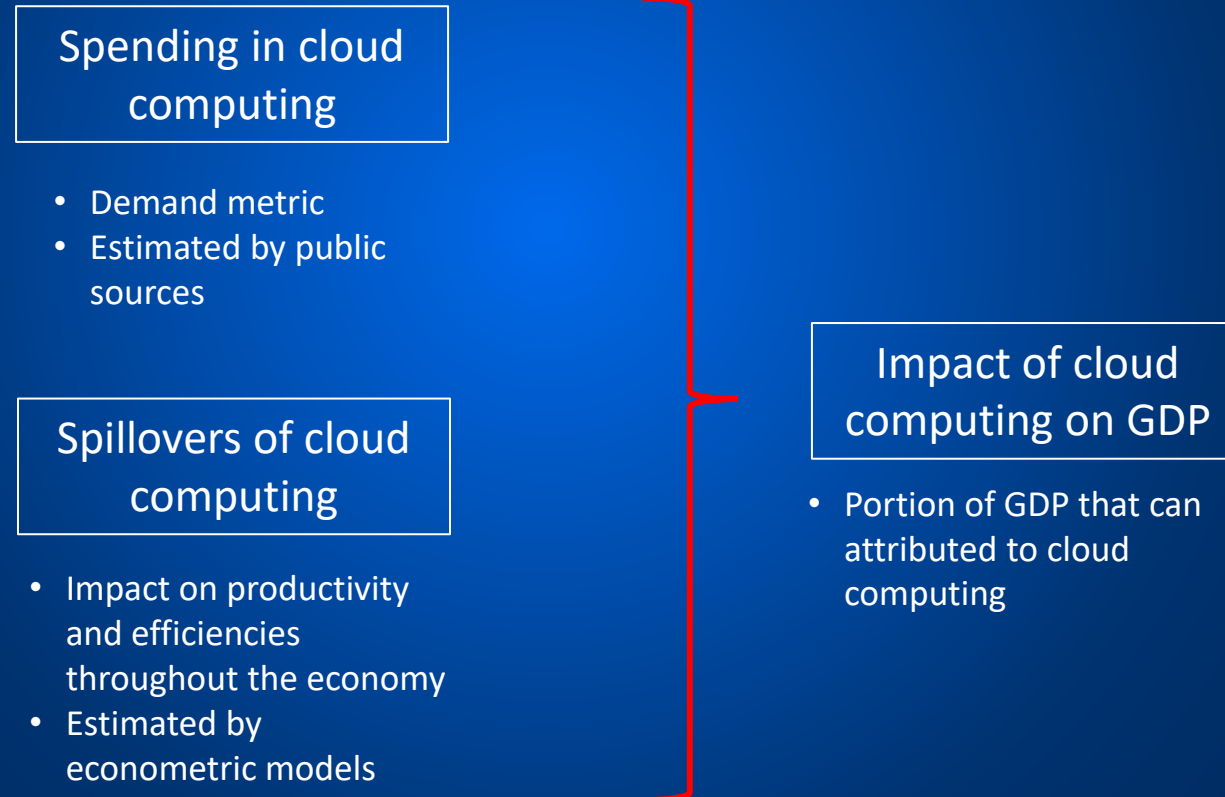
Sources: IDC; Telecom Advisory Services

OUR RESEARCH INDICATES THAT CLOUD CONTRIBUTES SIGNIFICANTLY TO THE ECONOMIES OF SUB-SAHARAN AFRICA



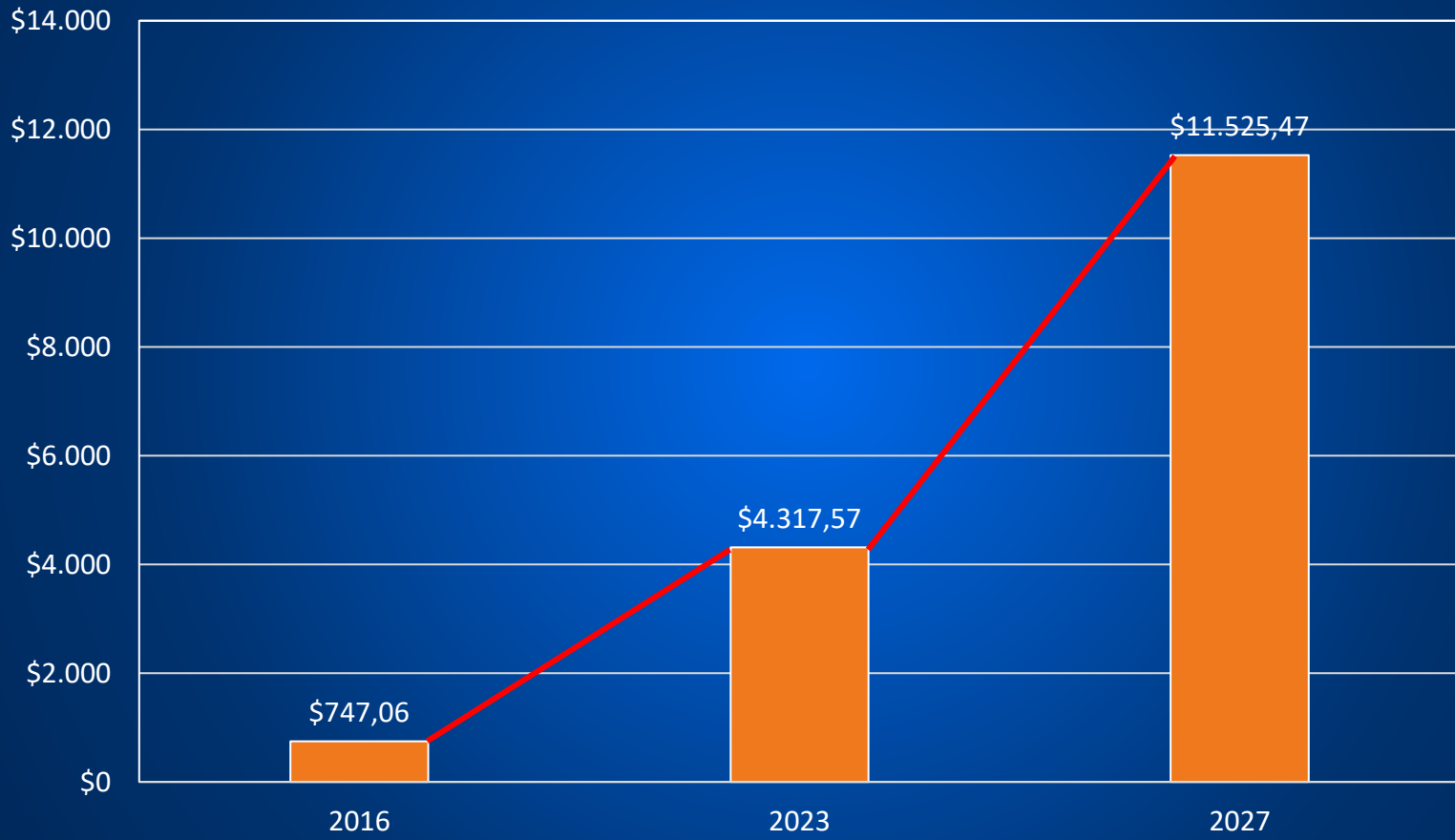
CLOUD COMPUTING REPRESENTS AN ENGINE OF ECONOMIC GROWTH IN TERMS OF ITS DIRECT AND SPILLOVER CONTRIBUTION TO GDP

CLOUD COMPUTING OVERALL ECONOMIC CONTRIBUTION



CLOUD SPENDING IN SUB-SAHARAN AFRICA IS GROWING AT A FAST PACE, EXPECTING TO REACH OVER USD 11.5 BILLION BY 2027

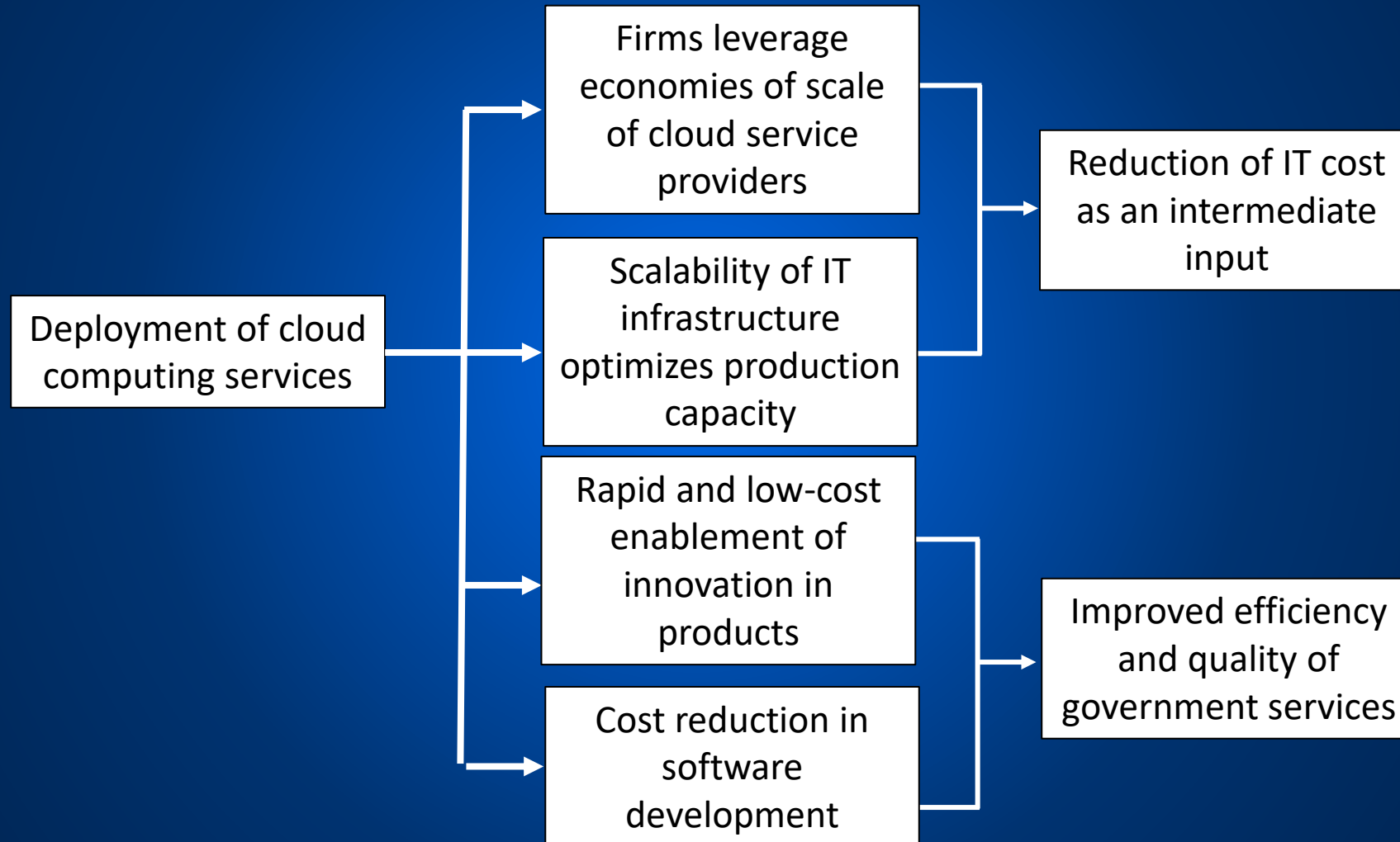
SUB-SAHARAN AFRICA(1): CLOUD SPENDING (2016-2027)



(1) Includes Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Gabon, Gambia, Ghana, Guinea, Cote d' Ivoire, Kenya, Madagascar, Mozambique, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Uganda

Source: IDC; Gartner; Statista; Telecom Advisory Services analysis

IN ADDITION TO SPENDING, CLOUD COMPUTING ALSO HAS AN IMPACT ON THE ECONOMY'S OVERALL PRODUCTIVITY AND BUSINESS PERFORMANCE -- A "SPILLOVER" EFFECT



CLOUD SPILLOVERS CAN BE ESTIMATED ECONOMETRICALLY THROUGH A STRUCTURAL MODEL THAT CONTROLS FOR LEVEL OF DEVELOPMENT

Aggregate production equation	$Y_{ist} = f(K_{it}, L_{it}, BB_{it}, CLOUD_{it})$	
Broadband equations	Demand equation	$BB_{it} = g(INCOME_{it}, P_{it}, HK_{it}, URBAN_{it})$
	Supply equation	$BB\ INV_{it} = h(P_{it}, COMP_{it})$
	BB infrastructure production	$\Delta BB_{it} = j(BB\ INV_{it})$
Cloud equations	Demand equation	$CLOUD_{it} = k(INCOME_{it}, P_{it}, HK_{it}, URBAN_{it})$
	Supply equation	$CLOUD\ INV_{it} = v(P_{it}, COMP_{it})$
	Cloud infrastructure production	$\Delta CLOUD_{it} = z(CLOUD\ INV_{it})$

This structural multi-equation model effectively endogenizes the variable that can drive reverse causality by specifying a micromodel of supply and demand, that is then jointly estimated with the macro production equation. To control for spurious correlations, the model includes fixed effects.

BASED ON THE STRUCTURAL MODEL, AN INCREASE OF 1% IN CLOUD PENETRATION FOR THE AVERAGE SUB-SAHARAN AFRICAN COUNTRY WILL YIELD A GDP INCREASE OF 0.02%

Country	Elasticity - Increase in GDP (%) after 1% increase in cloud adoption	Increase in GDP (USD million) after 1% increase in cloud penetration
Angola	0.020%	\$ 14.51
Benin	0.002%	\$ 0.33
Botswana	0.036%	\$ 6.01
Burundi	0.000%	\$ 0.00
Cameroon	0.037%	\$ 14.45
Cote d'Ivoire	0.039%	\$ 22.06
Kenya	0.030%	\$ 27.89
Madagascar	0.000%	\$ 0.00
Mozambique	0.000%	\$ 0.05
Nigeria	0.007%	\$ 29.39
Senegal	0.033%	\$ 7.46
South Africa	0.058%	\$ 227.31
Tanzania	0.051%	\$ 29.10
Zimbabwe	0.028%	\$ 6.96
Total	0.02%	

- South Africa is the country with the highest elasticity, since it is the country with the largest penetration of this technology and presents the largest fixed broadband penetration. The elasticity registered in South Africa is 3x more than in the average SSA country. As an economic multiplier, cloud adoption effect is therefore 24% of the 0.25 mobile broadband penetration impact on GDP
- Tanzania and Cote d'Ivoire are the countries that follow in terms of elasticity. Both countries present a significant adoption of cloud while fixed broadband subscriptions account for approximately 10% of households
- Cameroon and Botswana follow next, reaching an elasticity slightly below 0.04% GDP increase. In both cases they present a moderate adoption of cloud technology (respective penetration levels of 18.7% and 17.9% in 2021) and fixed broadband penetration above 15% in the period under analysis.
- Kenya will reach a 0.03% GDP increase after a 1% increase in cloud penetration. Despite having low fixed broadband penetration (below 4% of households), the country has been expanding cloud technology, reaching a penetration of 26% enterprises in 2021.

Note: Averages for broadband and cloud penetration for every country for the period under analysis were used in the calculations.

Source: Telecom Advisory Services analysis

WHEN COMBINING SPENDING AND SPILLOVER EFFECTS, CLOUD SERVICES IN SUB-SAHARAN AFRICA GENERATED AN AGGREGATE CONTRIBUTION EQUIVALENT TO 0.13% OF THE 2021 GDP

SUB-SAHARAN AFRICA: ECONOMIC CLOUD CONTRIBUTION (2021)

Cloud spending (USD B)	\$ 0.252
Average Cloud penetration (%)	22.42%
Average Broadband penetration (%)	9.58%
Percentage increase in GDP after a 1% increase in cloud penetration	0.05% (*)
Spillovers (% GDP)	0.12%
GDP (USD B)	\$ 1,918
Spillovers (USD B)	\$ 2.33
Total economic value (USD B)	\$ 2.59

Note: Includes Angola, Benin, Botswana, Burundi, Cameroon, Cote d' Ivoire, Kenya, Madagascar, Mozambique, Nigeria, Senegal, South Africa, Tanzania, Zimbabwe

(*) Elasticity increased with respect to the previous slide as in this case was calculated considering 2021 values for Cloud and Broadband penetration, rather than previous averages

Source: *Telecom Advisory Services analysis*

IF THE ENTIRE REGION INCREASES CLOUD PENETRATION TO 49.29% (THE OCDE AVERAGE), IT WOULD YIELD CUMULATIVE ECONOMIC VALUE OF USD 317.3 BILLION BY 2033 (0.83% OF THE GDP)

SIMULATION OF CONTRIBUTION OF CLOUD IN 2023-2033

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	TOTAL
Cloud spending (USD B)	\$ 0.29	\$ 0.31	\$ 0.33	\$ 0.35	\$ 0.37	\$ 0.40	\$ 0.43	\$ 0.46	\$ 0.49	\$ 0.52	\$ 0.55	\$ 4.49
Average Cloud penetration (%)	25.56%	27.30%	29.15%	31.13%	33.24%	35.50%	37.90%	40.48%	43.22%	46.16%	49.29%	36.27%*
Average Broadband penetration (%)	11.91%	13.28%	14.80%	16.51%	18.41%	20.52%	22.88%	25.52%	28.45%	31.72%	35.37%	21.76%*
Percentage increase in GDP after a 1% increase in cloud penetration	0.06%	0.07%	0.08%	0.09%	0.10%	0.11%	0.12%	0.13%	0.14%	0.16%	0.18%	0.11%*
Spillovers (% GDP)	0.43%	0.48%	0.53%	0.59%	0.66%	0.73%	0.81%	0.89%	0.98%	1.08%	1.19%	0.76%*
GDP (USD B)	\$ 2,250	\$ 2,437	\$ 2,639	\$ 2,859	\$ 3,096	\$ 3,354	\$ 3,632	\$ 3,934	\$ 4,261	\$ 4,615	\$ 4,999	\$ 38,076
Spillovers (USD B)	\$ 9.67	\$ 11.67	\$ 14.07	\$ 16.93	\$ 20.34	\$ 24.41	\$ 29.25	\$ 35.01	\$ 41.85	\$ 49.98	\$ 59.63	\$ 312.8
Total economic value (USD B)	\$ 9.96	\$ 11.98	\$ 14.40	\$ 17.28	\$ 20.72	\$ 24.81	\$ 29.68	\$ 35.46	\$ 42.34	\$ 50.50	\$ 60.18	\$ 317.3

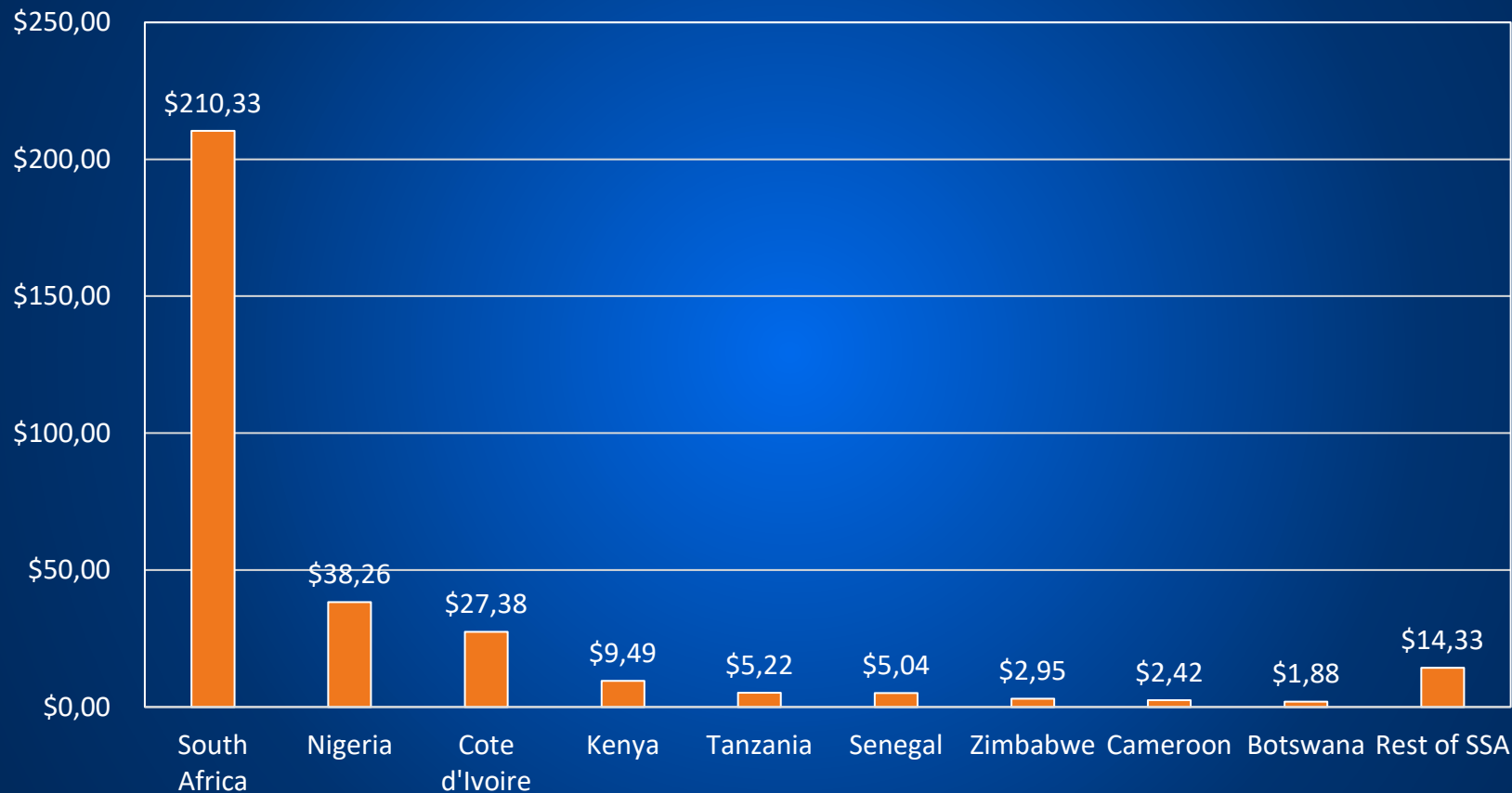
Note: Includes Angola, Benin, Botswana, Burundi, Cameroon, Cote d' Ivoire, Kenya, Madagascar, Mozambique, Nigeria, Senegal, South Africa, Tanzania, Zimbabwe

(*) denotes average for the period

Source: Telecom Advisory Services analysis

THE LARGEST CONTRIBUTION WOULD BE GENERATED IN SOUTH AFRICA, AS THE REGION'S COUNTRY WITH THE HIGHEST SPENDING AND PENETRATION, THUS LEADING DIRECT AND INDIRECT EFFECTS

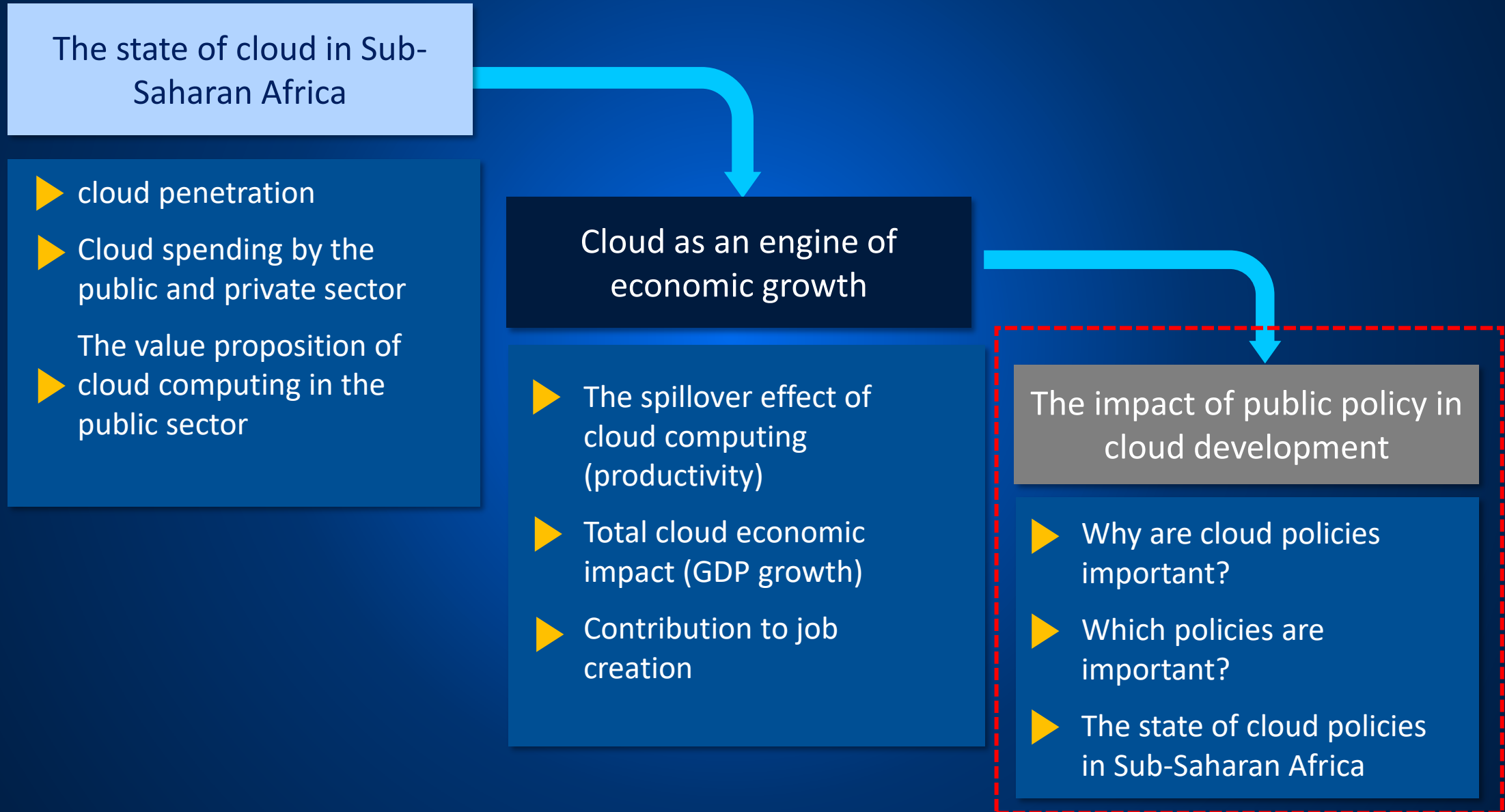
SIMULATION OF CONTRIBUTION OF CLOUD IN 2023-2033 (in USD billion)



Note: Rest of ASSA includes Angola, Benin, Burundi, Madagascar, Mozambique

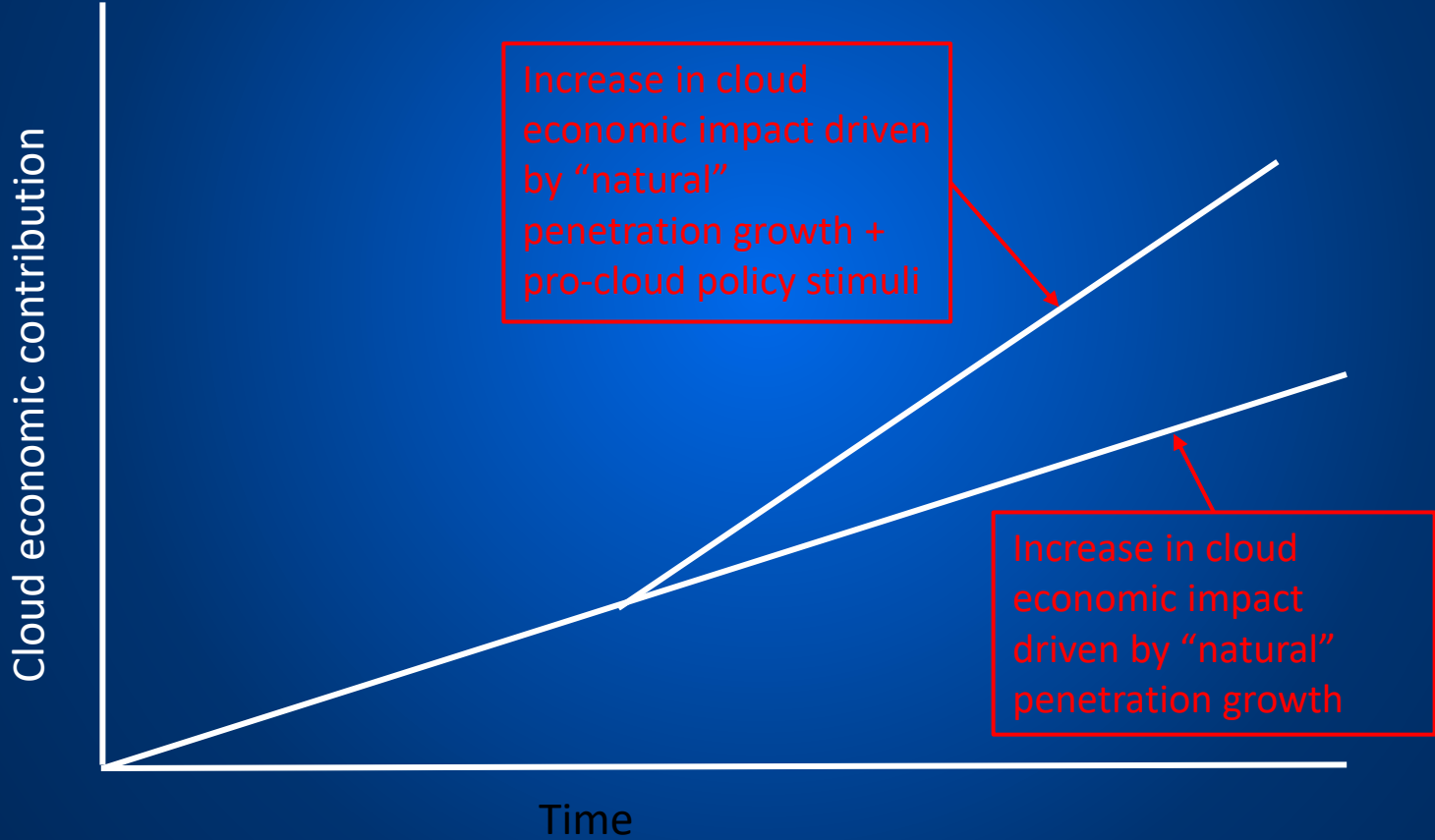
Source: Telecom Advisory Services analysis

THE TARGETS PRESENTED BEFORE ARE CONDITIONED BY IMPLEMENTING SEVERAL KEY POLICIES



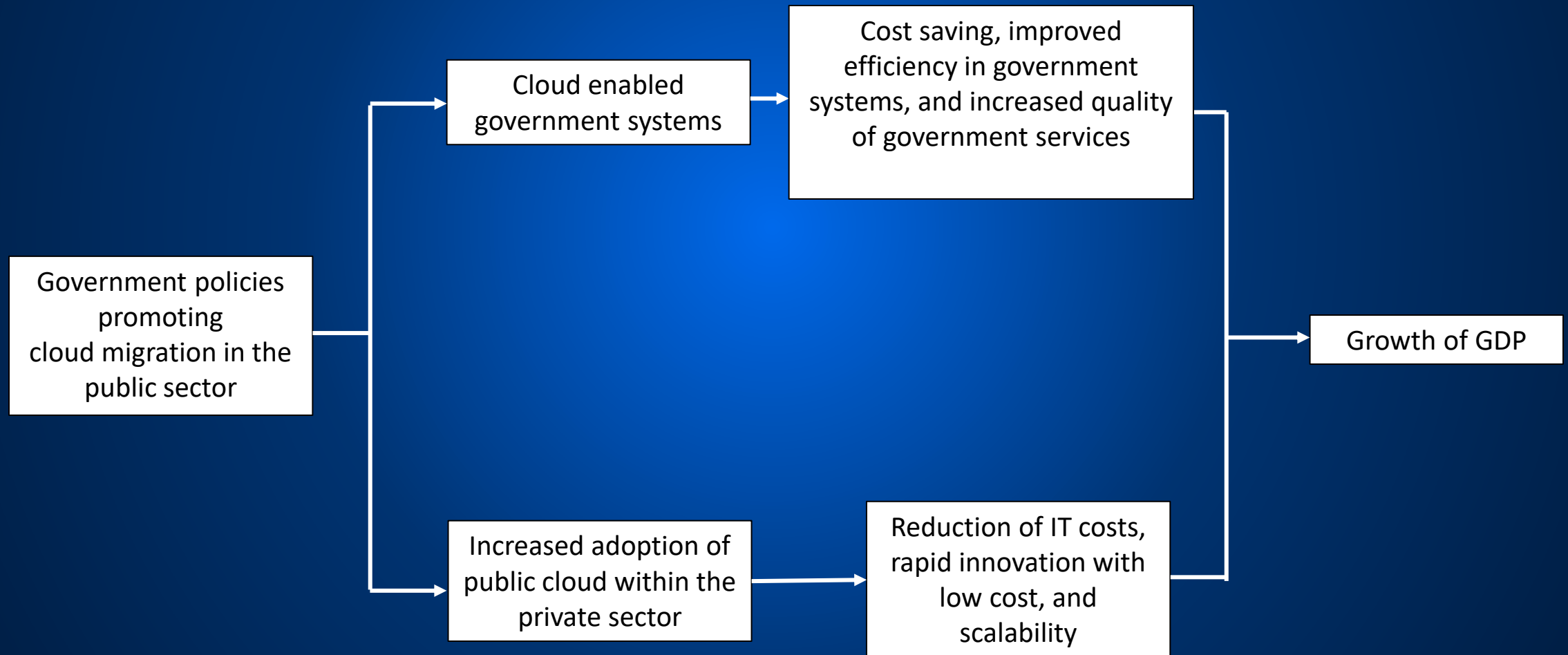
IF THERE IS RETURN TO SCALE, IT IS RELEVANT TO DETERMINE WHETHER POLICIES THAT STIMULATE CLOUD DEVELOPMENT SHOULD ENHANCE THE ECONOMIC CONTRIBUTION

POTENTIAL STIMULATION OF CLOUD ECONOMIC CONTRIBUTION FROM PRO-CLOUD POLICIES



PRO-CLOUD GOVERNMENT POLICIES HAVE AN IMPACT ON GOVERNMENT CLOUD MIGRATION AND A SPILLOVER EFFECT ON THE REST OF THE ECONOMY

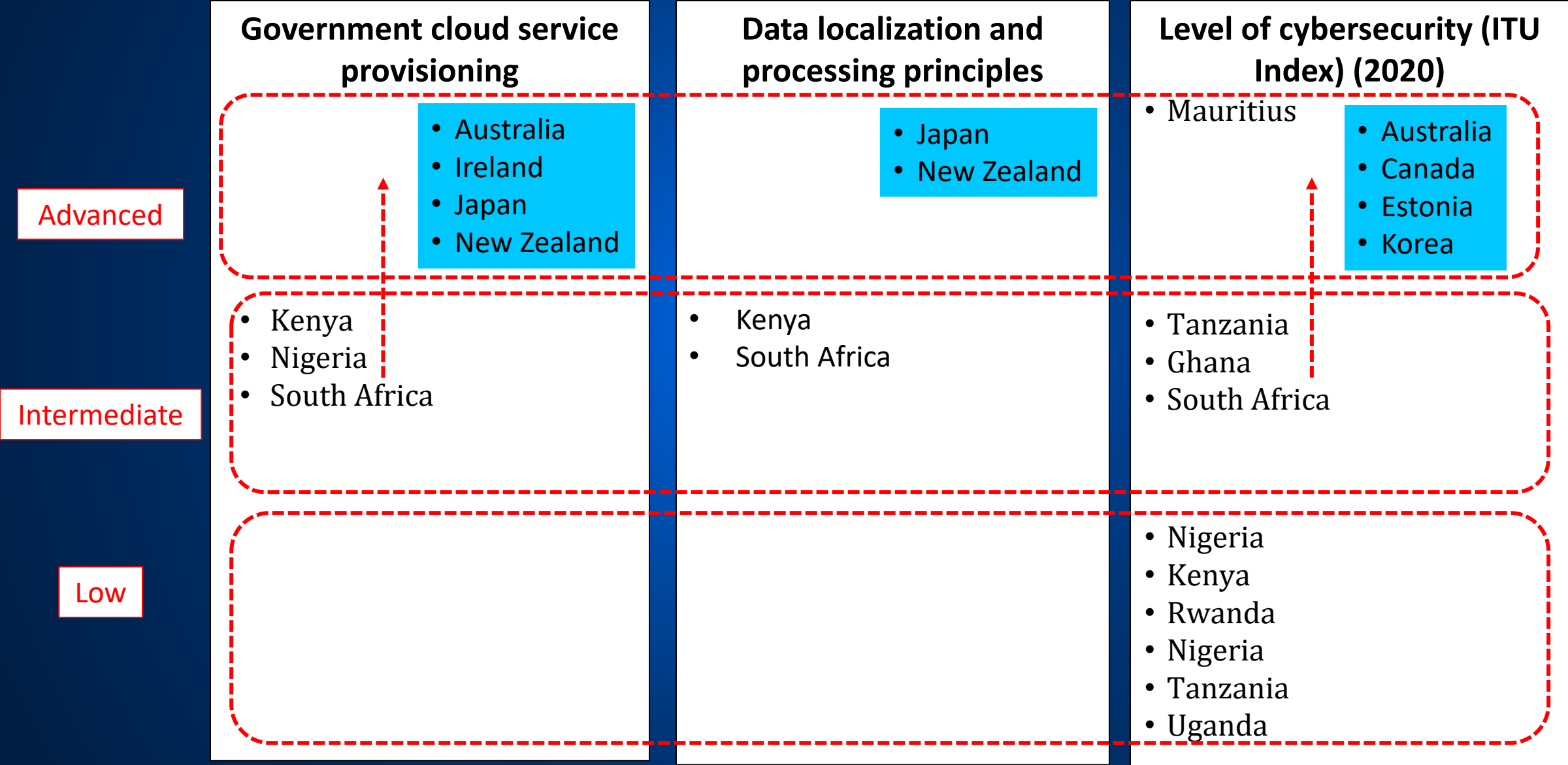
THEORY OF CHANGE LINKING GOVERNMENT CLOUD POLICIES TO ECONOMIC GROWTH



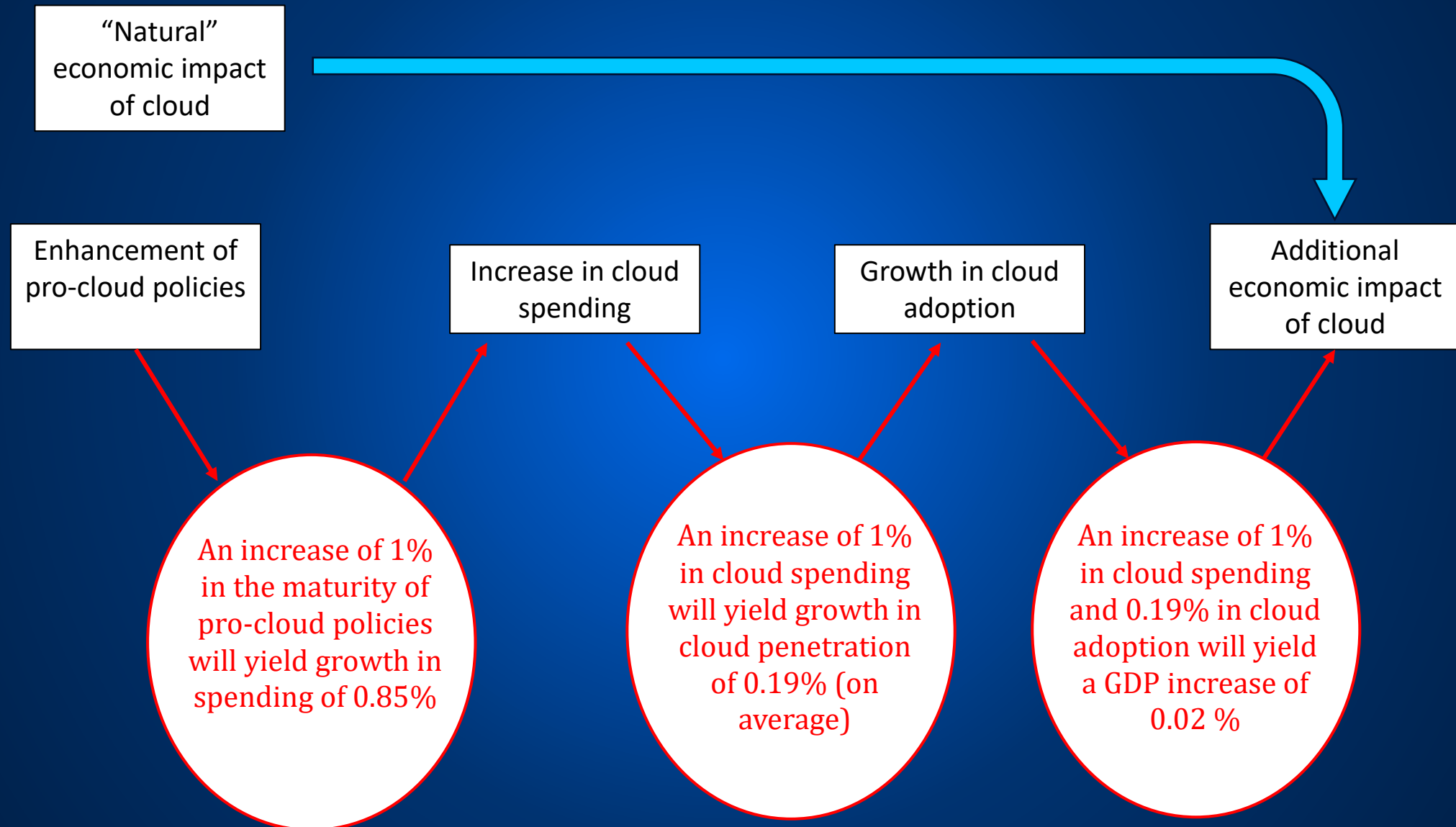
THREE POLICIES HAVE BEEN IDENTIFIED AS BEING CRITICAL FOR STIMULATING THE MIGRATION OF GOVERNMENT SYSTEMS AND PRIVATE ENTERPRISES TO THE CLOUD

	Government cloud service provisioning	Data localization and processing principles	Level of cybersecurity (ITU Index)
Advanced	<ul style="list-style-type: none">Public cloud services are provided by either multinational hyperscalers or local operators within a competitive market	<ul style="list-style-type: none">While government data must be stored locally, processing can take place beyond the national boundaries	<ul style="list-style-type: none">High (97-100)
Intermediate	<ul style="list-style-type: none">Local cloud providers comprised both the state-owned entity and private commercial enterprises	<ul style="list-style-type: none">Government data can be stored and processed locally or abroad depending on its nature	<ul style="list-style-type: none">Medium (85-97)
Low	<ul style="list-style-type: none">A state-owned cloud provider becomes the de-facto private cloud service provider	<ul style="list-style-type: none">Government data storage and processing must be conducted only locally, thereby prohibiting data transfers beyond the national boundaries	<ul style="list-style-type: none">Low (<85)

SUB-SAHARA AFRICAN COUNTRIES APPEAR TO BE POSITIONED AT THE INTERMEDIATE LEVEL



A MODIFICATION OF THE CLOUD ECONOMIC IMPACT STRUCTURAL MODEL ALLOWS ESTIMATING THE EFFECT ON SPENDING AND PENETRATION OF POLICY CHANGES



IN CONCLUSION

The state of cloud in Sub-Saharan Africa

- ▶ An average 25% of organizations in Sub-Saharan Africa have adopted cloud
- ▶ Cloud adoption is contingent upon the level of economic development, fixed broadband adoption, and pro-cloud development policies

Cloud as an engine of economic growth

- ▶ The elasticity that links GDP growth with cloud depends on cloud and broadband adoption
- ▶ On average, the overall economic effect associated to cloud approximates to 0.13% of the GDP; South Africa depicts a larger contribution
- ▶ If the SSA region cloud penetration increases by 10%, this would yield economic spillovers of USD 3.8 billion

Embark in policy reforms to address the barriers to service penetration

- ▶ Reduce broadband connectivity costs
- ▶ Remove stringent data localization obligations,
- ▶ Issue Cloud First policy for governments
- ▶ Put in place cloud procurement frameworks

TELECOM ADVISORY SERVICES, LLC

For more information, contact:

Raul Katz, raul.katz@teleadvs.com, +1 (845) 868-1653

Telecom Advisory Services LLC
139 West 82nd Street, Suite 6D
New York, New York 12581 USA