Estimation of Economic Opportunity Cost of Capital: An Operational Guide for Mozambique

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Abstract

In this paper, an analytical framework and a practical approach are developed to measure the economic opportunity cost of capital (EOCK). This national parameter is an essential determinant for practical application to the economic appraisal of investment projects in a consistent manner for a country.

An application of the model is carried out for Mozambique. Since Mozambique is a small open economy and is also integrated into the global capital market. Estimate of the EOCK is based on the hypothesis that when funds are raised in the capital market to finance any investment project, those funds are likely to come from displaced investment, newly stimulated domestic savings, and newly stimulated foreign capital inflows. It can then be estimated as a weighted average of the opportunity cost of each of the three alternative sources of funds. The EOCK is the most appropriate rate used to discount the economic benefits and costs of a project to see if the project is economically viable for society as a whole.

Keywords: Capital Market, Discount Rate, Investment Funds, Investment Projects, Economic Growth, Mozambique

JEL Classification: H43, O22

The empirical results generate 12.39% of the EOCK for Mozambique in the base case. To ensure the robustness of the estimates, a sensitivity analysis is conducted for the key parameters used in the study. The simulation results range from 10.52% to 14.26% and center around 12.39%. Given the data obtained and used for the analysis, these results suggest that a 12.5 percent real rate is an appropriate and conservative discount rate to use when calculating the net present value of the flows of annual economic benefits and costs over the life of a project.

1 Introduction

This study is developed to provide an analytical framework to government organizations and their personnel involved in public investment management with the aim to facilitate the empirical measurement of economic opportunity cost of capital (EOCK) required for the completion of an accurate and consistent economic appraisal of investment projects in Mozambique.

The economic opportunity cost of capital (EOCK) is a discount rate used to compare benefits and costs that occur at different times of an investment project to see whether the proposed public project or policy is feasible from the economy's point of view. If, on the one hand, the economic NPV of a project is positive, it is potentially worthwhile to implement the project. This implies that the project increases efficiency or raises the wealth of the country as it produces enough benefits to fully compensate all individuals in the economy. On the other hand, if the NPV is less than zero, the project should be rejected on the grounds that the resources invested would have yielded a higher economic return if they had been left for the capital market to allocate to other uses. The economic discount rate is similar to the concept of the private opportunity cost of capital used to discount the financial cash flows of an investment to find its financial net present value. However, the deviations of financial values from economic values of project costs and benefits may arise from various market distortions that are often created by government interventions such as taxes, subsidies, and price controls or by imperfect competition.

Over the last decade and a half, Mozambique has realised sustained economic growth, averaging 7.33% per annum between 2000 and 2015. However, since 2016, Mozambique's economy has experienced a severe slowdown that has led to a drop in GDP growth to an average of 3.33% per annum between 2016 and 2019.[1] This slowdown was due largely to a fall in the prices of traditional export products and a major slowdown in the inward foreign direct investment. In addition, the country's debt situation had become unsustainable, and governance issues related to debt accumulation had led to the deterioration of relations with the country's international partners.

Mozambique economy have increasingly become integrated into the global economy through the trade and financial markets channels. This level of integration, along with abundant natural resources, enhances their abilities to attract a sizeable amount of both domestic and foreign investment. The national accounts data show that investment rates in Mozambique significantly increased over the last decade. The share of 'gross fixed capital formation' (GFCF) in the GDP reached 41% in 2014, up from 17% in 2010. Between 2015 to 2019, the investment rate averaged about 28 per cent of GDP.

The current increase in investment rates mainly attributed to higher investment in extractive industry and public infrastructures. This investment was largely driven by foreign investment inflows with an average of 70 per cent of the gross fixed capital formation between 2010 and 2016.[2] In spite of the large share of the FDI over this period, the FDI has been in decline since 2015 due to the difficulties faced by the major investor countries and the falling commodity prices. To a lesser scale, public investment increased from 13 to 17 per cent of GDP between 2010 and 2014.

Despite sustained and sizable public investments in recent years, infrastructure development in Mozambique is still relatively poor meeting basic needs in most areas, such

[1] Source: World Development Indicators,2021.

[2] Data are obtained from AFDB Socio Economic Database, 2021.

as access to networked electricity, roads, clean water sources, sanitation, telecommunication, and Internet services.

The relatively poor state of infrastructure is confirmed by the index of infrastructure development compiled by the African Development Bank, which ranked Mozambique 11th from the bottom out of 54 countries in 2020.[3]

These trends raise concerns about the absorptive capacity and how the further increases in public infrastructure spending would be managed, even acknowledging the wide infrastructure gap. The quality of investments is a key determinant in the relationship between public investment and growth.

Mozambique's ability to accelerate growth through infrastructure investments to a large extent will depend on the quality of that infrastructure. For sustainable growth, it matters not only how much a country invests, but also how well it invests. While many countries have tried to increase public investment, the results have not always been successful due to factors including poor project selection, delays in project completion, weak procurement practices, cost overruns, incomplete projects, and inadequate operations and maintenance. This highlights the importance of having efficient public investment management processes.

An effective public investment management system will have a variety of elements, including the applying of the appropriate economic discount rate that would improve investment allocations and project selection processes to ensure that the best investment projects are selected and funded.

Even though investment in infrastructure decisively contributes to growth in the national economy (Aschauer,1989), the level of investment would not be translated into faster economic growth rates and making the growth effect more persistent if this investment's

[3] See, Africa Infrastructure Development Index (AIDI), 2020. https://infrastructureafrica.opendataforafrica.org/.

capital productivity is not increasing. With the existence of a crowding-out effect caused by public demand for funds on private investment, the selection of public investments yielding social returns lower than the opportunity costs of funds is economically non-viable. It can reduce output and productivity growth as the resources they employ would have made a higher benefit elsewhere in the economy. According to Agénor & Moreno (2006), In the short term, scaling up the public capital's stock in infrastructure may adversely impact the growth, to the degree that it crowds out private investment. If the fall in private capital investment persists over time, this short-term impact could be translated into an adverse growth effect.

Improving the growth effect and minimizing inefficiencies in the government's use of capital requires that any public investment is expected to yield a higher return in social terms than what would be earned by the economy if the funds were left in the capital market. Accordingly, the economic discount rate of the borrowed funds deemed to be appropriate if it is sufficient to compensate for the weighted average cost of (1) replacing investment displaced, (2) forgone consumption that to some degree will be postponed, and (3) in an open economy, paying for incremental funding from abroad.

Furthermore, the opportunity cost of capital also has an essential role in the choice of technology for a project during the project design process. "The use of a lower financial cost of capital instead of its economic opportunity cost would create an incentive to use production techniques that are too capital intensive. The choice of an excessively capital-intensive technology would lead to economic inefficiency because the value of the marginal product of capital in this activity is below the economic cost of capital to the country". (Jenkins et al., 2019).

This study uses the method of the weighted average for the determination of the economic discount rate considering the performance of the real economy, which could serve as a benchmark for best practice in the context of Mozambique economy.

2 Measurement of the Economic Opportunity Cost of Capital (EOCK)

2.1 Alternative Approaches

Implementation of cost-benefit analysis involves the important step of choosing an economic discount rate. Economists are in agreement that a very serious misallocation of resources can result from the use of an incorrect estimate of the economic discount rate.[4] While methods of estimating market discount rates are well known, the appropriate method of selecting an economic discount rate to be used in evaluating public sector investment projects has been one of the most contentious and controversial issues in this area of economics.

Based on efficiency criteria, methods for determining the economic discount rate are generally placed into three categories.[5] The first one is the evaluation of consumption that is related to the 'social rate of time preference' approach about society's willingness to give up an amount of consumption today in exchange for more in the future but only after adjusting the costs by the 'shadow price of capital' to take into account the existence of a higher marginal productivity rate of return on the displaced investments.

The second viewpoint of growth maximization focuses on the highest rate of return of an investment available outside of the public sector that could be financed by these funds. It has usually been the case that this option is to finance investment projects in the private sector.

The third method captures the essential features of the above two alternatives by taking into account the social opportunity cost of public investment as well as the impact of public investment on consumption spending, considering the capital market is the marginal source of funds. This method is founded on the contributions of Harberger. It recommends the use

[4] See, for e.g., Baumol (1968); Harberger (1969); Burgess (1988).
[5] Social rate of time preference as supported by: (Marglin, 1963), (Feldstein, 1964), (Sen, 1961), (Lind, 1982), (Bradford, 1975). Social opportunity cost of capital advocates by: (Baumol, 1968), (Mishan, 1967), (Diamond, P. & J. Mirrlees.,1971). The Weighted average approach as supported by: (Harberger, 1969), (Usher, 1969), Ramsey (1969), (Sandmo & Drèze, 1971), (Sjaastad & Wisecarver, 1977), (Harberger & Wisecarver, 1977), Boadway (1978), Hagen (1983), Marchand and Pestieau (1984), (Burgess D, 1988), (Jenkins, Kuo, & Harberger, 2019), (Burgess & Zerbe, 2013), and (Harberger & Jenkins, 2015).

of a weighted average of the 'marginal productivity of capital' in the private sector, the 'rate of time preference for consumption,' and the 'marginal cost of foreign financing,' with the value of weights representing the fractions of funds diverted from displaced investment demand, forgone consumption (increase in domestic supply of savings) and foreign savings when the government enters into a borrowing operation in the capital market.

In this study, we apply this weighted average approach using Mozambique national accounts and capital market information in order to estimate the appropriate economic discount rates to be used for appraising public investment projects in Mozambique.[6] What follows is to describe this approach and empirically measure the economic cost of capital for Mozambique.

2.2 Analytical Framework

The estimation of the (EOCK) is based on the view that "the 'marginal' source of funds for both the public and private sectors is usually the capital market (Jenkins & Kuo, 1998). When the sponsor of an investment project enters the capital market and bids for funds, the private demand for funds as well as the domestic supplies of investible funds are likely to respond to a change in market conditions. An increase in the cost of funds causes a postponement of some private investment in the country. On the other hand, domestic consumers tend to postpone their current consumption in order to save more as they are attracted to a greater amount of consumption that they can spend in the future by now saving and investing their funds in the capital market.

When we move to an open economy framework, borrowing from the international capital market becomes the third source of funds due to a higher rate of return in the home country. According to Sandmo & Drèze (1971) and Edwards (1986), the supply of funds from foreign savers depends positively on the rate of interest; hence, more foreign savers are attracted to the country's capital market. In this case, the cost is not solely the cost of

[6] This approach has been initially developed by Harberger (1969) and Sandmo & Dreeze (1971).

servicing the incremental foreign loans but also the additional costs of servicing the existing foreign debt where the interest rate on some of the current stock of debt is contracted at a variable interest rate. These debt instruments would be responsive to changes in the market rate of the interest.

In sum, the EOCK is a weighted average of the economic cost of funds from the three sources employed to finance the additional demand marginal investment project, with weights reflecting shares of funds extracted from their respective sources. They should be measured by the responsiveness of investors and savers to changes in interest rates caused by the government's additional demand for funds. This can be expressed as:

$$EOCK = f_1 * \rho + f_2 * r + f_3 * MC_f \quad (1)$$

Where ρ refers to the gross tax rate of return to domestic reproducible remunerative capital investment, r stands for the economic cost of newly stimulated household savings, and MC_f for the marginal economic cost of foreign financing. The corresponding weights (f_i) represent the share of funds diverted from private sector investors, private sector savers, and foreign savers. The sum of $f1 + f2 + f3$ will equal one.

2.3 Empirical Estimation

Following equation (1), estimating the economic opportunity cost of capital requires the estimation of two components. The first component is presented in section 2.3.1 and is concerned with the estimation of the economic cost of each of the three sources of investment funds, namely, the economic rate of return on displaced reproducible remunerative investments, the rate of return of on domestic savings (net of tax), and the marginal economic cost of foreign financing. Section 2.3.2 presents the estimation of shares of these three sources of funds.

2.3.1 The Economic Opportunity Cost of the Different Sources of Public Project Funds

2.3.1.1 The Gross of Tax Rate of Return on Reproducible Remunerative Capital (ρ)

The gross-of-tax return to reproducible remunerative capital measures the contribution of remunerative capital investment in the economy as a whole. In most estimates of the economic discount rate based on the weighted opportunity cost of funds, the largest share of the opportunity cost comes from the reduction in domestic reproducible remunerative capital investments. The relevant opportunity of funds will be partially determined by the economic return of those investments that will be displaced by the government's capital market operations.

The measurement of the return to capital can be reached by two main alternative approaches; while the two approaches are using the national accounting system, however, they are different in the way of calculating the flow of income generated by capital. The first method has been applied to Canada by Jenkins & Kuo (2007). In this method, the income to capital in the country is estimating by adding up all the returns to capital which includes interest income, dividend income, rent, profit income, as well as the associated direct and indirect taxes generated by capital. The total income accruing to capital is then divided by the stock of reproducible remunerative capital. The second approach is an aggregate and top-down approach.[7] At a conceptual level, if we assume that factor payments exhaust the value of output, we can obtain income accruing to capital as the value of output net of the contributions made by labor, land, natural resources, associated sales, and excise taxes and the gross consumption of fixed capital. According to the availability and types of detailed data recorded in Mozambique's national accounts, the second approach is adopted.

[7] The approach was first applied by Harberger & Wisecarver (1977) to calculate the rate of return to capital for Uruguay. This method was applied by Poterba (1998) to measure the 'rate of return to corporate capital' in United States, and used by Jenkins & Kuo (1998), Kuo et al. (2003) and Coppola et al (2014) to estimate the rate of return on capital as one of components used in calculating the economic discount rate for Philippines, South Africa and Mexico, respectively.

The rate of return to reproducible remunerative capital (ρ) at time t is the ratio of the value of national income (net of economic depreciation) that has accrued to capital (Y_t^K) to the value of the reproducible remunerative capital stock (K_t). with both numerator and denominator expressed in terms of prices of the same year

$$\rho = \frac{Y_t^K}{K_t} \tag{2}$$

In accordance with Gollin (2002), macroeconomists commonly calculate the shares of production factor not from data at the firm level but from national income accounts data and product accounts. The most used method in order to estimate the share of capital in GDP at current market prices is to estimate the labor share of national income from the share of employee compensation in GDP. The returns to capital are then taken to be residual" and can be expressed as follows:

$$Y_t^K = Y_t - Y_t^L \tag{3}$$

Where Y_t represents the national income and Y_t^L is the total labor income. Moreover, we will need to find the value of GDP after subtracting the contributions related to land and natural resources, associated indirect taxes, and the depreciation expense. Therefore, our proposed capital income at time t is specified as follows:

$$Y_t^K = Y_t - Y_t^L - pGVA_t^C - S^L T_t - R_t - D_t \tag{4}$$

Where in a given year t, Y_t^K is the return to capital, Y_t is the national income, Y_t^L is the total labor income, GVA_t^C is the gross value added of agriculture, p is the proportion of land's contribution to GVA_t^C, S^L is Labor's share of national income, T_t represents the sales and excise taxes, $S^L T_t$ is the amount of taxes on products borne by the value-added of labor, R_t is the value of natural resource rents, and D_t is the depreciation expense associated with the reproducible capital stock.

The first step is to estimate the total labor's share of national income representing the sum of wages and salaries paid to the workers by corporations plus the labor income of the non-incorporated enterprises. Since the owners or the members of unincorporated enterprises are working without receiving wages and salaries, this sector's operating surplus includes income accruing to both labor and capital. Therefore, the faction of mixed income that corresponds to the labor income for unincorporated enterprises needs to be estimated and added to the total remuneration paid to employees in the national accounts in order to find out the total income accruing to labor created by the economy in a given year.

The compensation of employees, which represents the lower bound of total labor income in the economy, is available in the national accounts of Mozambique; however, this item generally disregards the self-employed income, and without considering this share, the labor income will underestimate the true total labor income share. Therefore, to estimate the total share of labor in national income, one needs to add up the share of labor income of unincorporated businesses to the compensation of employees' items of national accounts.

To determine the total labor income in Mozambique, we assume that the labor income in the gross operating surplus and mixed income is 25 percent. Accordingly, the total share of labor in GDP for Mozambique ranges between 39.98% to 42.10% of national income between 2011 to 2020. In the empirical estimations that follow, sensitivity analysis is run to define the effect of changes in the labor income share and on the estimation of EOCK.[8]

The second step is to figure out income accruing to land. As land is not part of reproducible capital, it is not part of the base of our rate of return estimation. This task is not straightforward because we do not have direct information on the income generated by

[8] All data for the total share of labor income is shown in Appendix A.1

land; however, the land is a production factor contributing significantly to the value-added in the agriculture and housing sectors.[9]

Agriculture is a large sector in Mozambique which accounting for about 21 percent of the total value of the economy.[10] According to Harberger (1969) and Robles (1997), one-third of the value-added in the agricultural sector is an income accruing to land. Hence, we estimate the land contributions in the agriculture sector to the GDP as (1/3), multiplying by the sum of gross value added of agriculture sector as shown in Appendix A.1, column (6).

The third component to be deducted from the income to capital is natural resource rents, as it is not a return to reproducible capital. Natural resources combined with reproducible capital give rise to economic rents.

The mining and quarrying sector makes a considerable contribution to the Mozambique economy. The national figures show that the average rate of extractive industries output to GDP increased from less than one percent in 2000 to 12.21 percent in 2019.

In order to estimate the amount of resource rents created by the mining sector of Mozambique one first needs to examine the ways that the government has tried to appropriate these rents.

The government levies royalty rates on the value of the mineral sold plus surface tax and compulsory transfers to government. In addition, the government receives income from the mining sector through the free equity it has received in exchange for the rights of private investors received to develop the mines. The income received from the free mining equity is a part of the distribution of resource rents created by the sector. To the extent that their remains economic rents that increase the rate of return to the owners of the mine this higher than normal rate of return will also be shared with the government through higher income

[9] Disaggregated items of the GVA of housing sector or on the contribution of land to the sector are not available for Mozambique. Accordingly, in the absence of detailed information, the housing sector is excluded from this study.
[10] Agriculture, forestry and fishing accounting for 22% of the gross domestic product in 2020.

tax payments. With regard to ordinary taxes on income, profits and capital gains, we assume that half of this revenues is an income taxes levied on the economic rents included in the outputs of the corporations.

Thus, the total mineral resource rents of Mozambique equal to the amount of revenues from mineral royalties plus the free equity and the share of corporate tax on economic rents received by government. The calculation of the total economic rents of Mozambique that need to be deducted from the national income is presented in Appendix A.2.

The fourth part is indirect taxes and subsidies. Indirect taxes mainly include sales tax (i.e., value-added tax charged on the sale of goods or services), excise tax, and customs duties that are all included in GDP at market prices. To account for the return to reproducible capital, we need to allocate the total amount of indirect taxes between the value-added of capital and the value-added of labor.

Regarding sales taxes, Mozambique has implemented a value-added tax (VAT) at a rate of 17% currently. These value-added taxes apply to the consumption of goods and services in the economy. VAT is charged at each stage of the production and distribution process, and it is proportional to the price charged for the goods and services. Mozambique government allows the vendors full credit for their payments on capital goods like machinery and equipment. Consequently, the value-added tax is entirely borne by the value-added of labor. Hence, the total tax collections of VAT have to be excluded from the share of GDP accruing to capital alone.

Excise duties are levied on certain goods manufactured locally or imported, which are identified in a specific table that is an integrant part of the Excise Duty Act and indicates the applicable rates. Amongst others, the said table includes goods such as tobacco, beer and other alcoholic beverages, vehicles, cosmetics, cloths, airplanes, boats, etc.

The portion of this type of taxation that is a part of the value-added labor should be computed and excluded from the income accruing to reproducible capital. To this end, we

apply a similar proportion as the share of labor income in GDP and subtract this amount of taxes from GDP. This is shown in Column (3) of Appendix A.1.

Unlike taxes, subsidies reduce the estimated GDP expressed in market prices. Hence, the amount of subsidies attributed to the value-added of capital must be added back in order to derive the value-added of capital that reflects production costs. In order to do so, we only consider the subsidies on products. Subsequently, a share of subsidies attributable to the value-added of capital must be added to GDP. To do that, we use the information obtained from the National Institute of Statistics (INE).

After labor's share of national income and the income accruing to land and natural resource rents, as well as the proportion of indirect taxes attributed to capital income are estimated, the value of economic depreciation expense consumption of fixed capital reported by the national accounts needs to be deducted from GDP, which results in income accruing to the capital net of depreciation.[11]

Another reasonable adjustment that needs to be made to the rate of return calculation is the deduction of some portion of returns to capital in financial intermediation. According to Harberger & Jenkins (2015), when new demands for funds lead to the displacement of other investments, they automatically save the economy the intermediation costs that would normally be linked to those investments. In measuring the returns to the capital for the economy as a whole, such returns that would be received by capital in the financial sector are included. Hence, we need to exclude that part of these returns that are linked to the investments of each period. This will be approximately equal to half of the return to capital involved in financial intermediation of the year when funds are taken from the capital market.[12]

To this point, we have estimated the aggregate income that is directly accruing to reproducible remunerative capital throughout the period 2000 - 2019, i.e., gross-of-tax

[11] See, The World Bank, World Development Indicators
[12] We assume that the Capital's share in the GVA in financial sector is 0.67.

return to capital; the results are shown in Appendix A.1, Column (12). This income to capital is the remunerative income as captured by the national accounts.

In order to determine the real rate of return to capital, the amounts of capital return at current prices must be deflating by the GDP deflator to obtain the capital income in real terms. This step aims to express values for both the capital income and capital stock values at the same price level. In this study, we identify the price level of 2014 as the base year for Mozambique.

Mozambique has no official estimates of its capital stock. Therefore, we will construct our estimates. The perpetual inventory method is a method of constructing estimates of the capital stock and consumption of fixed capital from time series of gross fixed capital formation. More precisely, the method is based on the following relation:

$$K_t = (1 - \delta)K_{t-1} + I_t \quad (5)$$

Where K_t is the stock of physical capital at the end of period t, I_t is the flow of gross fixed investment during period t, and δ is the (exponential) rate of depreciation.

The database of Penn World Table (version.10) provides four categories of gross investment: (a) residential and non-residential structures; (b) machinery and (non-transport) equipment; (c) transport equipment; (d) other assets.[13] Our strategy will be to apply the perpetual inventory method separately to each of these categories.

With respect to depreciation, it is assumed that depreciation rates for machinery and (non-transport) equipment, transport equipment, and other assets are the same at 6 percent in the base case; however, we assume that residential and non-residential structures depreciate at a low depreciate rate of 2.5 percent in the base case.[14]

[13] Other assets include software, other intellectual property products, and cultivated assets.
[14] The assumed low and high annual depreciation rates are 2% and 3% for residential and non-residential structures, and 4%, and 8% for the other categories of assets.

The initial capital stock, i.e., capital at t = 0, is estimated based on Harberger (1988) approach. This approach employs neoclassical growth theory and relies on the assumption that the economy under consideration is at its steady state. As a consequence of this assumption, capital and GDP grow at the same rate g:

$$K_t = \frac{I_{t+1}}{g+\delta} \tag{6}$$

Equation (6) indicates that computing the capital stock in requires data on investment in and a representative measure of GDP growth around the same year, and an estimate of the depreciation rate. In this study we start the estimation of the initial capital stock from year 1994. The estimated growth rate g was approximated by the average annual growth from 1991 to 1993, 3.13%, as illustrated in Appendix B.

Therefore, initial stocks were estimated for each type of reproducible capital given the data on investment provided by the Penn World Table (version .10). Then the total initial reproducible capital stock has been computed for 1994.

Afterward, following equation (5), the capital stock in 1995 is just the initial capital stock computed according to (6) reduced by its real depreciation and augmented by the gross fixed investment in 1995; the subsequent capital values were calculated repeating the same procedure. All details on the construction of the capital stock series are presented in Appendix B.

To estimate the real rate of return on reproducible remunerative capital, we exclude a non-remunerative share of public sector capital such as the investment in roads, schools, and public buildings from the total reproducible capital. The main reason for doing that is the presumption that government investment (and saving) is not responsive to the funds demanded by an incremental public investment project. In other words, it is not likely that there will be any displacement of non-remunerative public sector investment expenditures when the government enters into a borrowing operation in the capital market. Hence, the reproducible remunerative investments that will primarily be private sector investments

would be reduced (crowded out). The remunerative capital stock represents a narrower class of investments than total reproducible capital. It includes only the private remunerative investments in reproducible capital as well as the remunerative share of the public sector, such as public corporations and public-private partnerships; however, a non-remunerative share of general government investment is excluded. (Othman & Jenkins, 2020).

For the purpose of this study, we assume that the remunerative reproducible capital stock is about two third of the total capital stock in Mozambique during the period 2000-2019. Accordingly, the capital stock series calculated based on equation 5 is multiplied by this ratio to derive the remunerative capital stock in Mozambique.

The real economic rate of return to capital is estimated as the capital's share of national income during a specific year divided by the reproducible remunerative capital stock for that year. For the past twenty years, the result indicates that the aggregate rates of return on capital in the Mozambique economy are high. The average real rate of return (net of depreciation expense) to domestic investment (ρ) over the study period has been 17.26%. This is the rate of return that measures the cost to the economy when the government displaces remunerative investment.

Figure.1 illustrates the estimations of the real rate of return to the reproducible remunerative capital investment of Mozambique from 2000 to 2019. The return to total reproducible remunerative capital for the overall economy in Mozambique fluctuated from 23.66% in 2008 to 10.81% in 2019, mainly affected by its business cycle.[15]

[15] Until the mid-2000s, Mozambique's growth was largely due to an economy recovering from conflict. However, the country's economic growth during the last decade has been fueled by large inflows of foreign aid and investment, which were utilized to rebuild the country following the conflict. In 2016, the economy grew at its lowest rate in 15 years, dropping from 6.72 percent to 3.82 percent. Between 2017 and 2019, economic growth slowed even more to an average of 3.16 percent. This is owing to a reduction in government spending, a drop in the pricing of important exports, and a drop in inward investment.

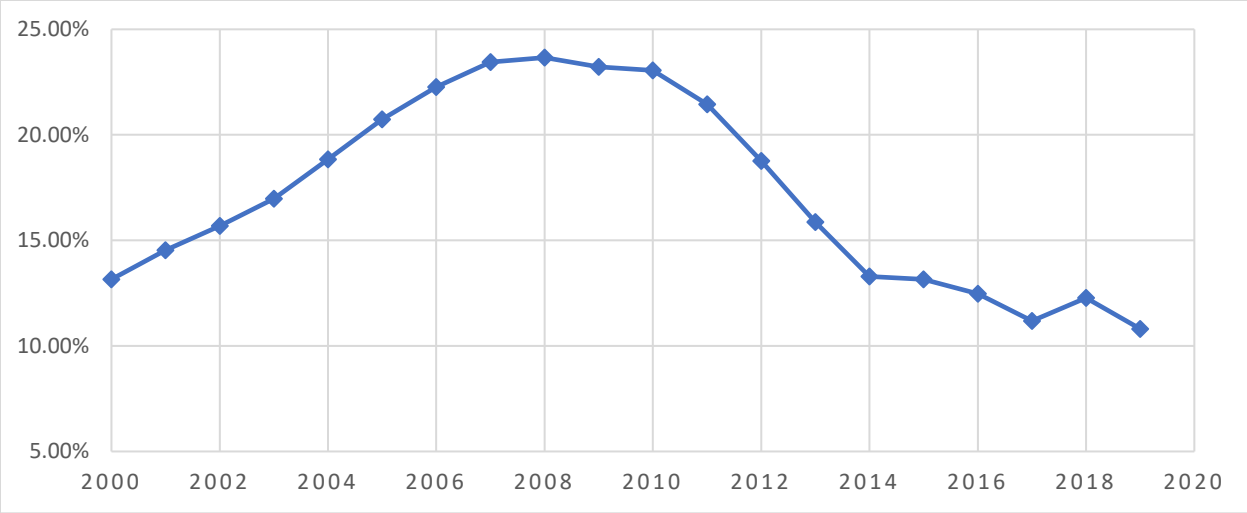

Figure 1 Real Rate of Return to Reproducible Remunerative Capital for Mozambique economy: 2000-2019.

2.3.1.2 The Rate of Return on Domestic Savings (r) in Mozambique

The second element in determining the country's economic opportunity cost of capital is the return to newly stimulated domestic savings. As we consider the market to be the source of funds for any investment, the marginal rate of return on additional savings will reflect the marginal value of forgone consumption in calculating the (EOCK). According to Jenkins *et al.* (2019), When funds are raised in a country's capital market to finance a new project, it will stimulate private savings in the country's financial institutions. This additional saving represents the forgone household consumption with an economic opportunity cost equal to the net-of-tax rate of return on additional savings.

The net of tax return of domestic savings will be estimated as a gross of tax return to the reproducible capital net of income tax from corporations. In addition to that, the property taxes paid by corporations and householders should be deducted. The reason to do that is these taxes falling on capital and derive a wedge between income accruing to investment and the income accruing to saving.

Finally, the national net of the tax return to domestic savings is deflated by the GDP deflator to express all figures in 2014 prices and then divided by the real values of the

remunerative capital stock.[16] The result is the average real rate of return to domestic savings.

Over the study period 2000 - 2019, the return investors receive from newly stimulated domestic savings that are invested in reproducible remunerative investments in Mozambique has averaged 15.32%. Detailed calculations and formulas are presented in Appendix C.

These rates of return contain the risk premiums on different types of investments over the period of the study. There is a need to recognize that not everyone who is saving and investing in these countries has the same degree of risk aversion. For those with the highest degree of risk aversion, the difference between riskless government bond rates and the net of tax rates of return on savings and investments reported above reflects the evaluation of the cost of risk. On the other hand, for those individuals who are not risk-averse, the net of tax rate of returns from the reproducible remunerative investment will reflect their rate of time preference rate between consumption and saving (investing).

For this purpose, we assume that the distribution of people's risk aversion is linearly distributed between these two extremes. Therefore, the cost of risk for society as a whole would, on average, be the mid-value of the distance between the net of the tax rate of returns from reproducible remunerative investment estimated above and the risk-free rate adjusted for inflation and personal income tax.[17] To determine the average rate of time-preference for consumption (r) by the residents in the country who are net savers, we subtracted the average risk premium from the net of the tax rate of return to domestic savings.[18]

[16] Remunerative capital stock is obtained from Appendix A.1

[17] Treasury bills are considerably risk-free, or at least low risk financial instrument.

[18] It is worth to mention here that a large fraction of people in developing countries are net borrowers not savers. Therefore, the rate of return on postponed consumption should include not only the after-tax rate of return on saving, but also the real rate of return on consumer borrowing. Including this category would increase the rate of return on postponed consumption, and the implied EOCK rate. However, the increase would be quite modest given the small proportion of incremental funding drawn from postponed consumption compared to displaced domestic investment.

Table 1 illustrates the calculation of this rate in Mozambique that represents (r) in the calculation of EOCK. The final estimates suggest that the rate of return on domestic savings is 8.96% in real terms.

Table 1 The Real Rate of Return on Domestic Savings (r)

Treasury bill (91 days)	11.41%
The personal income tax rate	20.00%
Treasury bill (net of tax)	9.13%
CPI (YOY%)	6.52%
The real rate of return to a risk-free bond	2.60%
The real primary rate of return to domestic savings	15.32%
Risk premium	6.36%
The real rate of return to domestic savings (r)	8.96%

Source: CBK & IMF.
Notes:
1. Treasury bills & CPI % are the average rate from 2012 - 2019.
2. Risk Premium = [Primary Real Rate of Return on Domestic Savings - A real rate of return to risk-free bond] / 2
3. Real Rate of Return on Domestic Savings (r) = [Primary Real Rate of Return to Domestic Savings - Risk Premium].

2.3.1.3 The Marginal Economic Cost of Foreign Financing (MCf) in Mozambique

The marginal cost of foreign borrowing is the third element we need for the estimation of the EOCK. In an open economy, when the government accesses the world capital market, raising funds stimulates the savings of foreigners to inflow into the economy. In particular, the higher demand for foreign funds will increase the interest rate faced by the country in the international capital markets, which implies that the higher rate will be paid not only on the extra borrowing demanded by the project but also on all the debt contracted by the country at variable interest rates.

Therefore, for the economy as a whole, the economic cost of foreign borrowing is not given by the interest rate faced by the incremental project, which represents the average cost of borrowing, but by the cost of funds faced by the project plus the extra cost generated on the existing debt, which represents the marginal cost of borrowing.

With the existence of a country risk premium, Edwards (1986) discusses that the country faces an upward sloping supply curve of foreign borrowing, and public projects impact the relevant marginal cost of foreign indebtedness. Therefore, the marginal economic cost of foreign funds is increasing above the average cost of foreign funds.

The marginal cost of foreign borrowing created by the projects can be calculated as follows:

$$MC_f = \frac{[i_f*(1-t_w)- gP_f]}{1+gP_f} * \left[1 + K * \left(\frac{1}{\varepsilon_s^f}\right)\right] \quad (7)$$

Equation (7) indicates that the $\boldsymbol{MC_f}$ is determined by is the average nominal interest rate charged on external loans, i_f, t_w is withholding tax rate on interest income, gP_f is the foreign inflation rate, K the proportion of foreign debt contracted in a floating interest rate, ε_s^f is the elasticity of the supply of foreign funds with respect to the interest rate.

According to the World Bank, International Debt Statistics, the outstanding amount of long-term external debts of Mozambique was at 18,331.70 million US dollars in 2019, in which 10,726 million US dollars is held by public and publicly guaranteed institutions. The currency composition of PPG debt shows that the US dollar-denominated long-term PPG debt accounts for 71% on average of the total for the last five years.[19] Accordingly, we consider that gP_f in equation (7) is the GDP deflator of the United States. Taking the average U.S. annual inflation rates throughout the study period, the gP_f equals 1.80%.

Regarding the proportion of foreign financing that is responsive to interest rate changes, World Bank, International Debt Statistics provide the percentage of long-term external debt with interest rates that float with movements in a key market rate. Over the last five years, the variable interest rate accounts for around 25.50% of the external debt stocks in Mozambique. For this analysis, we assume that this ratio represents the share of foreign borrowing responsive to interest rate changes (K).

With the purpose of finding the cost of foreign lending to domestic borrowers (if), we estimate that the interest rate charged on foreign financing would be at least the U.S. treasury long-term rate plus an additional charge for country risk. The U.S. treasury's long-

[19] According to the World Bank, International Debt Statistics, around 74% of the long-term external debt in 2019 is denominated in US dollar, 16% in SDR and other currencies, 7% in Euro, and 3% in Japanese Yen.

term average nominal interest rate is about 1.93%.[20] Using Damodaran's (2021) estimation of country risk premium, we obtained the estimated cost of foreign borrowing for Mozambique net of withholding tax at 10.65%.

The last component required for equation (7) is the elasticity of the supply of foreign funds with respect to the interest rate. This variable is set at 2; however, a sensitivity test has been undertaken to define the effect of changes in this parameter on the estimation of the economic opportunity of capital.[21]

Substitution the parameters and assumptions describe in equation (7), the estimate of the real marginal economic cost of foreign financing (MC_f) for Mozambique is at 9.79%.

2.3.2 Shares of the Three Diverted Funds in Financing the Projects

After we estimated the cost for each of the three components of EOCK, the next step is to assess the weights of each of the three sources of funds. According to Jenkins et al. (2019), the weights of each source of funding related to "the average contributions made from each source and their price responsiveness to the change in market interest rate as a result of raising funds for a new investment project in the capital market." For empirical estimation, the relevant formulas of Jenkins & Kuo (1998) can be followed:

$$f_1 = \frac{-\eta(\frac{I_t}{S_t})}{\varepsilon_h^s(\frac{S_d}{S_t}) + \varepsilon_f^s(\frac{S_f}{S_t}) - \eta(\frac{I_t}{S_t})} \tag{8}$$

$$f_2 = \frac{\varepsilon_h^s(\frac{S_d}{S_t})}{\varepsilon_h^s(\frac{S_d}{S_t}) + \varepsilon_f^s(\frac{S_f}{S_t}) - \eta(\frac{I_t}{S_t})} \tag{9}$$

[20] Source of U.S. Treasury Long-Term Average Rate data is U.S. Department of the Treasury. Long term treasury represents a treasury with 25 years or more remaining to maturity. We consider the annual average rate of U.S. treasury long-term in the last three year (2019-2021) as we are concerned with the apprising of public project in the future.

[21] It is worth noting that the elasticity of the supply of foreign funds has two compensating effects: to the extent that it increases the share of foreign funding, yet the marginal cost of these funds decreases.

$$f_3 = \frac{\varepsilon_f^s(\frac{S_f}{S_t})}{\varepsilon_h^s(\frac{S_d}{S_t}) + \varepsilon_f^s(\frac{S_f}{S_t}) - \eta(\frac{I_t}{S_t})} \quad (10)$$

Where, ε_f^s = the elasticity of the supply of foreign funds; η = elasticity of demand for private investment ε_h^s = supply elasticity of household savings; in response to the interest rate changes. S_t = total private-sector savings available in the economy; S_d = total domestic savings; and S_f = total net foreign capital inflows; I_t = private sector investment.

As noted in the preceding part, the supply elasticity of foreign funds has been set at 2 in Mozambique. Based on Ogaki et al.'s (1996) estimations, the average interest sensitivity of savings at an initial real interest rate of 3% was about 0.312 in low-income countries, while it was about 0.532 for the lower-middle-income countries. For this study, we use 0.4 as the supply elasticity of private savings in our calculations. The interest elasticity of demand for domestic investment is set at -1.0.

Our main concern is to examine the effect of incremental government borrowing on private-sector savings and investment. On the savings side, the national accounts data shows that the gross domestic saving accounts for an average of 54.97 percent of the total private-sector savings from 2005 to 2016, while the remaining is the share of foreigners' savings.[22]

On the investment side, the private-sector investment as a percentage of the total private-sector gross savings centered around 63.84% over the period from 2005 to 2016. For the purpose of this study, we assume that the ratio of (It/St) is equal to the study period average of 63.71 per cent.

[22] The total private-sector gross savings represents the summation of the amount of gross domestic saving (domestic financing of GFCF) and the amount of foreign financing of GFCF. The source of first variable is the INE, Contas Nacionais e BM, Balança de Pagamentos: www.bancomoc.mz; * dados preliminaries. The later variable represents the FDI Inflows (In % of Gross Fixed Capital Formation) and was obtained from African Economic Outlook March 2021.

With these rations and assumptions, the shares of funds diverted from the three sources described above can be derived. They are 36.25% from displaced or postponed domestic investment, 12.51% from domestic savings, and 51.24% from additional foreign capital Inflows.

2.3.3 Estimates for the EOCK

The estimation of EOCK now is carried out as a weighted average rate of return to displaced reproducible remunerative capital investment and the rate of return on domestic and foreign savings. These rates and the corresponding weight for each one is obtained in the previous sections. By applying equation (1), the economic discount rate of Mozambique is estimated at 12.39%.

2.3.4 Sensitivity Analysis

One of the challenges for measuring the EOCK for Mozambique relates to the availability of data required for estimation. When the data are not available, they are based on our observation of the economic indicators elsewhere. The empirical results in the base case depend on the values of several key parameters, including the share of labor income in GDP, the depreciation rate used for estimating the total capital stock for construction and other assets, the percentage share of the remunerative portion of investment in total capital stock, the foreign borrowing rate for Mozambique, and the elasticity of demand for domestic investment. We conduct a sensitivity analysis regarding the impact of these key parameters on the estimate of the economic opportunity cost of capital.

i. The Share of Labor Income in GDP

If the proportion of labor income in GDP is 6 percent less than the base case of 41%, the real rate of return to domestic investment would be raised on average to 21.07% over the past twenty years, and the time preference of consumption to 12.79%. Using 21.07% for ρ, 12.79% for r, and 9.79% for MC_f, the EOCK becomes about 14.26 percent, 1.87 percentage points higher than that for the base case.

On the other hand, if the portion of labor income in GDP is 6 percentage higher than the base case, the average rate of return to domestic investment and the time preference of consumption would be reduced to 13.41% and 5.13%, respectively. As a consequence, the EOCK decreases to 10.52 percent, which is 1.87 percentage points lower than that for the base case.

ii. Annual Depreciation Rates for Construction and Other Assets

If the depreciation rate used for the capital stock of construction and other Assets is 2.0% instead of 2.5%, the parameters ρ and r are calculated to be 16.1% and 7.9%, respectively. Substituting these opportunity costs of funds along with 9.79% for MC_f in equation (1) yields the EOCK at 11.82%.

On the other hand, if the depreciation rate is assumed higher at 3.0%, the values of ρ and *r* are estimated higher at 18.4% and 10.0%, respectively, compared to the previous cases. Accordingly, the EOCK would be slightly increased to 12.94 percent, 0.55 of one percentage point higher than that for the base case.

iii. The portion of Capital Stock Attributable to the Remunerative Capital

If the share of the remunerative portion of capital stock is adjusted upward to 75% of total capital stock from the base case at 67%, the average rate of return to domestic investment falls to 15.3%, so does the time preference of consumption to 7.3%. Using 15.3% for ρ, 7.3% for *r*, and 9.79% for MC_f, the EOCK is estimated at about 11.48 percent, 0.87 percentage points lower than that for the base case.

Suppose the portion of capital stock attributable to the remunerative is adjusted downward to 59%. The EOCK would be 13.45 percent.

iv. Elasticity of Demand for Domestic Investment

If the price elasticity of demand for domestic investment is -0.5 instead of the base case value of -1, the share of funds sourced from displaced private investment becomes smaller, and the EOCK would be reduced to 11.32 percent. On the other hand, if the price elasticity of demand for domestic investment is -1.5, the EOCK will increase to 13.13 percent, owing to the larger share of funds diverted from domestic remunerative investment sources.

v. Foreign borrowing rate

The foreign lending rate for Mozambique is estimated at 10.65% for the base case. When other estimates for cost of foreign borrowing are employed in the range of 2% lower and 2% above the base case, the range of the estimates of EOCK increases or decreases by approximately 1.13 percentage point from the base case estimation.

From the above sensitivity analyses, we find the estimates of the ECOK range from 10.52 percent to 14.26 percent, as shown in Table 2. Taking into consideration the results of all extreme cases, the average would be 12.38%. Given the data obtained and used for the analysis, these results suggest that a 12.5 percent real rate is an appropriate and conservative discount rate to be used to discount annual real resource costs and economic benefit over the life of an investment project.

Table 2 Results of Sensitivity Analysis for the EOCK for Mozambique

Scenarios	Key Assumptions	EOCK
Base Case	- Labor income share (%GDP): 41% - Depreciation rate for construction and other assets: 2.5% - Portion of capital stock attributable to the remunerative capital: 67% - Elasticity of Demand for Domestic Investment: -1 - Foreign borrowing rate: 10.65%	12.39%

Sensitivity Analysis:		
- Labor income share (%GDP)	47% 35%	10.52% 14.26%
- Depreciation rate for construction and other assets	2% 3%	11.82% 12.94%
- Portion of capital stock attributable to the remunerative capital	59% 75%	13.45% 11.48%
- Elasticity of Demand for Domestic Investment	-0.50 -1.50	11.32% 13.13%
- Foreign borrowing rate	8.65% 12.65%	11.25% 13.52%

4. Concluding Remarks

This paper has described the analytical framework and the practical approach to the estimation of the economic opportunity cost of capital for Mozambique. This national economic parameter is one of the key variables in estimating the net economic costs and benefits of investment projects.

The approach used to measure the economic opportunity cost of capital in this study is the weighted average approach. This approach considers the opportunity cost of raising funds in the capital markets for use in an investment project. Since the resources to be used in investment projects are limited, the rate of return to a proposed investment must be compared with the weighted average of the forgone returns that would have been generated by the ultimate sources of these funds. An increase in the demand for investable funds drives the market interest rate up. Consequently, some reproducible remunerative capital investment would be displaced, and the domestic and foreign savings would be stimulated.

Employing this method, we estimate that the real economic opportunity cost of capital would be approximately 12.39 percent in the base case.

Given the data obtained for the analysis and to ensure the robustness of the estimated values, we performed a sensitivity analysis by allowing the key parameters that have an impact on the measurement of the economic discount rate. The results suggest that estimates of the discount rate can range from 10.52 percent to 14.26 percent real. Consequently, we recommend that a 12.5 percent rate is an appropriate discount rate to use when calculating the economic net present value of the flows of economic benefits and costs over time.

The estimation of EOCK for Mozambique has been a challenge with respect to data availability. In spite of this challenge, the methodology employed in this report is sound and the empirical simulations with various sensitivity analyses present robust estimates for the economic discount rate to be used for economic appraisals of both public and private investment projects in Mozambique.

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Appendix A.1 Return to Domestic Investment in Mozambique 2000-2019 (Million MT)

Year	GDP	Total Labor Income	Taxes on Products	VAT	Subsidies (Products)	GVA by AFF	GVA-Extractive Industries	Natural Resource Rents	GVA-Financial Sector	Capital's share of Intermediation Cost	Economic Dep-Expense	Gross-of-tax Return to Capital	GDP- Def (2014=1)	Real Return to Capital (2014 prices)	Reproducible Capital Stock	Remunerative capital stock	Real Value of Remunerative capital stock (2014 prices)	Real Rate of Return to Remunerative Capital
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
2000	86,132	35,314	3,031	11,669	57	14,140	166	8	1,849	620	9,359	23,288	0.44	52,438	265,539	177,027	398,618	13.15%
2001	111,770	45,826	3,273	12,567	67	17,531	197	10	2,488	833	15,188	30,258	0.51	58,852	312,398	208,266	405,071	14.53%
2002	134,420	55,112	3,215	11,238	107	26,936	477	24	3,395	1,137	19,238	37,527	0.57	66,328	358,696	239,132	422,664	15.69%
2003	149,909	61,463	4,217	13,229	175	29,700	600	30	3,604	1,207	19,095	43,459	0.59	73,614	383,885	255,925	433,508	16.98%
2004	172,321	70,651	5,118	14,779	191	33,733	1,059	53	4,254	1,425	19,932	52,363	0.63	83,269	416,773	277,850	441,848	18.85%
2005	196,989	80,765	5,996	16,144	101	39,142	1,347	67	4,568	1,530	19,963	63,202	0.67	93,764	457,104	304,738	452,094	20.74%
2006	233,100	95,571	6,738	17,921	312	49,034	2,132	107	5,009	1,678	24,143	74,920	0.73	103,035	504,876	336,586	462,894	22.26%
2007	270,053	110,722	7,349	19,365	345	56,317	2,707	135	9,563	3,204	28,578	86,655	0.78	110,817	554,485	369,659	472,733	23.44%
2008	305,123	125,100	9,737	20,145	395	70,150	2,917	144	9,199	3,082	33,568	96,175	0.82	116,821	609,681	406,456	493,713	23.66%
2009	327,866	134,425	9,217	22,069	438	79,804	3,512	527	8,982	3,009	38,788	99,192	0.83	119,213	640,892	427,264	513,503	23.22%
2010	377,115	154,617	10,957	25,859	5,259	88,225	4,599	1,078	11,763	3,941	48,252	112,864	0.90	125,599	734,443	489,631	544,876	23.05%
2011	418,037	171,395	13,588	29,519	5,235	93,588	7,612	1,371	17,775	5,955	59,282	117,149	0.93	126,329	819,511	546,343	589,153	21.44%
2012	463,921	190,208	16,103	32,073	3,959	100,328	13,081	5,615	19,906	6,668	70,473	121,510	0.96	126,641	971,346	647,568	674,915	18.76%
2013	510,997	209,509	20,014	38,703	6,739	103,888	16,555	10,102	25,613	8,581	82,931	122,659	0.99	124,144	1,159,981	773,325	782,687	15.86%
2014	555,447	227,733	19,768	40,132	6,040	115,490	24,421	15,435	25,947	8,692	100,271	120,531	1.00	120,531	1,360,805	907,208	907,208	13.29%
2015	637,760	261,481	21,917	51,719	8,578	127,045	32,087	6,369	28,851	9,665	120,983	141,693	1.08	131,702	1,614,926	1,076,623	1,000,711	13.16%
2016	752,702	308,608	26,652	59,104	8,376	152,171	58,483	6,644	43,296	14,504	143,841	163,799	1.22	133,933	1,969,221	1,312,821	1,073,453	12.48%
2017	840,526	344,616	25,481	58,518	8,414	188,314	95,680	18,706	41,084	13,763	170,380	166,917	1.32	126,795	2,240,313	1,493,549	1,134,542	11.18%
2018	895,567	367,182	25,235	65,096	8,453	197,638	109,323	9,193	37,921	12,704	175,777	195,034	1.36	143,837	2,383,561	1,589,048	1,171,915	12.27%
2019	962,621	394,675	33,549	73,791	1,063	209,174	103,459	9,446	40,549	13,584	208,171	180,799	1.42	126,921	2,508,914	1,672,618	1,174,182	10.81%
																	Average	**17.24%**

Sources & Notes:
Columns (1), (3), (4), (5), (6), (7), (9) are obtained from the national accounts data, Instituto Nacional de Estatística. (INE).
Column (2) = (1) * 0.41
Column (8): The natural resource rents between 2008 and 2019 are obtained from appendix A.2. Between 2000 and 2007, we assume that the natural resource is (0.05 * (7)).
Column (10) = (9) * 0.67 * 0.50
Column (11) is obtained from World Bank, national accounts data.
Column (12) = (1) – (2) – ((3) *(0.41)) – (4) + ((5) *(1-(0.41)) – ((6) *33%) – (8) – (10) – (11)
Column (13) is obtained from World Bank, national accounts data.
Column (14) = (12)/ (13)
Column (15) is obtained from appendix B.
Column (16) = (15) * 67%
Column (17) = (16) / (13)
Column (18) = (14) / (17)

Abbreviations: GVA: Gross Value Added; AGR: Agriculture.

Appendix A.2 Total resource rents in Mozambique from 2008 - 2019 (Million MT)

	Extractive Industries Contribution to Government Revenue in Million MT (Excludes Personal Income Tax)										
Year	Ordinary taxes on income, profits and capital gains	Royalties (Production Tax)	Social security employer contributions	Other taxes payable by natural resource companies	License fees (Surface Tax)	General taxes on goods and services (VAT, sales tax, turnover tax)	From government participation (equity) (Dividend)	Compulsory transfers to government (infrastructure and other)	Total Extractive industries contribution to government revenue	Corporate tax on economic rents	Total resource rents
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2008	71.06	95.88	15.21	6.94	5.67	19.06	-	-	214	36	144
2009	549.26	54.73	-	-	27.75	-	11.20	159.00	802	275	527
2010	1,079.37	153.67	-	93.98	115.04	-	-	176.04	1,618	540	1,078
2011	1,796.73	241.00	-	-	34.13	-	14.58	182.70	2,269	898	1,371
2012	9,408.98	647.96	-	-	54.09	-	46.78	161.59	10,319	4,704	5,615
2013	18,070.88	748.26	-	8.04	51.92	-	76.87	181.49	19,137	9,035	10,102
2014	28,708.06	805.15	-	7.47	18.94	-	84.33	164.79	29,789	14,354	15,435
2015	8,761.40	1,202.85	-	264.59	36.63	-	316.51	167.47	10,749	4,381	6,369
2016	8,381.42	1,930.04	-	-	15.30	-	231.55	276.66	10,835	4,191	6,644
2017	28,369.90	3,924.42	-	-	60.28	897.06	212.10	323.90	33,788	14,185	18,706
2018	9,529.08	3,725.24	-	-	136.16	469.67	149.00	418.04	14,427	4,765	9,193
2019	7,975.38	2,974.69	-	810.83	193.64	227.80	530.65	948.51	13,661	3,988	9,446

Sources & Notes:

Columns (1), (2), (3), (4), (5), (6), (7), (8) are obtained from Extractive Industries Transparency Initiative (EITI).
Columns (9) is the summation of the columns from (1) to (8).
Columns (10) = 0.50 * (1).
Columns (11) = (2) + (4) + (5) + (7) + (8) + (10).

Appendix B. Estimates of Total Capital Stock (1994 - 2019)

	Low Case	**Base Case**	High Case					
Annual depreciation rate for construction	2.00%	**2.50%**	3.00%					
Annual depreciation rate for machinery, transport equipment and other assets	4.00%	**6.00%**	8.00%					
Initial Capital Stock (1994) (Current prices, Million MT)								
Capital stock of residential and non-residential structures	61,877.29							
Capital stock of machinery and (non-transport) equipment (computers, communication equipment and other machinery)	7,689.67							
Capital stock of transport equipment	5,853.24							
Capital stock of other assets (software, other intellectual property products, and cultivated assets)	117.99							
Total Initial Capital Stock (1994)	75,538.19							

	(Current prices, MT Million)									
Calendar Year	Investment in residential and non-residential structures	Investment in machinery and (non-transport) equipment	Investment in transport equipment	Investment in other assets	GDP Deflator (2014 =1)	Capital stock of residential and non-residential structures	Capital stock of machinery and (non-transport) equipment	Capital stock of transport equipment	Capital stock of other assets	Total capital stock
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1994	1,906	372	237	9	0.14	61,877.29	7,689.67	5,853.24	117.99	75,538.19
1995	3,484	702	534	11	0.21	94,910.22	11,656.05	8,872.38	178.85	115,617.50
1996	5,055	823	386	16	0.31	143,560.77	17,222.78	12,868.68	267.16	173,919.38
1997	6,353	801	503	22	0.34	161,292.29	18,722.05	13,892.97	300.47	194,207.79
1998	7,492	295	189	10	0.36	174,115.64	18,941.88	14,026.01	309.63	207,393.15
1999	8,990	518	299	18	0.40	194,631.05	19,988.84	14,716.88	336.75	229,673.52
2000	13,770	2,307	1,087	65	0.44	225,353.79	23,256.40	16,511.70	417.61	265,539.50
2001	12,536	1,108	604	43	0.51	266,910.40	26,416.65	18,573.31	497.17	312,397.53
2002	17,354	4,900	2,853	170	0.57	303,722.35	32,224.80	22,064.81	684.42	358,696.39
2003	14,194	4,524	2,082	166	0.59	323,191.86	36,131.92	23,723.87	837.67	383,885.33
2004	13,797	4,484	1,903	169	0.63	349,446.85	40,661.46	25,656.66	1,007.99	416,772.96
2005	15,594	5,424	2,818	218	0.67	380,806.25	46,394.53	28,669.49	1,233.90	457,104.17
2006	16,630	5,988	3,722	647	0.73	417,151.77	53,033.24	32,793.08	1,897.71	504,875.80
2007	17,874	6,650	3,405	488	0.78	455,264.31	60,259.77	36,554.54	2,406.39	554,485.02
2008	29,093	7,960	6,378	727	0.82	496,422.23	67,595.80	42,554.60	3,108.82	609,681.45
2009	30,442	8,245	4,743	681	0.83	519,622.55	72,463.76	45,171.83	3,634.31	640,892.45
2010	45,148	10,816	7,015	1,196	0.90	592,304.00	84,379.94	52,872.77	4,885.96	734,442.67
2011	58,653	15,172	10,063	1,783	0.93	654,610.94	97,024.78	61,352.56	6,522.82	819,511.09
2012	101,483	27,552	18,283	3,281	0.96	761,850.76	121,916.74	77,953.77	9,625.20	971,346.48
2013	129,164	35,339	23,515	4,263	0.99	894,077.05	153,351.24	98,972.98	13,579.69	1,159,980.96
2014	151,122	41,546	27,787	5,096	1.00	1,033,400.50	187,441.19	121,947.82	18,015.41	1,360,804.93
2015	134,302	36,578	24,453	4,489	1.08	1,218,299.56	226,139.06	147,779.39	22,707.87	1,614,925.89
2016	131,739	35,478	23,570	4,333	1.22	1,482,025.80	277,118.73	181,479.33	28,597.19	1,969,221.03
2017	129,269	35,068	23,342	4,298	1.32	1,684,650.80	315,462.60	206,966.46	33,232.78	2,240,312.65
2018	261,561	110,618	63,023	13,010	1.36	1,953,390.51	416,052.44	263,409.71	45,186.65	2,383,560.64
2019	272,752	86,068	68,389	14,072	1.42	2,262,070.93	494,562.88	327,014.26	58,438.19	2,508,913.84

Sources & Notes:

- Columns (1), (2), (3), (4) are obtained from the University of California, Davies, Penn World Table 10.0.
- Column (5) is obtained from World Bank, national accounts data.
- Initial capital stock (1994) for all categories is calculated as: [Investment (1995) / (Average annual growth rate + Annual depreciation rate$_i$)]. Average annual growth rate (1991-1993) = 3.13%
  For example, initial Capital stock of residential and non-residential structures (1994) equals 61,877.29 = [1,906 / (3.13% + 2.5%)].
- Columns (6), (7), (8), (9) is estimated as follows:
  $K_{ti} = K_{ti-1} * (1 - \text{Annual depreciation rate}) * (1 + \Delta\text{GDP deflator}) + \text{Investment}_{ti}$
  For example, for Capital stock of residential and non-residential structures (1995) equals 94,910.22= 61,877.29 * (1-2.5%) * (0.21/0.14) + 3,484
- Column (10) is the summation of Columns (6), (7), (8), and (9).

Appendix C. Return to Domestic Saving (Million MT)

	Current Prices (Million MT)				Constant Prices (Million MT)			
Calendar Year	Gross-of-tax Return to Capital	Corporate Income Tax	Building taxes	Return to Domestic Savings	GDP Deflator Index (2014=1)	Real Return to Domestic Savings	Remunerative capital stock	Rate of Return to Domestic Savings
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2000	23,288	-	-	23,288	0.44	52,438	398,618	13.15%
2001	30,258	-	-	30,258	0.51	58,852	405,071	14.53%
2002	37,527	-	-	37,527	0.57	66,328	422,664	15.69%
2003	43,459	-	-	43,459	0.59	73,614	433,508	16.98%
2004	52,363	-	-	52,363	0.63	83,269	441,848	18.85%
2005	63,202	-	-	63,202	0.67	93,764	452,094	20.74%
2006	74,920	2,378	0.19	72,542	0.73	99,764	462,894	21.55%
2007	86,655	4,042	0.14	82,612	0.78	105,648	472,733	22.35%
2008	96,175	5,426	0.14	90,748	0.82	110,230	493,713	22.33%
2009	99,192	7,054	0.23	92,138	0.83	110,735	513,503	21.56%
2010	112,864	9,467	0.27	103,397	0.90	115,063	544,876	21.12%
2011	117,149	13,950	0.28	103,200	0.93	111,286	589,153	18.89%
2012	121,510	24,400	0.33	97,109	0.96	101,210	674,915	15.00%
2013	122,659	34,082	0.61	88,576	0.99	89,649	782,687	11.45%
2014	120,531	44,326	0.65	76,204	1.00	76,204	907,208	8.40%
2015	141,693	36,092	0.60	105,600	1.08	98,154	1,000,711	9.81%
2016	163,799	36,682	0.30	127,116	1.22	103,939	1,073,453	9.68%
2017	166,917	46,085	-	120,832	1.32	91,787	1,134,542	8.09%
2018	195,034	56,937	-	138,098	1.36	101,846	1,171,915	8.69%
2019	180,799	54,142	-	126,657	1.42	88,913	1,174,182	7.57%
							Average	**15.32%**

Sources & Notes:
Column (1) is obtained from column (12) in Appendix A.1
Columns (2) and (3) are obtained from Conta Geral Do Estado for different years.
Column (4) = (1) - (2) – (3)
Column (5) is obtained from World Bank, national accounts data.
Column (6) = (4) / (5).
Column (7) is obtained from column (17) in appendix A.1
Column (8) = (6) / (7).