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Evaluating foreign direct investment in Mozambique's natural gas industry

An economy-wide perspective

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Abstract: The recent discovery of large fields of natural gas in Mozambique has led to great international interest and expectations of future gains. However, many resource-rich countries have struggled to achieve long-term sustainable growth, whether because of poor management, unequal outcomes, or political conflict. Many authors argue that this 'resource curse' can be avoided with the right management tools and incentives for other sectors of the economy. We examine selected economy-wide impacts of such tools and incentives in Mozambique, using a computable general equilibrium model. Simple simulations are developed to illustrate how increased foreign direct investment might flow. In addition, the analysis considers measures to avoid resource dependency through government grant programmes for agriculture and manufacturing. The results suggest that the gains from the production of natural gas will have positive impacts on the Mozambican economy overall, and will enable additional programmes to aid growth in other sectors.

Key words: social accounting matrix, structure of production, trade, economy-wide, computable general equilibrium, natural-resource-dependent economies

JEL classification: C68, D31, F41, Q33

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1 Introduction

The extractive sector is currently the activity in Mozambique with the best prospects, due to recent discoveries of large natural gas fields. The anticipated high volumes of natural gas production have attracted international interest regarding foreign direct investment (FDI) in the sector.

The first discoveries of hydrocarbons by the extractive sector started at the beginning of the 20th century, when early explorers discovered thick sedimentary basins. However, a lack of funds and proper technology meant that these exploration attempts failed. This situation led to increasing international interest in Mozambique, and further exploration studies funded by international companies took place. As a result, in 1961 the first gas field, known as Pande, was discovered. Búzi and Temane were added to the list in 1962 and 1967 respectively. Subsequently, many activities were established, resulting in the growth of the sector and culminating in Law 3/81 of 3 October 1981. This law aimed to regulate petroleum operations and developments, established the National Hydrocarbon Company, and made efforts to map and appraise gas fields.

In 2000, Sasol, a South African petroleum and chemical company, started exploration activities and agreed a 25-year contract with Mozambique for the purchase of 120 million gigajoules (MGJ) of natural gas for export to South Africa. The promulgation of Petroleum Law 3/2001 ensured feasible projects for the production of natural gas in Temane (2004) and the construction of an 865-kilometre pipeline between Pande and Temane, as well as a second one in South Africa. The project made Mozambique the biggest natural gas exporter in sub-Saharan Africa (NPI 2019).

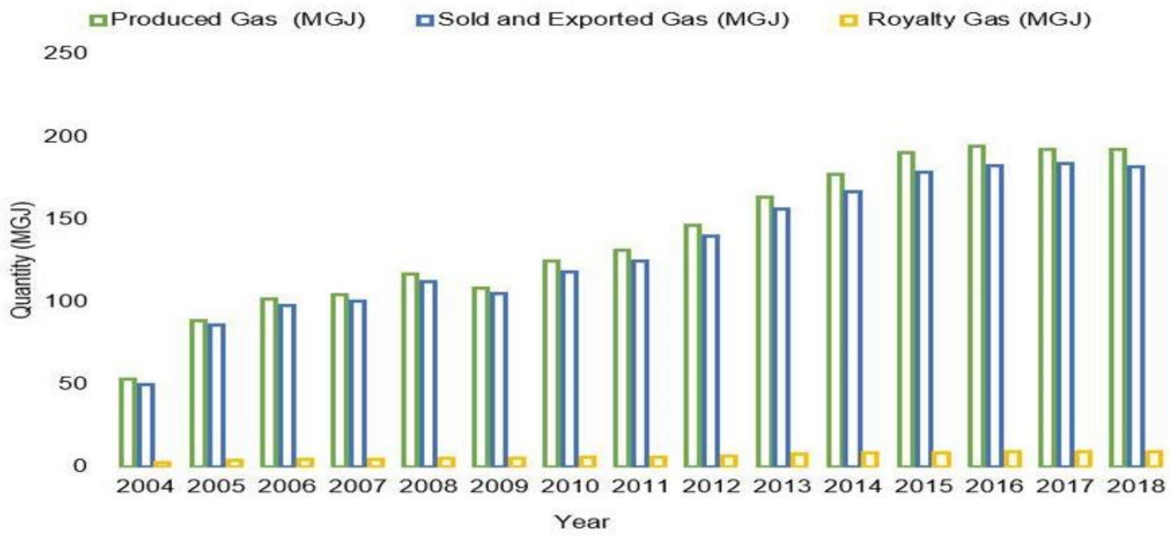
According to the National Petroleum Institute (NPI), actual production of natural gas started in 2004, in the Temane field. In 2009 Pande was added to the production fields. The total amount of gas produced from 2004 to December 2018 was 2,087 MGJ, and the condensate[1] produced was 7.1 million barrels.

Figures 1 and 2, extracted from an NPI presentation document, illustrate the evolution of the production of natural gas and condensate for the period 2004 to 2008. The graphs show a significant increase in the production of these resources due to investments in exploration and the discovery of new fields.

While the production and sales of natural gas (Figure 1) report a steady increase, the same cannot be said for condensate (Figure 2). The latter appears to be linked to the general global economy, and shows a marked decline during the global financial crisis around 2008, and a somewhat reluctant recovery up to 2016. Subsequently, the production and sales of condensate have come down somewhat.

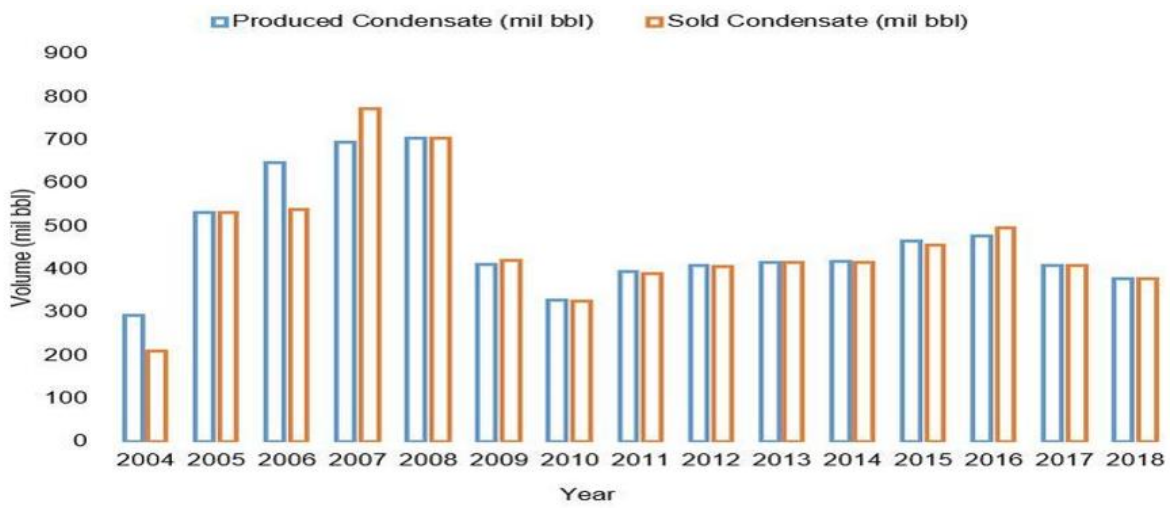
[1] Condensate refers to the natural gas liquids contained in raw gas. Raw gas is composed of natural gas (80 to 95 per cent) and condensate (five to 20 per cent).

Figure 1: Production and sales of natural gas by Mozambique (Pande and Temane), 2004–18



Source: NPI (2019: 15).

Figure 2: Evolution of condensate production and sales by Mozambique (Pande and Temane), 2004–18



Source: NPI (2019: 15).

2 Context

According to World Integrated Trade Solution data, in 2017 Mozambique's total exports were about US$4,719 million and total imports US$5,702 million, resulting in a negative trade balance of around US$983 million. Mozambique is an open economy, and its overall exports of goods and services as a percentage of gross domestic product (GDP) are 40.7 per cent, while imports are 72.7 per cent.

Products such as natural gas, petroleum, oils, and others in the same group occupy the top five categories of exports and imports by Mozambique. This illustrates not only the weight of natural resources for the Mozambican economy, but also a lack of downstream value being added to resource activities.

Recently, major discoveries have taken place in Mozambique of large fields of natural gas, with the potential to become the third-largest discovery in the world. This also offers the potential for Mozambique to become one of the main sources of liquified natural gas (LNG) exports to the world. The additional export revenue expected from the exploration of natural gas is estimated to reach around US$39 billion by 2035, according to studies by Standard Bank (2019).

2.1 Recent developments in the natural gas industry in Mozambique

This paper was conceived in the context of the most recent discoveries of natural gas in Mozambique. These discoveries have created great interest from international investors in this sector, and prospects of a significant boom in this economic activity in Mozambique (Standard Bank 2019).

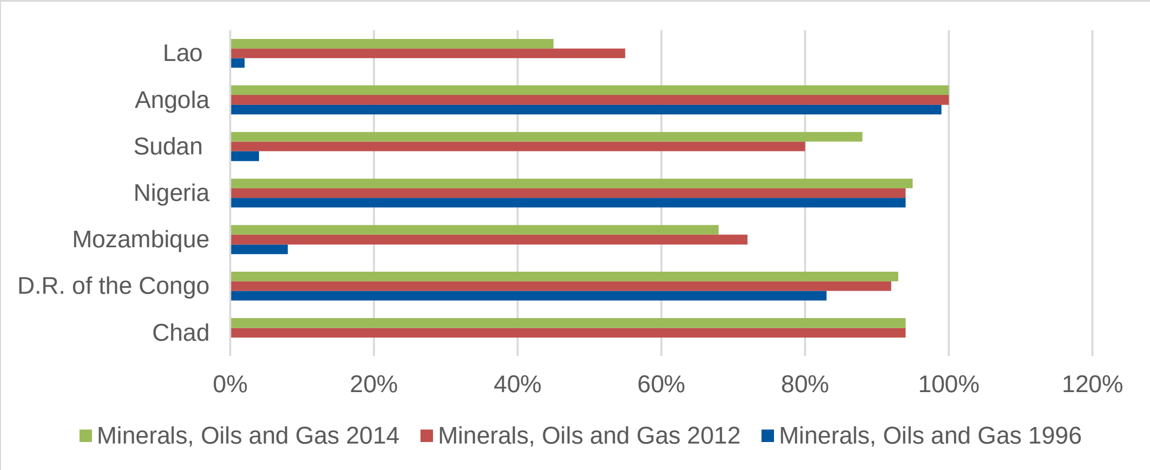
The discoveries, by the international petroleum company Anadarko Mozambique, took place in the Rovuma Basin in the north-east of Mozambique. Anadarko Mozambique's wholly owned subsidiary Lda and another company, Eni East Africa SpA, are responsible for research and exploration in earmarked areas. The discoveries were made between 2009 and 2011. In 2010/11 the discovery of 33 to 38 trillion cubic feet (tcf) of natural gas offshore in Cabo Delgado was announced to the public. This would make it the third-largest holding of natural gas reserves in Africa (after Nigeria and Algeria), and it confirmed the presence of commercial quantities of natural gas. The next step was to set contracts between international petroleum companies and the Mozambican government to ensure the installation and production of LNG. The total investment for the exploration and production of natural gas in these areas was estimated at around US$100 billion. This would make it the largest investment project in sub-Saharan Africa (ERM and Impacto 2014; IMF 2019; Roe 2018).

The IMF (2016) assessed possible future levels of income and gains from this project, taking into account levels of production, exports, government revenues, and other factors. Highly positive benefits are expected from the exploration and production of LNG in the Rovuma fields alone. The IMF expected (i) a volume of production of approximately 89 million tons of LNG per annum by 2028, with production starting in 2021 (IMF 2016: 4); (ii) an average annual growth rate in the real GDP of Mozambique of 24 per cent between 2021 and 2025 (IMF 2016: 5); (iii) total fiscal revenues of up to US$500 billion from the LNG project during its entire duration (2021 to 2045) (IMF 2016: 6); (iv) improvements in the current balance of payments, reaching a surplus by 2025, where LNG will contribute 75 per cent to total exports. However, so far this boost to the Mozambican economy has not taken place. This may be due to the economic downturn after the 2015 Mozambican debt crisis and adjustments to the country's economic plans (IMF 2016; Roe 2018).

Mozambique, like many other low-income economies that benefit from extractive industry discoveries, has shown an increasing dependence on this sector for its wealth creation, and significant expansion throughout the years. In many least developed countries, growth in the extractive sector is not matched by other sectors. This ultimately creates a curse rather than a blessing. Since such resources are not renewable and are scarce, this pattern of dependency creates a range of problems; hence references to the natural resource 'curse'.

According to Roe and Dodd's (2017) article about lower-income countries and the extractive industries, for most of the countries they listed there was a strong increase in dependence on exports from extractive industries. Between 1996 and 2012, no fewer than 63 of the 72 countries listed saw such increases. According to UNCTAD export trade data, the percentage point increases were as high as 94 per cent for Chad, 76 per cent for Sudan, 64 per cent for Mozambique, and 54 per cent for Lao (Figure 3). The simple average increase over that 16-year period (1996 to 2012) was 18 percentage points. However, even though the increase was predominantly upwards, over the years it reduced in magnitude (Roe and Dodd 2017).

Figure 3: Changes in extractive export dependence, 1996–2014



Source: Roe and Dodd (2017: 9–11).

2.2 The natural resource curse

It is widely recognized that the discovery of natural resources in any nation has the potential to impact on rapid, sustainable, and broad-based economic growth and development, and to help nations achieve the United Nations Millennium Development Goals. However, wealth from the extractive sector needs to be carefully managed to ensure that these goals are achieved. Empirical evidence from many countries that have experienced the discovery of natural resources such as minerals, oil, gas, and others has shown that they often perform worse in terms of sustainable economic growth. Economic development and good governance are often worse than in countries with fewer natural resources. Lack of natural resources has not proven to be a barrier to economic success; for example, the Asian Tigers' successful exports were based on manufacturing industries. Other discrepancies can be noted in the performance of resource-rich countries. Some have had a positive experience and managed the additional wealth, while others have failed to ensure sustainable economic growth and development. In countries that are resource-rich, income inequality often increases, with elite minorities benefiting from the gains (Humphreys et al. 2007). Political instability, corruption, and the non-transparent use of revenues for personal gain have repeatedly been the results. This has called for careful and detailed analysis to identify the correct approach to the exploration and management of the extractives sector so that each economy can achieve sustainable development (Addison and Roe 2018; Uongozi Institute 2013).

According to Humphreys et al. (2007), the term 'natural resource curse' refers to the failure of resource-rich countries to properly benefit from their natural wealth. This curse can take the form of various mechanisms, such as: (i) fluctuations in commodity prices on world markets, which can create disruptive effects; (ii) macroeconomic instability created by unstable exchange rates and government spending; (iii) a crowding-out effect on other sectors of the economy that could have more dynamic benefits and spillover effects; (iv) the distribution of wealth benefits to powerful positions in the government and the already rich elite of the population, making the country less likely to develop broad-based institutions and more likely to see increased levels of inequality; (v) detrimental effects on political stability and armed conflict if conflicts arise due to the struggle for resources, creating negative effects on economic growth (Frankel 2010; Humphreys et al. 2007).

This calls for effective resource management procedures and policies that are efficient in creating lasting economic growth. What is required are policies based on all productive sectors, avoiding dependency while contributing to the development and self-sustainability of the economy.

3 Modelling

By way of illustration through simulations using a computable general equilibrium (CGE) model, we explore the economy-wide impact of a substantial increase in the productive capacity of Mozambique's natural gas industry financed by FDI, versus a public sector-supported development of the agriculture and manufacturing sectors as a mechanism to avoid the natural resource curse, and finally a combination of both.

3.1 A standard CGE model

We use a standard comparative static CGE model formulated along the lines of Lofgren et al. (2002). The model is based on a 2015 social accounting matrix (SAM) for Mozambique (Cruz et al. 2018). The SAM is constructed with unpublished data for 2015 from the Mozambican National Statistical Institute (Instituto Nacional de Estatistica, INE) giving industry-level production accounts, supply-demand balances at the commodity level, and a supply matrix. This is combined with official public finance statistics, national accounts and IMF balance of payment statistics, a use matrix from a 2007 SAM for Mozambique (Arndt and Thurlow 2014), and household and labour market survey data for 2014 to 2015. The SAM identifies 55 activities and commodities, urban and rural labour and households (in some detail), government, investment demand, and exports and imports.

The CGE model is made up of a set of equations that are either accounting identities or behavioural equations. The latter capture decision-making processes of industries and households, based on the principle of optimizing surplus and utility subject to cost and income constraints respectively. Producers require both domestic and imported intermediate inputs as well as primary inputs from the factors of production. The latter include capital, labour, and in the case of agriculture, land. Intermediate goods and services consumption is described by Leontief functions, while the consumption of production factors is specified according to constant elasticity of substitution functions. As a result, there are fixed shares of intermediate and primary inputs in the production process, but production factors, i.e. the primary inputs, can be substituted according to changes in their relative prices.

The underlying SAM data specifies that each activity only produces one commodity. Commodities are sold to other industries as intermediate inputs or as investment goods, and to households, government, and the rest of the world for final consumption. Commodities supplied to domestic versus international markets are based on relative prices according to a constant elasticity of transformation function. Likewise, goods and services imported are represented by an Armington function. World prices remain fixed.

Earnings from industry's labour, land, and capital, and transfers from government and the rest of the world, constitute household income. Returns to foreign-owned factors of production are repatriated. Households buy a composite of domestic and foreign commodities, transfer abroad, pay taxes, and save. A linear expenditure system of demand describes household consumption.

3.2 SAM data adaptation for natural gas

Since our focus here is on the natural gas industry and its mainly foreign ownership, we make adjustment to the SAM for Mozambique. We do this in such a way that most (89 per cent) of the country's foreign repatriation of operating surpluses is attributed to this industry. The rest of the repatriated surpluses reported in the balance of payment are generated by other activities. At this stage we also assume that 21 per cent of the operating surplus of the natural gas industry is transferred to the government as royalties, and 38 per cent to the rest of the world. The rest is transferred to local firms. Data for the natural gas industry from the Extractive Industries Transparency Initiative (ITIEM 2015) shows the information in Table 1 on employment in the natural gas industry in Mozambique.

Table 1: Employment data for the natural gas industry in Mozambique, 2013–14

	Local workers	Expats
Sasol	162	64
Mozambican natural gas companies	167	–
Natural gas investing companies	142	68

Source: authors' compilation based on data from ITIEM (2015).

Lack of data forces us to distribute employment in this industry across education attainment levels according to those of a proxy industry, for which coal mining is used. We apply wage rates in the coal mining industry, derived from SAM and employment data, to estimate earnings, and we assume that the wage rate for expatriate labour is at the highly skilled level only and is double the rate of local workers.

3.3 Scenarios

We initially consider a 25 per cent increase in the capital stock of the natural gas industry. While this may not be anywhere near the ballpark that is talked about (IMF 2019; Standard Bank 2019), it may be interpreted as an annual increase over the next couple of years. In our comparative static framework, we accompany this increase with a matching rise in investment demand. In other words, investment demand should increase by the same amount as the increase in capital stock. The increase in investment demand is funded by FDI, which is absorbed by foreign savings. Initially, we therefore assume that the exchange rate is impacted on by the investment. We turn the tables in a subsequent set of simulations in which the exchange rate is allowed to adjust.

The discussion above of the resource curse suggests that the pursuit of FDI in extractive industries as a single-minded development strategy has detrimental impacts on economic growth, employment, and income distribution. Even though the discovery of natural resources gives nations the expectation of big gains, empirical studies have proven that resource-rich countries do not necessarily grow at a higher pace than resource-poor countries. Moreover, sometimes resource-rich countries fail to guarantee long-lasting structural changes in the economy, and the level of inequality tends to increase. It has been argued that it would be better to focus on the home-grown development of agriculture, manufacturing, education, and other sectors that are more likely to contribute in terms of positive externalities and sustainable growth and development, even if they are financed locally. How exactly this might unfold in practice is not discussed here. Our interest is merely in the potential economy-wide implications of such a policy.

One simplified way to model this is to grant production subsidies to relevant industries. For our purpose, these sectors are agriculture and manufacturing. The suggested application of these policies is explained in subsections 3.3.1 and 3.3.2.

3.3.1 Modernization of the agricultural sector in Mozambique

The agricultural sector is almost entirely made up of small producers that mostly produce food crops, constituting the priority sector of the economy and the basis of development in Mozambique. About 70 per cent of the population is thought to live in rural areas, and this sector is an important source of employment; 75 per cent of the population is dependent on agriculture (World Bank 2006).

Another important fact is that poverty in Mozambique is mainly dominant in rural areas, so about 52.7 per cent of the (rural) agriculture-dependent population is poor, not to mention that there is high food insecurity (IMF 2015).

The identified problem in the agricultural sector in Mozambique is low productivity, and it has been suggested that a subsidy to support the modernization of this sector will increase productivity and therefore income. The intervention to be made in our simulation is a government production subsidy modelled as a negative activity tax. This intervention in the agricultural sector is expected to stimulate modernization (fertilizers, better seeds, etc.) and increase production.

The cost of this intervention is broadly consistent in terms of the cost of seeds and fertilizers for certain crop types used as examples (i.e. maize and rice). This intervention would cost US$67.3 million, which is 13.46 per cent of expected natural resource revenues by 2050.

Table 2 illustrates the cost of fertilizers and seeds for maize and rice crops, which will be used as a guide for the average cost of the modernization of the sector with better inputs to increase productivity. It also shows the distribution plan over the years.

Table 2: Costs associated with increased productivity in the agriculture sector

	N° of hectares	Fertilizers (Cost/Hec)		Seeds (Cost/Hec)		Government	Cost (USD)	Cost (USD)	Total Cost
Year	(Hec)	Maize	Rice	Maize	Rice	Subsidies	Maize	Rice	(USD)
2019	5,892	$150.00	$200.00	$75.00	$40.00	95%	$1,325,700.00	$1,414,080.00	$2,602,791.00
2020	5,892	$163.00	$218.00	$81.75	$43.00	95%	$1,445,013.00	$1,541,347.20	$2,937,042.19
2021	5,892	$178.00	$237.62	$89.11	$47.52	95%	$1,575,064.17	$1,680,068.45	$3,092,375.99
2022	5,892	$194.25	$259.01	$97.13	$51.80	95%	$1,716,819.95	$1,831,274.61	$3,370,689.83
2023	5,892	$211.74	$282.32	$105.87	$56.46	95%	$1,871,333.74	$1,996,089.32	$3,674,051.91
2024	5,892	$230.79	$307.72	$115.40	$61.54	95%	$2,039,753.78	$2,175,737.36	$4,004,716.58
2025	5,892	$251.57	$335.42	$125.78	$67.08	90%	$2,223,331.62	$2,371,553.72	$4,135,396.81
2026	5,892	$274.21	$365.61	$137.10	$73.12	85%	$2,423,431.46	$2,584,993.56	$4,257,161.27
2027	5,892	$298.88	$398.51	$149.44	$79.70	80%	$2,641,540.29	$2,817,642.98	$4,367,346.62
2028	5,892	$325.78	$434.38	$162.89	$86.88	70%	$2,879,278.92	$3,071,230.85	$4,165,356.84
2029	5,892	$355.10	$473.47	$177.55	$94.69	60%	$3,138,414.02	$3,347,641.62	$3,891,633.39
2030	5,892	$387.06	$516.09	$193.53	$103.22	50%	$3,420,871.29	$3,648,929.37	$3,534,900.33
2031	5,892	$421.90	$562.53	$210.95	$112.51	45%	$3,728,749.70	$3,977,333.01	$3,467,737.22
2032	5,892	$459.87	$613.16	$229.94	$122.63	40%	$4,064,337.17	$4,335,292.99	$3,359,852.06
2033	5,892	$501.26	$668.35	$205.63	$133.67	35%	$4,430,127.52	$4,725,469.35	$3,204,458.91
2034	5,892	$546.37	$728.50	$273.19	$145.70	30%	$4,828,839.00	$5,150,761.60	$2,993,880.18
2035	5,892	$595.55	$794.06	$297.77	$158.81	25%	$5,263,434.51	$5,614,330.14	$2,719,441.16
2036	5,892	$649.15	$865.53	$324.57	$173.11	20%	$5,737,143.61	$6,119,619.85	$2,371,352.69
2037	5,892	$707.57	$943.42	$353.78	$188.68	15%	$6,253,486.54	$6,670,385.64	$1,938,580.83
2038	5,892	$771.25	$1,028.33	$385.62	$205.67	10%	$6,816,300.35	$7,270,720.35	$1,408,702.07
2039	5,892	$840.66	$1,120.88	$420.33	$224.18	7%	$7,429,767.35	$7,925,085.18	$1,074,839.68
2040	5,892	$916.32	$1,221.76	$458.16	$244.35	5%	$8,098,446.42	$8,638,342.84	$836,839.46
							Programme Cost		$67,409,147.02

Source: authors' compilation based on data from Vieira (2018).

Similar costings can be made for other crops, but since we are mainly interested in the broad economy-wide implications of such an intervention, we take a more naïve approach for our modelling purposes. The modelled intervention consists of a subsidy on all crop production. This can be interpreted as modernization, say in the use of fertilizers and improved seeds. Since the assumption does not allow the model to be very specific in this regard, the modelled intervention only considers the economy-wide impacts of the improved economic performance of crop production.

3.3.2 Investment in the manufacturing sector in Mozambique

The manufacturing sector is one of the main sectors to foster growth and development in any economy, and has traditionally played a key role in the growth of many developed countries. In his theory of growth, Simon Kuznets (1966) described the long-term and sustainable development patterns of countries based on empirical analyses of national accounts. He argued that the manufacturing sector was a key feature of modern economic growth, and he based this argument in part on the observation of much lower growth rates in the world before the onset of the industrial revolution. Moreover, other authors argue that industrialization, as the transformative sector, is the main engine of fast growth (Smeets 2016).

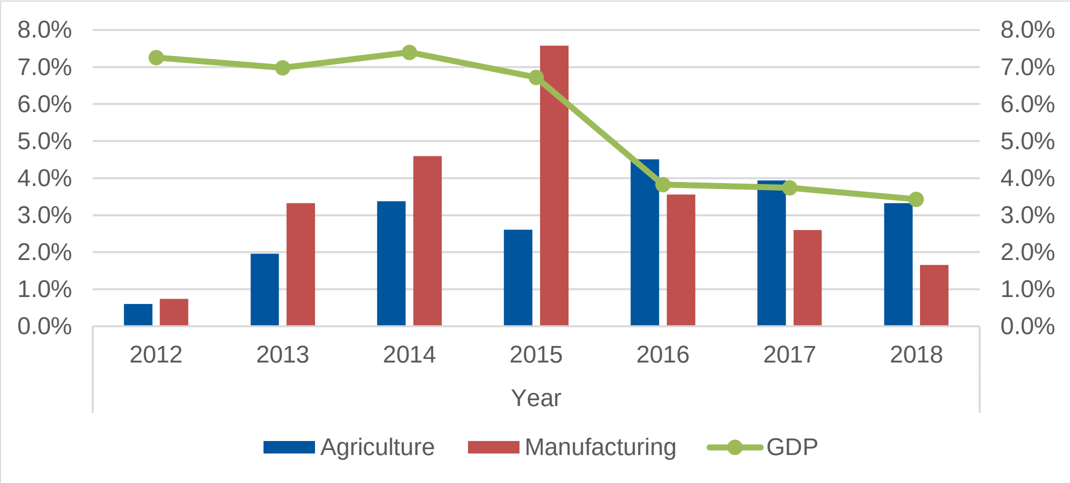
However, developing countries currently do not have strong manufacturing sectors. This has led economists to advise the prioritization of this sector and better manufacturing policies.

Structural adjustment and liberalization after the civil war in Mozambique led to rapid growth in the Mozambican economy, and an important share of this growth since 1992 has been in the manufacturing sector. Although the manufacturing sector in Mozambique only accounts for about nine per cent of GDP, it has been showing stronger growth in the last few years, with an average annual growth rate of 5.1 per cent between 2013 and 2015, and a high of 8.5 per cent in 2015—higher than the economy-wide GDP growth rate of 6.6 per cent. This sector is mainly comprised of low-technology intensive micro companies, with a few small and medium-sized firms that are mostly dominated by foreign companies, which are generally more capital intensive. Significant subsectors are metals, chemicals, construction, industrial products and services, forestry, paper and packaging, textiles, paint, soap, food and drink products, furniture and wood products, and leather and shoes. There is still a lot of room for growth in this sector in Mozambique, and it is believed that manufacturing can create wealth, job opportunities, and many positive externalities (Biggs et al. 1999; Monitor Deloitte 2017).

Figure 4 illustrates the GDP growth rates in Mozambique along with the agriculture and manufacturing sectors. We can see that over the years, GDP and these two sectors have shown positive growth tendencies. The manufacturing sector in particular grew at a higher rate than GDP in 2015, and in other years it was very close, which suggests some potential.

There may be potential for manufacturing to grow in Mozambique—for example, by exploring domestic markets that could expand on the back of a resource windfall, and/or by improving transport linkages to neighbouring countries (South Africa, Malawi, or Zimbabwe) or a competitively priced labour supply (Monitor Deloitte 2017). However, this sector faces many challenges, such as bureaucracy and the cost of doing business, competition with South Africa, the country's high dependency on imported inputs, and high interest rates that make it difficult to access financing, among others.

Figure 4: Agriculture and manufacturing sectors and GDP growth rates, 2012–18



Source: authors' compilation based on data from Instituto Nacional de Estatistica.

We model the granting of production subsidies to the manufacturing sector in Mozambique, similarly to the subsidy programme for the agriculture sector discussed earlier. Given the importance of both sectors, we assume a subsidy rate for both. The total cost of the proposed state grant programme for maize and rice production is around US$67.3 million, as explained in Table 2. Although the time frames do not match, this turns out to be about three per cent of the gross value of manufacturing production per annum, while the matching subsidy is around four per cent of crop production. In this way the impact on the budget deficit is initially the same for both production subsidy schemes.

3.4 Adjustment rule assumptions

'Closures' are used to define how the macroeconomy adjusts to various exogenous shocks and policy interventions. Adjustments include changes to the exchange rate, investment, government savings, and prices and quantities of factors of production. In this exercise, we assume that the exchange rate initially remains fixed, and foreign savings absorb shocks to the economy. The level of investment is determined exogenously, while private savings (rates) adjust. Government savings adjust to changes in public income and expenditure; all tax rates remain fixed. The consumer price index is used as the model numeraire; the model therefore does not look at inflation specifically. We assume that tertiary-educated labour is fully employed and mobile, while all other types of labour are considered to be unemployed; their wage rates remain fixed, and the level of employment adjusts. Capital and livestock are fully employed and sector-specific, as is land, but the latter can be used for different crops. Since the model is comparative static, the length of the adjustment period is undetermined, but it could be considered to be around three to five years.

In terms of the exchange rate, it is not clear a priori whether to assume a fixed or flexible regime. The question is whether the exchange rate is driven by changes in trade or by financial forces. The latter is not modelled by our CGE. Moreover, some of the exchange rate impacts may be offset by lower foreign donor aid if Mozambique starts accruing significant royalties. We therefore examine both regimes.

In summary, we examine the follow scenarios (with scenario codes in parentheses):

1. The natural gas industry (FDI):
   a. a 25 per cent increase in capital stock;
   b. an increase in investment demand of the same quantity as the increase in capital stock;
   c. foreign savings to absorb the value of the increase in investment demand and other changes in the balance of payment.
2. A government production subsidy for crop production of 4.1 per cent, which totals MZN 4.6 billion (asubs):
   a. The government budget is assumed to absorb the shortfall.
3. A government production subsidy for manufacturing production of three per cent, which totals MZN 4.6 billion (isubs):
   a. The government budget is assumed to absorb the shortfall.
4. A combination of the above three scenarios (comb).

4 Scenario results

We start by discussing the results of the illustrative scenarios described above under a fixed exchange rate regime, followed by the same scenarios under a flexible exchange rate regime.

4.1 Fixed exchange rate scenarios

In Table 3 we show impacts on macroeconomic variables under a fixed exchange rate regime.

Table 3: Impacts on selected macroeconomic variables and ratios with a fixed exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
		MZN billion		% change		
1.	Consumption	401	-2.4	4.1	1.4	3.4
2.	Investment	189	19.3	0.2	0.1	19.6
3.	Government	158	0.2	0.5	0.6	1.3
4.	Exports	191	3.9	-0.6	7.9	10.7
5.	Imports	-426	5.4	1.1	1.8	8.3
6.	GDP at market prices	592	2.0	2.1	2.5	6.5
		%		% point change		
7.	Investment/GDP %	32.0	5.4	-0.6	-0.7	3.9
8.	Private savings/GDP %	13.8	2.4	-0.6	1.5	3.0
9.	Foreign savings/GDP %	35.5	1.9	0.2	-2.1	0.2
10.	Trade balance/GDP %	53.5	2.4	0.2	-2.1	0.6
11.	Public savings/GDP %	-4.0	0.9	-0.4	-0.4	0.1

Source: authors' calculations.

GDP increases by two per cent in the case of the FDI in the natural gas scenario (Scen1: FDI), 2.1 per cent with crop subsidies (Scen2: asubs), 2.5 per cent with manufacturing subsidies (Scen3: isubs), and 6.5 per cent when all scenarios are combined (Scen4: comb). It would appear that there is very little interaction between the scenarios, i.e. the whole (in the last column) is more or less the same as the sum of the components. The demand composition of GDP, however, is distinctly different across the scenarios, although this is mainly by design. In the FDI scenario we assumed that investment would enjoy the same increase as capital stock. This represents 5.4 per cent of GDP (row 7) and more than 19 per cent in nominal terms (i.e. in current relative prices, see row

2). Natural gas is the sole beneficiary of the capital stock increase; its production goes up. Since the sector is modelled to supply to the rest of the world only, exports are set to increase. Imports increase as a result of the higher investment demand, as it has a relatively high import content, and also as a result of the higher GDP growth. Consumption is down, as the exogenous increase in investment is assumed to be financed not only by increased foreign savings but also by increases in household and government savings (see rows 8, 9, and 11 respectively). Private and public savings rise as a result of increased GDP, household income, and tax revenues.

In production subsidy scenarios 2 and 3, the price of the higher GDP is a budget deficit increase from four per cent of GDP to 4.4 per cent for both (row 11 of Table 3). In the crop subsidy scenario (Scen2, asubs), the trade balance and therefore foreign savings (rows 10 and 9 respectively) are slightly up, since exports do not respond much, but imports are up due to the higher GDP. As a result, household savings rates (row 8) are down, and consumption is up. In the manufacturing subsidy scenario (Scen3, isubs), foreign savings are down, since exports respond more vigorously than imports, and private savings have to make up the difference to maintain initial real investment. Hence, household consumption is down. The combined scenario (i.e. FDI and production subsidies together) shown in the last column therefore has a bias towards investment and exports. There is a more muted increase in consumption, which can be attributed to the FDI and manufacturing subsidy scenarios.

In Table 4, the impact on exports and value added is reported for selected commodities and industries. Unsurprisingly, natural gas exports are up significantly in scenarios 1 and 4, as its capital stock is raised. Its value added rises by the same rate, since all output is exported. Since consumption is down, agriculture suffers. The other industries reported here see small increases in output due to the increase in GDP and income, but also because they are linked to natural gas through industry linkages. This may raise some eyebrows, but this is so because natural gas is assumed to be the same as other mining in terms of structure of intermediate inputs. The reason is a lack of data, which highlights the need for data collection on the intermediate inputs of natural gas (and indeed all other industries), as pointed out by Cruz et al. (2018).

Table 4: Illustrative impacts on exports and value added of selected industries with a fixed exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
	Exports	MZN billion		% change in quantity		
1.	Agriculture	8	-2.7	5.2	0.8	3.3
2.	Natural gas	40	24.2	-0.1	-0.1	24.0
3.	Other mining	12	3.2	-2.1	5.5	6.0
4.	Manufacturing	11	-1.0	-1.7	4.7	1.5
5.	Private services	32	0.3	0.8	2.1	3.2
	Value added	% share		% change in quantity		
6.	Agriculture	24	-2.1	6.1	1.0	5.3
7.	Natural gas	5	24.2	-0.1	-0.1	24.0
8.	Other mining	2	3.5	-1.8	6.1	7.2
9.	Manufacturing	6	6.4	-0.9	4.4	9.6
10.	Private services	34	1.4	1.2	1.9	4.6

Note: The shares in the second tableau do not add up to 100%, as only selected industries are reported.

Source: authors' calculations.

It can also be seen that the subsidy scenarios show a clear benefit to agriculture and manufacturing. Natural gas is not much affected by these scenarios. Resource shifts of scarce highly skilled labour make manufacturing and other mining suffer when agriculture is subsidized. Nevertheless, the sector does benefit from a subsidy on manufacturing due to the higher GDP and intermediate input linkages. The combined impact of all scenarios, reported in the last column, is positive for all sectors, but least so for agriculture and services.

If the exchange rate is kept relatively competitive, outwards-oriented industries other than natural gas tend to benefit more than non-tradeable industries, of which agriculture forms a part given its low export orientation (lower even than services).

The impact on factor supplies is shown in Table 5. Tertiary-educated labour (both urban and rural), land, livestock, and capital other than natural gas remain constant by design. Other rural labour suffers in the FDI scenario as discussed above, but it benefits from the subsidy interventions such that the combined effects are still positive. Urban labour improves in the FDI scenario due to the positive response by services and manufacturing (recall Table 4). Interestingly, urban labour also improves in the agricultural scenario; hence the higher benefits to urban labour in the combined scenario.

Table 5: Illustrative impacts on factor supplies with a fixed exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
		MZN billion	% change in quantity			
1.	Labour - rural not completed primary	4,289	-9.4	9.1	2.3	1.8
2.	Labour - rural completed primary	1,164	-6.1	8.6	2.7	5.2
3.	Labour - rural completed secondary	160	-6	7.2	3.2	4.1
4.	Labour - rural completed tertiary	27	0.0	0.0	0.0	0.0
5.	Labour - urban not completed primary	916	2.6	7.5	4.1	14.3
6.	Labour - urban completed primary	1,144	7.6	7.0	4.7	19.4
7.	Labour - urban completed secondary	511	9.8	5.8	6.0	21.7
8.	Labour - urban completed tertiary	295	0.0	0.0	0.0	0.0
9.	Labour - natural gas	0	0.0	0.0	0.0	0.0
10.	Crop land	19	0.0	0.0	0.0	0.0
11.	Livestock	7	0.0	0.0	0.0	0.0
12.	Capital - all activities except natural gas	1,387	0.0	0.0	0.0	0.0
13.	Capital - natural gas	1,999	100.0	0.0	0.0	100.0

Source: authors' calculations.

Finally, we consider the impact on household incomes. Table 6 suggests that the impact of the natural gas FDI scenario on rural households is negative, while urban households benefit. As expected, there is also a clear bias towards urban households in the manufacturing subsidy scenario (isubs). The opposite is the case for the agriculture subsidy scenario (asubs). The combined effect has a slight bias towards urban households, in particular towards the lower end.

In spite of the positive benefits of agricultural subsidies for rural households, this cannot offset the degree to which they are left behind in the other scenarios. Rural households benefit the least from the FDI and manufacturing subsidy scenarios, and the agricultural subsidies do not offer sufficient compensation in the combined results, although they go some way.

Table 6: Illustrative impacts on household income with a fixed exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
	Exports	MZN billion		% change in quantity		
1.	Rural - quintile 1	11	-2.6	5.1	2.0	4.6
2.	Rural - quintile 2	17	-2.0	5.2	2.2	5.5
3.	Rural - quintile 3	24	-2.4	5.3	2.1	5.1
4.	Rural - quintile 4	34	-2.1	5.3	2.3	5.5
5.	Rural - quintile 5	71	-1.2	4.6	2.3	5.6
6.	Urban - quintile 1	5	6.3	3.5	3.9	13.7
7.	Urban - quintile 2	8	3.4	2.9	2.9	9.3
8.	Urban - quintile 3	14	3.2	2.8	2.8	8.9
9.	Urban - quintile 4	35	4.1	2.6	3.1	9.9
10.	Urban - quintile 5	265	5.2	2.1	3.6	10.8

Source: authors' calculations.

4.2 Flexible exchange rate scenarios

So far, the scenarios have been conducted under a fixed nominal exchange rate regime. The real exchange rate appreciates slightly in all the scenarios above such that the combined appreciation is just over one per cent in the combined scenario. If we allow for a flexible exchange rate regime, and assume that the capital increase in natural gas and associated investment demand is funded by a dedicated inflow of foreign savings, the appreciation in the FDI scenario (Scen1) is about 6.5 per cent. The economy-wide impact can be expected to be significantly different. We now repeat the results shown in the previous subsection for a flexible exchange rate regime in Tables 7 to 10. The layout of the tables is the same.

Table 7: Illustrative impacts on selected macroeconomic variables and ratios with a flexible exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
		MZN billion		% change		
1.	Consumption	401	8.0	2.5	3.4	13.7
2.	Investment	189	14.2	0.9	-0.7	15.0
3.	Government	158	-1.1	0.8	0.3	0.1
4.	Exports	191	-13.2	2.5	3.6	-7.5
5.	Imports	-426	1.8	1.6	1.0	4.7
6.	GDP at market prices	592	3.5	1.9	2.6	7.8
		%		% point change		
7.	Investment/GDP %	32.0	3.3	-0.3	-1.0	2.1
8.	Private savings/GDP %	13.8	-3.4	0.4	0.2	-2.8
9.	Foreign savings/GDP %	35.5	4.4	-0.4	-1.3	3.0
10.	Trade balance/GDP %	54.5	4.4	-0.3	-1.3	3.0
11.	Public savings/GDP %	-4.0	1.3	-0.5	-0.3	0.5

Source: authors' calculations.

In the first tableau of Table 7 it can be seen that GDP is up by a higher rate in the FDI scenario compared with the fixed exchange rate scenario (3.5 per cent compared with two per cent). But the main difference is in the macro composition of expenditure GDP. This can be explained by means of the following identities:

$$\text{GDP} = \text{C} + \text{I} + \text{G} + \text{X} - \text{M} \quad [1]$$

$$\text{GDP} + \text{M} - \text{E} = \text{C} + \text{I} + \text{G} \quad [2]$$

With exports down due to the appreciation that follows from the FDI inflow, and imports up at a lower rate, absorption (domestic demand) must go up, as can be seen in the above identities. Thus, while consumption was down in the fixed exchange rate FDI scenario, it is now up considerably. The opposite is the case for exports, in spite of the increased exports of natural gas following the FDI and associated capital stock and productive capacity increase. Imports are still up, albeit at a lower rate from the base.

With unemployment closure for all labour except the highly skilled, this expansion in demand requires more unemployed labour. Compositional shifts in output also drive employment increases, since appreciation favours the production of non-traded goods. Non-traded goods, such as low-skill services, are often labour intensive. The appreciation shifts production in that direction and away from, for example, mining, which is capital intensive. As was noted earlier, agriculture is not much traded internationally and thus benefits from the compositional shift in the same way as services, as can be seen in the second tableau of Table 8.

Table 8: Illustrative impacts on exports and value added of selected industries with a flexible exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
	Exports	MZN billion		% change in quantity		
1.	Agriculture	8	-19.6	8.9	-2.8	-13.9
2.	Natural gas	40	23.2	0.0	-0.3	23.1
3.	Other mining	12	-13.2	0.8	1.4	-10.8
4.	Manufacturing	11	-12.9	0.5	1.6	-11.0
5.	Private services	32	-8.4	2.4	0.2	-5.0
	Value added	% share		% change in quantity		
6.	Agriculture	24	5.8	4.9	2.6	13.5
7.	Natural gas	5	23.2	0.0	-0.3	23.1
8.	Other mining	2	-10.1	0.6	2.6	-7.1
9.	Manufacturing	6	-0.6	0.4	2.5	1.8
10.	Private services	34	1.7	1.2	1.9	4.8

Note: The shares in the second tableau do not add up to 100%, as only selected industries are reported.

Source: authors' calculations.

The second tableau of Table 8 reveals not only an increase in household demand, but also a decline in government spending. Since we report results at current prices, and the quantity of goods and services purchased by the public sector remain constant, the lower spending is the result of lower composite prices of government purchases. Given a flexible budget deficit, with revenues up due to a rise in GDP, public sector savings are set to rise. Fewer savings are required by households, and more is available for spending.

When manufacturing is targeted with subsidies, exports are up less than in the fixed exchange rate scenario, as the exchange rate also appreciates. In the case of agricultural subsidies, a slight depreciation occurs which encourages higher exports, compared with lower exports under the fixed exchange rate regime. In both scenarios, the impact of GDP is similar to the fixed exchange rate counterpart scenarios.

The combined scenario is dominated by the FDI (with 3.5 per cent) and manufacturing subsidy (2.6 per cent) scenarios. For both subsidy scenarios, household demand plays an important role.

For agriculture, this is the case in spite of a slight depreciation, which would discourage non-traded industries.

In Table 8, it can be seen that the subsidy scenarios benefit the exports and output of the respective industries, but more so compared with the fixed exchange rate counterparts in the agricultural subsidy scenario due to the slight devaluation, and less so in the manufacturing subsidy scenario.

The urban-rural pattern of factor supplies, shown in Table 9, follows the agriculture-manufacturing pattern of Table 8 in that rural unemployed labour gains with agricultural subsidies, and urban labour with manufacturing subsidies. Rural labour is more or less in the same demand in the FDI scenario with flexible exchange rates, and in the end they split the honours in the combined scenario.

Table 9: Illustrative impacts on factor supplies with a flexible exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
		MZN billion	% change in quantity			
1.	Labour - rural not completed primary	4,289	9.1	7.6	4.5	21.6
2.	Labour - rural completed primary	1,164	9.1	7.2	4.8	21.4
3.	Labour - rural completed secondary	160	6.3	6.3	4.6	17.2
4.	Labour - rural completed tertiary	27	0.0	0.0	0.0	0.0
5.	Labour - urban not completed primary	916	9.3	6.5	5.6	21.7
6.	Labour - urban completed primary	1,144	9.3	6.1	5.9	21.5
7.	Labour - urban completed secondary	511	7.3	5.4	6.5	19.1
8.	Labour - urban completed tertiary	295	0.0	0.0	0.0	0.0
9.	Labour - natural gas	0	0.0	0.0	0.0	0.0
10.	Crop land	19	0.0	0.0	0.0	0.0
11.	Livestock	7	0.0	0.0	0.0	0.0
12.	Capital - all activities except natural gas	1,387	0.0	0.0	0.0	0.0
13.	Capital - natural gas	199	25.0	0.0	0.0	25.0

Source: authors' calculations.

Table 10: Illustrative impacts on household income with a flexible exchange rate

		Initial value	Scen1 FDI	Scen2 asubs	Scen3 isubs	Scen4 comb
	Exports	MZN billion		% change in quantity		
1.	Rural - quintile 1	11	11	6.6	4.2	3.4
2.	Rural - quintile 2	17	17	6.5	4.3	3.5
3.	Rural - quintile 3	24	24	6.5	4.4	3.5
4.	Rural - quintile 4	34	34	6.3	4.4	3.5
5.	Rural - quintile 5	71	71	5.5	3.9	3.3
6.	Urban - quintile 1	5	5	5.0	3.2	4.3
7.	Urban - quintile 2	8	8	5.3	2.4	3.6
8.	Urban - quintile 3	14	14	5.1	2.3	3.5
9.	Urban - quintile 4	35	35	4.5	2.3	3.6
10.	Urban - quintile 5	265	265	2.4	2.1	3.5

Source: authors' calculations.

The upshot of this compositional shift in terms of income distribution is shown in Table 10. In the case of the FDI and also the combined scenario, with the increase in consumption, demand, and therefore production, agriculture goes up, and therefore its prices rise (not shown here) because land and capital are fully employed while labour is drawn into its production. This is likely to benefit rural low-income households more than urban and high-income households. The combined scenario benefits rural households slightly more than urban households.

Rural households obviously also benefit from the agricultural subsidies, while urban household incomes rise more in the case of the manufacturing subsidies, particularly at the lower end of the income scale. The combined scenario therefore tends to equalize the income distributional impacts somewhat when the subsidies are accounted for.

5 Conclusion

While the FDI scenario has been questioned in some debates as a viable policy option, there is no denying that in a neoclassical modelled economy, the impact of FDI in the extractive sector in Mozambique is positive. We also show that what happens to income distribution is very much contingent on the exchange rate. If an appreciation follows, then the results suggest a shift towards domestic demand, which will ultimately benefit rural low-income households, as agriculture is largely a non-traded activity, like the service sectors. With increased demand for agricultural products, prices rise if capital stock and land are assumed to be fully employed, while additional labour requirements contribute to rising incomes. In the flexible exchange rate scenario, exports are not negatively impacted on, but the resulting outwards direction does not benefit low-income rural households, since there is no strong reaction from agriculture because as mentioned above for all intents and purposes it is a non-traded activity.

The analysis suggests that either way, the home-grown policy option of subsidizing agriculture and manufacturing may offset some of the negative income distribution impacts of the pursuit of FDI in natural gas. In particular—and this may come as no surprise—rural households are expected to benefit from such an intervention. Policymakers may argue that this will be detrimental to the public sector's current account. However, the FDI scenario offers a window to pursue public sector intervention, given the increase in government income that can be expected from the FDI scenario. In this way, the revenues can be distributed in a productive as well as progressive manner.

The perceived negative effects that are often associated with FDI in extractive industries come from theft, the corrosion of institutions and productivity, increased incentives for graft, consequent social distrust, inequality, and so forth—issues that are outside the parameters of our modelling framework. In this way, the economy-wide impacts presented above could be used as a benchmark, in that if they are not attained (provided that all other economic shocks and interventions are accounted for), institutional matters need to be considered.

A couple of extensions to the work described in this report may be useful. As mentioned earlier, donor aid is an important source of currency inflows for Mozambique. If foreign donors decide to reduce transfers to the Mozambican government when their revenues are ramping up courtesy of natural gas royalty earnings, this may offset some of the appreciation of the exchange rate that is likely to occur. Our simulations suggest that this will benefit other traded activities but not necessarily rural low-income households. Moreover, the window of opportunity for domestic support programmes such as those examined in this paper may be smaller, although it may still be large enough.

We mention in passing the value-adding (albeit limited) of natural gas by the downstream production of LNG. The latter is not considered in our analysis, simply because the industry does not yet exist in the SAM data. Moreover, we have already mentioned that natural gas as such is at this stage poorly represented in the Mozambique SAM. In particular, this refers to the degree to which this activity links back to the local economy. This also applies to LNG, and highlights a gap in our knowledge. There is a clear need here to collect better data. Any future CGE or other SAM-based analysis would then be able to assess in a more comprehensive and robust manner what the impact of the natural gas and LNG developments on the Mozambique economy might be.

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