A Distributional Analysis of Artisanal and Industrial Wage Levels and Expenditure in the Congolese Mining Sector

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Abstract: Across low–income African countries, a process of foreign–controlled mining (re)industrialisation has been underway since the 1980s, gathering pace during the most recent decade. This paper aims to shed light on the long–term effects of this process on the strength and vibrancy of local mining economies. It does so through the analysis of original empirical data collected during 15 months of fieldwork at and around an industrial gold mine in South Kivu Province of the Democratic Republic of the Congo, centred on how the entry of industrial mining into pre-existing artisanal mining economies has affected the total volume of mining wages earned, consumed and invested locally. It is demonstrated that, despite generating a 25–fold increase in productivity, mining reindustrialisation in South Kivu has not resulted in significant wage growth for most industrial workers, compared to the wages earned in artisanal mining. In addition, as a result of the displacement of artisanal mining to more marginal deposits (and the inability of new industrial jobs or wages to compensate), seven years on, the local availability of mining employment has halved and the volume of locally consumed and invested mining wages has decreased by around 40 per cent. Drawing on the findings, the wisdom of current World Bank and African government mining policy is questioned.

Introduction

Since the 1980s, the World Bank has loaned more than $1 billion to low–income country (LIC) governments across Africa to liberalise, privatise and deregulate the mining sector,[1] resulting in the en masse arrival of transnational corporations (TNCs) to lead a foreign–controlled, large–scale mining (LSM) economy across the continent. The scale of the trend has been such that 'for many low–income countries [today], particularly in sub–Saharan Africa, the mining sector represents one of the most crucial sources of investment and income in their economies' (Farole & Winkler, 2014, p. 117). To make way for the construction of new industrial mines, Africans working in artisanal and small–scale mining (ASM) – estimated to number around 10 million people across the continent (World Bank, 2019) –. have been forcibly displaced from major deposits. In August 2017, for example, Ugandan military and police displaced around 70,000 artisanal gold miners (Ssekika, 2017, November 3).

Building on insights from the African mining and Global Value Chain (GVC) literatures, and drawing on Arthur Lewis' theorisation on the relationship between productivity and wages in the global periphery, this paper aims to shed light on the long–term effects of TNC–led mining industrialisation on the strength and vibrancy of local economies in low–income African countries. It does so through the presentation and analysis of original empirical data collected at and around an industrial gold mine in South Kivu Province of the Democratic Republic of the Congo (DRC), on the relative wage volumes earned in ASM and LSM, and how TNC arrival has affected the total volume of mining wages (ASM and LSM together) earned, consumed and invested locally. While the 'resource curse' literature drew general attention to the enclave–like nature of resource extraction (Auty, 1993; Sachs and Warner, 1995), more recent, Africa–focused scholarship has highlighted the continued difficulty of creating production linkages between capital–intensive mining projects and the

surrounding economy in African LIC settings (Ferguson, 2005; Bond, 2007; Bush, 2008; Radley 2019a). Given this, the health of local economies in mineral–dependent African regions is likely to be most strongly affected by the long run impact of TNC arrival on locally earned wage volumes in mining. Enhanced understanding of this issue is particularly pressing in light of what Hilson (2019) has recently referred to as the continued 'LSM bias' of the World Bank and African governments, towards the continued marginalisation of ASM in favour of TNC–led industrial mining.

To the author's knowledge, this is the first attempted analysis of its kind, centred on two interrelated questions. First, how does the size and strength of the local ASM sector evolve, following its initial displacement to make way for incoming TNCs? Second, to what extent does the greater productivity of TNC–led LSM drive higher wages for industrial mineworkers compared to ASM (and thus, compensate for any losses that might be incurred in ASM)? Following this line of questioning, and based on the case of the industrial Twangiza mine in South Kivu, owned by the Canadian corporation Banro, the main argument advanced by the article is that while Twangiza generated a 25–fold productivity increase compared to the surrounding ASM economy, this did not result in significant wage growth for most industrial workers, compared to the wages earned in ASM. Rather, the main beneficiary of the increased wage inequality induced by Banro's arrival has been a narrow and generally externally–oriented managerial group. Meanwhile, as a result of ASM being pushed to more marginal and less productive deposits (and the inability of new industrial jobs or wages to compensate), seven years after the construction of Twangiza, the local availability of mining employment has halved and the volume of locally consumed and invested mining wages has decreased by around 40 per cent. Drawing on these findings, the wisdom of the continued 'LSM bias' in Africa is questioned.

In the sections that follow, the second locates the paper's empirical contribution, and the third discusses methodology. The fourth section provides a brief historical overview of mining in South Kivu, with a particular focus on the relationship between labour and wages, and calculates the scale of productivity growth induced by Banro's recent arrival in the province. The effect of this productivity growth on wages is evaluated in section five, through a comparative distributional analysis of the respective wages earned by industrial mining labour and labour in the surrounding ASM economy. The sixth section assesses how the revival of LSM in South Kivu has impacted the total volume of mining wages (artisanal and industrial) consumed and invested at the local level, to determine the effect of this process on the strength of the local economy. The seventh section concludes by considering the implications of the findings.

Mining Industrialisation and Wages: Problems of Scale and Directionality

Problems of both scale and directionality are encountered when considering, based on the existing literature, the likely long–term effect of TNC–led mining industrialisation in African LICs on the total volume of locally available mining wages. Related to the first question guiding analysis – how the size and strength of the local ASM sector might evolve following its initial displacement – the intuitive answer is that the sector will shrink, and the local availability of mining labour will decrease, as a labour intensive form of production is replaced by one that is highly capital intensive. This is supported by case study research, which has drawn attention to the negative impact of African LSM on ASM and local livelihoods (Luning, 2008; Owusu–Korantang, 2008; Bush, 2009; Yankson and Gough, 2019). However, this picture is complicated by additional literature on African mining which has noted that over a longer time period, ASM and LSM can and often do continue to exist in close proximity to one another, partly due to the propensity of artisanal miners to exploit deposits of little strategic value to LSM operators (Hilson, 2002; Nyame and Blocher, 2010;

Geenen, 2011). In a case study from Ghana, for example, Hilson (2002, p. 149) documented that despite initial conflict, over time 'both parties [have been] able to coexist in harmony within the same land plot'. Given this, the scale of change is less evident than might first be assumed, and even its directionality, if the long–term effect on ASM is minimal and industrial wages are high enough to compensate for any job losses incurred.

This then leads into the second question, which presents similar ambiguity, on the extent to which the greater productivity of LSM leads to higher wages for industrial mineworkers. Theoretically, the neoclassical model of wages 'suggests that wages are set according to the marginal productivity of workers so that differences in wages result from differences in productivity' (Kerswell, 2013, p. 507). According to this theory, then, as the productivity of mining increases in the shift from ASM to LSM, so will local worker wages. Providing empirical support to this theory, a revisionist line of historical scholarship argues mining was an important driver of increased wages and economic diversification during the early stages of (capitalist) development in today's industrialised countries, such as Spain, Sweden, Finland, the US and Australia (Blomstrom & Kokko, 2007; Wright & Czelusta, 2007; Domenech, 2008; Calvo et al. 2019). Yet both neoclassical wage theory and the supportive empirical evidence emanate from the global North, where the literature has also emphasised the centrality of non–resource sector production linkages and other complementarities (such as technological innovation); factors noted earlier as generally absent in African LICs.

Of more relevance to these countries, then, might be the Saint Lucian economist Arthur Lewis' (1954) seminal open economy model of economic growth with unlimited supplies of labour, in which Lewis theorises the relationship between productivity and wages in the global periphery, as distinct from its historical evolution in today's industrialised centres. Pursuing the question of why Caribbean commercial crops were so cheap despite

their high productivity, Lewis argued that wages in this industry are set according to the productivity of what he called 'subsistence sectors' rather than in capitalist export sectors. As a result, he contended, the benefits of increasing productivity in capitalist export sectors accrue not to the workers, but 'to the (Northern) importers of these exports by way of lower prices' (Fischer, 2011, p. 521).

Transposed to African LICs today, Lewis' model suggests industrial mining wages will be set in the 'subsistence sectors' of the surrounding informal economy, not according to the productivity of the formal export sector. While there is a general dearth of studies on LSM wage levels in Africa, Lewis' theorisation is nonetheless supported by recent evidence from critical GVC scholarship, which has highlighted the low wage levels earned by African workers in other export sectors, facilitated by the expansion of labour informality and subcontracting within these formal sector chains (Barrientos, 2014; Goger et al., 2014; Meagher, 2016, 2019; Alford et al., 2017). These findings run contrary to an implicit assumption underpinning the mainstream GVC literature, and more closely aligned to the neoclassical wage model, 'that economic upgrading in GVCs will automatically translate into social upgrading through greater employment opportunities and higher wages' (Taglioni & Winkler, 2014, p. 199, see also Selwyn, 2018). Given the global mining industry's openly anti–union stance, lobbying governments for more 'flexibility' around labour (Marshall, 2015), and the observed shift in the industry towards workforce casualisation (Haglund, 2010), similar outcomes to those noted by the more critical GVC literature should be expected.

While this tempers prospects that the greater productivity of African LSM will drive a significant increase in industrial worker wages compared to those earned in ASM, Meagher (2016, p. 493) has noted that although economic gains within GVCs have failed to benefit informal workers at the bottom of these chains, they *have* tended to benefit formal workers.

This raises additional questions as to how far labour informality has spread in African LSM, and to what extent its formal workers have benefited from increased wages? Yet the absence of distributional data on LSM wage levels, together with the above–noted uncertainty over the long–term impact of LSM arrival on the size and vibrancy of the local ASM sector, render both the scale and directionality of change in the volume of locally available mining wages unclear, and in need of further empirical investigation. It is to this task that the remaining sections now turn.

A Note on Methods

Banro's Twangiza mine provides an ideal case for this study, as it's located in a peripheral region of one of the most income–poor African countries. The case is also typical of the privatised and deregulated sector installed across the continent following World Bank–financed reform. Fieldwork for the study was undertaken between May 2016 and July 2017, consisting mainly of site visits to the Twangiza mine and the adjacent artisanal mine of Kadumwa, alongside extended stays in Luhwindja (the area in which the mines are located). Data was collected from a wide range of sources, including direct observation, corporate archives and documentation, a labour survey reaching 316 artisanal workers at Kadumwa and 126 industrial workers at Twangiza, and conversations, interviews or oral histories with at least 287 artisanal and industrial mine workers and managers. A combination of convenience and snowball sampling was used to identify respondents and interviewees, with a focus on ensuring adequate representation from across the respective ASM and LSM labour hierarchies.

To estimate productivity and the distribution of wages at the informal artisanal Kadumwa mine, extended, empirical fieldwork was undertaken, taking general inspiration from the pioneering work of Polly Hill (1963) in Ghana. To this end, 13 monthly production and financial logbooks were collected from four of Kadumwa's artisanal shaft managers

(who oversee the labour and production process) over a one–year period, representing just less than 10 percent of the 44 shaft managers working at the mine that year. The logbooks kept daily records of shaft production, and the distribution of in–kind or monetary payments to different groups of labour. Collecting the logbooks across twelve months controlled to some extent for climate–induced variation in productivity, as the wet season is typically less productive than the dry season due to the increased danger and difficulty of working under heavy rains. In addition, effort was made to control for fluctuations in productivity along the lifecycle of a shaft, by ensuring the sample contained a range of new, mature and ageing shafts. Typically, periods of lower productivity in artisanal gold mining occur at the beginning (when workers are looking for the auriferous rock) and towards the end (when the deposit is nearing exhaustion).

Two further notes about the data must be added. First, at both Twangiza and Kadumwa, gross (or end) value rather than value–added is used, in light of the difficulty of determining the value of inputs to industrial mining. Second, the calculations contain an in–built assumption of a stable workforce, although in reality there was a degree of churning at both sites, particularly at Kadumwa. The impact on productivity was likely minimal, however, as a departing artisanal worker – for example, to harvest his agricultural production – was usually replaced by a new one. Survey and logbook data were collated and interpreted using Microsoft Excel, and interview data was collated, coded and interpreted with the assistance of ATLAS.ti software.

Mining, Labour and Productivity in South Kivu

Unlike precolonial copper production in the DRC's Katanga region, mining in South Kivu began in the early twentieth century. According to corporate archives, the first minerals extracted from the province were shipped to Belgium in 1924, through the Belgian–owned subsidiary *Société minière des Grands Lacs* (MGL) – Great Lakes Mining Company.

Throughout the colonial period, Bami (customary rulers, singular 'Mwami') were relied upon to mobilise local labour across the province, in part due to the general indifference of the peasantry to wage labour, given their on–farm capacity to meet their subsistence needs and ensure their social reproduction (Bezy, 1957, p. 159–161). Many people in Luhwindja – the government collectivity where Banro's Twangiza mine is located today – saw the work as undesirable, so the local Mwami resorted to sending those in conflict with him to work in the mines as punishment (Bisharhwa, 1982, p. 88).

Yet from at least as early as the 1950s, a parallel network of informal artisanal mining began to emerge. Internal MGL correspondence shortly after Congolese Independence in 1960 details an established network of illegal gold production and trade in South Kivu, in which 'a fistful of audacious men, without scruples and of undefined nationality, are making fortunes'. At least as early as the 1980s, following a quadrupling of the Kivu population since the 1930s (World Bank, 1984, p. 145), industrial worker wages had fallen below revenue earned in the informal ASM sector. By this time, MGL had merged with other foreign subsidiaries into *Société minière et industrielle du Kivu* (SOMINKI) – Kivu Mining and Industrial Company (still under majority Belgian ownership), and SOMINKI's 1980 annual report documented increasing worker desertion. The report noted the problem 'to find its origin in the growing attraction of artisanal gold exploitation, which procures for those interested revenue and savings and the means to acquire…consumer goods available on the market'. The implication, supported by interviews with former SOMINKI workers (Bukavu and Kamituga, February to April 2017), is that worker wages were too low to save or purchase consumer goods. Corporate archives indicate that real wages continued to decline into the 1990s. SOMINKI eventually collapsed in 1997, shortly after the onset of the First Congo War, having failed to recover from the tin price crash of 1985, during which the

international tin price more than halved (just before the crash, in 1984, tin contributed 74 per cent of SOMINKI's revenue).

With the withdrawal of Belgian–led industrial mining in the late 1990s, ASM firmly established itself as the most important off–farm source of employment in South Kivu. Available estimates for the total number of artisanal miners working in South Kivu and the neighbouring province of North Kivu today put the figure at between 200,000 and 350,000 (Geenen & Radley, 2014, p. 59), with four out of five estimated to be mining gold (Weyns et al., 2016, p. 4). In South Kivu's gold sector, Geenen (2014, p. 173–174) has estimated artisanal worker wages to be twice to several times higher than those available in agriculture or petty trade locally.

Following the official end of the Congo Wars in 2002, Banro's Twangiza gold project – managed by its DRC–based subsidiary Twangiza Mining – became the first industrial mine to reach the production phase, beginning commercial production in 2012. In 2010, to make way for the construction of Twangiza, artisanal miners were forcibly evicted from Mbwega, the largest artisanal mine in Luhwindja at the time. The land immediately surrounding the site was also enclosed, resulting in the forced displacement of around two–and–a–half thousand villagers to the nearby hilltop of Cinjira (Geenen & Honke, 2014). In response to Mbwega's appropriation, hundreds of artisanal miners reoccupied Kadumwa and Lukunguri (Geenen & Radley, 2014, p. 62), two smaller sites located around two kilometres downhill from the Twangiza mine. Of the two, Kadumwa became by far the largest, employing around 800 people in 2017.

Calculating the respective productivity of Kadumwa and Twangiza provides a useful benchmark to assess the extent to which the greater productivity of the capital–intensive Twangiza mine is reflected in higher wages to its industrial workers. At Kadumwa, shaft manager logbooks indicated an estimated annual production of 59.7 kilograms. This equated

to $2,341,772 of value created by Kadumwa in 2017, based on the average 2017 London Gold Fixing price of $40.42, and taking into consideration the gold's 97 per cent purity (a percentage provided by local traders). Based on a shaft census and observation on–site, a total of 762 workers and managers was estimated at the site that same year. By dividing the annual value by the estimated units of labour, it can be estimated that in 2017 Kadumwa's productivity (the value created, or output, per unit of labour) was $3,073, or around eight dollars per day.

At Twangiza, the year 2013 is used, as this was the most recent year for which comprehensive data was collected, drawn primarily from Twangiza Mining's 2013 financial accounts. Triangulating data across the Congolese Ministry of Mines, Twangiza Mining's financial accounts, and Banro's consolidated financial statements, in 2013 the Twangiza mine produced 2,564.9 kilograms of gold, creating $114.7 million of value. Based on corporate documentation and correspondence with Twangiza Mining's Senior Human Resources Officer, that same year, there were 1,366 employees at the mine (either employed directly by Twangiza Mining or working through subcontracted firms). Based on this production and employment data, it can be estimated that in 2013 the labour productivity at Banro's Twangiza mine was $83,983.

Adjusting to the average 2017 gold price to facilitate comparison, Twangiza's labour productivity can be estimated at $75,892 (or $208 per day) compared to the $3,073 (eight dollars per day) of Kadumwa. This represents a dramatic 25–fold productivity increase in Luhwindja's mining economy. Yet despite the significantly greater productivity of Banro's Twangiza mine compared to the surrounding ASM economy, local worker wages at Twangiza have been broadly equivalent to those earned at Kadumwa.

The Informal Logics of Formal Sector Wage Setting

To determine wages earned at the artisanal Kadumwa mine, labour was divided into three main groups, based on direct observation at the mine: site workers (composed of water carriers, ore carriers and ore washers), shaft workers and shaft managers.[2] Site workers stay above ground, while shaft workers descend underground to extract the ore. Shaft managers invest the finances required to construct and maintain the shaft, mobilise and organise labour in production, and manage the distribution of payment to workers. Consequently, shaft managers earn profits, while worker payments effectively function as wages.

Beginning with site workers, water carriers earned 250 Congolese Francs (or $0.2) per 20–litre can of water carried, with each worker carrying between four and six cans a day. Taking five cans as the average daily labour performed by a water carrier, a water carrier's daily wage was estimated as one dollar. Ore carriers earned 500FC ($0.4) for each bag of ore carried, with each worker carrying between five to six bags a day. Taking five bags as the average daily labour performed by an ore carrier, an ore carrier's daily wage was estimated as two dollars. Interviews and conversations with ore washers reported daily wages of between one to five thousand Congolese Francs (around one to four dollars) a day per worker. From this, an average daily wage of $2.5 was taken. Subtracting for informal taxes paid to local government authorities, and based on Kadumwa's six–day working week, net monthly wages were estimated as $27 for a water carrier, $50.4 for an ore carrier and $57.6 for an ore washer.

All shaft workers were paid by shaft managers, each according to different logics but with remuneration always dependent, to greater or lesser degrees, upon production. To determine shaft worker wages, shaft manager production and financial logbooks were used. The logbooks recorded the monetary and in–kind payments made by managers to shaft workers. All taxes were paid by shaft managers, with none incurred by the shaft workers

themselves. Combining the data across the 13 monthly logbooks generated an estimated average monthly wage of $163 per worker (see Appendix Table A).

To estimate shaft manager profits, worker wages, rent and taxes were subtracted from the total value created by their shafts (all of which were recorded in their logbooks). This leads to estimated average shaft manager monthly profits of $1,379 (see Appendix Table B). To this must be added the profits they make from engaging in gold trade, with many buying gold from their own and other workers to sell directly to the traders in Bukavu, the nearby provincial capital of South Kivu, around a five–hour bus journey from Luhwindja. Drawing on the buying and selling prices recorded in the logbooks, shaft manager trading activity increased their average monthly profits by $295, from $1,379 to $1,674 per month. Compiling worker and manager data, Table 1 presents an overview of wage and profit distribution at Kadumwa in 2017.

Table 1. Kadumwa wage/profit distribution, 2017

Group		Units of Workers and Managers	Net Monthly Wages / Profits per Unit ($)	Net Annual Wages / Profits per Unit ($)	Total Annual Wages / Profits ($)	Distribution (%)
Site Workers	Water Carriers	30	27	324	9,720	0.5
	Ore Carriers	80	51	605	48,384	2.3
	Ore Washers	80	58	691	55,296	2.7
Shaft Workers		528	163	1,956	1,032,768	50
SUBTOTAL WORKERS		**718**	–	–	**1,146,168**	**55.5**
Shaft Managers		44	1,674	20,088	883,872	42.8
Taxes		–	–	–	**34,080**	**1.7**
TOTAL		**762**	–	–	**2,064,120**	**100**

Sources: Author estimates based on shaft census, conversations, interviews, a labour survey and shaft manager logbooks.

Supporting the earlier findings of Geenen (2014, pp. 173–174), most wages, with the exception of those earned by water carriers, compared favourably to agriculture, which was remunerated locally at a daily rate of around one dollar per worker. Monthly shaft workers' wages also compared favourably with more skilled forms of local labour, such as teaching, with local primary and secondary school teachers earning between $30 and $50 per month. Shaft manager monthly profits propelled them into Luhwindja's economic elite.

To determine wages earned at the industrial Twangiza mine, labour was once again divided into three categories, based on direct observation at the site: hired labour, subcontractor workers, and Twangiza Mining employees. Hired labour are informal day labourers working for local firms. Subcontractor workers work for firms subcontracted by Twangiza Mining to provide a range of goods, services and activities to the mine, such as security and catering. As with hired labour, many subcontractor workers were informal, working with no contract and limited benefits. Twangiza Mining employees are those directly contracted by the Canadian subsidiary.

For Twangiza Mining, an internal corporate document from 2016 listed worker and manager wages by category, and the subsidiary's financial accounts provided a detailed breakdown of the number of employees belonging to each of these categories. This documentation was triangulated through a labour survey and interviews and conversations with workers and managers. For hired labour and subcontracted employment, in the absence of company documentation (with a few exceptions), wage data was collected through a labour survey and worker and manager interviews and conversations. Workers and managers across all three categories (hired labour, subcontractors and Twangiza Mining) paid three different government taxes, with the rates paid across each tax indicated by Twangiza Mining's payrolls and worker and manager payslips. Deducting for these different taxes, the

net wages to the different worker and manager groups at Twangiza in 2017 are presented in Table 2 (including overtime and allowances).

Based on this data, it can be seen that 822 of Twangiza's 1,149 workers, or 72 per cent, earned monthly wages of $270 or less that were broadly comparable to shaft worker wages. The lowest paid hired labour workers – of which there were 169, or 15 per cent of all industrial workers – earned $110, significantly below average artisanal shaft worker wages. While skilled Twangiza Mining workers – representing 26 per cent of all workers at the mine – earned wages considerably higher than those earned by artisanal workers, none of the industrial workers earned more than the average monthly shaft manager profits of $1,674.

Table 2. Twangiza wage distribution, 2017

Group				Units of Workers and Managers	Net Monthly Wages per Unit ($)	Net Annual Wages per Unit ($)	Total Annual Wages ($)	Distribution (%)
Workers	Hired Labour			323	154	1,851	597,970	3.6
	Subcontractor Workers			285	226	2,713	773,091	4.7
	Twangiza Mining	Unskilled	I	214	270	3,240	693,257	4.2
			II	24	360	4,325	103,789	0.6
		Skilled	III	128	511	6,135	785,328	4.8
			IV	42	614	7,369	309,500	1.9
			V	133	930	11,165	1,484,978	9
SUBTOTAL WORKERS				**1,149**	–	–	**4,747,914**	**28.9**
Congolese Managers				146	1,578	18,933	2,764,238	16.8
Foreign Managers				71	6,605	79,265	5,627,816	34.2
SUBTOTAL MANAGERS				**217**	–	–	**8,392,054**	**51**
Taxes				–	–	–	**3,307,272**	**20.1**
TOTAL				**1,366**	–	–	**16,447,240**	**100**

Notes: The employment data in Twangiza Mining's financial accounts divides unskilled workers across categories I and II, and skilled workers across categories III, IV and V; Wage data includes overtime and allowances. On top of their base wage, workers and managers at Twangiza Mining receive lodging, transport, and child and spouse allowances, with managers also receiving a responsibility allowance. Overtime makes a significant difference to worker wages, often as much as doubling the base wage in the case of subcontractor workers.
Sources: Twangiza Mining wage classification documentation; Twangiza Mining 2013 financial accounts; labour survey; conversations and interviews.

In addition, comparing Twangiza Mining worker payroll data and worker payslips from 2012 with the subsidiary's 2016 wage structure indicates wage levels to have been stagnant for all

groups across this five–year period. In 2010, Twangiza Mining also annulled its 3 per cent annual wage increase (a legal requirement according to Congolese labour law), and by 2017, it had yet to be reinstated (Interviews, Twangiza Mining union delegates, Twangiza, June and July 2017).[3] Across this time period, from 2010 to 2017, data from the Congolese Central Bank indicates that the DRC's annual inflation rate was 7.5 per cent. Over the last several years, then, the nominal value of Twangiza Mining worker wages has stagnated, while the real value has declined.

The low and stagnant wages earned by the lower strata of workers at Twangiza can be ascribed, at least in part, to the downwards pressure exerted by the shift in the local labour supply from scarce to abundant. According to government data, Luhwindja's population density increased from around 44 people per square kilometre at the beginning of the twentieth century to around 530 people per square kilometre in 2017 (or from 8,200 inhabitants to 97,080). In the early twentieth century, as noted earlier, local people were generally resistant to working for Belgian mining companies, and the Mwami of Luhwindja had to forcibly recruit members of families with whom he was in conflict to work in the mines. By 2017, however, the situation had reversed. As one manager at the Luhwindja office of a labour hire firm reflected: There are days when ten people come to ask for work when we don't have any…. We even receive text messages. It's enough just to have heard there's a job available and you'll find even 100 people for the one job (Interview, Diphil manager, Luhwindja, 23 April 2017).

A second contributory factor has been the relatively weak position of workers vis–à–vis their managers. Between 2016 and 2017, around 40 per cent of Twangiza's workforce had no form of contract, and labour at the mine was separated across 15 different firms. As Radley (2019b) has argued, this high degree of labour informality and fragmentation reproduced and further entrenched pre–existing spatial and social divisions between

Twangiza's workers, hindering their ability to self–organise and negotiate higher wages, despite the existence of a formally recognised union at the mine since 2014. This has been reflected in the near total absence of labour militancy at Twangiza since the mine was constructed in 2010.

Productivity growth in South Kivu's mining sector has, then, failed to lead to meaningful wage growth for most industrial mine workers, particularly those at the lowest levels of Twangiza's labour hierarchy. Luhwindja's abundant labour supply and barriers to collective action at Twangiza shed some explanatory light on why this has been the case. Exacerbating this situation, the total availability of mining labour (both ASM and LSM) in Luhwindja has nearly halved since Banro's arrival, contributing to an overall decrease in the amount of mining wages consumed and invested locally.

Artisanal Displacement and Uneven Wage Distribution

The availability of mining labour in Luhwindja has declined significantly since the construction of Twangiza in 2010, driven by ASM's failure to recover following the above–mentioned forced closure of the artisanal Mbwega mine to make way for Twangiza's construction. A labour census conducted at Mbwega prior to its appropriation estimated the presence of 500 shaft managers and 5,000 workers (Observatoire gouvernance et paix, 2008, p. 27). Discussions with an elected committee representing artisanal miners in Luhwindja, the *Comité des creuseurs artisanaux de Luhwindja* (CCALU) – the Artisanal Miners' Committee of Luhwindja – suggested there were a further 500 miners working at other sites across the collectivity at the time, leading to an estimated total of 6,000 people directly employed in Luhwindja's ASM sector prior to 2010.

Three artisanal sites – Cinjira, Lumpumpu and Ntagare – were opened after the closure of Mbwega, but proved unproductive. As a result, many who had been relatively

prosperous through their engagement in ASM fell into difficulty, as the following summary of an interview with a former Mbwega shaft manager demonstrates:

> His family owned maize and manioc fields near to the mine, along with five cows. When they were displaced to Cinjira they received $500 in compensation for their land. He used the money to construct two shafts at the new mine at Cinjira but both are now closed as they only led to a very small amount of gold. They sold all of their cows to generate some income, and today his two wives work as agricultural day labourers. He is looking for work (Interview, former Mbwega shaft manager, Cinjira, 7 April 2017).

Author site visits, triangulated with data provided by CCALU and local government authorities, suggested there were an estimated 2,000 artisanal workers and managers across seven sites in Luhwindja in 2017, around one third the number prior to Banro's arrival.

Compounding this fall in locally available ASM labour, the low level of industrial employment and the uneven distribution of industrial wages has led to a rerouting of mining wages away from, rather than into, Luhwindja. With few exceptions, site and shaft workers at Kadumwa heralded from local herder–farmer families, and their wages were consumed and invested locally in Luhwindja or neighbouring collectivities. While most ASM workers reported little left over from their wages once subsistence needs had been met, some had made modest investments in land, livestock and housing locally. Shaft managers were all from Luhwindja, and most reported more sizeable local investments, while many also reported using their profits to buy land in and move their families to Bukavu.

As with workers at Kadumwa, the overwhelming majority of hired labour, subcontractor workers and unskilled Twangiza Mining workers were from local herder–farmer families, and consumed or invested most of their wages locally. Among Twangiza Mining's skilled workers, there was a greater representation of people from urban families whose parents were wage earners (in mines or plantations), state agents, teachers, clerks and

traders. This group of workers tended to expend their wages outside of Luhwindja, primarily in Bukavu, where many of them were from. In addition, most skilled Twangiza Mining workers were lodged and fed on–site, meaning they rarely set foot outside of the mine during their time in Luhwindja. Thus, while some of the consumption and investment patterns of skilled Twangiza Mining workers were oriented locally, they were generally directed away from Luhwindja and towards Bukavu.

This non–local orientation of wage expenditure was even more pronounced among Twangiza's managerial group, which to recall from Table 2, captured 51 per cent of the total wages accruing to labour at the mine in 2017. Once on–site, and as with skilled workers, Twangiza Mining's managerial group ate and drank at company restaurants and bars and rarely left the compound. As one manager said, 'I'm not familiar with the locals. I come for one month then after one month I fly back' (Interview, African Assay Laboratories manager, Twangiza, 6 June 2017). On the whole, managerial consumption and investment took place outside of Luhwindja, and for foreign managers (who captured $5.6 million of the $8.4 million accruing to this managerial stratum, or 67 per cent), almost exclusively outside of the DRC. As a Kenyan subcontractor manager explained, 'when we stay on site, we spend very little…. I'm investing back home' (Interview, Aggreko manager, Twangiza, 6 June 2017). Some Congolese managers also had externally–oriented investment patterns, as their families were based overseas, predominantly in South Africa but also in the US, Canada and Europe.

Drawing on this analysis, and by extrapolating backwards from the wage data presented in the previous section, it's possible to make an approximate comparison between the mining wages and profits earned, consumed and invested locally prior to and seven years after the construction of the Twangiza mine. From this comparison, it can be seen, first, that the total number of people employed in mining locally has decreased from around 6,000 to 3,000 across this time frame. Second, the total annual income accruing to groups of mining

labour who consume and invest their income locally has also decreased, from around $16 million to $10 million (Table 3).

Table 3. Mining income before and after Banro's arrival, Luhwindja

Time Period	Group	Units of Workers and Managers	Total Annual Wages / Profits ($)	Wage Expenditure Orientation
Pre–2010	**Artisanal Site Workers**	1,496	846,772	Local
	Artisanal Shaft Workers	4,157	8,132,031	Local
	Artisanal Shaft Managers	346	6,957,890	Local/Non–Local
TOTAL PRE–BANRO		**6,000**	**15,936,693**	_
2017	**Artisanal Site Workers**	499	297,717	Local
	Artisanal Shaft Workers	1,386	2,710,677	Local
	Artisanal Shaft Managers	115	2,319,897	Local/Non–Local
	Industrial Workers (Unskilled)*	846	2,168,108	Local
	Industrial Workers (Skilled)	303	2,579,806	Local/Non–Local
TOTAL POST–BANRO		**3,149**	**10,075,604**	_

Notes: ***** Unskilled denotes hired labour, subcontractor workers and unskilled Twangiza Mining workers; To determine the units of workers and managers across each category in artisanal mining, the same weighting was used as observed between the three categories at Kadumwa; To determine the total annual wages of site workers, the wages earned by water carriers, ore carriers and ore washers were likewise weighted as observed at Kadumwa.
Source: Author data presented above.

The scale and directionality of these findings are supported by the many testimonies from local farmers, herders, teachers, hospital workers, priests, civil servants and youth, who in conversation consistently foregrounded the relative strength of the local Luhwindjan economy prior to Banro's arrival. The following statement from a young churchgoer is illustrative:

> I think that artisanal mining is very important for us. All of us grew up in this system and made progress in this way. Our parents had a market thanks to the work of artisanal miners. When a miner comes from work, he buys something, and this something allows me to study. Since Banro has arrived, you see parents saying "I don't have money to pay school fees" and children staying at home…We hadn't experienced that before (Interview, Luhwindja Parish youth member, Luhwindja, 27 November 2016).

Thus, rather than strengthening the economy through the provision of additional and well–remunerated labour, the process of TNC–led mining (re)industrialisation in South Kivu has, on the contrary, led to a generalised deterioration in local conditions.

Conclusion

Lewis' theorisation on the relationship between productivity and wages in the context of peripheral development provides a useful lens to interpret the findings. To recall, Lewis' model contends that in an open economy with unlimited supplies of labour, formal sector wages will be set in the 'subsistence sectors' of the informal economy and will tend to stagnate, unless the productivity of those operating in the informal economy (or the overall level of employment) is simultaneously increased. This appears to hold in the case of Luhwindja in South Kivu, where in a context of labour abundance and in a continuation of historical trends from at least as early as the 1980s, industrial worker wages at Banro's Twangiza mine have been set more in the informal ASM economy, than in relation to labour productivity in LSM. In 2017, despite the industrial Twangiza mine inducing a 25–fold increase in productivity compared to the nearby artisanal mine of Kadumwa, 72 per cent of workers at Twangiza earned broadly equivalent wages to those earned at Kadumwa, and industrial wages have been stagnant since at least 2012.

These findings corroborate the insights generated by critical GVC scholarship, in particular that the expansion of labour informality and subcontracting has facilitated low worker wages, while only formal workers seem to benefit from GVC inclusion (Meagher, 2016). Forty per cent of workers at Twangiza were informal, all working for hired labour or subcontractor firms at the lowest levels of the mine's labour hierarchy. The only industrial worker group earning significantly higher wagers than artisanal workers was the skilled workers formally contracted to Banro's Congolese subsidiary, Twangiza Mining. The findings also further this literature, which tends to focus on worker–level dynamics, by

providing a distributional wage analysis thatpoints to the severity of the income inequality generated across GVC labour hierarchies. In the case of Banro, a managerial class representing 16 per cent of Twangiza's labour was the main beneficiary of the increased wage inequality induced by Banro's arrival, capturing 51 percent of total wages (with the foreign stratum of this class, representing just five percent of labour, capturing 35 per cent).

Meanwhile, due to the forced displacement of artisanal miners and the low level of industrial employment, seven years after the construction of Banro's Twangiza mine, the overall amount of mining labour available in Luhwindja had nearly halved. Combined with low wages to most industrial workers and the uneven distribution of these wages, this led to an estimated decrease of around 40 per cent in the total amount of mining wages consumed and invested locally, from around $16 million before 2010 to $10 million in 2017. This has, in turn, had damaging effects on the strength and vibrancy of the local economy. Based on the data presented, the wisdom of the continued LSM policy 'bias' in Africa (Hilson, 2019) is questioned, particularly if taken in conjunction with existing literature on the enclave–like nature of LSM in African LIC settings (Bush, 2008). Further research is needed, nonetheless, both on gold and other industrially mined minerals across African LICs, to test the generalisability of the findings.

Turning more generally to the relationship between productivity and wages, a consideration of the findings suggests that prioritising African LIC integration into high productivity export sectors (whether mineral or otherwise) – the preferred approach of African mining industrialisation enthusiasts (Radley 2019a) and mainstream GVC proponents (Meagher, 2019) – will not necessarily equate to improved wages. Rather, as per the insight of Lewis, a central component of any strategy to achieve these outcomes must be to prioritise investment to increase the productivity of informal 'subsistence sectors', most notably smallholder agricultural producers, a group long marginalised and neglected by many African

governments, including in the DRC. The case study evidence presented in this article suggests that failure to address Lewis' structural wage constraint will result in the continuation of low and stagnant wages to the majority of export sector workers in the African periphery, irrespective of productivity growth in these sectors.

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Appendix

Table A. Kadumwa shaft worker net monthly wages ($)

Monthly Log Number	Payment–in–Kind ($)	Monetary Payment ($)	Total Wages ($) (a)	Workers (b)	Wages per Unit ($) (a/b)
1	932	3,460	4,392	9	488
2	1,355	1,511	2,866	9	318
3	419	236	655	9	73
4	1,051	0	1,051	12	88
5	934	0	934	14	67
6	575	0	575	12	48
7	1,061	808	1,868	10	187
8	1,083	0	1,083	8	135
9	1,714	510	2,224	12	185
10	1,834	560	2,394	12	200
11	938	0	938	12	78
12	1,267	543	1,809	12	151
13	0	834	834	8	104
AVERAGE MONTHLY WAGES					163
AVERAGE ANNUAL WAGES					1,956

Source: Calculations based on author data.

Table B. Kadumwa shaft manager profits (excluding trade), November 2016 to June 2017 ($)

Monthly Log Number	Value Created (a)	Wages to Workers ($) (b)	Rent (c)	Taxes (d)				Profits (a – b – c – d)
				Govt.	Army	Police	CCALU	
1	6,379	4,566	128	14	11	4	11	**1,645**
2	3,620	2,994	73	14	11	4	11	**514**
3	861	740	0	14	11	4	11	**82**
4	4,079	1,194	0	14	11	4	11	**2,845**
5	2,619	1,009	0	14	11	4	11	**1,570**
6	1,567	687	0	14	11	4	11	**840**
7	3,829	2,023	192	14	11	4	11	**1,575**
8	3,904	1,231	195	14	11	4	11	**2,438**
9	2,943	2,368	147	14	11	4	11	**388**
10	4,660	2,488	233	14	11	4	11	**1,899**
11	2,013	1,029	101	14	11	4	11	**844**
12	4,057	1,906	203	14	11	4	11	**1,908**
AVERAGE MONTHLY PROFITS								**1,379**
AVERAGE ANNUAL PROFITS								**16,549**

Notes: 'Wages to Workers' were taken from a combination of the shaft worker wage data presented in Table A and the wages paid by shaft managers to water carriers and ore carriers, as recorded in the monthly logbooks; One logbook has been excluded as bag production was not adequately recorded.
Source: Calculations based on author data.

[1] Author calculations based on data from the World Bank Country Database.

[2] Net rather than gross figures are presented throughout, considering both formal and informal taxes.

[3] Supporting union delegate interview data, in a 2017 employee contract template provided to the author by Twangiza Mining's Senior Human Resources Officer, there was no reference to wage increases.