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Structural change and sectoral interconnectedness in two resource-abundant economies

ABSTRACT

A historical overview of structural change is presented in order to motivate the calculation of sectoral factor productivities in Guyana and Suriname, the purpose of which is to observe complementarities, self-propagation and crowding out amongst sectors. The empirical results indicate that the extractive (or industry) sector (ES) displaces manufacturing in Suriname but not in Guyana, and increases the service sector (SS) – comprised mainly of non-tradable activities – in both countries. In turn, SS facilitates the long-term manufacturing growth in Suriname and to a lesser extent Guyana and weak agricultural growth in both cases. The ES self-propagates indicating an enclave-like structure of production. The SS also produces self-propagation, but its effect in Guyana is much stronger in this regard. Manufacturing plays an outsized role in stimulating long-term agriculture growth in Guyana, but not Suriname. Manufacturing also reduces the long-term growth rate of SS, indicating that structural change away from petty and non-tradable services is still possible even when manufacturing accounts for a small share of GDP.

KEY WORDS: Total sector productivity, economic growth, natural resource curse, Guyana, Suriname

JEL Codes: O10, O11, O14, O47

1. Introduction

Production sectors rise and others decline as the economy evolves over the very long term, promoting overall economic progress, stagnation or even decline. The canonical development texts provide insights into what might be needed for structural change to accompany material progress. The surplus of a nation must be spent in a manner that exploits internal and external economies of scale instead of being wasted on 'irrational' consumption and production (Baran 1953). Investments may produce backwash effects (negative spillovers) that overpower the favorable spread effects (positive spillovers), thereby resulting in stagnation and decline of regions, industries and groups through a cumulative effect – hence economic duality may also be associated with structural change (Myrdal 1957). The great Caribbean economist, W. Arthur Lewis, proposes that the trick is to absorb surplus labor from the subsistence sector (low productivity sector) into a modern sector (high productivity sector) by courting foreign capital (Lewis 1954). Then, there is the question of whether a balanced or an unbalanced growth framework is appropriate for sustaining favorable structural change given the inherent indivisibilities of investment processes, as well as the need for complementarities in demand (Rosenstein-Rodan 1976, Hirschman 1958, Nurkse 1953).

This paper explores structural change in two resource-rich economies on the northern South American mainland: Guyana and Suriname. These economies have never been manufacturing success stories and much of the manufacturing that existed in the 1960s and 1970s has declined significantly by 2021. In other words, these economies have undergone structural change, the ebbs and flows of industries and sectors, without industrialization – a theme that was observed elsewhere in the developing world (Carmignani and Mandeville 2014). Indeed, the services sector – comprising mainly non-tradable production activities – and natural resource sector have always been the largest in both countries.

The historical predominance of services and natural resource extraction raises the question of whether they reinforce each other to the detriment of agriculture and manufacturing. One channel through which the reinforcement effect works is the Dutch disease – a situation in which large export earnings from natural resources induce an appreciation of the real exchange rate (Corden and Neary 1982). The large inflows of foreign exchange increase government spending and boost the domestic demand for services, namely non-tradable services such as housing, land, banking and finance, retailing, among others. Alternatively, the service sector can stimulate favorable structural changes if it comprises mainly production activities such as telecommunications, transport, and overall intermediate business services that integrate with manufacturing in global value chains (Di Meglio and Gallego 2022, Kordalska and Olczyk 2021, Mishra et al. 2020, Qulton 2001).

Another channel of the Dutch disease is the factor movement effect, whereby labor is drawn away from the agricultural and manufacturing sectors towards the natural resource sector (van der Ploeg 2011). Indeed, there is evidence of de-manufacturing in the cross-country analysis presented by Auty and Kiiski (2004). More specifically, as one study on Guyana indicates, there is descriptive evidence supporting the idea of labor movement away from farming and agro-processing towards gold mining (Gavin and Laing 2017). Moreover, the banking industry appears eager to finance the gold mining sector, housing construction, retailing and wholesaling, and consumption of imported durable consumer goods when there is a gold boom (Ibid.). Hence, there is a reinforcement and self-propagation of the non-tradable service sector.

Circumventing the adverse effects of resource dominance – such as drawing labor away from manufacturing and agro-processing into the extractive industries – often involves the intervention of a capable government, as, for example, highlighted by the Norwegian government's intervention in creating a centralized and coordinated wage formation system (Dyrstad 2017). In addition, a high degree of state capacity (good governance) is very important when it comes to transforming a subsoil asset (or subsea in the case of offshore oil and gas) into surface assets such as human and physical capital (Venables 2016). More generally, the adverse economic effects often associated with resource dominance are more pronounced when there are limited checks and balances on political decision making (Brückner 2010). Specifically, the process of structural change is accompanied by ethno-political contests that often undermine the developmentalist role of the government, thereby helping to entrench the status quo (Constantine and Khemraj 2019, Constantine 2017). Moreover, the cases of Guyana and Suriname show that ethnic electoral competition that produces demands on government resources from ethnic constituencies can also undermine the developmentalist capacity of the civil service, among other adverse effects (Khemraj 2021a, Edwards 2020, Hout 2008)[1]. To the extent that the government – which is perhaps the largest component of non-tradable services in both economies – fails in its developmentalist role, we expect to observe a negative relationship between the service sector and manufacturing or agriculture[2].

The degree of diversification of countries is further enforced by the products they produce. The products themselves embody the technology and capabilities of the society. One approach to measuring this capability is done by using the product space, which is defined as the probability that any two global products are exported by the same country (Hidalgo and Hausmann 2009, Hidalgo et al. 2007)[3]. The probabilities are mapped into a product forest that shows networks and linkages in the production structure of the economy, with economies producing products at the center of the 'forest' being more diversified and owning greater technological capabilities. Petroleum, fishing, animal agriculture and other basic agriculture are on the outer edges of the product forest, thereby illustrating fewer diversification possibilities and technological complexity[4].

Why should we be interested in two small, very open economies in South America but are usually not known by many to be there? The answer is that they will be an important source of fossil fuel for the foreseeable future as the US oil majors shift production closer to home by focusing on the Americas (Paraskova 2023). ExxonMobil and its partners have made spectacular offshore discoveries in the Guyana waters that offer light sweet crude at a low average cost of production (Smith 2022a, Smith 2022b). The first barrel of oil was exported from Guyana in December 2019. Oil production is anticipated to reach nearly 1.2 million barrels per day by 2027 and exceed that of Norway and the United States by 2035 (Smith 2022a, Blackmon 2022). The discoveries by TotalEnergies and Apache in the Suriname waters have been less spectacular and the unit production cost is expected to be higher (Smith 2023). Nevertheless, Suriname could produce about 650,000 barrels per day by 2032 (Smith 2022b), in addition to the small amounts it has been producing since the mid-1980s.

These stunning projections are made on top of the fact that both economies already have a large natural resource sector extracting primarily gold and bauxite for several decades, as well as relatively smaller amounts of diamonds. Therefore, we argue historical structural change is a good starting point for guidance into future changes. The paper not only conducts a brief review

[1] Several scholars of development studies have outlined the characteristics of a developmentalal, predatory or intermediate state.

[2] Unfortunately, the dataset that we use does not allow for disentangling government services from other services.

[3] However, an ideal location on the product forest does not emerge exogenously like manna from heaven. The location on the forest is endogenous to history, geography, smart market-based institutions, the right political institutions to manage ethnic and other forms of conflict, effective government interventions, and political consensus.

[4] Prognosticating on Guyana's fortunes as an oil-based economy, Mandle (2016) uses the insights from the product-space approach of Hidalgo and his associates to explain the limited diversification of the economy of Trinidad and Tobago (TT), even as that country has over 100 years of experience in oil and gas production. It should be noted that TT, Guyana and Surname are members of the Caribbean Single Market and Economy (CARICOM).

of the history of structural change in Section 2, but also performs an econometric analysis of sectoral interconnectedness (Sections 4 and 5). Perhaps it is ideal to use input-out tables when measuring linkages and interconnectedness among firms and sectors. However, firm-level data over a long enough time series are impossible to obtain; therefore, we conduct a sector-level analysis using a structural VAR and long-run identification of the sector productivity shocks (Section 3 theoretically motivates the shocks in the context of a structural VAR). Our method follows a similar approach of Khemraj et al. (2013), but introduces a new resource-dominant and secondary service-dominant empirical identification strategy. The empirical results are explained in detail in Section 5, while Section 6 concludes with a summary of the findings and policy implications.

2. Structural Change: A Brief History

Both countries can trace their colonial origins to Dutch and British plantation agriculture and settlements (Hoefte 2014, Clementi 1937). The territories that make up contemporary Guyana and Suriname were settled by Dutch pioneers and British colonists out from Barbados since the early 1700s. Following the Anglo-Dutch wars, the Treaty of 1814 between the Netherlands and England would cement colonial ownership: the three former Dutch colonies of Demerara, Essequibo and Berbice remained under British rule and would eventually be merged into British Guiana (BG), while Suriname was returned to the Dutch. Guyana, formerly BG, became independent in 1966 and Suriname gained the same status in 1975.

Plantation agriculture required draining low-lying coastal swamp lands with a polder technology imported from the Netherlands. The first step required reclaiming swamp lands (empoldering) from the 1720s and establishing a grid system of canals, dams and sluice gates (kokers). Each plantation was essentially protected by dams that not only kept the sea water out, but also the vast amounts of sweet water coming from the Amazonian hinterland savannas. Sluice gates in the front dams would release excess water through gravity drainage into the sea or the main rivers, while gates punctuating the back dams would let in fresh water from the savannas when needed. There were also side dams that protected one person's plantation from flooding in another person's plantation.

Reclamation was only the first step of an extremely labor-intensive process that required slave and indentured laborers to dig the canals and fortify the dams. The 'trenches, canals and embankments demanded an unending labor of maintenance. Otherwise, weeds quickly impede proper irrigation and drainage, and the dams collapsed' (Adamson 1972, p. 168). Sugar plantations, generally, required a more complex drainage system than that of cotton and coffee plantations. The drainage requirements, furthermore, increased the relative mortality and work burden of enslaved people on sugar plantations (Oostindie and Van Stipriaan 1995).

Another recurring problem, as documented by Adamson (1972), was the formation of mud banks from alluvial mud and floating vegetation. These mud banks, ranging from one to two miles wide, obstructed the gravity draining technology from discharging excess water from the gates in the front dams. Moreover, a plantation could still experience flooding when the high tide coincides with heavy rainfall, preventing the opening of front-dam sluice gates. By the

1840s, a few plantations would utilize steam pumps as a complement to the gravity drainage method, but these were said to be very expensive and added significantly to the unit cost of production of sugar (Ibid., p. 169).

The high cost of production of plantation agriculture and the unfavorable and often volatile international commodity prices of the nineteenth century induced wage suppression and extreme work requirements (often with less pay), particularly from the 1850s. The long-term wage stagnation moved economic historian, Mandle (1973), to label nineteenth-century Guyana as one of a self-reinforcing cycle of nondevelopment. Furthermore, the mechanization of field operations is difficult because the often-soggy soil and field layout result in a low elasticity of technical substitution between labor and machines (Moohr 1972). The idea that the coastal polder system (and general coastal ecology) can produce adverse path dependence that continues to shape contemporary settlements and structural change has not gone unnoticed (Khemraj 2015).

While the high cost imposed by the geographical conditions served to make large-scale plantation agriculture, let alone a peasantry dominated by small farmers, less competitive in the international markets (Williams 1945, Khemraj 2015), a few interesting 'natural experiments' occurred relating to peasant agriculture that served mainly the small and dispersed domestic markets in both economies. A successful Maroon peasant transition was made in the Para and Coronie districts of Suriname, where more enabling ecological circumstances facilitated a better outcome than regions that lacked the centralized mechanism for maintaining a costly drainage system (Oostindie and Van Stipriaan 1995). After successfully purchasing previous cotton plantations by pooling their savings, Africans created a peasantry in British Guiana after 1838. The drainage problem and cost of road construction in a canal-segmented grid system will prove decisive in restricting the small-scale farming of the previously enslaved people in British Guiana (Clementi 1937, pp. 281-283; Farley 1954).

It took amalgamation into large-scale agriculture to remain in international business in British Guiana, as in the case of the sugar industry that led economic activities for much of the twentieth century. In twentieth century Suriname, however, there was a greater preference for small-scale farming. The latter succeeded through government intervention in solving the drainage problem (Hoefte 2014). Meanwhile, in twentieth century Guyana, the amalgamated sugar industry was crucial in providing drainage with favorable spillover effects to various small-scale farmers and neighboring villages.

In order to appreciate the flood intensity and likelihood, consider the average precipitation levels in Guyana and Suriname, as well as the Netherlands' from which the polder technology was initially copied but was expanded by the British. Consider, also, that around 88 % of the population in both countries lives on the coastal plain close to the main cities. These regions are below or just above the sea level at high tide. From 1901 to 2021, the average annual rainfall in Guyana was 2, 421 cm with a standard deviation of 303.3 cm (The World Bank 2022a). For the same period, Suriname received an average annual rainfall of 2, 358 cm with a standard deviation of 289.3 (Ibid.). The Netherlands received an average yearly precipitation of 770 cm from 1901 to 2021 with a standard deviation of 103.8 (Ibid.). The high annual rainfall in

Guyana and Surname occurs under tropical conditions in which vegetation grows all year, unlike the temperate climate of the Netherlands.

The production structure of both countries for the period 1960 to 2021 is outlined in Table 1, which presents decennial averages for the four sectors defined by the World Bank (The World Bank 2022b). There are a few notable similarities and differences in the sectoral trends between the two case studies. The service sector accounts for the highest percentage of GDP for both countries since 1960, except for the decade 1960 to 1969, when the average was just slightly eclipsed by industry and construction in Suriname, given the booming bauxite industry.

The service sector in both countries is largely made up of non-tradable production activities such as retailing and wholesaling, transportation, storage, banking and other financial services, real estate, public administration and defence, telecommunication, among others. A few researchers have underscored the importance of considering the complexity and tradability of services when considering the export performance of an economy (Mishra et al. 2020). Historically, non-tradable public administration that comprises various services of the central government has been a sizable source of employment in both societies. In the case of Suriname, government employment is viewed as a form of consensus building among electoral coalition factions after elections, albeit producing inefficiency in the civil service (Nozaki et al. 2009, Khadan 2018). Guyana's two main political parties have also relied on the government sector for providing employment for supporters, but with much more contestation than consensus (Khemraj 2021b, Brown 1999).

Table 1 Production structure: decennial averages (percentages), 1960 to 2021

	Sectors, % of GDP	1960 - 69	1970 - 79	1980 - 89	1990 - 99	2000 - 09	2010 - 21
Guyana	Agriculture, Forestry & Fishing	21.2	20.5	22.9	38.1	30.8	22.2
	Manufacturing	10.9	11.3	11.7	3.4	4.4	5.2
	Industry and Construction	31.4	31.9	24.3	20.8	20.7	29.4
	Services	36.5	36.3	41.1	37.7	44.1	43.2
Suriname	Agriculture, Forestry & Fishing	8.5	6.7	8.5	12.1	8.1	9.4
	Manufacturing	12.0	13.6	5.4	11.8	10.5	5.7
	Industry and Construction	40.5	38.9	27.8	22.8	31.8	33.7
	Services	39.0	40.8	58.3	53.3	49.6	51.2

Source: authors' calculation using World Development Indicators.

Table 1 indicates that industry and construction (hereafter industry) accounts for a high percentage of GDP in both Guyana and Suriname, thus cementing the commodity-based production structure. It should be noted that according to the World Bank's definition, industry involves natural resource mining and processing, as well as construction, electricity, water and gas. Industry, in the 1960s, accounted for a higher share of GDP in Suriname (40.5 %), although the share in Guyana was also high amounting to 31.4 %. The industry sector declined in relative share until the decade of 1990 to 1999. The reason for this has to do with the unwinding of bauxite and alumina production in Suriname and the plateauing of bauxite operations in Guyana.

Suriname experienced an earlier recovery because of the emergence of crude oil and small-scale oil refining from the mid-1990s, as well as the significant increase in gold production from the early 2000s (Fraser et al. 2020). The recovery of the extractive sector in Guyana was delayed because of the plateauing of large-scale gold production in the mid-1990s and its subsequent decline (Laing 2019). However, there was a significant increase in small-scale and medium-scaler gold production from around 2004 to the present. However, the expansion of small-scale mining often comes with a backdrop of serious ecological constraints and harsh tenant-landlord relations (Hook 2019).

Clouded by the long-term trends of Table 1 is an important qualitative difference between bauxite production in Guyana versus Suriname. Bauxite production in Guyana remains less processed and instead focuses on exporting the basic raw material. The growth of the alumina plant stagnated on account of two unfavorable geographical features: the shallowness of the river channel – which has to be dredged regularly – greatly restricts the load capacity of ships and the high levels of overburden to ore (ratios above 4:1), which must be removed to access ore deposits (Thomas 2016).

From 1917, bauxite production thrived in Suriname, becoming the country's leading source of tax revenues. Alcoa, the main bauxite company in Suriname, engineered the Brokopondo push (1964 to1967) into hydroelectricity to fuel an alumina plant and aluminum smelter in Paranam (Hoefte 2014). The initial agreement of the early 1960s allowed Alcoa to own the Afobaka dam as long as it carried out aluminum production in Suriname. However, with the closure of Alcoa's operations in 2015, the government assumed ownership of the dam (MacDonald 2021).

The industrial sector recovered strongly in both countries in the first two decades of the twenty-first century. In the case of Suriname, gold and oil production replaced bauxite and alumina as the main export earners and industrial activities. The state-owned Suriname oil company, Staatsolie, is not only involved in oil exploration and crude production, but also oil refining at a daily capacity of approximately 15,000 barrels per day. Before the Covid-19 pandemic, the annual average economic growth rate of 3.4% (2001 to 2019) exceeded that of many Caribbean small states (MacDonald 2021).

The recovery of the industrial sector in Guyana from 2003 is associated with the increased production and export of gold, as well as efforts to increase electricity production, and water and sewage capacity. For example, gold production in 2021 amounted to 274,000 ounces compared with 182,000 ounces in 2006 (BoG 2021). In constant Guyana dollars, electricity output rose from G$3,905 million in 2012 to G$5,580 in 2021, while water and sewage increased from G$2,556 million to G$3, 269 for the same period (Ibid.). However, perhaps the most significant structural change in the post-independence era would occur in December 2019 when ExxonMobil pumped the first barrel of oil. The oil sub-sector has already registered its presence by enabling the industrial sector to become the largest share of GDP in 2020. Industry now accounts for 50.1% of GDP in 2021, significantly higher than the 2010 to 2021 average of 29.4% reported in Table 1.

The agricultural, forestry and fishing sector (hereafter agriculture) presents an important quantitative difference between the two countries. As shown by Table 1, the Guyanese agricultural sector has been consistently more than twice the size of that in Suriname, measured as a percentage of GDP. One possible explanation for this difference is the scale of agricultural enterprises over the twentieth century. The amalgamation of various small sugar estates was more or less completed by 1920 in Guyana. The merging of various sugar enterprises into one large-scale operator achieved managerial and field economies of scale. It also helped to partially solve the public good problem of drainage in the polder system. The rice sub-sector also witnessed the emergence of a few large-scale farmers and millers by the 1940s on account of favorable international demand and the colonial government's marketing associated with the war effort (Potter 1998), thus emphasizing the importance of foreign demand and trade.

It should be noted that peasant agriculture is still prevalent in Guyana, but the large-scale sugar industry and large private family rice mills and farms were more a feature of Guyana compared with Suriname. Indeed, various efforts by the colonial government to promote large-scale sugar and rice production in Suriname failed, as Surinamese, overall, took to peasant agriculture for various reasons (Hoefte 2014). One factor was the preference of Maroons for peasant crops of ground provision and small animal flocks in the Para and Coronie regions (Ibid, p. 37). In addition, younger people – namely Indian and Javanese farmers – preferred small-scale farming in the government-built rice polders of Nickerie in order to supply mainly the domestic market (Ibid., p. 39).

Although slightly higher in Suriname, the manufacturing sector accounted for a relatively small share of GDP. This sector produces small amounts of pharmaceuticals, as well as beverages, building materials, agro-processed goods, garments and shoes, home appliances, cement, among others. Two major limiting factors in both countries pertain to the size of the domestic market and the difficulty of transporting finished products to international markets. The steep decline of manufacturing in Guyana from the 1990s reflects the liberalization of the trade regime (1986 to 1992) that allowed for imports of much cheaper goods, namely from Asia. Also, the currency devaluations of the late 1980s and early 1990s made it very expensive for manufacturers to import critical machines and inputs. Meanwhile, in Suriname the steep decline of the manufacturing share of GDP from the 1980s to 5.4% likely reflects the severe political instability of the decade: military coups in 1980 and 1990, an authoritarian government and the interior war that lasted from 1986 to 1992.

The developmental outcomes of these structural changes are presented in Table 2. Pre-independent Suriname grew at a rapid average growth rate of 8.47% over the decade 1960 to 1969. The Brokopondo push, which opened up hydroelectricity that fueled higher value processing of bauxite, and relative political stability accounted for much of the pre-independent success. Meanwhile, Guyana, which received its independence in 1966, registered a slower average rate of 3.66%. The decade was one of serious ethnic riots and political instability (1962 to 1964) in Guyana. The higher growth rate in Suriname gave that country an early lead in per capita income of US$4,652 compared with Guyana's average of US$2,742.

Both countries were adversely affected by the global oil shocks of the 1970s. However, the decade was a period of widespread nationalization of almost all the main private companies in Guyana, particularly foreign ones. This resulted in an exodus of management talents and displacement of foreign marketing links, resulting in tremendous pressure on the small class of existing local managers (Blackman 2006). The period was also one of growing political discontents.

Despite growing political uncertainties in Suriname, also stemming largely from ethnic disagreements regarding the desire for independence, the country received a 'golden handshake' at independence in 1975, thus helping to blunt some of the political consequences – particularly the outward migration of many who did not support independence. The golden handshake involved the most generous post-independence economic package from the Netherlands, amounting to the highest per capita development aid from a former colonial master to a former colony (Mhango 1991).

Table 2 Selected development indicators

	Development indicators	1960 - 69	1970 - 79	1980 - 89	1990 - 99	2000 - 09	2010 - 21
Guyana	GDP growth: %	3.66	1.67	-2.80	4.79	1.88	8.44
	GDP per capita (constant 2015 US$)	2742	3243	2734	3214	4087	7392
	HDI*	-	-	-	-	0.722	0.682
Suriname	GDP growth: %	8.47	3.24	-0.31	0.29	4.64	-2.67
	GDP per capita (constant 2015 US$)	4652	6359	6902	6273	7173	8597
	HDI*	-	-	-	-	0.769	0.738

Source: authors' calculation using World Development Indicators.

**Note*: GDP growth and per capita are period averages; HDI indicates single year measure for 2007 and 2019 (UNDP 2009, 2020).

In general, the ethno-political conflict in Suriname has been less intense than in Guyana (Singh 2008). Hindustanis (Indians) largely opposed independence while Creoles largely took the other side of the issue, and some radical Hindustanis even called for partition (Hoefte 2014, pp. 135 – 136). However, despite heated disagreements between the Creole and Hindustani leaders, they found a way to collaborate after independence (Ibid.) This collaboration involves haggling over the sharing of resources in a more private enterprise-driven economy after free and fair elections (Singh 2008). The latter form of consensus building has not evolved in Guyana, as the contestation over the outcome of the 2020 general election revealed (Edwards 2020). We are not aware of a quantitative analysis of the effect of political conflict on growth in Suriname; however, Pasha (2020) quantifies the adverse effect on Guyanese economic growth using an econometric model.

Guyanese political and economic crises deepened in the 1980s, causing a contraction of economic growth and a steep decline of per capita GDP, as well as significant migration of professionals and business owners. The period also witnessed severe political crises over the eastern border in Suriname culminating in a military coup in 1980 and a long interior war between Maroons and the military. The Netherlands also suspended the generous development aid after the 1980 military coup.

Guyana's economic growth recovered in the 1990s under the sponsorship of policies advocated by the IMF and World Bank. On the other hand, Suriname's economic troubles commenced as the bauxite industry entered its twilight years, partly accelerated by heightened political risks owing to the interior war that lasted until 1992. The resumption of Dutch development aid following the reintroduction of democracy in 1991 helped to offset the adverse effect of the declining bauxite sub-sector. Free and fair elections were reintroduced in Guyana in 1992, but political instability and an extreme crime wave – some politically inspired – after the 1997 general election would curtail economic growth for much of the decade from 2000 to 2009.

Guyana, by the 2010s, had caught up with Suriname in terms of economic growth and per capita GDP that exceeded that of Suriname for the first time in 2020. In 2021, Guyana's per capita GDP was US$10,857 while Suriname's was US$7,008 (The World Bank 2022b). Guyana's relative growth success is explained by the impressive offshore oil discovery in 2015, immediately after which foreign investments poured into the country in anticipation of the first barrel of oil in 2019. However, it should be noted that Suriname was hit very hard by the Covid-19 pandemic, contracting by 15.9% in 2020 and 3.5% in 2021. In contrast, the oil discoveries and quick production helped Guyana to spectacular economic growth rates of 43.5% in 2020 and 19.9% in 2021 (Ibid.).

In 2007 both Suriname and Guyana were classified as medium human development, respectively, scoring 0.769 (rank = 97) and 0.722 (rank = 114) (UNDP 2009). Suriname moved up to the category of high human development in 2019, scoring 0.738 and placing once again at a rank of 97. Guyana was again classified as medium human development by 2019, recording 0.682 and falling to a rank of 122 (UNDP 2020).

The two large exogenous shocks – the Covid-19 pandemic and the discovery of vast amounts of offshore oil in Guyana – are already rearranging the relative rankings of the two economies (UNDP 2022). Suriname lost seven places in the HDI ranking of 2021 by scoring 0.730 (rank = 99). However, Suriname is still categorized as high human development. Guyana moved up twelve places (rank = 108) given the 2021 index of 0.714, gaining the classification as high human development.

3. Sectoral Productivity Shocks

Consider the following VAR representation of the sectoral relations, where v_t^n = industry (natural resource sector), v_t^s = services sector, v_t^m = manufacturing, v_t^a = and agriculture; and all variables are expressed as growth rates. For tractability, assume that a single lag is enough to capture the sectoral growth dynamics of the system as given by equation 1.

$$BY_t = \Gamma_0 + \Gamma_1 Y_{t-1} + \Gamma_2 X_t + \varepsilon_t \quad (1)$$

Where: $Y_t = \begin{pmatrix} v_t^n \\ v_t^s \\ v_t^m \\ v_t^a \end{pmatrix}$, $Y_{t-1} = \begin{pmatrix} v_{t-1}^n \\ v_{t-1}^s \\ v_{t-1}^m \\ v_{t-1}^a \end{pmatrix}$, $B = \begin{pmatrix} 1 & -b_{12} & -b_{13} & -b_{14} \\ -b_{21} & 1 & -b_{23} & -b_{24} \\ -b_{31} & -b_{32} & 1 & -b_{34} \\ -b_{41} & -b_{42} & -b_{43} & 1 \end{pmatrix}$, $\Gamma_0 = \begin{pmatrix} b_{10} \\ b_{20} \\ b_{30} \\ b_{40} \end{pmatrix}$,

$\Gamma_1 = \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{pmatrix}$, $\varepsilon_t = \begin{pmatrix} \varepsilon_t^n \\ \varepsilon_t^s \\ \varepsilon_t^m \\ \varepsilon_t^a \end{pmatrix}$ and

X_t = exogenous variables controlling for global shocks and domestic political conflict while Γ_2 is a matrix of coefficients.

It follows from equation 1 that the growth dynamics of a single sector, say the industry sector, can be expressed as follows.

$$v_t^n - b_{12}v_t^s - b_{13}v_t^m - b_{14}v_t^a = b_{10} + \gamma_{11}v_{t-1}^n + \gamma_{12}v_{t-1}^s + \gamma_{13}v_{t-1}^m + \gamma_{14}v_{t-1}^a + \varepsilon_t^n \quad (2)$$

Rearranging produces equation 3.

$$v_t^n - b_{12}v_t^s - b_{13}v_t^m - b_{14}v_t^a - \gamma_{11}v_{t-1}^n - \gamma_{12}v_{t-1}^s - \gamma_{13}v_{t-1}^m - \gamma_{14}v_{t-1}^a = b_{10} + \varepsilon_t^n \quad (3)$$

Each sector employs labor and capital, also expressed as growth rates. The sectoral production functions (sectoral technologies) are given by 4, while 5 gives the one-period lagged technology as given by previous-period employment of labor and capital, thereby exhibiting the flexibility of technology from one period to the next.

$$v_t^j = f_j(l_t^j, k_t^j) \quad (4)$$

$$v_{t-1}^j = f_j(l_{t-1}^j, k_{t-1}^j) \quad (5)$$

Where: $j = n, s, m, a$

Substituting these functions into equation 3 produces the following equation for the industry sector.

$$f_n(l_t^n, k_t^n) - b_{12}f_s(l_t^s, k_t^s) - b_{13}f_m(l_t^m, k_t^m) - b_{14}f_a(l_t^a, k_t^a) - \gamma_{11}f_n(l_{t-1}^n, k_{t-1}^n) - \gamma_{12}f_s(l_{t-1}^s, k_{t-1}^s) - \gamma_{13}f_m(l_{t-1}^m, k_{t-1}^m) - \gamma_{14}f_a(l_{t-1}^a, k_{t-1}^a) = b_{10} + \varepsilon_t^n \quad (6)$$

From the equation 6, b_{12}, b_{13} and b_{14} express the contemporaneous sectoral productivity parameters or weights. Similarly, γ_{11}, γ_{12}, γ_{13} and γ_{14} indicate the one-period lagged sectoral productivity parameters (productivity weights). These parameters, as well as others, have to be estimated using an empirical procedure, which is the subject of the next section. The basic intuition behind equation 6 is the relative sectoral productivity shock (current period) is identified as a residual that remains after we subtract the other contemporaneous and lagged technologies from the current technology of the natural resource sector.

Furthermore, assume that $E(\varepsilon_t^n)=0$ and $Var(\varepsilon_t^n)=\sigma_n^2$, we see that the relative sectoral productivity shock is given by ε_t^n, while the overall relative sectoral productivity is given by a constant plus the shock: $b_{10}+\varepsilon_t^n$. The term 'relative' is meant to emphasize the idea that the measured technology shock is relative to that of other sectors after subtracting the respective production functions and productivity weights – for both the current and one-period lag. As can be seen, the sector's own lagged production function [$f_n(l_{t-1}^n,k_{t-1}^n)$] and lagged productivity weight (γ_{11}) are also subtracted to come up with the sectoral productivity shock. The long-run measure of overall sectoral productivity could be positive, negative or zero.

Following the same logic, we can obtain the relative sectoral productivity shock for the service sector, the manufacturing sector and the agricultural sector. Equation 7 illustrates the growth dynamics of the service sector.

$$-b_{21}v_t^n+v_t^s-b_{23}v_t^m-b_{24}v_t^a=b_{20}+\gamma_{21}v_{t-1}^n+\gamma_{22}v_{t-1}^s+\gamma_{23}v_{t-1}^m+\gamma_{24}v_{t-1}^a+\varepsilon_t^s \tag{7}$$

Substituting the sectoral production technologies produce the following.

$$\begin{aligned}&-b_{21}f_n(l_t^n,k_t^n)+f_s(l_t^s,k_t^s)-b_{23}f_m(l_t^m,k_t^m)-b_{24}f_a(l_t^a,k_t^a)-\gamma_{21}f_n(l_{t-1}^n,k_{t-1}^n)-\gamma_{22}f_s(l_{t-1}^s,k_{t-1}^s)-\\&\gamma_{23}f_m(l_{t-1}^m,k_{t-1}^m)-\gamma_{24}f_a(l_{t-1}^a,k_{t-1}^a)=b_{20}+\varepsilon_t^s\end{aligned} \tag{8}$$

It is clear that the productivity shock of the service sector is given by ε_t^s, where $E(\varepsilon_t^s)=0$ and $Var(\varepsilon_t^s)=\sigma_n^2$; while the overall sectoral productivity is given as $E(b_{20}+\varepsilon_t^s)=b_{20}$.

The first-order equation of motion showing the growth dynamics of the manufacturing sector is given by 9. Substituting the manufacturing sectoral technologies gives equation 10.

$$-b_{31}v_t^n-b_{32}v_t^s+v_t^m-b_{34}v_t^a=b_{30}+\gamma_{31}v_{t-1}^n+\gamma_{32}v_{t-1}^s+\gamma_{33}v_{t-1}^m+\gamma_{34}v_{t-1}^a+\varepsilon_t^m \tag{9}$$

$$\begin{aligned}&-b_{31}f_n(l_t^n,k_t^n)-b_{32}f_s(l_t^s,k_t^s)+f_m(l_t^m,k_t^m)-b_{34}f_a(l_t^a,k_t^a)-\gamma_{31}f_n(l_{t-1}^n,k_{t-1}^n)-\gamma_{32}f_s(l_{t-1}^s,k_{t-1}^s)-\\&\gamma_{33}f_m(l_{t-1}^m,k_{t-1}^m)-\gamma_{34}f_a(l_{t-1}^a,k_{t-1}^a)=b_{30}+\varepsilon_t^m\end{aligned} \tag{10}$$

Note that $E(b_{30}+\varepsilon_t^m)=b_{30}$ and $Var(b_{30}+\varepsilon_t^n)=\sigma_m^2$. Therefore, the long-run sectoral productivity is b_{30}(a static measure). A shock will then produce dynamic adjustments around the static measure.

Finally, equation 11 presents the equation of motion for the agricultural sector's growth rate, while equation 12 shows the sectoral productivity as the residual that remains after accounting for the other sectoral technologies.

$$-b_{41}v_t^n - b_{42}v_t^s - b_{43}v_t^m + v_t^a = b_{40} + \gamma_{41}v_{t-1}^n + \gamma_{42}v_{t-1}^s + \gamma_{43}v_{t-1}^m + \gamma_{44}v_{t-1}^a + \varepsilon_t^a \quad (11)$$

$$-b_{41}f_n(l_t^n, k_t^n) - b_{42}f_s(l_t^s, k_t^s) - b_{43}f_m(l_t^m, k_t^m) + f_a(l_t^a, k_t^a) - \gamma_{41}f_n(l_{t-1}^n, k_{t-1}^n) - \gamma_{42}f_s(l_{t-1}^s, k_{t-1}^s) - \gamma_{43}f_m(l_{t-1}^m, k_{t-1}^m) - b_{44}f_a(l_{t-1}^a, k_{t-1}^a) = b_{40} + \varepsilon_t^a \quad (12)$$

Where, $E(b_{40} + \varepsilon_t^a) = b_{40}$ and $Var(b_{40} + \varepsilon_t^a) = \sigma_a^2$.

4. Resource-Dominant Empirical Strategy

In order to estimate the sectoral productivity shocks, we have to place restrictions on the system of equations outlined by equation 1. We articulate the resource-dominant identification strategy in order to restrict the system of equations. Consider the reduced form VAR given by equation 13.

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 X_t + e_t \quad (13)$$

Where: $A_0 = B^{-1}\Gamma_0$, $A_1 = B^{-1}\Gamma_1$, $A_2 = B^{-1}\Gamma_2$ and $e_t = B^{-1}\varepsilon_t$

X_t includes exogenous dummy variables for the Covid-19 pandemic, the oil price shocks of the 1970s and the Great Recession of 2008-09, as well as a political conflict dummy variable similar to that of Pasha (2020) for Guyana and other one accounting for the internal war and coup in Suriname were. It should be noted that these exogenous control variables had no major effect on the responses or dynamic adjustments of the sectors. Therefore, the final results are based on a model without the exogenous variables in order to maximize the degrees of freedom.

Wold representation theorem tells us that equation 13 can be re-expressed in vector moving average (VMA) form in equation 14 once the variables are stationary, which they are given that we are dealing with growth rates of the four sectors' level of value-added production.

$$\begin{pmatrix} v_t^n \\ v_t^s \\ v_t^m \\ v_t^a \end{pmatrix} = \begin{pmatrix} C_{11} & C_{12} & C_{13} & C_{14} \\ C_{21} & C_{22} & C_{23} & C_{24} \\ C_{31} & C_{32} & C_{33} & C_{34} \\ C_{41} & C_{42} & C_{43} & C_{44} \end{pmatrix} \begin{pmatrix} e_t^n \\ e_t^s \\ e_t^m \\ e_t^a \end{pmatrix} \quad (14)$$

Each C represents the accumulated effects of unit impulses in ε_t^j after T periods. The VMA allows us the recover the structural sectoral shocks by imposing restrictions that are institutionally and historically consistent, as given by equation 15. These structural shocks are our relative sectoral productivity shocks that were defined in the previous section.

The empirical identification strategy accounts for the stylized fact that both economies have an abundance of natural resources that form a sizable share of GDP. Moreover, the natural resource sector (industry) is a main source of foreign exchange for these two small open economies. The logic of the identification strategy implies that no other sector has a long-term effect on the natural resource sector, especially given that the sector imposes enclave-like features.

Once the positive resource shock is realized, various firms making up the services sector – dominated by non-tradable services – respond by providing the imported goods (consumption and intermediate goods) for the expanding sector; banks provide working capital to facilitate the expanding sector, as well as credit for construction and consumption, and so on. Therefore, the services sector is affected in the long run by its own shock and that of the industrial sector.

The expanding service and natural resource sectors can have a positive spillover effect on manufacturing. On the other hand, the effect on manufacturing could be negative if the sector loses labor to services and industry. Therefore, the manufacturing sector is affected in the long term by its own shock and that of the service and industry sectors.

Manufacturing is ordered ahead of agriculture indicating that the natural resource shock, services shock and the sector's own shock determine its evolution in the long run. Moreover, the idea that manufacturing shocks induce positive spillovers in agriculture, but not the other way around, is consistent with the notion of Kaldorian growth dynamics (Kaldor 1968). The basic idea is manufacturing engenders favorable spillovers by boosting labor productivity and faster absorption of labor from sectors of the economy characterized by subsistence production and diminishing returns.

Therefore, the six long-term restrictions are imposed on the VMA (equation 14). These are as follows:

$$\sum_{k=0}^{T} c_{12}(k)=0\,;\ \sum_{k=0}^{T} c_{13}(k)=0\,;\ \sum_{k=0}^{T} c_{14}(k)=0\,;\ \sum_{k=0}^{T} c_{23}(k)=0\,;\ \sum_{k=0}^{T} c_{24}(k)=0\,;\ \text{and}\ \sum_{k=0}^{T} c_{34}(k)=0\,.$$

Each restriction sets the accumulated effects to zero, implying that there is no long-run effect of a given sectoral shock on the specific sector. For example, as discussed earlier, the first restriction indicates that the industry sector is enclave in which its evolution is not affected by the other three sectors. The long-term evolution of the service sector is determined by its own shock and that of industry, and so on.

The long-run restriction technique was proposed by Blanchard-Quah (1989) in the context of an aggregate demand-aggregate supply business cycle model. Previously, Khemraj et al. (2013) implemented a short-term restriction on the contemporaneous coefficients for measuring sectoral spillovers and interactions in Guyana. They were interested in measuring sectoral production spillovers in Guyana, but did not position their study in the context of a resource-dominant identification strategy. Imposing the said restrictions produce the just-identified shocks in the system of equations (equation 15).

$$\begin{pmatrix} e_t^n \\ e_t^s \\ e_t^m \\ e_t^a \end{pmatrix} = \begin{pmatrix} C_{11} & 0 & 0 & 0 \\ C_{21} & C_{22} & 0 & 0 \\ C_{31} & C_{32} & C_{33} & 0 \\ C_{41} & C_{42} & C_{43} & C_{44} \end{pmatrix} \begin{pmatrix} \varepsilon_t^n \\ \varepsilon_t^s \\ \varepsilon_t^m \\ \varepsilon_t^a \end{pmatrix} \tag{15}$$

5. Empirical Results and Data Matters

Sourced from the World Development Indicators, the variables are measured in growth rates of four sectors: (i) agriculture, forestry and fishing (v^a), (ii) industry and construction (v^n), (iii) manufacturing (v^m), and (iv) services (v^s). Unit root tests indicate that the growth series are all stationary. Both the AIC and SIC indicate that a lag of one year is enough to capture the growth dynamics. Each VAR produces roots that fall within the unit circle.

The estimated VAR model (using annual data) produces impulse response functions (IRFs) that enables us to observe structural changes for Guyana from 1960 to 2021, as well as for Suriname over a shorter time period: 1975 to 2021[5]. The IRFs also enable us to measure dynamic intersectoral linkages. Moreover, IRFs are ideal given that structural change is a dynamic process, unlike input-output tables that provide static coefficient estimates of linkages. For example, we would like to observe how the growth rates in manufacturing and agriculture respond given a unit productivity shock in industry and services. Evidence consistent with a resource curse should indicate a decline in manufacturing given a positive shock to industry (*first-order* resource curse dynamics, FORD). Secondary evidence (*second-order* resource curse dynamics, SORD) would be a positive relationship between the industry shock and services and subsequently services being negatively related to manufacturing[6].

Corroborating information comes from the degree to which variation in growth rate in agriculture and manufacturing is explained by industry (the decomposition of variance). Once the IRF shows a positive response and dynamic adjustment (crowding-in effect), the variance decomposition would provide added evidence of the strength of the complementary relationship. The same idea holds when the IRF produces a negative relationship between two sectors and there is also a high variance decomposition (crowding-out effect). Moreover, evidence of limited intersectoral linkages would indicate a high degree of self-propagation if a shock to industry produces long memory (persistent growth in industry). Similarly, a service shock that self-propagates the services sector is also evidence of limited linkages. Finally, it is also interesting to observe the relationship between agriculture and manufacturing, as well as the effect of a service shock for these two sub-sectors.

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[5] The World Development Indicators (at the time we accessed it) did not have the sectoral growth rates going back to 1960. However, the database does have the sectoral shares, which were useful for computing the decennial averages of Table 1, going back to 1960. Note, also, that the WDI aggregates industry and construction.

[6] Ideally, we would have liked the relatively small tourism sector (tradable) to be disaggregated, but such a disaggregation is not available.

The first column of Figure 1 indicates the impact response and dynamic adjustment in each sub-sector following an industry shock. There is strong evidence in favor of the self-propagation thesis, whereby a 1% industry shock produces about a 22% impact effect in period t = 1, after which period the industry growth sustains itself for four years[7]. The impact effect of industry on services in period 1 is -1.2%, but it turns positive in period 2 (2%) and subsequently settling at a long-term growth rate of 0.2% for the rest of the forecast horizon and beyond. Hence, the sum of the accumulated positive growth is larger than the one-period negative response, thereby providing evidence in favor of the complementarity between industry and services.

The 1% industry shock elicits a strong positive response in manufacturing growth of 2%, falling to 0.3% in period 3 to period 5, and 0% for the rest of the forecast period. Therefore, industry has a long-term positive effect on manufacturing. Finally, the sector's impact effect on agriculture is a brisk 4% in the impact period (t = 1); however, the growth rate turns negative in period 2 (-1.2%) and from period 3 settling at an equilibrium of -0.3% for the rest of the forecast horizon. Nevertheless, the accumulated effect on agriculture is positive over the forecast period of seven years.

The second column shows that a 1% service shock engenders a negative impact effect on industry amounting to -3%, turning to positive 1% in period 3 and subsequently settling at 0% for the rest of the forecast horizon. The relatively small accumulated effect on the industry sector is anticipated given the small linkages between them and the enclave feature of bauxite and large-scale gold mining. The service shock produces strong short-term self-propagation with an impact effect of 6.2%. The self-propagation effect falls to 0.2% in the second forecast year and rises to 0.3% in year 3, subsequently petering out to 0% in period 6.

Of importance are the negative impact effects of the service shock on manufacturing and agriculture of -0.5% and -3.3%, respectively. In the case of manufacturing, the service sector has an overall positive, albeit small, growth effect if we sum the impact and accumulated effects. In the case of agriculture, the positive effect of 2.7% in period 2 and 0.3% in period 3 were not enough to overturn the negative impact effect and the accumulated negative effects of -0.3% from period 4 to the end of the forecast horizon. These effects indicate mixed evidence in favor of second-order resource curse dynamics.

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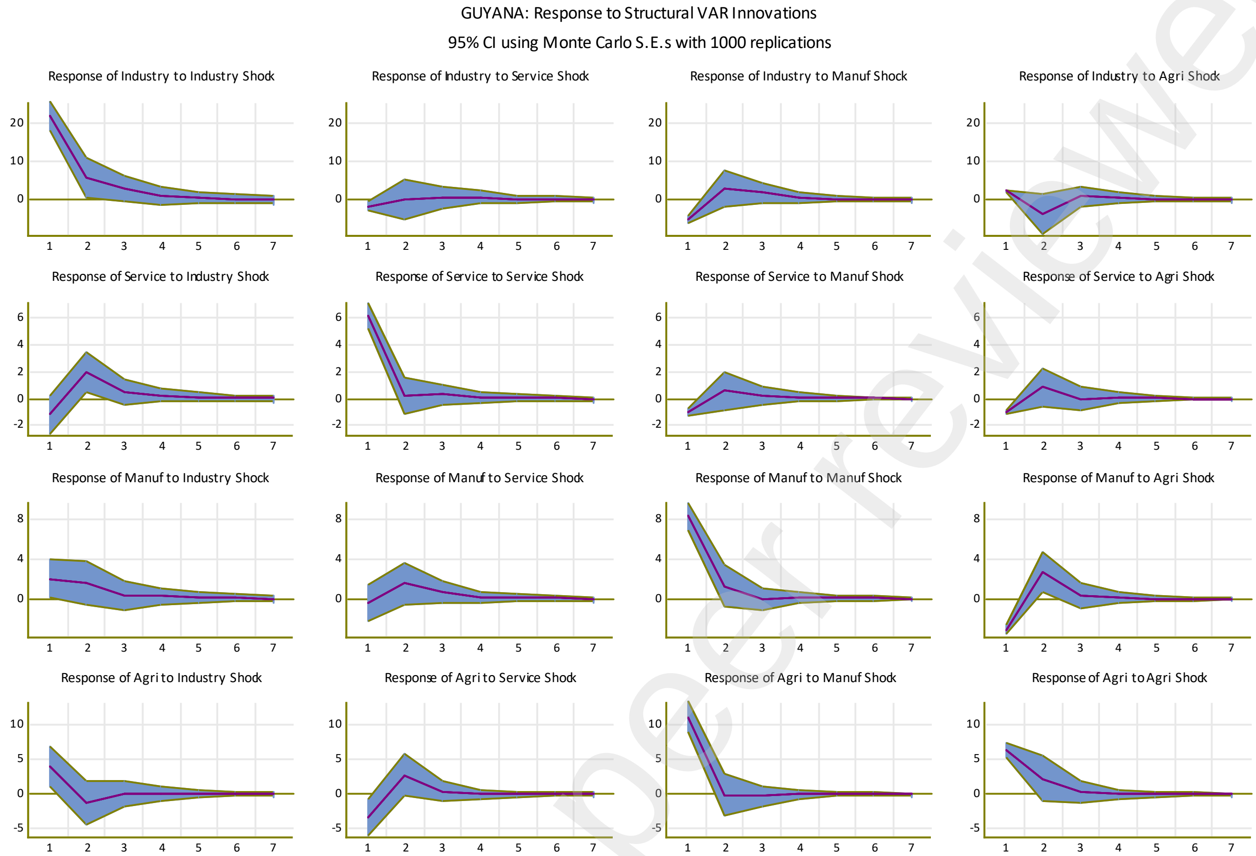
[7]As an aside, note that the software uses t = 1 for the impact period, which mathematically has to be t = 0 when calculating the impact response. This means for that t = 2 on chart is really t = 1, t = 3 on the chart is really t = 2 in the derivation under the hood, and so on. However, for the rest of the paper, we will use the forecast time periods illustrated by the charts.

Figure 1 Guyana: impulse response functions (vertical axes: percentages, horizontal axes: time periods in years)



The third column indicates the impact and dynamic adjustments of a manufacturing productivity shock. A 1% manufacturing shock engenders a very high positive impact effect on agriculture amounting to 11.1%. However, the effect turns to a small negative of -0.2% in period 2 until period 4, after which the agricultural growth rate converges to 0% by period 6, producing an overall positive dynamic effect. The manufacturing sector also elicits a healthy rate of self-propagation amounting to 8.1% impact effect, after which the dynamic adjustment falls to 0% in period 3, remaining there for the rest of the forecast horizon. However, its high positive spillover to agriculture indicates that manufacturing has a strong linkage elsewhere. Indeed, the agricultural response is largest with respect to manufacturing, even larger than the agriculture-on-agriculture self-propagation shock (column 4, row 4).

The fourth column shows the effects of a 1% agriculture shock, which exerts a large impact or self-propagating effect (5.4%). The dynamic adjustment is 2.2% in period 2 and 0.3% in period 3, after which the adjustment turns -0.3% from period 5 until the end of the forecast period. An interesting result is the negative impact effect (-3.2%) on manufacturing in period 1. The manufacturing growth rate, however, rises to 2.7% in period 2 and subsequently falls to 0.3% from period 3, 0.2% in period 4, and remaining at 0.1% for the rest of the forecast horizon, thereby suggesting a small overall long-term positive effect[8]. An important contrast must be

[8] Note, the growth effect does not reach equilibrium at 0% until period 14.

drawn between the latter result and previously discussed favorable effect of a 1% manufacturing shock on agriculture. In spite of its small share relative to GDP, the manufacturing sector produces much stronger favorable growth amplification compared with agriculture, a result that resembles the argument proposed by Kaldor (1968) and the empirical findings of more contemporary researchers (Gabriel and Ribeiro 2019).

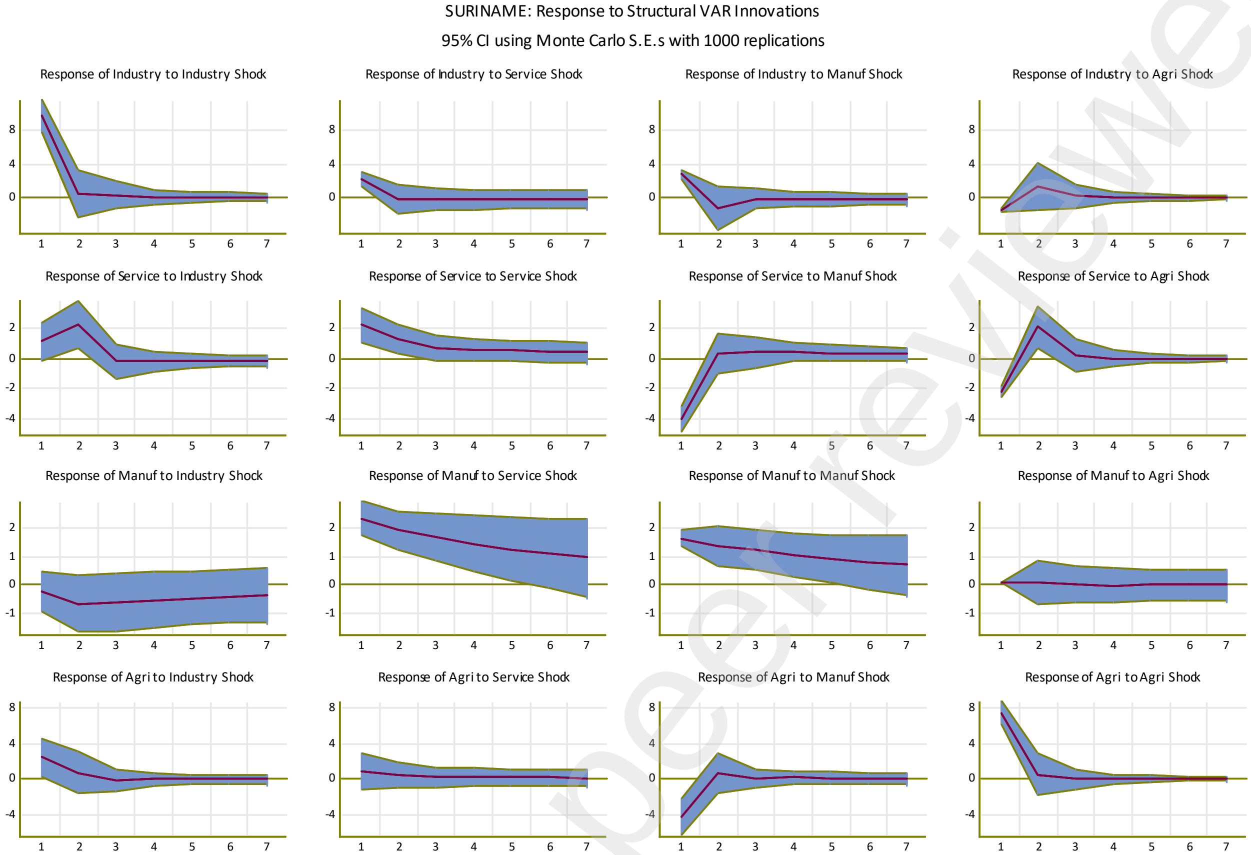
The empirical results for Suriname, shown by Figure 2, have some similarities and notable differences relative to the previous results. The first column indicates that industry shock produces a high degree of self-propagation, suggesting an enclave-like structure. The industry shock produces a strong response of 9.6%, subsequently falling to 0.3% in period 2 and 0.1% for the rest of the forecast horizon. The 1% industry shock produces an impact response of 1.1% and dynamic effect of 2.2% in period 2. The dynamic adjustment falls to -0.2% in periods from periods 3 to 6, returning to 0% in period 7. The latter evidence suggests a complementarity between industry and service, similar to the Guyanese result.

The first column shows that the 1% industry shock crowds out the manufacturing sector (-0.2 impact effect and a persistently negative adjustment over the forecast horizon). The latter result suggests that there is stronger evidence of first-order resource curse dynamics related to crowding out of manufacturing, unlike the outcome for Guyana. It also suggests that the focus on crude oil production and small-scale oil refining (starting from the mid-1990s) did not boost manufacturing growth. In addition, the relatively cheap hydroelectric power generated by the enclave bauxite industry played a limited role in facilitating Surinamese manufacturing.

Unlike the Guyanese results, the 1% service shock (second column of Figure 2) produces positive impact effects across all the sub-sectors, indicating that there is no evidence to support the second-order resource curse dynamics. However, industry crowds out manufacturing in Suriname, unlike Guyana.

Surprisingly, the manufacturing shock engenders a negative impact effect on Surinamese agriculture amounting to -4.2% (column 3, row 4). The subsequent dynamic adjustments in agriculture are not enough to offset the large negative impact response. As noted earlier, manufacturing has a much larger favorable effect on Guyanese agriculture. We believe this has to do with greater linkages between the two sub-sectors in Guyana that historically had a higher degree of large-sale farming and agro-processing. This finding is supported by the evidence in column 4 and row 3 of Figure 2, which shows that there is a flatline response of manufacturing given a shock to agriculture. In Suriname, moreover, agriculture has mainly a self-generating effect with an impact effect of 7.4% and small adjustment effects from period 3.

Figure 2 Suriname: impulse response functions (vertical axes: percentages, horizontal axes: time periods in years)



<u>Variance decomposition</u>

The decomposition of variance, Table 3, provides added information about the interconnectedness of the sectors. It is clear that industry's growth variation is explained mainly by its own shock (approximately 90% across the forecast horizon); hence, providing added evidence of self-propagation and limited linkages. There is also evidence of self-propagation in the Guyanese service sector. However, around 12% of variation (over the seven forecast periods) of the service sector's growth is explained by the service sub-sector, providing additional evidence of the complementarity between industry and service.

The decomposition of agricultural growth rate is quite interesting in the case of Guyana. In spite of manufacturing being a relatively small share of GDP in Guyana, it has an outsized effect on agricultural growth rate; hence, corroborating previous findings. Over 60% of the variation in agricultural growth is explained by manufacturing growth. Only about 22% of agricultural growth is explain by its own growth. The services sector contributes approximately 8% of agricultural growth. The strong complementary relationship between agriculture and manufacturing in Guyana is a fortuitous historical position that we hope an oil-dominant economy will not disrupt. We believe this favorable outcome has to do with the history of large-scale agriculture that is linked to agro-processing.

Table 3 Guyana: Variance decomposition using Structural VAR

GUYANA: Structural VAR

Variance Decomposition of Industry:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	92.89	0.56	5.62	0.93
2	89.78	0.51	6.47	3.25
3	89.27	0.56	6.87	3.30
4	89.17	0.63	6.89	3.32
5	89.15	0.64	6.89	3.32
6	89.15	0.64	6.89	3.32
7	89.15	0.64	6.89	3.32

Variance Decomposition of Service:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	3.33	91.61	2.54	2.51
2	11.61	81.58	2.99	3.82
3	12.04	81.09	3.08	3.79
4	12.17	80.92	3.11	3.80
5	12.19	80.90	3.11	3.80
6	12.19	80.90	3.11	3.80
7	12.19	80.90	3.11	3.80

Variance Decomposition of Manufacturing:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	4.81	0.27	82.81	12.11
2	6.51	2.57	72.79	18.13
3	6.57	3.07	72.25	18.10
4	6.64	3.08	72.19	18.09
5	6.65	3.08	72.18	18.09
6	6.65	3.08	72.18	18.09
7	6.65	3.08	72.18	18.09

Variance Decomposition of Agriculture:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	8.42	5.58	64.86	21.13
2	8.58	8.86	60.45	22.10
3	8.57	8.90	60.42	22.11
4	8.57	8.90	60.41	22.11
5	8.57	8.90	60.41	22.11
6	8.57	8.90	60.41	22.11
7	8.57	8.90	60.41	22.11

Source: authors' calculation.

Manufacturing growth in Guyana is mainly explained by its own productivity, around 72% across the forecast periods. However, a substantial amount of variation in manufacturing growth (approximately 18%) is explained by agricultural productivity. As noted earlier by the IRF, there is a long-term positive effect of agriculture shock on manufacturing, albeit much smaller than the converse relationship. The results, therefore, further indicate a strong complementarity between agriculture and manufacturing, which might be worth nurturing as Guyana enters an oil-dominant economy.

Table 4 indicates the decomposition of variance for sectoral growth rates for Suriname. Overall, it is clear that industry shock explains approximately 75% of its own growth variation, indicating a high degree of enclave-ness but not as high as Guyana's. Manufacturing accounts for about 12% of industry's growth variation. We have to look at the impulse IRF to observe whether there is a crowding-in or crowding-out effect of manufacturing on industry (Figure 2, column 3 & row 1). Manufacturing exerts a positive impact effect of 2.7%, subsequently falling to 1.3% in period 2 and -0.1% up to period 6. The latter indicates that manufacturing has a small accumulated positive effect on industry, possibly indicating the connection between small-scale oil processing and extraction. In the case of Guyana, the manufacturing sector crowds out the industry sector.

Interestingly, the service sector has a much smaller self-propagation effect in Suriname relative to Guyana's. The manufacturing sector accounts for the largest variation in service growth averaging about 42% across the forecast period. The IRF in Figure 2 shows that a manufacturing shock produces 4% decrease in service growth. To the extent that services are non-tradable, this is potentially a good position for Suriname. The results could be interpreted in the context of recent empirical literature focusing on the role of tradable services in boosting other sectors, particularly manufacturing (Kordalska and Olczyk 2021, Di Meglio and Gallego 2022).

The services sector plays a much greater facilitative role of manufacturing in Suriname compared with Guyana's service sector; hence ruling out second-order resource curse dynamics. On average around 63% of variation in manufacturing growth is explained by service sector productivity shocks, whereas in Guyana this was just around 3%. This is a possibly favorable outcome on which Suriname can build as it also considers booting oil production. However, the services sector contributes a tiny variation of agricultural growth in Suriname.

Confirming earlier results, the variation of agricultural growth is explained mainly by its own shocks, about 68%. The manufacturing sector accounts for a noticeable share of variation in long-term agricultural growth (average of 22%) over the forecast period. However, the latter result is inconsistent with that given by the IRF showing a flatline of agriculture given a shock to manufacturing. The industry sector accounts for approximately 8% of variation in agriculture, which IRF indicates is a complementary relationship.

Table 4 Suriname: Variance decomposition using Structural VAR

SURINAME: Structural VAR

Variance Decomposition of Industry:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	78.18	7.16	12.19	2.47
2	75.84	7.00	12.38	4.78
3	75.79	7.08	12.37	4.77
4	75.70	7.15	12.38	4.76
5	75.63	7.21	12.40	4.76
6	75.58	7.25	12.42	4.75
7	75.53	7.28	12.44	4.75

Variance Decomposition of Service:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	4.78	17.64	59.73	17.85
2	16.53	17.00	42.69	23.78
3	16.35	17.85	42.35	23.46
4	16.22	18.45	42.22	23.12
5	16.14	18.89	42.10	22.87
6	16.07	19.22	42.02	22.69
7	16.03	19.46	41.96	22.55

Variance Decomposition of Manufacturing:

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	0.74	66.75	32.47	0.05
2	3.48	64.88	31.59	0.06
3	4.54	63.73	31.68	0.04
4	5.11	63.16	31.70	0.04
5	5.42	62.83	31.71	0.03
6	5.62	62.63	31.72	0.03
7	5.75	62.49	31.73	0.03

Variance Decomposition of Agriculture

Period	Industry shock (%)	Service shock (%)	Manuf. Shock (%)	Agri. shock (%)
1	7.54	0.81	22.53	69.12
2	8.01	0.98	22.62	68.39
3	8.07	1.02	22.61	68.30
4	8.07	1.07	22.62	68.24
5	8.07	1.11	22.62	68.20
6	8.07	1.13	22.63	68.17
7	8.07	1.15	22.63	68.15

Source: authors' calculation.

6. Conclusion

This paper examined structural change in two economies with abundant natural resources. A brief review of the history of structural change in Guyana and Suriname uncovered important stylized facts that motivated the empirical identification strategy. Therefore, the notion of a resource-dominant identification strategy was proposed in order to estimate the sectoral factor productivity shocks. A sector's shock, empirically estimated by a structural VAR, stimulates an impact effect and a dynamic adjustment in its own evolution and that of all other sectors in the economy. We noted that this structural VAR approach allows us to measure complementarities (linkages and positive spillovers), self-propagation and crowding out among sectors in the absence of input-output tables.

The empirical results indicate that the extractive sector crowds out manufacturing in Suriname, but not in Guyana. The latter result, relating to Suriname, is consistent with what we defined as first-order resource curse dynamics (FORD). Although we do not observe FORD in Guyana, there is strong evidence of self-propagation in the extractive sector in both economies, implying that there are few forward linkages with other sectors (positive spillovers). The FORD and self-propagation have some important policy insights. Firstly, the resource sector is dominated by mainly enclave-like production, largely related to bauxite and gold mining operations. Secondly, the cheap hydroelectric power generated by the enclave bauxite industry likely played a limited role in facilitating Surinamese manufacturing. Looking into the future, Guyana appears to be on the right path in developing the gas-to-energy supply that will stimulate external economies of scale (in line with Hirshman's unbalanced growth), thus circumventing the formerly enclave energy supply associated with the Surinamese bauxite industry for a very long period of the twentieth century.

Thirdly, crude oil production and small-scale oil refining in Suriname, starting from the mid-1990s, did not boost manufacturing growth, providing yet another result that could be of interest to Guyanese policy makers as they consider the establishment of a private small-scale oil refinery. If anything, the deeper investments into oil refining – an industry with high import content and enclave features – might have accounted for the redirection of national savings away from traditional manufacturing, thereby accounting for the FORD in Suriname. Fourthly, the result questions whether small-scale gold mining operations owned by locals – promoted as a matter of policy in both countries from the mid-1980s – can engineer meaningful linkages that large-scale operations have failed to operationalize.

The results indicate that when manufacturing succeeds in Guyana, it is largely integrated into the agricultural sector, underscoring yet another policy insight. We find evidence, some quite strong, of positive spillovers from manufacturing to other sectors. This is most notable in the case of Guyana, where a 1% positive manufacturing shock induces a very strong positive response in agriculture. The same magnitude of the manufacturing shock elicits a positive, albeit smaller, accumulated effect on Suriname's agriculture. These results imply that Guyana has a distinctive historical advantage over its eastern neighbor in scaling up the processing of agricultural products. Large-scale farming, in which the sugar and rice industries historically played a central role, possibly established the conditions for the strong positive impact of manufacturing on agriculture (processing of sugarcane and rice paddy into higher valued products). As noted in the historical review, the sugar industry disappeared in Suriname decades earlier, and the greater emphasis was on peasant agriculture in the same type of polder ecological system.

The manufacturing shock exerts a strong negative response on services in the case of Suriname, as well as a negative but weaker effect on services in Guyana, implying that if manufacturing is crowding out non-tradable services, then that is a good position in which to be. However, policies would have to still ponder the complementarities between tradable services and manufacturing.

There is evidence of complementarity between industry and service sectors in both countries. In other words, an industry boom is followed by expansion of services, which we noted are largely non-tradable. Meanwhile, a positive service sector shock facilitates manufacturing and agriculture in both countries. Hence, we do not find evidence of second-order resource curse dynamics (SORD).

Still, the complementarity between industry and services in Guyana and Suriname is still reason to be cautious. A serious risk of the impressively large oil discoveries and quick scaling up of production in Guyana is the entrenchment of the non-tradable services – especially in the area of government employment, real estate, and finance for imported consumer durables and luxury items – at the expense of tradable investments. The slower pace of oil production in Suriname, partly because of the higher royalty and profit-sharing terms of that country's oil contract with the oil majors, presents a future 'natural experiment' for comparing two different approaches to natural resource exploitation.

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