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Abstract

Purpose – The purpose of this paper is to present the estimates of the value of the built environment stock in Cape Verde, a Sub-Saharan African country that is scattered through ten relatively small islands.

Design/methodology/approach – It applies the perpetual inventory method in a long series of construction investment data at 1980 and 2007 constant prices published by the Cape Verde's National Statistics Office.

Findings – The results show that the capital-output ratio is similar to those in the advanced industrial countries. The high value of this indicator suggests that the country should shift its focus from building new investment projects to managing the considerable amount of built stock.

Originality/value – The main originality of the paper comes from the use of different data sets from the National Statistical Office to construct the indicators of the construction industry activity in a comprehensive way.

Keywords Cape Verde, Construction, Methodology, Estimating, Built stock, Capital accounts, Perpetual inventory method

Paper type Research paper

1. Introduction

Built environment stock is a major component of the produced fixed capital assets as designated in the System of National Accounts (SNA) of the United Nations (United Nations, 2008a). Building and other construction assets constitute a significant part of a country's physical and economic infrastructure. Infrastructure plays a role as a capital input into production and wealth generation. The economic impact can be transformative, especially at lower levels of income (OECD, 2013). As pointed out by Maddison (1987, 2006), the close association between physical capital and different measures of national economy is one of the reasons why physical infrastructure has been considered a powerful engine of economic growth and development. With respect to the role of construction investment, historical reviews point to the importance of the construction industry activity in the process of industrialisation and urbanisation in Western and Northern Europe and other parts of the globe. Several macroeconomic studies dealing with both developed and developing countries (Strassmann, 1970; Turin, 1973; World Bank, 1984; Bon, 1992; Ruddock and Lopes, 2006) have posited that the construction sector, as a major component of a country's physical capital, plays a determinant role in the development process. It should be noted, however, that a significant number of studies (De Long and Summers, 1991; Ganesan, 2000; Yiu *et al.*, 2004; Lopes, 2012, to name but a few) have not shared the generalised view on the positive role of construction investment, namely, at the magnitude of investment and the direction of causality between construction investment and economic growth.

The importance of infrastructure investment and its financing needs has gained momentum since the setting up of the Commission for Africa by the then Prime Minister, Tony Blair, in 2004. The Group of Eight summit in Gleanegles in 2005 called for action by the major economies and multilateral donors in the financing of Sub-Saharan African infrastructure. This also was a central tenet of the Commission Report – Our Common Interest (Commission for Africa, 2005).

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This renewed interest in the role of construction infrastructure in the development process of the less developed regions of the world calls on the construction research community to undertake studies on the measurement of different indicators of the construction industry and ancillary activities. For example, what is the minimum level of a country's built capital stock for an efficient functioning of the economy? How to address the twin challenges of finance and sustainability in Sub-Saharan Africa in the effort towards attaining the Sustainable Development Goals (SDGs)? As pointed out by Ruddock (2002), international comparability studies are needed to allow comparability between countries. These would make a greater understanding of an individual country's economic development. However, collecting comparable data on capital stock statistics is fraught with difficulties, particularly in the context of developing countries (OECD, 2013). Thus, individual country studies are the substratum needed to enhance our comprehension of the role construction plays in the process of development. This study attempts to be a contribution to shed more light on the issue. It applies the perpetual inventory method (PIM) in a long series of construction investment data to estimate Cape Verde's net capital stock in built assets.

The remainder of the paper is as follows: the next section presents the statistical sources and discusses the methodology for estimating the built capital stock. The third section presents an analysis of Cape Verde's macroeconomic performance in the period 2007–2016. The fourth section presents the estimates of the built capital stock. Data are presented and commented upon, and the results of the analyses are discussed and commented upon. A concluding remark finalises the study.

2. Statistical sources and methodology

The main statistical sources used in the analysis are two sets of economic statistics published by Cape Verde's National Statistical Office: National Accounts – Main Indicators (old series–1980 base year) (INE, various years-a); National Accounts – Main Indicators (new series–2007 reference year) (INE, various years-b). The first set of the National Accounts presents construction investment data for the period 1980–2007 both in current and at 1980 constant prices. The second set of the National Accounts presents construction investment data in current prices and chain-linked volumes at the 2007 reference year. The National Accounts also present data on gross domestic product (GDP) in both the expenditure, production and income approaches. It presents various economic series detailing the evolution of GDP and GDP per capita and its components over the long period 1980–2014, data on population and the evolution of GDP per capita in both national currency and Euros. The 2010 Census of Population and Housing published by the National Statistical Office (INE, 2011) is used to estimate the base-year stock in built assets.

Investment in building and other construction structures is a component of gross fixed capital formation (GFCF) as described in the SNA of the United Nations. According to the SNA 2008, GFCF consists of the purchase of goods (and services) that are used in production for more than one year. This publication classifies capital stock statistics according to: type of assets; institutional sectors; and economic sectors as described in the International Standard Classification of Economic Activities (ISIC revision 4) (United Nations, 2008b). The SNA identifies five institutional sectors: non-financial corporations; financial corporations; general government; and households. In terms of type of assets, the built capital stock is comprised of: dwellings; and other buildings and structures (including land improvements). It is worth noting that and major improvement to dwellings and other building and structures are also accounted for as built assets. Other productive fixed assets which are recognised in both the European System of Accounts (ESA, 2010) and SNA 2008 are: machinery and equipment; cultivate assets; cost of ownership transfer on non-produced assets; and intellectual property products.

Within the context of national accounting, there are two types of capital measures, each reflecting a different role of capital (OECD, 2009, 2013). The first type of measure looks at capital in its function as a provider of services in production. The second type of capital measure captures its role as a store of wealth. Its aggregate is the net capital stock (also known as wealth stock) that captures the market value of capital goods. Unlike gross capital stock (which does not take depreciation of assets into account) net capital stock is part of an economy's balance sheet in the context of income and wealth accounting. Most modern works, both at national and international levels, that publish capital stock data (see for instance Eurostat, various years; EU KLEMS, 2017; Derbyshire *et al.*, 2011) are based on the PIM methodology outlined in the two editions of the OECD Manual Measuring Capital (OECD, 2001, 2009). The 2nd edition of the Manual took into account the changes to methodologies that occurred in the SNA 2008.

The PIM methodology involves accumulating past capital formation and deducting the value of assets that have reached the end of their service lives. Both capital formation and discards of assets are revalued either to the prices of the current year (current prices) or to the prices of a single year (constant prices).

To estimate the total capital stock, the following data and assumptions, broken down by type of asset, are required (OECD, 2013):

- a sufficiently long time series of data on GFCF;
- a sufficiently long time series of price indices (deflators);
- an estimate of the capital stock for a certain year in the past;
- guesestimates or assumptions regarding the average service lives of the relevant assets;
- assumptions regarding the depreciation function of the relevant assets; and
- assumptions regarding the mortality function, or "retirement function", of the relevant assets.

One critical aspect of this methodology is the setting up of the depreciation method to account for the writing-off of consumed fixed capital. In the straight line depreciation method, the consumption of fixed capital is linear in nature as can be seen in Equation (3) below. The corresponding mortality function is the "simultaneous exit", i.e., an asset is removed from the capital stock when its value has depreciated to zero in the final year of its service life (OECD, 2009). These assumptions are adopted by the Singapore Department of Statistics and, according to Maddison (1992, cited in Derbyshire *et al.*, 2011), represent a useful approximation of reality when calculating the capital stock. However, OECD (2009) suggests that simultaneous exit is not a realistic retirement pattern and suggests that other retirement patterns that assume a certain bell-shaped function around the average age of retirement are more realistic.

The application of the PIM methodology involves the following steps (Derbyshire *et al.*, 2011):

(1) The calculation of the gross capital stock:

$$CS_t = \sum_{i=0}^{d-1} I_{t-i}, \tag{1}$$

where CS_t is the gross capital stock in an asset in year t; I_t, investment in year t; d, the assumed service life of the asset.

This values the gross capital stock at its historical (or acquisition) costs. The goal of the PIM, however, is to arrive at a valuation in prices of the year for which the value of the stocks is calculated:

(2) The revaluation of the capital to prices in year t from the value of the capital at its historical cost:

$$CS_{t,t} = \sum_{i=0}^{d-1} I_{t-i} \times P_{t-i,t}, \tag{2}$$

where $CS_{t,t}$ is the capital stock in an asset in year t, in prices of year t; $P_{t-i,t}$, the asset price index in year $t-i$, with t the year to which the capital stock is valued; the calculation of the net capital stock from the gross capital stock minus the accumulated consumption of fixed capital:

$$\mathrm{NCS}_{t,t} = \sum_{i=0}^{d-1} \left(I_{t-i} \times P_{t-i,t}\right) \times \left(1 - \frac{i}{d}\right), \tag{3}$$

where the inputs are as in Equations (1) and (2), with the addition of $(1-(i/d))$, which represents the consumption of fixed capital, and d is the assumed service life of the asset i is the current year the asset is at within its service life.

3. Cape Verde's Macroeconomic environment and sectoral performance

Cape Verde is a Sub-Saharan African developing economy, scattered through ten relatively small islands, which has been experiencing a remarkable economic performance, as illustrated by its accession to the World Trade Organisation in 2008, becoming its 153rd Member. The openness to the international trade and implementation of structural reforms, started in the early 1990s, have strengthened the process of economic development that led the country to graduate from a low-income economy to the lower-middle income economy status in 2008, according to the standards established by the United Nations (WTO, 2015). Indeed figures drawn from the World Development Indicators (WB, 2018) show that the gross national income (GNI) per capita increased from $890 in 1990 to $3,540 in 2008 and the share of exports in GDP increased from 16.7 to 45.4 per cent in the same period. However, this transition process has been fraught with difficulties that are characteristic of the middle-income status trap, especially owing to the country's unfavourable geographical location and scarcity in natural endowments (WTO, 2015).

Table I shows that after a spectacular growth (15.2 per cent) in 2007, Cape Verde's economy slowed down in 2008, with a 6.7 per cent growth, followed by a recession

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Population (thousand)	486.5	491.7	497.0	502.4	508.1	514.0	520.1	526.4	532.9	539.6
GDP (current $ million)	1,514	1,789	1,712	1,664	1,865	1,752	1,851	1,858	1,574	1,617
GDP growth (annual %)	15.2	6.7	−1.3	1.5	4.0	1.1	0.8	0.6	1.1	3.9
GNI per capita (current $)	3,044	3,543	3,357	3,167	3,526	3,262	3,434	3,354	2,846	2,845
GDP deflator (annual %)	4.5	6.8	1.0	2.1	4.5	2.5	1.5	−0.2	0.1	−0.4
Exports (% of GDP)	37.8	45.1	36.0	36.9	31.1	32.7	35.5	40.4	40.5	40.4
Imports (% of GDP)	66.6	72.7	66.2	63.1	57.0	61.8	64.3	59.8	54.8	60.7
External debt stock (current $ million)	580.1	626.1	726.7	892	1,039	1,245	1,488	1,542	1,540	1,539
Remittances (current $ million)	138.8	155.0	135.6	130.1	176.9	177.0	175.9	197.0	200.9	212.0
Net ODA (current $ million)	166.1	221.9	196.6	327.0	251.3	245.6	245.1	231.4	152.8	113.4

Source: World Development Indicators (World Bank, 2018)

Table I. Macroeconomic performance in Cape Verde, 2007–2016 of −1.3 per cent in 2009. In the following years, the national economy grew at an average rate of 1.6 per cent in 2009–2016 compared to a remarkable growth rate of 10.6 per cent between 1990 and 2000 and 5.8 per cent in the period 2000–2010 (WB, 2018). This growth deceleration and even a decline in per capita income in the late years of the period was mainly due to the 2008 international crisis that affected the Eurozone – the country's main economic partner – and a slowdown in the tourism property development sector. The GNI per capita decreased from $3,540 in 2011 to $2,845 in 2016.

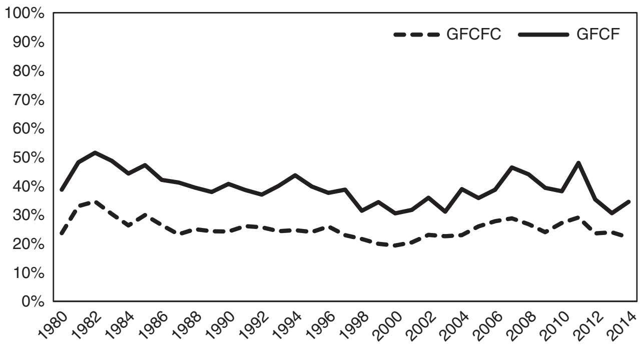
Cape Verde's foreign trade in goods and services has been marked by its structural deficit. However, the trade balance of about −20 per cent of GDP in the period 2014–2016 represents an improvement from that of the period 2009–2013, owing to faster export growth particularly in travel services. The heavy reliance on external funding has contributed to the increase in the external debt from 38 per cent of GDP in 2007 to 95 per cent of GDP in 2016. Table I shows that besides official development assistance (ODA) from the Development Assistance Committee countries, personal remittances contribute significantly to the country's external financing. These two sources of external financing represented about 25 per cent of GDP throughout the period 2007–2016. One aspect worthy of note is the low rate of inflation (GDP deflator) in the period analysed, particularly from 2009 onwards. The inflation rate raised from 4.5 per cent in 2007 to 6.8 per cent in 2008, and then showed a trend of decline that fell to −0.4 per cent in 2016. This positive development may be partly explained by the adoption in 1998 of a fixed exchange rate of the Cape Verde Escudo (CVE) against the Euro (1 Euro = 110.265 CVE) through the Exchange Cooperation Agreement between Cape Verde and Portugal.

Table II shows the structure of GDP in selected years of the period between 1990 and 2104. A particularly striking feature is the country's low-industrial basis and a high service-based economy, particularly in trade. Cape Verdean GDP structure, in 2014, was divided among agriculture and fishing (8.5 per cent), industry (9.1 per cent), construction (9.2 per cent) and services including trade (61.2 per cent). Looking at the evolution of the economic sectors throughout the period analysed, there is remarkable uniformity in the weight of agriculture and fishery, and services. Agriculture and fishery represent about 9 per cent of GDP (except in 1990) and services represent just over 60 per cent of GDP. Another aspect worthy of note is the development pattern of the construction sector. The share of construction valued added in GDP is one of the highest in Sub-Saharan Africa. The contribution of construction to the GDP was 11.9 per cent in 1990, 9.9 per cent in 2000 and reached 12.2 per cent in 2008 and 2009. In the following years, it showed a trend of decline and a slight recovery occurred in 2014, reaching 9.2 per cent of GDP. The clout of the construction industry in the national economy is also apparent when this is viewed at the expenditure approach. Figure 1 depicts the evolution of GFCF and GFCF in construction (GFCFC) in the long period 1980–2014. It shows that GFCFC varied from 20 per cent (in 1995) to 34.6 per cent (in 1982), averaging 25.2 per cent for the period 1980–2014. The GFCF varied from 30.5 per cent (in 2000) to 51.5 per cent (in 1982) and the mean value was 39.4 per cent in the same period. The proportion of GFCFC of total GFCF was 64.1 per cent (average for the period), which is characteristic of countries in the low to

Table II. Structure of the GDP by economic sectors (selected years), 1990–2014

	1990	2000	2007	2008	2009	2010	2011	2012	2013	2014
Agriculture, fishery and quarrying	15.1	9.7	9.2	8.5	8.9	8.5	8.3	8.8	8.7	8.5
Industry	8.7	6.3	5.2	5.8	6.5	6.8	7.0	7.8	8.4	9.1
Construction	11.9	9.9	11.0	12.2	12.2	10.8	10.4	8.8	8.7	9.2
Services	58.9	65.8	61.0	59.8	60.2	61.2	60.6	62.2	61.8	61.2
Taxes (net of subsides)	5.4	8.3	13.6	13.7	12.2	12.7	13.8	12.4	12.4	12.0
GDP at market prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: National Accounts (INE various years-a, b)



Source: National Accounts (National Statistics Office-INE)

Figure 1. Proportion of GFCFC and GFCF in GDP (1980–2014, current prices)

lower-middle income range. If one takes into account that the value of GDP in 2014 was about 4.2 times higher than that in 1980 (measured in terms of constant prices) (INE, various years-a, b), the accumulation of high level investment in built assets is evident. Indeed, data on fixed investment published by the United Nations going back as far as the 1950s (UN, various years) indicate that there has been a relatively consistent level of 20–25 per cent of GDP for GFCF and 10–15 per cent of GDP for GFCFC (both measures viewed as the world average). However, when countries are analysed according to their development status, a trend of relative decline is apparent as countries go through development stages, a fact already pointed out by Bon (1992).

4. Estimates of the built capital stock in Cape Verde

4.1 Data and assumptions

As discussed above, the application of the PIM methodology to estimate the Cape Verde's built capital stock requires a set of assumptions and inputs: the base-year estimate of the country's built capital stock; statistics on GFCF in construction extending back to the benchmark year; asset price indices; depreciation function to devalue the assets; and information on the average service lives of different construction assets and on the mortality function.

The depreciation method and mortality function used in this study are, respectively, the straight-line depreciation method and the simultaneous exit retirement function. These are assumptions adopted, for example, by the Singapore Department of Statistics and Derbyshire *et al.* (2011). With respect to the average service lives, service lives for structures are usually based on statistical surveys, administrative records, expert advice and other countries' estimates. For every type of investment, there is a different average service life, because every year the product, industry and sectoral composition of service lives may change (OECD, 2009). Other sources for estimating service lives are depreciation rules for companies as set up by tax authorities, but these are not suitable for the majority of built assets (OECD, 2013). For Cape Verde, there are no available data sources that provide information on the service lives of building and other construction structures. Thus, for this study, other countries' estimates are the base for setting up the average service lives of built assets.

The OECD Manual presents average services lives for different type of assets for a number of countries. For example, the average services lives used by the Singapore Department of Statistics are the following:

- residential Buildings – 80 years;
- non-residential Buildings – 40 years;
- other construction and works – 40 years;

- ships and boats – 20 years;
- aircraft – 15 years;
- road vehicles – 10 years; and
- machinery and equipment – 15 years.

A study dealing with the capital stock in the NUTS 2 regions of the EU-27 (Derbyshire *et al.*, 2011) adopted the following service lives: 68 years for housing construction; 50 years for other construction works; 38 years for "other" assets; 14 years for metal products and machinery; and 18 years for transport equipment.

The National Accounts of the Cape Verde's National Statistical Office presents data on GFCFC that are consistent with the SNA of the United Nations. In the "Old Series" of the National Accounts, construction investment data for the period 1980–2007 are disaggregated in the following format: residential housing; non-residential housing; civil engineering works and "other" construction. The "New Series" of the National Accounts presents data for the period 2008–2014 that are disaggregated by: private construction works; and public construction works. It is assumed, based on data obtained from the "Use and Supply Table" of the National Accounts, that civil engineering works and "other" construction works for the period 2008–2014 represented 80 per cent of the public GFCF. Thus, for reasons of consistency in the data throughout the period 1980–2014, these are disaggregated in the following type of assets: building construction; and civil engineering works and other construction.

Climatic conditions have a great effect on the service lives of structures and other fixed assets. Therefore, service lives of fixed assets in Cape Verde would, ideally, approximate those adopted by the Singapore Department of Statistics. It should also be noted that asset service lives are strongly influenced by country-specific factors such as the relative prices of capital and labour, and government investment policies. Thus, other countries' estimates may provide a broad credibility check but should not be adopted without question (OECD, 2009). Assuming that a typical housing unit in Cape Verde has lower quality than that of Singapore and the fact that the latter is a city-state, we tentatively set up 65 years as the average service life of residential building. As the country has a low-manufacturing base, the non-residential building stock is mostly comprised of government departments building, private commercial building, and hotels and other tourism development property, both of which are of relatively recent origin. The average service lives are set up at 50 years. Taking into account that the aggregate investment in residential housing in the period 1980–2014 was just under two-thirds of total building investment, the joint average service life for building (housing and non-housing building) is 60 years. Regarding civil engineering and other construction, major construction infrastructures are almost comprised of transport infrastructure. Again, this infrastructure is relatively new as three out of four international airports were constructed after the year 2000, and major renovation of the country's two international sea-ports and the heavy level of construction of urban roads in the country's two main urban centres also took place after that year. OECD (2013) recommends a service life of around 50 years for transport infrastructure. Thus, an estimated service life of 45 years takes into account the country's climatic conditions and the assumed lower quality of the structures.

The estimated averaged service lives for built assets are, therefore, the following:

- building construction – 60 years; and
- civil engineering and other construction works – 45 years.

In order to estimate the initial capital stock in the benchmark year (1980), the OECD Manual provides some recommendations for estimating the stock of structures under limited information. When the housing stock is used as input, a minimum of the information that is required is the following (OECD, 2009):

- the number of dwelling units at mid-year of the period under consideration ($W^{D,t}$), which is usually available from the most recent census;
- an estimate of the long-term growth rate (b) of the number of dwellings;
- the average price level of period t of a newly constructed dwelling (of a particular category), excluding land ($P_0^{D,t}$), where the subscript 0 indicates the age of the asset which in the present case is new; and
- an estimate of the expenditure on major improvements on dwellings and land during the present year ($P_0^{D,t}$ Mt).

The *2010 Census of Population and Housing* (INE, 2011) provides some useful information for estimating the built capital stock of the base year, by using the OECD methodology. Table III shows that the number of buildings in Cape Verde totalled 114,469 units in 2010. Of these, 22,284 were built before 1975. The year of construction was unknown (DK) for 27,109 buildings and 2,492 were either labelled "not determined – ND" or "not evaluated – NE" by the country's National Statistical Office. It can also be seen that the number of buildings constructed in the five-year periods increased from 6,987 in 1970–1974 to 10,936 in 2005–2010. It is worthy of note that private buildings with one dwelling represent 83 per cent of the country's total number of buildings. Assuming that half of the buildings labelled as DK, ND and NE existed prior to 1975, the rate of growth in the number of buildings in the period 1975–1985 is 3.41 per cent per year. This can be assumed as the long-run annual growth rate in the number of buildings. As there are no available data on major improvement in housing, it is assumed that the share of major improvement to total housing investment in 1980 is 0.1. The average service life is set up at 60 years and the depreciation rate is 0.02667 (geometric depreciation), as recommended by OECD (2009). It is worth noting that investment in dwellings for 1980 is known, so there is no need to estimate the average price level of a typical building constructed in that year. The data obtained from the 2010 Census are, thus, utilised to set up the long-run annual growth rate in the number of buildings, and to add a credibility check to the formulae recommended by OECD. The latter will be dealt with in the next subsection.

	Private buildings					
	With one dwelling	With two dwellings	With three or more dwellings	Collective buildings	Non- classic buildings	Total
Year of construction						
Before 1975	20,490	1.216	578	0	0	22,284
1975–1979	6,147	542	298	0	0	6,987
1980–1984	6,143	735	404	1	0	7,283
1985–1989	6,470	714	436	0	0	7,620
1990–1994	7,493	994	563	0	0	9,050
1995–1999	8,433	1,068	610	2	0	10,113
2000–2004	8,673	1,103	818	1	0	10,595
2005–2010	9,176	870	898	1	0	10,936
DK	21,494	3,301	2,314	0	0	27,109
ND/NE	389	106	73	243	1,681	2,492
Total	94,909	10,649	6,983	248	1,681	114,469

Source: 2010 Housing and Population Census (INE, 2011)

Table III. Number of buildings according to type and year of construction

4.2 Results and discussions

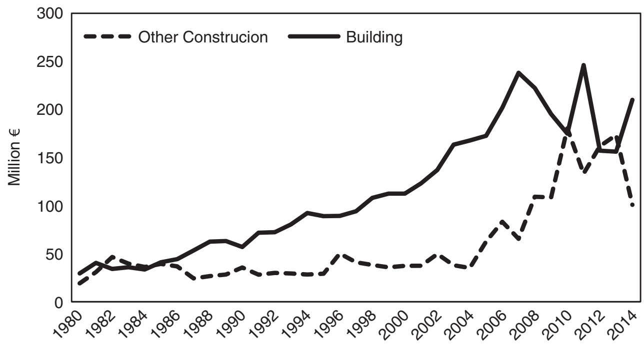
Figure 2 depicts the evolution of the GFCFC in the period 1980–2014, disaggregated in building construction (building), and civil engineering and other construction works (other construction), both measured at 2014 prices. Figure 2 shows that, annual fluctuations apart, both GFCF in building and in other construction increased steadily in the period between 1980 and 2014. Investment in building increased from €29.4m in 1980 to €209.9m in 2014. Other construction increased from €19.1m in 1980 to €100.7m in 2014. Particularly striking is the evolution of both indicators, particularly in other construction, in the period from mid 2000s (the change to the lower-middle income status) up to 2014. Gross fixed capital in civil engineering and other construction works averaged €138, 9m in the period 2008–2014, which represented 9.9 per cent of GDP in 2014.

Net capital stock in built assets for 2014. The net capital stock in built assets for 2014 is the sum of the results of three aggregates: accumulation of the fixed capital formation, net of depreciation, in the period 1980–2007; accumulation of the fixed capital formation, net of depreciation, in the period 2008–2014; and the base-year dwelling stock (1980), also net of depreciation. As stated in subsection 4.1, the average service lives for building and other construction are, respectively, 60 and 45 years. The depreciation method is the straight-line one.

Period 1980–2007. Data on GFCF in construction for this period are both available in current prices and at 1980 constant prices. Thus, 1980 constant prices data are used for calculating the gross capital stock in construction according to Equation (1), as investment for the whole period is valued at the prices of the same reference year. The aggregate figures are firstly rebased to 2007 prices by using a series of GFCF deflators (building and other construction works), and then revalued at 2014 prices by using the private GFCG's and public GFCF's implicit chain-linked indices for, respectively, building and other construction works. The Net Capital Stock (2014 prices) is calculated according to Equation (3). For reasons of comprehensiveness, the results are presented in Euros:

(1) Gross capital stock (1980 constant prices):
- building = €689,150,682.45; and
- other construction = €257,136,897.47.

(2) Gross capital stock (2014 prices):
- building = 689,150,682.45 × 3.528 × 1.077 = €2,618,772,593.30; and
- other construction = 257,136,897.47 × 3.773 × 1.112 = €1,078,894,322.12.



Source: Own calculations, based on National Accounts and Use and Supply Table (National Statistics Office-INE)

Figure 2.
Evolution of GFCF in building and other construction (2014 prices)

(3) Net capital stock (2014 prices):
- building = €1,916,063,743.41; and
- other construction = €626,872,597.10.

(4) Total net capital stock in construction = €2,542,936,700.51.

Period 2008–2014. Data on GFCF in construction for this period is available at both current prices and chained-linked volumes at the 2007 reference year. First, data at the 2007 prices are used for calculating the gross capital stock in construction according to Equation (1), as investment for the whole period is valued at the prices of the same reference year. The aggregate results are then revalued at 2014 prices by using the private GFCF's and public GFCF's implicit chain-linked price indices for, respectively, building and other construction. The Net Capital Stock (2014 prices) is calculated according to Equation (3):

(1) Gross capital stock (2007 prices):
- building = €1,264,121,461.00; and
- other construction = €869,507,686.30.

(2) Gross capital stock (2014 prices):
- building = 1,264,121,461.00 × 1.077 = €1,361,458,814.00; and
- other construction = 869,507,686.30 × 1.112 = €966,892,547.10.

(3) Net capital stock (2014 prices):
- building = €1,287,069,384.00; and
- other construction = €749,872,133.60.

(4) Total net capital stock in construction = €2,036,941,517.60.

(5) Net built stock of the base year (1980):
- housing investment in 1980 (It_{1980}) = €4,451,095.00 (1980 constant prices);
- average service life = 60 years;
- rate of depreciation (r) = 0.02667;
- long-run growth rate per year (b) = 0.0341;
- share of major improvements (α/b) = 0.1; and
- $C = (1 + \alpha/b) \times (1 + /b)/(b + r) = 18.12$, which corresponds to the ratio of new investments to the net stock.

(6) Stock of dwelling in the base year (1980 constant prices):
- $It_{1980} \times C = 4{,}451{,}095.00 \times 18.12 =$ €80,653,860.00;
- stock of dwelling in the base year (2014 prices) is calculated in the same manner as that of the period 1980–2007; and
- 80,653,860.00 × 3.528 × 1.077 = €306,484,668.00.

(7) Net built stock of the base year (2014 prices) is calculated according to the Equation (3) = €132,780,334.00.

In order to check the fitness of the formulae outlined in the OECD (2009) methodology (the C ratio), the ratio of number of buildings that existed prior to 1980 to the number of buildings constructed in 1980 is calculated. Again, it is assumed that half of the buildings labelled as DK, ND and NE existed prior to 1975. Number of buildings constructed before 1980 = 44,070; number of buildings constructed in 1980; 6,987/5 = 1,457. The ratio is 30.25. Thus, the C value (18.12) seems to be a fairly adequate ratio. According to the *2010 Census of Population and Housing*, the proportion of urban housing in total housing increased from 42 per cent in 1980 to 57 per cent in 2010. Furthermore, the growth rate in urban population in the period 1960–1980 was far greater than that of total population (INE, 2011). Thus, housing constructed before 1980 is, generally, less robust and, consequently, has lower value than that built after 1980.

Ratio of capital stock to GDP. The value of the country's net built stock for 2014 was €4,713m. Net capital stock in building represented 70.8 per cent of total built assets and civil engineering and other construction works represented 29.8 per cent of the total stock in built assets. The relatively high value of the latter may be explained by the country's geographic location. Cape Verde holds four international airports; one of them (in Boa Vista Island) is practically used for international tourism services. Furthermore, the country has taken advantage of the process of graduation to the middle-income status (through international loans at concessional terms) to upgrade its infrastructure in transport, water and sanitation sectors (WTO, 2015).

According to the figures provided by the EU KLEM database (EU-KLEMS, 2017), the stock of dwellings and other construction represented 75–90 per cent of the net capital stock in the EU Member countries, in the period from 2000 to 2016. As Cape Verde has a low-manufacturing base, this ratio is expected to be at the higher tier. The country's GDP totalled €1,400.60m in 2014. Thus, the ratio of the capital stock to GDP is estimated at 3.74. In an international perspective, this ratio for Cape Verde seems to be an outlier. Indeed, data provided by Derbyshire *et al.* (2011) indicate that the most advanced economies in the EU (including Germany, France, The Netherlands and Italy) had, in 1995, a capital-GDP ratio around 3 and the majority of countries, including the UK, had a ratio in the range between 2 and 3. Neo-classic growth theory implies that the return of capital diminishes at a rate which depends upon the amount of capital already put in place (Aghion and Howitt, 1999, cited in Derbyshire *et al.*, 2011). However, it also implies that the more advanced an economy is the higher the capital-output ratio tends to be because it will be nearer the "steady sate".

Of course, every developing country aspires to attain the main economic and social targets encapsulated in the SDGs. As Cape Verde is well positioned for attaining the key targets of de SDGs (INE, 2016), it is reasonable to suggest that sound economic considerations should be the primary base for the planning of new construction investment projects.

5. Concluding remarks

This study has presented an estimate of the built capital stock in Cape Verde, a country that is scattered through ten relatively small islands. It applies the PIM methodology in a long series of construction investment data obtained from the National Accounts of the National Statistics Office. The results of the study have shown that the country has accumulated a remarkable amount of built assets, which is illustrated by a capital-output ratio of 3.74 in 2014. Neo-classic growth theory suggests that the high value of this indicator is more prevalent in countries in the upper-middle to high-income range. However, the stock built-up is consistent with the evolutionary process of the two types of construction investment aggregates analysed in the study: building construction; and civil engineering and other construction works. Total investment in construction averaged 25.2 per cent of GDP in the period 1980–2014, a value that has few matches in the world over. Particularly remarkable was the evolution of the investment in civil and other construction works in the period 2008–2014 – the mean value for this period represented a striking 9.9 per cent of GDP in 2014. Gross capital stock in "other construction" accumulated in 2018–2014 represents 47.3 per cent of that built up in the entire period

1980–2014. The country has taken advantage of the change in economic development status to construct or renovate major infrastructure projects, particularly in the transport infrastructure sector. A recent work dealing with infrastructure investment needs in 50 countries (Oxford Economics – Global Infrastructure Hub, 2017) indicates that Africa current trends in infrastructure investment is 4.3 per cent of GDP and the investment needs for the period 2016–2040 is 5.9 per cent of GDP. Although investment in civil engineering works does not exactly equate infrastructure investment, the results of the study are in line with the earlier findings of Lopes *et al.* (2002), who put forward the view that in the developing countries of Africa that reach a certain level in construction investment (measured as a percentage of GDP), the development pattern of construction industry should follow that of the general economy.

As pointed out by Ruddock and Ruddock (2012), whether infrastructure financing comes from private, public or agency funding, good infrastructure will continue to be a prerequisite for economic and social development in developing countries. However, infrastructure investment needs should be placed in the wider context of a country's macroeconomic and sectoral performance. Thus, there is a need of international comparative analyses on the measurement of different indicators of the construction industry and the role of construction investment in the process of development. Studies on the measurement of built wealth in individual countries will certainly aid to our understanding of this process.

The quality of the statistics published by national statistical offices in many Sub-Saharan African countries have been recently improving through cooperation with the national statistical offices of Europe and other developed regions of the world. The stated aim is to allow data comparability across countries. This also seems to be the case of Cape Verde's National Statistical Office. This study has undertaken an exhaustive analysis of the available data on construction investment (some of them dispersed through different data sources) and attempt to present a comprehensive picture on the measurement of the country's built capital stock. Further studies of individual countries in different stages of economic development, within the SNA 2008 framework, would provide a better comprehension of the relationship between construction investment and economic growth and development.

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