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Analysis of Exogenous Shocks and Policy Reforms in Guyana's Agricultural Sector

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by

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Abstract

Guyana faces important new opportunities and challenges associated with an enormous offshore petroleum discovery. The Government has ambitious reform objectives and seeks to transform its agricultural sector through investments within the sector and in supporting infrastructure. The analysis to be presented uses a detailed geospatial model of the agricultural sector as a basis for analysis of reform options. This approach is chosen partly because of its power at capturing the detailed responses of the sector and partly because traditional databases such as Social Accounting Matrixes and household surveys are unavailable. Following the approach of important recent studies of global climate change, the modelling approach uses detailed geospatial information on over 20 crops in 727 fields within Guyana's agricultural sector to represent the responses of the agricultural sector. The analysis captures both responses to the natural resource boom and to policy reforms such as investments in research and development, infrastructure, and pricing policies.

Analysis of Exogenous Shocks and Policy Reforms in Guyana's Agricultural Sector

This study comes at a particularly critical juncture, as the economy of Guyana adjusts to the enormous shocks associated with the discovery and exploitation of oil reserves and the Government of Guyana (GoG) formulates its agricultural policies for future decades. It builds on substantial work in Guyana's National Strategy for Agriculture (MoA 2013), the Agriculture Investment Prospectus (MoA 2022), and important studies of agricultural incentives in Guyana (Derlanger et al 2015; and Gachot et al 2022).

The agricultural sector in Guyana remains an important source of employment, although its importance as a share of GDP is likely to drop substantially as the oil and gas sector expands dramatically. With the oil and gas sector on track to generate revenues roughly twice the size of Guyana's pre-oil GDP, Guyana is beginning to experience the Dutch disease phenomenon (Corden and Neary 1982) that—if not well managed—can turn a resource boom into a resource curse. The fundamental challenge of managing a resource boom is that the resource revenues increase demand for nontraded goods and services, pushing up the prices of these goods and drawing resources away from production of traded goods. The effect on wages is likely to be strong in Guyana given the size of the shock. Rapid increases in wages have already put considerable pressure on the agricultural section in Guyana.

One common response to the pressures on traded goods sectors associated with a resource boom is to provide protection to import-competing sectors. However, this puts additional pressures on more productive agricultural activities—creating pressures to shelter more of them from import competition and dashing policymakers' hopes of expanding competitive agricultural activities and becoming a larger agricultural exporter—particularly to the CARICOM countries where Guyana faces relatively low tariff barriers. The just published IADB study (Gachot and de Salvo 2022) of agricultural incentives points to an additional source of pressure for adjustment from the loss of preferential access to the European market.

A better response might be to use some of the revenues coming from the resource to improve the competitive position of Guyana's agricultural sector. Improving infrastructure, strengthening the country's research and development system and strengthening agricultural value chains can all contribute to making the agricultural sector more competitive, creating more productive and well-paid jobs for Guyanese workers. Because the government of Guyana has multiple objectives—seeking to reduce poverty, improve nutrition and contribute to mitigation of global warming—no one policy intervention can reach all these goals and a package of measures will need to be considered. The Government of Guyana (GoG) includes many investments of this type in its Agricultural Development Strategy and,

presumably, would be able to make many more of these investments with the increased resources becoming available from the offshore oil boom.

The analysis in this paper uses detailed geospatial data for 727 pixels that are roughly 9km by 9km with detailed data for 42 different agricultural commodities. The use of gridded datasets for analysis of agricultural policy reforms and shocks like those from the Dutch Disease in Guyana is particularly promising for two reasons. The first is that, as in Baldos et al (2020), Costinot et al (2016) and Gouel and Laborde (2021), there are enormous gains to be had from incorporating the detailed spatial information available in datasets like the FAO's GAEZ database (Fischer et al 2021) and IFPRI's MapSPAM database (Yu et al 2020). The second reason is the paucity of other types of data—such as social accounting data or household survey data—for representing the agricultural sector of Guyana.

The next section discusses the nature of the policy instruments and goals relevant to Guyana's agricultural sector. The third section examines the magnitude of the oil shock relative to other countries and considers some of the lessons learned from the experience of other countries during such natural resource shocks. The fourth section outlines the proposed approach to analysis.

Goals and Instruments in Guyana's Agricultural Policies

Guyana's comprehensive agricultural strategy to 2020 (MoA 2013) identifies a set of goals as part of its vision for agriculture and discusses in broad terms the instruments used to achieve those goals. This strategy had five broad goals:

- Food Security- consolidating the end of hunger in Guyana,
- Making fiber and Nutritious Food Accessible by citizens,
- Fuel Production - helping to develop alternative fuel sources,
- Fashion and Health Products—developing new industries, and
- Furniture and Crafts.

Guyana's new Agricultural Investment Strategy (MoA 2022) continues the focus on developing a higher-yielding agricultural sector both to raise farm incomes and to reduce agricultural imports. It appears to reduce the emphasis in the former report on biofuels, while continuing the strong emphasis on innovation both in agricultural production and in the downstream processing sectors. Perhaps reflecting the much-improved fiscal situation following the oil boom and the major investments under way in improved infrastructure, it emphasizes the importance of the key road development to the Brazilian border at Lethem, construction of key bridges and a deep seaport. Another key feature of this prospectus is a strong emphasis on export promotion, particularly into markets such as CARICOM, where Guyana

has entered into preferential trade agreements. While recognizing the need to preserve Guyana's forests, and their potential for carbon sequestration, the prospectus holds out prospects for development of corn and soybean production in the Savannah regions of the interior.

The recent Inter-American Development Bank report on agricultural policy in Guyana (Gachot et al 2022) points to relatively modest levels of agricultural support, with an average Producer Subsidy Equivalent of 17.6 percent over the 2015-19 period. This is likely higher than the degree of support going forward because the government made the challenging decision to end budget support to the Guyanese sugar processor, GuySuCo, from 2019. Because this contributed roughly 36 percent of total producer support during the 2015-18 period, a better estimate of current support would be around 11 percent.

Roughly 70 percent of the producer support remaining in 2019 was provided in the form of market price support to the poultry industry. This support, provided largely through a tariff of 100 percent on poultry meat imports raises important questions, unless it is seen as a purely temporary infant-industry protection measure. A first concern with this approach is that it substantially raises the cost to consumers of a basic food item. A second is that it generates an enormously magnified increase in value added, indicated by the Effective Rate of Protection (Barber 1955). If we use a standard producer budget from the United States[1], where value added at market prices is about 36 percent of gross output value, a 100 percent tariff translates into a 380 percent increase in value added. Do producers of poultry meat really require an increase of 380 percent to their value added to produce poultry meat in Guyana over the long term?

Another feature of the agricultural trade regime in Guyana is that Value-Added Tax (VAT) is levied on imports but domestic producers are exempted (Gachot et al 2022, pp19-20). This tax is levied at a 16 percent rate, in the same order of magnitude as agricultural support measures. However, this deviation from the standard principles of a VAT has some surprising consequences. For producers in import-competing sectors such as poultry, it likely raises output prices. However, this benefit to these producers must be offset by their inability to obtain credits for VAT paid on their intermediate inputs[2]. For producers in export-oriented industries such as rice, the situation is even worse. They receive world prices for their output yet are unable to obtain credits for the "stranded" VAT paid on their intermediate inputs. Clearly, they are worse off than producers under a standard VAT (Ebrill et al 2001), who also receive world prices for their production and receive credits for the VAT paid on their intermediate inputs. Policy reforms to include farmers in the VAT net, with zero-rating for exported goods, could overcome these problems.

[1] https://extension.psu.edu/enterprise-budgeting-for-small-poultry-flocks

[2] While some reductions in VAT rates on intermediate inputs to agriculture are provided, these do not provide complete relief.

An important strength of Guyana's agricultural policy regime is in the General Services Support Estimate (GSSE) transfers that were reasonably substantial prior to the government revenue increases associated with the oil boom. Expenditures on agricultural knowledge generation were about 0.6 percent of the gross value of agricultural production, almost certainly very close to the 1 percent of agricultural value-added benchmark (Nin-Pratt 2021) for developing country investment in agricultural R&D. Another important investment for Guyana's agricultural productivity is hydrological infrastructure. The agricultural investment prospectus (MoA 2022) suggests that the GoG plans to substantially increase investments in these two important areas.

Another important feature of the GoG's planning for the future is a strong focus on land use and the environment (GoG 2013). This pays particular attention to the agro-ecological characteristics of Guyana's diverse landscapes, while making clear the government's intention to preserving the natural environment. It also considers a wide range of possible innovations in cropping and livestock industries, and the development of coastal aquaculture. More recently, the Ministry of Agriculture has begun investigating the possibility of developing tropical wheat production in interior regions IX and X (Parris 2022). These increases in productivity will become particularly important for ensuring the survival of industries under the cost pressures associated with the oil boom. If the resulting innovations reduce emission intensities of crop and livestock production, they may also play a critical role in reducing greenhouse gas emissions from Guyana's agriculture (Gautam et al 2022).

Guyana's support regime for agricultural products fits within an overall trade regime with relatively modest trade restrictions. The average tariff on non-agricultural goods was 9.3 percent, well within the range for developing countries, although well above the rate in relatively open developing countries such as Colombia (4.2%) and Costa Rica (4.6%) (UNCTAD 2021).

Lessons from Economics and Experience

Agricultural policymakers in Guyana face some critically important pressures in the coming years. Some of these pressures arise from Guyana's enormous offshore oil discoveries. Others emerge from the goals of increasing the sustainability of agricultural policies. The size of the shocks associated with the oil boom can usefully be put in context by comparing Guyana's post-discovery reserves with those of other countries. These are presented in Table 1 for the twenty countries with the largest proven oil reserves.

Table 1. Oil Reserves Relative to Population

Total			Per person		
Country	Reserves	Population	Country	Reserves	Value
	m bbl	m		'000 bbl/head	$ per person
Venezuela	303806	28	Kuwait	23.9	955,268
Saudi Arabia	258600	36	Guyana	13.7	546,878
Iran	208600	88	Venezuela	10.8	430,933
Canada	170300	38	UAE	10.4	417,719
Iraq	145019	44	Qatar	9.4	375,622
Kuwait	101500	4	Saudi Arabia	7.2	287,730
UAE	97800	9	Libya	7.2	287,222
Russia	80000	143	Canada	4.5	178,110
Libya	48363	7	Iraq	3.3	133,248
United States	47107	332	Iran	2.4	94,901
Nigeria	36890	213	Kazakhstan	1.6	63,155
Kazakhstan	30000	19	Norway	1.5	60,070
China	26022	1,412	Russia	0.6	22,308
Qatar	25244	3	Ecuador	0.5	18,593
Brazil	12714	214	Algeria	0.3	11,046
Algeria	12200	44	Angola	0.2	9,023
Guyana	11000	0.8	Nigeria	0.2	6,915
Ecuador	8273	18	United States	0.1	5,677
Norway	8122	5	Brazil	0.1	2,373
Angola	7783	35	China	0.0	737

Sources: Reserves : US Energy Information Agency cited by Wikipedia https://en.wikipedia.org/wiki/List_of_countries_by_proven_oil_reserves. Downloaded Jan 28, 2023. Population in 2021: World Bank World Development Indicators. Downloaded Jan 28, 2023. Note: Value per person estimated at $40 net per barrel.

The left-hand side of the table shows total oil reserves and population, while the right presents reserves and their estimated value relative per person. While Guyana's reserves are only the world's 18th largest, they are enormous on a per capita basis with a value per person second only to stupendously oil-rich Kuwait. If we very crudely assumed a sustainable yield of 4 percent from the present value of Guyana's oil reserves, the annual benefit per person would be around $22,000, close to four times GDP per capita when the oil was first discovered in 2015. The size of Guyana's reserves relative to other countries that have had major oil discoveries suggests that any pressures associated with an oil boom are likely to be very intense.

The fundamental challenge of managing a resource boom is that the resource revenues increase demand for nontraded goods and services, pushing up the prices of these goods and drawing resources away from production of traded goods (Snape 1977; Corden and Neary 1982). One possible effect of this

so-called Dutch Disease is strong contraction of other traded goods sectors as their costs rise relative to returns. Nontraded good sectors are better able to withstand these pressures, as increases in their costs feed into higher prices for their output, while the prices of output for traded goods are more or less determined by world prices in small, open economies like Guyana. Harding et al (2020) find real exchange rate appreciations consistent with the theory of the Dutch Disease occur in countries undergoing resource booms. Rapid increases in wages have already put considerable pressure on the agricultural section in Guyana.

The literature on the Dutch Disease points to two other potentially important linkages from a resource boom to economic outcomes. One is the potential impact of booms on human capital accumulation. A common concern is that rises in real wages for unskilled workers may raise the cost of obtaining an education and hence reduce accumulation of human capital. Emery et al (2012) conclude that this is not a problem in Canada, although this result may be specific to the Canadian environment in which the resources needed for human capital accumulation are likely more available than in many other countries. This phenomenon highlights the importance of the government of Guyana's intention to invest some of the oil boom funds into creating better educational opportunities for citizens of Guyana.

Another potential concern is associated with risks that large amounts of resources as increased government revenues may create serious economic losses due to rent seeking as individuals move away from productive activities to pursue these rents. Clearly, this can be an enormous problem if the institutional environment does not have strong guardrails against nontransparent rent-seeking activities. Where these problems are serious, as in Venezuela and Iran, a strong resource curse is likely to result, with declining long term growth rates, or even collapses in real output. Sachs and Warner (1999) examine seven Latin American countries undergoing natural resource booms and find that these booms did little or nothing to promote long term growth.

One common response to the pressures on traded goods sectors associated with a resource boom is to provide protection to import-competing sectors. However, this puts additional pressures on more productive agricultural activities—creating pressures to shelter more of them from import competition and dashing policymakers' hopes of expanding competitive agricultural activities and becoming a larger agricultural exporter—particularly to the CARICOM countries where Guyana faces relatively low tariff barriers.

Pinto (1987) contrasts the experiences of Indonesia and Nigeria in managing their oil booms. He finds that the oil boom in Nigeria created severe disruption in the agricultural sector, with dramatic falls in production of Nigeria's major cash crops. A major difference between the two countries was in their

agricultural trade policies, with real prices paid to farmers in Nigeria declining sharply during the oil boom period. Another important difference was in exchange rate policy, with Nigeria maintaining an overvalued exchange rate that sharply reduced returns to export-oriented producers and contributed to the disappearance of almost all non-oil exports from Nigeria. Another important difference was in spending policies, with Indonesia investing in physical infrastructure, education and agricultural development that helped the remainder of the economy benefit from the oil shock.

Cust et al (2019) show that natural resource abundance is not necessarily a curse. They examine oil and gas booms within regions of Indonesia. They find that resource windfalls cause increases in wages, which one might expect to reduce employment and output in manufactures. But they find that manufacturing productivity rises as the least competitive firms are driven out. The resulting increase in industry productivity results in increases, rather than decreases, in manufacturing output. While the determinants of productivity in agriculture are different, this points to a particularly important channel of effect. If investments in raising agricultural productivity are successful, they can help agricultural industries to survive the cost increases resulting from the Dutch Disease.

Approach to Analysis

What seems to be needed in the context of the opportunities and constraints facing Guyana in the coming decade is an analytical framework that can incorporate heterogeneity in the climate and geography of Guyanese agriculture and can incorporate the effects of changes in technology and in prices resulting from oil shocks, policy reforms and investments in infrastructure.

The fundamental changes in Guyana's economy require careful evaluation of agricultural policy options and their impacts on the sector. Evaluation of impacts is very challenging in Guyana, because the available data on the structure of the economy are limited. No recent Input-Output table suitable for constructing a traditional Computable General Equilibrium model appears to be available—although a supply and utilization table was prepared around 2010. Nor is there a recent household survey for poverty analysis, with the most recent available survey being from 1992.

A major project at IFPRI on mapping global agriculture, the Spatial Production Allocation Model (MapSPAM) (Yu et al 2020) provides a firm basis for representing the spatial structure of agriculture in Guyana and for analysis of the impacts of changes in policies on both the level and spatial pattern of agricultural production. For Guyana, it provides information on crop production in 727 pixels that are roughly 9km by 9km. Data on both physical area and harvested area, production and yield are presented for 42 different agricultural commodities from almost 12,000 land parcels in the 727 pixels. The

MapSPAM data are compatible with the FAO GAEZ data (Fischer et al 2021), with the same base year of 2010, allowing complementarities between the two databases to be exploited.

This study develops a model of Guyana's agricultural sector that focusses on the opportunities for reform in Guyana's agricultural sector in the context of an enormous resources boom and changes in the external trade environment—particularly the elimination of European preferences on sugar exports and the opportunities created by preferential access to Caribbean markets.

This will require examination of policy options to raise productivity in existing agricultural activities and marketing chains, and—as envisaged by Guyana's latest *Vision for Agriculture*—including assessment of options for expansion of high productivity agricultural sector in areas such as the Savannah of Regions IX and X. The model will include a concise representation of the non-agricultural sector needed to assess the impacts of the oil shock on wage rates and the prices of nontraded goods, and then a much more detailed data-driven representation of the agricultural sector appropriate for evaluating agricultural policy options at a more granular level.

The modeling framework will be used to assess packages of policy reforms directed to the government's multiple objectives. These policy options will include pro-development options such as investments in R&D that raise productivity; investments that reduce emission intensities and investments that expand agriculture in areas—such as savannah plains— where expansion does not compromise the government's objectives of carbon sequestration, provision of ecosystem services. These reforms will be compared with reactive approaches that seek to insulate some subsectors using agricultural protection.

An important step in the analysis will be the collection of new information needed to implement the modeling approach. A key step will be to validate the yield information contained in the MapSPAM data by region in 2010 to ensure that it remains broadly valid for analysis. Another important step will be to obtain data on input coefficients by crop and region. For this it would be extremely valuable to have access to the basic data contained in the 2010 Supply and Utilization table for Guyana. Another highly desirable source of information would be farm budget data prepared by analysts in the Ministry of Agriculture or research institutes. A third important piece of data would be information on transport costs between regions. A fourth key input would be assessments of feasible productivity improvements from new crop varieties and management practices. This information would be sought from researchers within the country and from experts at FAO and CGIAR Centers.

The key elements needed for the analysis are data on production costs by commodity and region. With this information, it is possible to calculate the returns to land from production of each commodity, and to examine the sensitivity of this residual return to changes in prices of outputs and inputs, and in the

production technology. Using these changes, a simple but now widely used model of land allocation (see Costinot, Donaldson and Smith (2016) and Gouel and Laborde (2021)) can be employed to examine changes in land use, agricultural production and other outcomes of concern. Because Guyana is a small, open economy, we can simplify the analytical structure of and Gouel and Laborde (2021) by taking output prices as determined by world prices adjusted, if needed, by the effects of trade policy measures such as import duties or preferential access to Caribbean markets.

The critical elements of the Gouel and Laborde (2021) specification for our purposes are the land rent equation for crop *k* in field *i*, and the acreage allocation within each field. For this application, the rent equation must be generalized to:

$$(1) \quad r_f^k = p_f^k - \sum_i \beta_{if}^k w_{if}$$

Where r_f^k is land rent per ton of output *k* in field *f*; p_f^k are the output prices per ton of commodity *k* in field *f*; β_{if}^k are the intermediate, labor and capital inputs (*i*) needed per ton of output; and w_{if} are the prices of those inputs in field *f*. This specification allows for different prices of outputs and inputs in different parts of the country, depending upon the costs of transporting goods and inputs between regions, and the prevailing wage rates in different parts of the country.

Obviously, only crops for which r_f^k>0 will be produced. But how the land in a field is allocated will depend on the ratio of returns per unit of land in different crops. Following Gouel and Laborde (2021), the share of field *f* allocated to crop *k* is given by:

$$(2) \quad \pi_f^k = \frac{(r_f^k . A_f^k)^\theta}{\sum_l (r_f^l . A_f^l)^\theta}$$

where A_f^k is the yield per hectare of crop *k* in field *f* and θ is a parameter that determines the ease with which crops can be substituted in response to changes in rents.

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