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KIRIBATI

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KIRIBATI

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April 15, 2024

Approved By
Asia and Pacific Department

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CONTENTS

COPRA SUBSIDY IN KIRIBATI: A CASE STUDY[1]

The copra subsidy, disbursed as a minimum support price, is a major part of the social safety net in Kiribati. The subsidy has multiple purposes—including as a means to transfer resources to the outer islands and to stem migration to the capital. However, the subsidy is inefficient, distortive, and costly. The support price was doubled to AUD 4/kg in 2022, consuming 8 percent of GDP and pushing the domestic price far above regional and international market prices. This wide price gap has created significant imbalances in export and labor markets. We develop a theoretical economic model to replicate these distortions and show that they increase with a higher subsidy. Given the subsidy's far-reaching economic effects, we propose several subsidy reforms and trace out their impact on Kiribati's fiscal position. We estimate that: (i) lowering the support price to AUD 2/kg, or (ii) capping the existing subsidy at the poverty rate—and channeling a portion of the savings to a social assistance program—could yield meaningful fiscal savings and improve debt sustainability while retaining the subsidy's poverty-reduction benefits.

A. History of Copra Subsidy in Kiribati

1. Kiribati, an island country in the central Pacific Ocean, faces multiple development challenges. These include geographic remoteness, an infrastructure gap, a narrow economic base, and vulnerability to climate change. Without independent monetary and exchange rate policies—given the adoption of the Australian dollar (AUD) as legal tender—the government relies on fiscal policy to manage the impact of shocks and support growth.

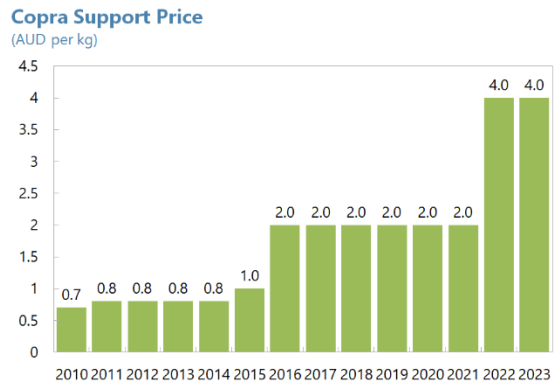
2. The copra subsidy is a key part of the Government of Kiribati's (GoK's) budget. Copra, the dried section of the "meat" of a coconut, and its associated by-products such as crude coconut oil are a major component of Kiribati's exports and GDP. Between 2010 and 2021, copra and broader coconut products on average accounted for 8 percent and 45 percent of Kiribati's exports, respectively. According to the 2019–20 Household Income and Expenditure Survey (HIES), around 40 percent of households in Kiribati produce copra for the purpose of sale or exchange, with the highest participation (up to 87 percent of households) occurring in the outer islands. Coconut harvests account for nearly 50 percent of all fruit produced in Kiribati. Given the importance of copra in the economic landscape of Kiribati, the government has enacted a subsidy on the product since the mid-1990s. The subsidy takes the form of a minimum support price, guaranteeing farmers a fixed price per kilogram of copra sold. The subsidy has manyfold objectives: it is a transfer scheme through which GoK redistributes resources (including from fishing license revenues) and social welfare to the outer islands where copra is primarily grown (World Bank, 2018). It also serves as an unemployment benefit for individuals who have experienced job loss, enabling them to engage in copra cutting as an alternative source of income. Additionally, it is a type of conditional cash transfer program aimed at curbing migration from the outer islands to Tarawa, the capital.

[1] Prepared by Faizaan Kisat (FAD, previously APD), Saraf Nawar (APD), and Danny Xufeng Jiang (SEC).

3. The subsidy was doubled in 2022, consuming a considerable fraction of the budget and pushing the support price well above international market prices. The support price has increased significantly since 2010, doubling in mid-2016 and then doubling again to its current price of AUD 4/kg in 2022 (Figure 1, top left panel). The most recent increase, aimed at expanding the social safety net in Kiribati, raised the subsidy cost to 9 percent of government expenditure (8 percent of GDP) in 2022 versus 5 percent in 2021 (Figure 1, top right panel). While the domestic price of copra has risen, international market prices have fluctuated around USD 1/kg, widening the gap between the price received by producers and earned by exporters (Figure 1, bottom left panel). The differential creates an estimated loss of AUD 6,400 (about US$4,300) for every ton of exported crude coconut oil, even before accounting for processing and labor costs. Applying this figure to 2021 export volumes implies a loss of AUD 19 million, equivalent to 5 percent of GDP.[2] In addition, historical increases in the subsidy have generally not translated to higher production or exports of coconut products (Figure 1, bottom right panel), implying that production is mostly driven by supply-side factors.

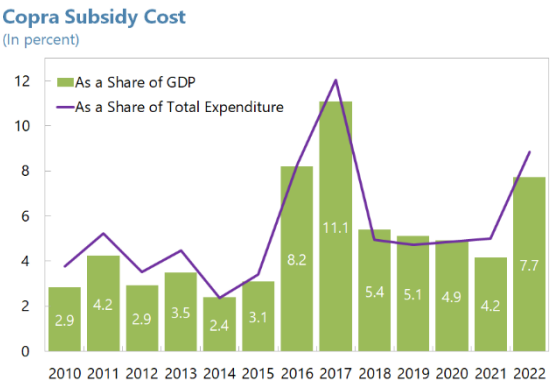
Figure 1. Overview of Copra Support Price in Kiribati

The support price was doubled in 2016 and 2022…



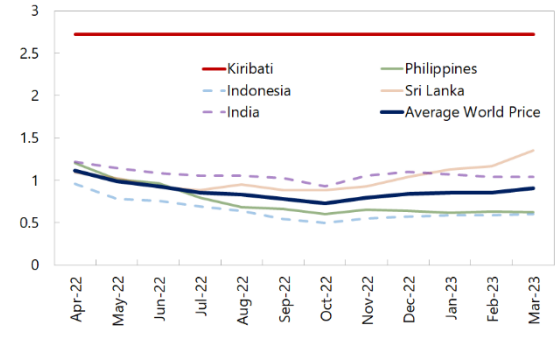
Sources: Kiribati National Statistics Office and IMF staff calculations.

… consuming a high fraction of government expenditures.



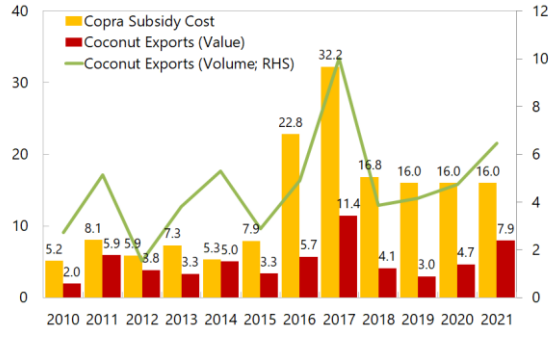
Sources: Kiribati National Statistics Office and IMF staff calculations.

The support price of AUD 4/kg is almost triple the international market price…



Sources: International Coconut Community and IMF staff calculations

… creating a wide gap between the cost of the subsidy and the value of coconut exports.



Sources: Kiribati National Statistics Office and IMF staff calculations.

[2] 2021 is the latest year for which export volumes for crude coconut oil are available.

4. The subsidy is disbursed in the outer islands by the state-owned Kiribati Coconut Development Limited (KCDL) and copra is mostly transported by Kiribati National Shipping Line Limited (KNSL), also a state-owned enterprise (SOE). The procedure for distributing the subsidy involves multiple actors, each with their own incentives. Agents and private cooperatives bring copra to weigh stations on each outer island. KCDL uses funds from the government to pay these groups the copra support price of AUD 4/kg.[3] Following the purchases, the copra is stored until it is shipped to Tarawa. KNSL provides most shipping facilities and receives compensation for freight and handling costs from KCDL. Once the raw copra reaches Tarawa, a portion of it is processed into crude oil and other by-products for exports.

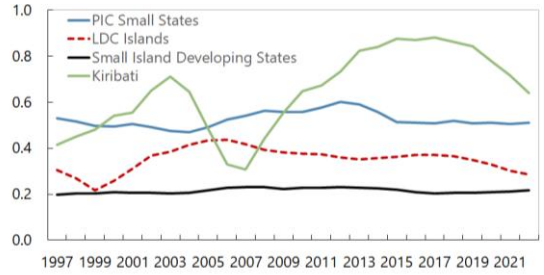
5. These processes are fraught with inefficiencies. Since agents are paid the support price as soon as the copra is weighed (and not when it is eventually received in Tarawa), there are incentives to steal the copra and resell it to buyers; indeed, there are reports that purchased copra "can grow legs, run off, and come back again." [4] While cut copra can last longer than 7 months, copra stock can be damaged as storage facilities are often exposed to extreme weather. Furthermore, shipping services are irregular and unreliable, and private shipping outside of KNSL is limited to certain islands. Government payments for loading and unloading cargo are far below the copra support price. Therefore, workers faced with a choice of either cutting copra of their own or helping with transportation would much rather engage in the former. This disparity in incentives means that there is not enough labor to load copra onto ships, increasing storage times.

6. The economic effects of the subsidy are far reaching. As already mentioned, the support price is almost triple the international market price. Indicative evidence suggests that such a wide gap has created significant distortions in export and labor markets in Kiribati, including:

- **Reducing diversification to non-coconut exports**. By offering such a high price for a particular good, the copra scheme may discourage diversification to other products, such as seaweed and aquaculture. Coconut products have accounted for around half of Kiribati's annual exports by value since 2010, increasing Kiribati's export concentration relative to global and regional peers (Figure 2). Such a high concentration increases the risk that a supply-side shock (for example, bad weather or a drought) significantly depresses exports and economic output.

Figure 2. Concentration of Goods Exports

(Herfindahl-Hirschman index at the SITC 3-digit level, 3-year moving average)



Sources: UNCTAD; and IMF staff calculations.
Note: Higher index indicates greater concentration. PIC small states include Fiji, Marshall Islands, Micronesia, Nauru, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

- **Inhibiting production of higher value-added coconut products**. Copra is a primary product

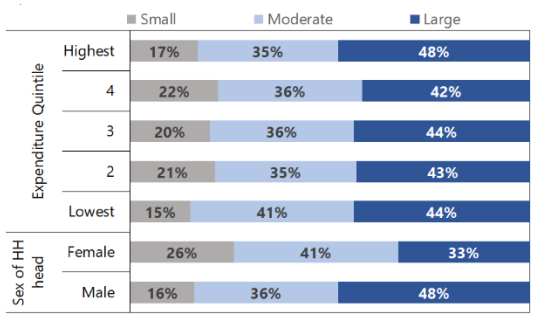
[3] The funds disbursed to each outer island are based on historical output.

[4] Kiribati Economic Reform Taskforce Mission (2023), *Aide Memoire,* Asian Development Bank, Australian Department of Foreign Affairs and Trade, European Union, New Zealand Ministry of Foreign Affairs and Trade, and World Bank.

and the first step in the coconut value chain; a high support price for copra therefore raises input costs for firms aiming to upgrade to higher value-added products such as virgin coconut oil (VCO), a more refined product made using fresh coconuts. According to KCDL estimates, producing VCO competitively requires an equivalent copra price of around AUD 1.50/kg, far below the current support price.

- **Exacerbating wealth and gender inequality**. The copra subsidy benefits those individuals and households with the highest capacity to produce (i.e., cut) copra, which means that households with more land and males tend to reap greater rewards from a higher support price. According to survey responses produced by the authorities from the 2019-20 HIES Report, 48 percent of male-headed households reported a large increase in income from the increased copra subsidy, whereas the corresponding proportion for female-headed households was much lower at 33 percent (Figure 3). In addition, 48 percent of households in the highest expenditure quintile (i.e., the richest households) reported a large increase in income, above the corresponding proportion for households who spend less (i.e., poorer households).[5] While these distributional effects are only mildly regressive, they nonetheless contrast with the authorities' stated purpose of using the copra subsidy as a form of social welfare for vulnerable households.

Figure 3. Increase in Income due to Higher Copra Subsidy
(In percent)



Source: Kiribati 2019-2020 Household Income Expenditure Survey Report: Copra Brief

- **Creating overproduction and lowering productivity**. Reports from the outer islands suggest that copra production is declining, the quality of coconuts is falling, replanting is slow, and premature cutting of coconuts is widespread. These outcomes could all be linked to copra overproduction in the wake of the subsidy being doubled in 2022 (though a severe drought at that time may have also played a role).

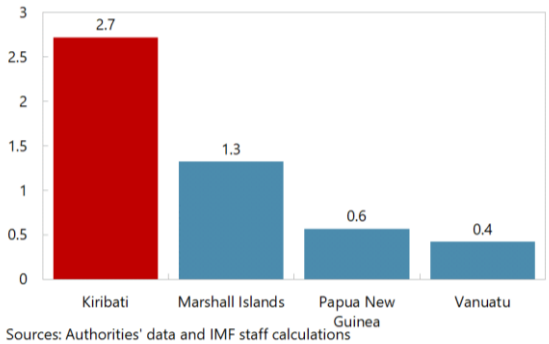
7. Other Pacific Island countries (PICs) have similar support schemes for copra, but Kiribati's is by far the most generous. Copra support programs in nearby PICs also consist largely of minimum support price schemes intended to boost rural incomes. Authorities across many PICs have mirrored GoK's actions and recently raised support prices for copra. For instance, in September 2022, Vanuatu approved a subsidy of US$0.1/kg (up to a maximum subsidized price of US$0.4/kg)

[5] These results are based on households' own perception of income increases following the doubling of the copra subsidy. A more thorough incidence analysis that relies on administrative expenditure or income data would more accurately describe the impact of the subsidy on inequality.

to support the recovery of livelihoods impacted by a cyclone and COVID-19.[6] In January 2023, Papua New Guinea increased the copra support price from US$0.3/kg to U$0.6/kg as a form of relief for coconut farmers in rural areas and villages. Despite these price hikes, however, Kiribati's current copra support price far exceeds those in peer countries (Figure 4).

Figure 4. Copra Price: Kiribati vs. Peer Countries

(USD per kilogram, as of YE 2022 or latest available)



Sources: Authorities' data and IMF staff calculations
Note: Vanuatu's price is the maximum price at which the subsidy is capped.

B. Economic Impact of Price Support Schemes: Evidence from Other Emerging Markets

8. An extensive literature has studied the impact of minimum support prices on agricultural outcomes in developing countries. Countries such as Bangladesh, Brazil, China, Ghana, India, and Pakistan have agricultural price support schemes intended to enhance agricultural output, rural income, and food security. However, Minimum Support Price (MSP) programs may also result in overproduction of subsidized commodities and increased usage of agrochemicals (Table 1).

Table 1. Kiribati: Economic Impact of MSPs in Select Emerging Market Economies

Country	Scheme	Crops	Justification	Outcome
China	China has a minimum grain procurement price program.	Rice, Wheat, and Corn.	To boost rural income and ensure national food security.	**Positive**: China's grain output achieved a growth rate of 54 percent from 2003 to 2019 (Su et al., 2021). **Negative**: Chemical fertilizer and pesticides consumption rose by 22.5 percent and 4.5 percent, respectively, during above period. MSPs led to overproduction, challenges with managing stockpiles, and trade disputes with other countries (Wu and Zhang, 2016).
Ghana	Ghana has a buffer stock operations (BSO) system that uses a dual pricing mechanism (Abokyi et al., 2018).[1]	Maize, Rice, and Soybean.	To enhance the incomes of smallholder farmers and ensure emergency food security.	**Positive**: The output price support (OPS) implemented via BSO intervention improved total farm income and farm income per output of smallholder farmers (Abokyi et al., 2020). **Negative**: None as per literature.
India	The government sets price guidelines annually for 23 commodities through its MSP program.	Various types.[2]	To support domestic food security and foster increased agricultural output.	**Positive**: Numerous Indian farmers shifted to cultivating high-yield strains of rice and wheat in response to the government's emphasis on MSPs (Chhatre et al., 2016). **Negative**: Excessive use of pumps and a substantial decline in groundwater reserves in Punjab province, due to the heavy reliance on growing rice and wheat, combined with incentives like free electricity and water. Intensive cultivation also led to soil degradation and stagnating yields.

[6] For example, if a farmer sells copra at VT 25/kg (US$0.2/kg), the Vanuatu government will add VT 10/kg (US$0.2/kg) to it. However, if the selling price is VT 35/kg (US$0.3/kg), the government only adds VT 5/kg to it as the maximum subsidized price is VT 40/kg (US$0.3/kg).

Table 1. Kiribati: Economic Impact of MSPs in Select Emerging Market Economies (concluded)				
Pakistan	The government sets MSPs for major crops.	Wheat, Rice, Sugarcane, Cotton, and Oilseeds.	To ensure a smooth supply of wheat by incentivizing farmers to produce more.	**Positive**: Wheat MSP encouraged farmers to produce larger quantities of wheat (Shahzad et al., 2019). **Negative**: Wheat MSP increased more slowly than production costs, leading to a decline in profitability of wheat growers (Abedullah, 2022).

[1] Under this mechanism, eligible products are purchased at the minimum (floor) price, and inventories are subsequently sold at a maximum (ceiling) price later in the year.

[2] Rice, Sorghum, Pearl Millet, Finger Millet, Corn, Cotton, Groundnut, Sunflower Seed, Soyabean, Sesame, Niger Seed, Wheat, Barley, Rapeseed & Mustard, Safflower, Ridge Gourd, Copra, De-husked Coconut, Jute, and Various Lentils.

C. Economic Impact of Copra Subsidy: A Theoretical Approach

9. We use a theoretical economic model to illustrate the potentially distortive effects of the subsidy on key economic variables such as income, production, and inequality. The model incorporates (separately) a simple two-good and two-producer environment to show how the subsidy on a good affects the production of that good as well as the non-subsidized good relative to an economy where no subsidies are imposed. The model is not fully calibrated as the micro-level data required to perform such an exercise is not available. However, we can still use its outcomes to illustrate the welfare impacts of the subsidy. Specifically, we model three different environments:

- **Model 1**: A two-good economy with one representative consumer (representing the rest of the world) and two (domestic) firms producing two separate goods ("horizontal diversification" model). The model shows how the subsidy on one good affects potential diversification in production, an important exercise in the Kiribati context as there are concerns that a large copra subsidy may reduce incentives to diversify to non-coconut exports such as seaweed and aquaculture.

- **Model 2**: A two-good economy with one representative consumer and two firms, where one firm's output is entirely used as an input into the second good's production ("vertical diversification" model). The model shows how a subsidy on the primary good, i.e., the good used as an input, affects the production of the final good. The exercise shows how the subsidy on copra can impede efforts to upgrade to higher value-added products such as VCO.

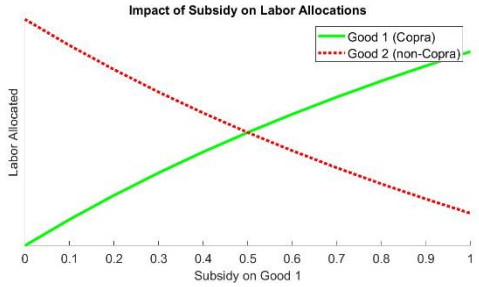
- **Model 3**: A two-good, two-producer economy with one producer possessing a relatively greater endowment of inputs needed to produce one good ("inequality" model). The model shows how the subsidy disproportionately benefits those producers that have a greater ability to produce the subsidized good. In the copra subsidy context, this model reflects recent survey results which show that the copra subsidy benefits wealthier and male-headed households more relative to poorer and female-headed ones.

10. The horizonal diversification model shows that a higher subsidy on copra diverts production and labor towards copra but lowers overall income. A subsidy on one of the goods

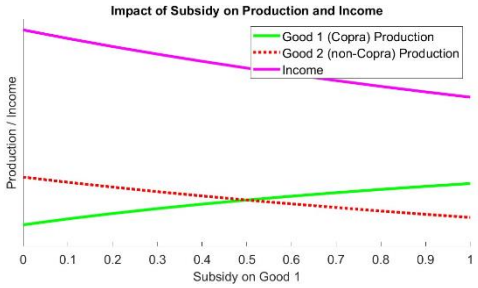
in the economy (that is, copra) raises the post-subsidy price, production, and labor allocation for that good. However, in an economy with limited resources, modeled as a fixed supply of labor, an increase in the labor allocated to the subsidized good necessarily reduces production of the non-subsidized good. This distortion in labor allocation away from a competitive economy not only reduces the production of the non-subsidized good, but also lowers overall income—that is, the sum of the revenue generated from selling both goods. Moreover, the reduction in income increases uniformly with a higher subsidy, as shown in Figure 5.

Figure 5. Horizontal Model: Impact of Subsidy on Labor and Production

A subsidy on good 1 diverts labor towards that good…



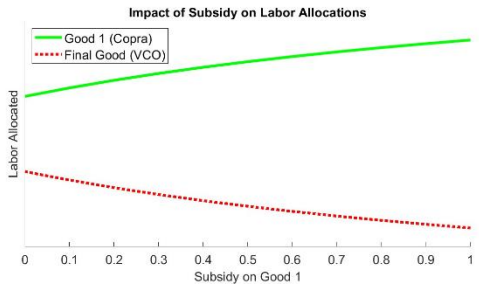
… increasing production of that good but reducing overall income.



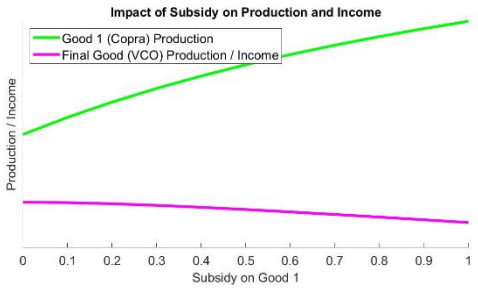
11. The vertical diversification model demonstrates how a subsidy on a primary product increases its supply but reduces production of the final good. A subsidy on the intermediate good increases labor allocated towards that good, necessarily lowering the resources allocated towards final good production. Income, which is generated from the production of the final good only, therefore declines as there is less of it in the economy (Figure 6).

Figure 6. Vertical Model: Impact of Subsidy on Labor and Production

A subsidy on the intermediate good (copra) increases labor allocated to it…



… reducing the production of the final good and overall income.

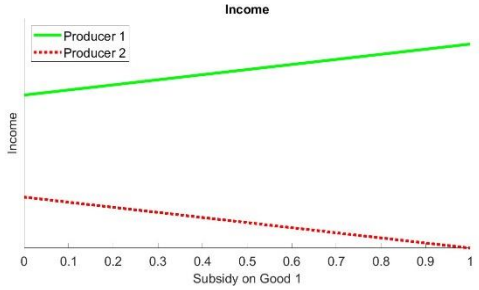


12. The inequality model shows how a subsidy disproportionately benefits those individuals who have a greater comparative advantage in producing the subsidized good; in the context of Kiribati, this implies widening wealth and gender gaps. The producer endowed with a greater relative ability to produce the subsidized good receives a higher income boost from the subsidy. The producer who is wealthier before the subsidy is imposed becomes wealthier still, exacerbating inequality (Figure 7). Notably, this reallocation of income occurs even if the subsidy

itself is not distortive as in the previous two models; that is, even if the overall income level in the economy is unchanged relative to a scenario without a subsidy.

Figure 7. Inequality Model: Impact of Subsidy on Relative Income and Production

A subsidy on good 1 (copra) reallocates income towards the producer with a greater comparative advantage in producing copra.



D. Fiscal Impact of Potential Reforms to Copra Subsidy

13. We consider five subsidy reform scenarios and assess their impact on the fiscal deficit and public debt:

- **Scenario 1: Reduce wastage**. The scenario assumes that removing inefficiencies along the subsidy payment chain yields annual cost savings of 5 percent. The savings could be achieved, for example, by reducing delays between shipping collections, or reimbursing KCDL based on the copra received (and processed) in Tarawa as opposed to the amount weighed in the outer islands.

- **Scenario 2: Cut support price by half to AUD 2/kg**, reversing the doubling of the subsidy in 2022 and bringing the local price closer to international market prices.

- **Scenario 3: Cut support price by half to AUD 2/kg, channel savings to social assistance program**. The savings generated from reducing the support price are channeled to a poverty-targeted social assistance program. Such a program would be much more effective at reaching those in need and is forecast to reduce the poverty rate from 21.9 percent of households to 6.1 percent (World Bank, 2023). In contrast, the doubling of the subsidy is simulated to reduce national poverty to 18.1 percent.

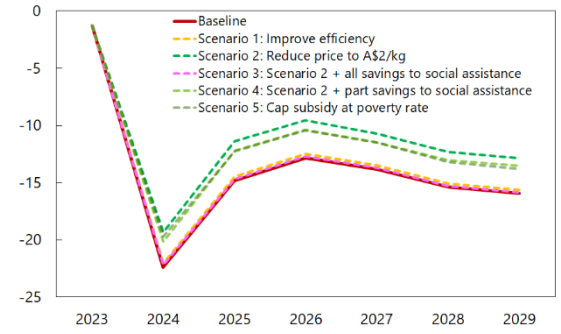
- **Scenario 4: Cut support price by half to AUD 2/kg, channel *part* of the savings to a social assistance program**. The fraction of savings diverted to the program is calibrated to achieve the same level of poverty reduction as the AUD 4/kg subsidy (World Bank, 2023).

- **Scenario 5: Cap subsidy at the poverty rate**. The AUD 4/kg support price is retained, but total payments at the subsidized price are capped at AUD 142/month, corresponding to the national poverty line in Kiribati.[7]

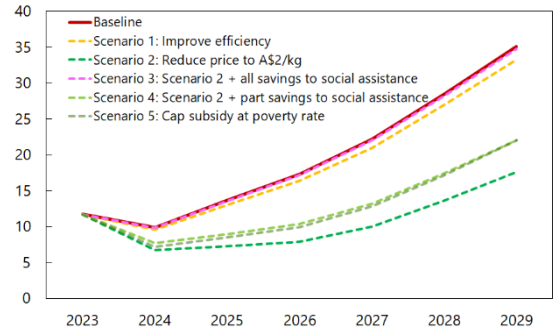
Figure 8. Fiscal Scenarios

Subsidy reform could lower the deficit by up to 3 percentage points of GDP annually…

… and put public debt on a more sustainable footing.



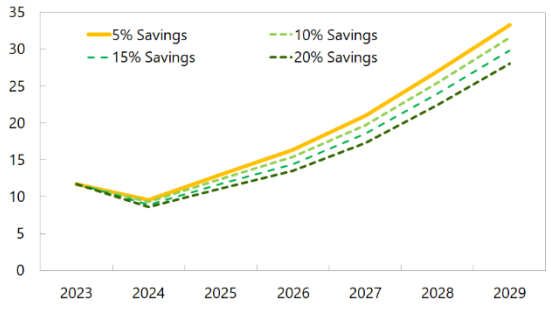
Sources: Country authorities and IMF staff calculations.



Sources: Country authorities and IMF staff calculations.

14. Subsidy reforms could yield meaningful fiscal savings while retaining the subsidy's social benefits. Figure 8 plots the path of the overall fiscal balance (left panel) and public debt (right panel) corresponding to the baseline projections and the reform scenarios. Scenario 2 creates the greatest reduction in deficit and debt, though scenario 4 also generates around 2-3 percentage points in annual deficit reduction while retaining the current subsidy's poverty reduction benefits. Similarly, while scenario 5 maintains the subsidy at AUD 4/kg, imposing a payment cap generates almost identical fiscal benefits as in scenario 4. All the scenarios are sensitive to assumptions such as efficiency gains and GDP multipliers. For example, in scenario 1, a larger reduction in wastage could lower public debt in the forecast years even further (Figure 9).

Figure 9. Scenario 1: Public Debt Under Higher Savings Assumptions
(In percent of GDP)



Sources: Country authorities and IMF staff calculations.

E. Conclusion and Policy Recommendations

15. The copra subsidy has both economic and social benefits, but it is costly and distortive. The subsidy transfers economic resources to the outer islands and helps to prevent migration to the crowded capital. At the same time, the subsidy consumes a high and growing fraction of

[7] As defined by the 2019–20 HIES Report. The associated savings of about AUD 13 million per year are based on a (forthcoming) World Bank analysis on the copra subsidy. The scenario assumes that farmers are paid the market price for any additional copra sold beyond the AUD 142/month threshold.

government expenditures. After its increase to AUD 4/kg in 2022, the support price is currently triple the international market price and double the level in the next highest PIC. Market participants widely acknowledge that the subsidy is loss making, inefficiently disbursed, and inhibits production of higher value-added and non-coconut exports. In the face of these challenges, GoK has acknowledged the importance of enacting meaningful subsidy reform. It notes that "in 2024, the Copra Subsidy and Support for the Unemployed will continue to be funded from [Local Contribution to the Development Fund]…There is a very high opportunity cost for these payments, and they have significantly constrained the fiscal space available to support other Government priorities. Further work to improve the targeting of these schemes should improve their effectiveness as a social safety net, and free up fiscal space."[8]

16. Subsidy reforms could reduce distortions and create fiscal space. We construct a theoretical economic model to show how increases in the subsidy can reduce export competitiveness and increase inequality. Additionally, we find that rationalizing the subsidy—by either reversing its recent increase or imposing a cap at the poverty line—could lower the fiscal deficit by up to 3 percentage points of GDP annually and improve debt sustainability while retaining the subsidy's poverty-reduction gains. Considering these benefits, the government could boost the subsidy's efficiency (for example, by improving incentives along the payment chain), replace the scheme with a poverty-targeted social assistance program, or impose a cap on payments. Development partners, including the IMF and the World Bank, stand ready to provide support in both areas as needed.

[8] Kiribati Government, 2024 Recurrent Budget.

Appendix I. Model Details

A. Model 1: Horizontal Diversification Example

Equilibrium Without Subsidy

The economy consists of a representative (rest of the world) consumer that consumes two goods (denoted by subscripts 1 and 2) produced by two separate domestic firms. Labor is perfectly mobile, so wages are equal across the two firms.

Consumer: Preferences are given by a log utility function. Taking prices as given, the consumer maximizes utility from consuming good 1 and good 2 subject to the following budget constraint:

$$\max_{c_1,c_2} u(c_1 c_2) = \alpha \log c_1 + (1-\alpha)\log c_2$$

$$s.t. \quad p_1 c_1 + p_2 c_2 \leq I$$

Where α denotes the preference for consuming good 1 (copra), and c_1 and c_2 indicate consumption of good 1 and good 2, respectively. Prices of good 1 and good 2 are given by p_1 and p_2, respectively, and I is income.[1]

Utility maximization yields the standard condition that the consumer spends a constant fraction of her income on each good, with α denoting the fraction of income spent on good 1.

Firms: Taking prices as given, firm i chooses labor (only) to maximize production, which occurs according to a decreasing returns-to-scale production function. The firm solves the following maximization problem:[2]

$$\max_{\ell_i} p_i A_i \ell_i^{\gamma} - w\ell_i$$

Where $i \in \{1,2\}$ indicates the good i.e., good 1 (copra) or good 2 (non-copra). A_i is total factor productivity, ℓ_i denotes labor demand, w is the wage rate, and $0 < \gamma < 1$ is the returns-to-scale factor.

Market clearing: In equilibrium, labor and goods markets clear:

$$c_i = A_i \ell_i^{\gamma}$$

$$\ell_1 + \ell_2 = L$$

[1] The price of good 2 is set equal to one i.e., p_2 is the numeraire in this and all subsequent models.

[2] Subject to the constraint that total labor demand is less than L, the total amount of labor supplied.

Solution: The model yields the intuitive solution that the economy allocates a constant α fraction of labor to the production of good 1:

$$\ell_1 = \alpha L, \ell_2 = (1-\alpha)L$$

The price of good 1 is set such that demand and supply in the goods market clears:

$$p_1 = \left(\frac{\alpha}{1-\alpha}\right)^{1-\gamma}\frac{A_2}{A_1}$$

Equilibrium With Subsidy

Now suppose that the government subsidizes the production of good 1 by offering a subsidy of τ percent, to be paid for by a lump sum tax (on firm 2). Firm 1's profit maximization problem is then given by:

$$\max_{\ell_1}(1+\tau)p_1 A_1 \ell_1^{\gamma} - w\ell_1$$

Where $(1+\tau)p_1$ denotes the post-subsidy priced received by producers of good 1. All other optimization and market clearing conditions remain unchanged, except that overall revenue is reduced by a lump sum tax amount T such that the government's budget is balanced:[3]

Solution: The subsidy on good 1 diverts production and labor *towards* good 1. The equilibrium labor allocation is then given by:

$$\ell_1 = \frac{\alpha(1+\tau)L}{1+\alpha\tau}, \ell_2 = \frac{(1-\alpha)L}{1+\alpha\tau}$$

The above allocations show that the labor supplied to good 1 increases under the subsidy, since τ is greater than zero. The post-subsidy price of good 1 is also higher than the competitive equilibrium price:

$$p_1^{subsidy} = \left(\frac{\alpha}{1-\alpha}\right)^{1-\gamma}\frac{A_2}{A_1}(1+\tau)^{1-\gamma}$$

The equilibrium levels of production and income can then be obtained by plugging in the solutions for price and labor into the goods market clearing condition and the consumer's budget constraint, respectively:

$$c_1 = A_1\left(\frac{\alpha(1+\tau)L}{1+\alpha\tau}\right)^{\gamma}, c_2 = A_2\left(\frac{(1-\alpha)L}{1+\alpha\tau}\right)^{\gamma}$$

$$y = p_1 c_1 + c_2$$

[3] The government's budget constraint is given by: $\tau p_1 A_1 \ell_1^{\gamma} = T$.

B. Model 2: Vertical Diversification Example

Equilibrium Without Subsidy

The model also consists of two firms producing two separate goods, with the key difference being that good 1 (copra) is an input into the production of good 2. There is only one final good and the consumer's utility structure is the same as in model 1.

Firms: The production structure is as follows:

Firm 1: $q_1 = A_1 \ell_1$

Firm 2: $q_2 = A_2 \ell_2^{1-\alpha} q_1^{\alpha}$

Where q_i denotes the quantity of good i that is produced, and all other variables are as in model 1. Firm 1 then solves the following maximization problem:

$$\max_{\ell_1} p_1 A_1 \ell_1 - w\ell_1$$

Firm 2 now pays both a labor cost and an input cost. Its maximization problem is as follows:

$$\max_{q_1, \ell_2} p_2 A_2 \ell_2^{1-\alpha} q_1^{\alpha} - w\ell_2 - p_1 q_1$$

Market clearing: In equilibrium, labor, and goods markets clear:

$$q_1 = A_1 \ell_1$$

$$\ell_1 + \ell_2 = L$$

$$c_2 = A_2 \ell_2^{1-\alpha} q_1^{\alpha}$$

Solution: As in model 1, the economy allocates a constant fraction of labor to the production of each good:

$$\ell_1 = \alpha L, \ell_2 = (1-\alpha)L$$

Equilibrium prices and final goods production are as follows:

$$p_1 = \alpha^{\alpha}(1-\alpha)^{1-\alpha} A_2 A_1^{\alpha-1}$$

$$c_2 = \alpha^{\alpha}(1-\alpha)^{1-\alpha} A_1^{\alpha} A_2 L$$

Equilibrium With Subsidy

As in model 1, suppose that the government subsidizes the production of good 1 by offering a subsidy of τ percent, to be paid for by a lump sum tax on the consumer. Firm 1's modified profit maximization problem is as follows:

$$\max_{\ell_1}(1+\tau)p_1A_1\ell_1 - w\ell_1$$

Solution: The subsidy on good 1 diverts production and labor *towards* good 1 and raises input costs for the producers of good 2. The equilibrium labor allocations and (post-subsidy) price are given by:

$$\ell_1 = \frac{\alpha(1+\tau)}{1+\alpha\tau}L, \ell_2 = \frac{(1-\alpha)}{1+\alpha\tau}L$$
$$p_1^{subsidy} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}A_2A_1^{\alpha-1}(1+\tau)^{\alpha}$$

The solution shows that the subsidy on good 1 reduces the labor allocated to the production of the higher value-added final good, thus reducing income.

C. Model 3: Inequality Example

Equilibrium Without Subsidy

The model is a two-good, *two-producer/consumer* economy. As a simplifying assumption, there is no production function. Rather, each producer is endowed with a fixed quantity of each good and can sell her endowment in the market.

Consumers: Taking prices as given, consumer j maximizes the following utility function:

$$\max_{c_1,c_2} u^j(c_1c_2) = \alpha\log c_1^j + (1-\alpha)\log c_2^j$$

$$s.t. \quad p_1c_1^1 + p_2c_2^1 \leq I^1$$

Producers: We assume that producer 1 has a higher relative endowment of good 1, meant to reflect that some producers in Kiribati have a greater endowment of land or skills needed to produce copra. Letting γ and δ denote producer 1's relative endowment of good 1 and good 2, respectively, producer 1's revenues are given by the following:

$$y^1 = p_1\gamma\omega_1 + p_2\delta\omega_2$$

Where ω_1 and ω_2 denote, respectively, the total endowment of good 1 and 2 in the economy. It follows that producer 2's income is as follows:

$$y^2 = p_1(1-\gamma)\omega_1 + p_2(1-\delta)\omega_2$$

Market clearing: In equilibrium, goods markets clear (note there is no production function so there is no labor market)

$$c_1^1 + c_1^2 = \omega_1$$

$$c_2^1 + c_2^2 = \omega_2$$

$$I^1 = y^1, I^2 = y^2$$

Solution: Consumer 1's consumption is a constant (identical) fraction of the total endowments of goods 1 and 2. The consumption of both goods increases with relative endowments:

$$c_1^1 = [\alpha\gamma + (1-\alpha)\delta]\omega_1$$

$$c_2^1 = [\alpha\gamma + (1-\alpha)\delta]\omega_2$$

$$p_1 = \frac{\alpha}{1-\alpha}\frac{\omega_2}{\omega_1}$$

Equilibrium With Subsidy

The government subsidizes the production of good 1 and pays for the subsidy by taxing production of good 2. Producer 1's modified income is as follows:

$$y^1 = p_1(1+\tau)\gamma\omega_1 + p_2(1-\tau_2)\delta\omega_2$$

Where $\tau > 0$ is the subsidy on good 1, as before, and τ_2 is the tax imposed on good 2.[4] Producer 2's income is similarly modified.

Solution: Producer 1's income *increases* relative to the equilibrium without a subsidy, as the producer has a higher relative endowment of good 1 ($\gamma > 0.5$). The equilibrium allocations are as follows:

$$c_1^1 = [(1+\tau)\alpha\gamma + (1-\alpha-\alpha\tau)\delta]\omega_1$$

$$c_2^1 = [(1+\tau)\alpha\gamma + (1-\alpha-\alpha\tau)\delta]\omega_2$$

$$p_1 = \frac{\alpha}{1-\alpha}\frac{\omega_2}{\omega_1}$$

[4] The tax on good 2 (τ_2) is set so that the government budget is balanced i.e., $\tau p_1\omega_1 = \tau_2 p_2\omega_2$.

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